European Commission

JRC TECHNICAL REPORT

Common Shareholding in Europe

Rosati, N.

Bomprezzi, P.

Ferraresi, M.

Frigo, A.

Nardo, M.

2020

Joint Research Centre

EUR 30312 EN

EU Science Hub
https://ec.europa.eu/jrc

JRC121476

EUR 30312 EN

PDF ISBN 978-92-76-20876-1 ISSN 1831-9424 doi:10.2760/734264

Luxembourg: Publications Office of the European Union, 2020

How to cite this report: Rosati, N., Bomprezzi, P., Ferraresi, M., Frigo, A., Nardo, M., *Common Shareholding in Europe*, EUR 30312 EN, Publications Office of the European Union, Luxembourg, 2020, ISBN 978-92-76-20876-1, doi:10.2760/734264, JRC121476

JRC TECHNICAL REPORT

Common Shareholding in Europe

Rosati, N.

Bomprezzi, P.

Ferraresi, M.

Frigo, A.

Nardo, M.

2020

Contents

Acknowledgments and disclaimer

This document is the conclusive report of the project "Possible anti-competitive effects of common ownership (PACECO)", Parts 1 and 2, developed under the Administrative Arrangements No. COMP/2017/022 and No. COMP/2018/014.

This report has been prepared by researchers of the Joint Research Centre (JRC), the European Commission's science and knowledge service. The JRC aims to provide evidence-based scientific support to the EU policy making process. The scientific output exposed in this report does not imply a policy position of the European Commission. Neither the European Commission nor any person acting on behalf of the Commission is responsible for the use that might be made of this publication.

The analysis in this report is based on firm-level information on companies, mostly listed, active in the countries of the European Union in the period 2007-2016. All firms' information - regarding their ownership, financial performance, area of activity, and other characteristics - is extracted from the Orbis commercial database, provided by Bureau van Dijk.

The identification of the relevant companies representing specific industries of interest followed an ad hoc process that benefitted from crucial input from specialist teams at the Directorate-General for Competition (DG COMP), which we gratefully acknowledge.

In particular, the authors would like to thank the following DG COMP colleagues who provided valuable input into the development of the project and the shaping of this document: Azevedo João, Bergevin Jean, Bjorkroth Tom, Chauve Philippe, Despott Maria Elena, Elías Cabrera José Enrique, Greenaway Sean, Hariton Cyril, Jelinski Igor, Materia Francesco, Porumbrica Ana, Schmidt Cornelius, and Sikora-Wittnebel Joanna.

The authors would also like to thank the following JRC colleagues, who gave valuable contributions at different stages of the development of the project: Bellia Mario, Bellucci Andrea, Ferrara Antonella, Giua Ludovica, Gucciardi Gianluca, Hallak Issam, Marcucci Andrea, Panzica Roberto, Pericoli Filippo, and Wingender Anthea.

Abstract

Common shareholding is the simultaneous ownership of shares in many firms active in the same market. Common shareholders are typically institutional investors (banks, pension funds, insurance companies or mutual investment funds), who hold stakes below the level of control and do not actively participate in firms' decisions. Although traditionally common shareholding has not been seen as an antitrust issue, in recent years researchers and policy makers have started to consider its potential anticompetitive effects.

Scholars have raised concerns that common shareholding could have anticompetitive effects when a common owner has a majority control over at least one of the firms, and minority stakes in competing companies. Nevertheless, little is known about common shareholding by institutional investors, whose control seems to be limited to minority voting rights. Such institutional investors have historically implemented a passive investment strategy, whereby fund managers invest the assets of their customers following an index. At the same time, they collect the voting rights of their customers and potentially gain some influence over the management decisions of the firms they are mandated to invest in. As a result, fund managers have acquired substantial shares - always on behalf of their customers - in a large number of firms that in many cases are direct competitors, creating a new corporate governance setup.

Common shareholders can indeed acquire a broad level of participation across a market; for example, in 2016 we find that the firms in BlackRock's portfolio in the EU Oil&Gas industry represented roughly 90% of Total Assets for this market. Moreover, common shareholding has become increasingly prevalent in recent years. For instance, 60% of US public firms in 2014 had common shareholders that held at least 5% both in the firm itself and in a competitor. This occurred in only 10% of cases back in 1980 (He and Huang, 2017). In Europe, we find that common shareholding with at least 5% participation involved 67% of the listed companies in 2016.

Although the existence of the phenomenon is widely witnessed across the globe, little evidence is available to date about European markets. The Finance & Economy Unit of the JRC, on request of DG COMP,[‡] undertook an extensive analysis of common shareholding in Europe. To the best of our knowledge, this is the first comprehensive study on this topic in Europe, including not only listed firms but also a series of relevant unlisted corporations in select industries.[§]

[‡]Project: "Possible anti-competitive effects of common ownership (PACECO)", Parts 1 and 2, developed under the Administrative Arrangements No. COMP/2017/022 and No. COMP/2018/014.

[§]Recent reports by the Monopolies Commission (2018) and by the European Parliament (2020) also investigate the extent of common shareholding in Europe, however their investigation is limited in scope to specific geographic areas or industries. See more details in Chapter 1.

The aspects of common shareholding investigated in this study are:

(A) *Measuring common shareholding*: analysis of methodological and measurement issues;

(B) *Common shareholding indices*: derivation of new indicators (and respective properties) to overcome the criticisms of the current measures of the phenomenon;

(C) *Ownership structure of EU listed firms*: construction of a database comprising all listed firms active in the EU in 2007-2016, with historical ownership data, industry classification, legal and financial information;

(D) *Identification of industries of interest*: construction of ad-hoc lists of firms identifying all relevant actors active in five specific EU markets during 2007-2016 (Electricity, Oil&Gas, Mobile Telecoms, Trading Platforms and Beverages);

(E) *Common shareholding and common shareholders*: picture of the extent and trends of common shareholding in the last decade for the listed firms active in the EU and the five chosen markets;

(F) *Top players*: closer look at ownership of top competitors of each industry, and at portfolios of the largest institutional investors;

(G) *Holding thresholds*: analysis of level of participation as an expression of effective monitoring of shareholders on companies; effects of holding thresholds on common shareholding indicators;

(H) *Linking common shareholding and market performance of companies*: development of a methodology for testing the link between the level of common shareholding and firms' performance, with an application to EU data for the Beverages sector (this topic is partially developed in collaboration with the Competence Centre on Microeconomic Evaluation of the JRC).

Executive Summary

The debate on common shareholding - and its potential antitrust effects - is currently on the agenda of all major think tanks and institutions worldwide. Common horizontal shareholders are usually institutional investors - e.g. pension funds and asset managers - holding concomitant shareholdings in a given market.

In the last two decades, these investment funds have grown substantially in Europe and worldwide, both in total size and concentration, especially channeling savings towards investment strategies that replicate the performance of stock market indices, such as the S&P500 or the FTSE100. As a result, wealth fund managers have acquired substantial shares - always on behalf of their customers - in a large number of firms that in many cases are direct competitors, creating a new corporate governance setup. According to the Financial Times[i] *“BlackRock, Vanguard and State Street, the three biggest index-fund managers, control about 80 per cent of the US equity ETF market, about $1.6tn in total. Put together, the trio would be the largest shareholder of 88 per cent of all S&P 500 companies”.*

Despite claiming a so-called passive engagement strategy (not intervening directly in firm’s decisions), institutional investors in fact collect, together with the shares, the associated voting rights of their customers. This has led some economists to worry about the effects of this concentration of power, as well as the influence exerted on the management decisions of the firms that common shareholders are mandated to invest in.

As shown in the seminal paper by Azar, Schmalz and Tecu,[ii] a major concern is that these common shareholdings, though in minority shares, may create competition distortions in certain sectors. However, the possible effects of common shareholders on market efficiency and competition have only been investigated in a small number of specific industries, and no consensus has been reached concerning a more general effect on the economy.

In the literature, common shareholders are mostly known as “common owners”. The term “common owners” is somehow misleading, as these investors do not actually own companies, they rather own (usually small) participations in many companies. In this report, to be consistent with the literature, the terms *common owners* and *common shareholders* are used interchangeably. Moreover, this reports looks at shareholding participations in the same market (horizontal), disregarding concomitant participation in upstream or downstream related companies.

Over the past months, the debate on common shareholding has continued to gain increasing attention from academic and policy actors, having generated several interventions and roundtables, as well as published research in the areas of corporate governance and antitrust law.

[i] Financial Times, *“Common ownership of shares faces regulatory scrutiny”*, January 22, 2019.

[ii] Azar, J., Schmalz, M. C., and Tecu, I., 2018, "Anti-Competitive Effects of Common Ownership", *Journal of Finance*, Vol. 73, No. 4, pp. 1513-1565.

Even though common shareholding is widely witnessed across the globe, little evidence is available to date about European markets. Moreover, consistent results are still lacking on its actual implications, such as possible anticompetitive practices and other negative externalities affecting firms' performance and managerial decisions. The present report - to the best of our knowledge - is the first comprehensive study on common shareholding in Europe and its possible anticompetitive effects, including not only listed firms but also many relevant unlisted corporations in selected industries.[iii]

The investigation of a causal link between the presence of common shareholding in a market and its competitive outcomes poses several challenges. First of all, the definition of a market of reference; secondly, the measurement of common shareholding itself; furthermore, the choice of an appropriate competition indicator, be it based on market power and/or market concentration; lastly, however no less important, data availability at firm or even product level. This report principally addresses these questions. Below is a summary of the main findings.

Common shareholding and common shareholders in the EU[iv]

The overall results for listed firms active[v] in the EU in 2007-2016 show that **the number of common shareholders increases over time**, from around 14 thousand in 2007 to above 16 thousand in 2016 (Table I).[vi]

The total number of registered shareholders has also been increasing over the ten years, reaching a value of almost 127 thousand in 2016. However, the large majority of shareholders only hold participation in one of the listed firms, being therefore "single" shareholders (more than 85% of the cases).

The number of listed firms that are cross-held by block-holders[vii] has been increasing, going from around 15.5 thousand to around 17.5 thousand. In relative terms, **67% of all listed firms active in the EU are cross-held by common shareholders holding at least 5% in each company**, that is more than two-thirds of all listed firms active in the EU are thus linked to at least one other firm through a common shareholder that holds a non-negligible amount of shares in both. These results for Europe are in line with those for the US: about

[iii] Recent reports by the Monopolies Commission (2018) and by the European Parliament (2020) also investigate the extent of common shareholding in Europe, however their investigation is limited in scope to specific geographic areas or industries, and is kept at a descriptive level. See more details in Chapter 1.

[iv] In this context the term EU comprises the 28 countries of the EU as of 2017, excluding candidate countries and countries which are simply associates of the European Economic Area (EEA).

[v] Either registered in the EU, or registered outside, but holding shares in at least one EU firm.

[vi] We recall that a common shareholder by definition is an investors holding participation in at least two firms in a given market, otherwise it is labelled as a "single" shareholder.

[vii] An investor is defined as being a block-holder of a firm if holding at least 5% of the shares of the firm. Two firms are cross-held by a block-holder if the investor holds at least 5% of shares in both firms. This definition, coming from the US literature on common shareholding, will be maintained also in the sectoral analyses.

60% of US public firms in 2014 had common shareholders that held at least 5% both in the firm itself and in a competitor. This occurred in only 10% of cases back in 1980.[viii]

Table I: Summary statistics for listed firms active in the EU in 2007-2016.
NOTE - Number of firms; number and percentage of firms cross-held by block-holders (BH) at minimum 5%; total number of shareholders (SH); number and percentage of common shareholders (i.e. shareholders with more than one firm in their portfolio).

Year	Number of Firms	Number (%) Firms Cross-held by BH	Number of SH	Number (%) Common SH
2007	23,624	15,454 (65.41)	97,578	14,570 (14.93)
2008	24,453	15,891 (64.99)	100,856	14,799 (14.67)
2009	24,910	15,883 (63.76)	101,190	14,959 (14.78)
2010	25,307	16,001 (63.23)	105,803	15,398 (14.55)
2011	25,493	16,059 (62.99)	104,798	14,772 (14.10)
2012	25,515	16,203 (63.50)	105,237	14,733 (14.00)
2013	26,090	17,800 (68.23)	107,430	14,991 (13.95)
2014	26,375	18,235 (69.14)	113,071	15,599 (13.80)
2015	26,282	17,678 (67.26)	120,307	16,196 (13.46)
2016	25,995	17,460 (67.17)	126,810	16,236 (12.80)

The distribution of the size and intensity of portfolios[ix] varies enormously, and only a limited group of top investors presents significant values. Table II reports the indices measuring common shareholding for the top portfolio in terms of market penetration.

The **top portfolio holds as many as 25% of the firms in the market**[x] (column "Density" in Table II), i.e. more than 6 thousand companies, steadily through the decade. Additionally, the value-based indices (column "Tot. assets density") reveal that the firms included in the largest portfolios represent a significant proportion of the total value of the market, reaching a coverage of above 80% of Total Assets and more than 90% of Market Capitalisation in almost all years (column "MKT CAP density"). This means that the top investors not only hold shares in a considerable number of firms, but also typically choose the largest enterprises, leaving out only minor players - which together do not account for more than 10-20% of the market value. Also of note is that both indices have been increasing over time, showing that the preference for the largest market players has become stronger over time.

Looking at the weighted indices (which account for the concomitant shareholding and the value of the companies held), we see that the proportion of **market value held by the top common shareholder** through its participation shares is rather tangible, showing values **above 3% - and increasing - for Market Capitalisation.** For **Total Assets even higher** values are observed, with a steep increase in the last years to values above 6%.

[viii] See He, J., and Huang, J., 2017, "Product Market Competition in a World of Cross-Ownership: Evidence from Institutional Blockholdings". *The Review of Financial Studies*, vol. 30, no. 8, pp. 2674-2718.

[ix] A portfolio is defined by the set of firms where an investor holds shares in a specific market. The size of a portfolio reflects the number of included firms, while the intensity is determined by the amount of shares held in each firm.

[x] The term "market" refers, here and onwards, to the set of listed firms active in the EU, unless otherwise stated.

Table II: Common shareholding indices for listed firms active in the EU: top player.
NOTE - Density: Proportion of firms in a shareholder's portfolio relative to the total number of analysed firms. Tot. assets density: Proportion of Total Assets of the analysed firms represented by the firms in portfolio. Weighted Tot assets density: Proportion of Total Assets of the analysed firms held by shareholder through participation shares. MKT CAP density: Proportion of Market Capitalisation of the analysed firms represented by the firms in portfolio. Weighted MKT CAP density: Proportion of Market Capitalisation of the analysed firms held by shareholder through participation shares.

Year	Density	Tot. assets density	Weighted tot. assets density	MKT CAP density	Weighted MKT CAP density
2007	25.29	75.86	2.29	86.74	2.34
2008	25.79	79.78	3.62	85.95	2.38
2009	25.42	79.04	4.11	89.20	3.11
2010	26.02	81.71	3.21	91.20	3.38
2011	25.81	83.91	2.88	91.84	3.33
2012	25.59	83.83	2.87	90.32	3.11
2013	24.84	85.01	5.52	91.50	3.42
2014	23.92	86.97	5.82	91.16	3.43
2015	23.85	87.65	6.27	91.38	3.67
2016	23.87	88.37	6.32	92.58	3.86

The portfolio composition of common shareholders varies largely with the investor in terms of nationality of the firms held. For companies based in the EU, the most frequent countries of registration are the UK, Germany, France and Italy. However, many firms active in the EU are registered outside Europe (around 40%), with a large representation of the US. Given that **the major common shareholders hold large participation stakes in US-based corporations, they could be able in turn to influence the European industries through the firms that US companies hold in the EU.** This adds to the direct participation that such investors hold in EU-based companies, completing the picture of their potential influence in the EU. Table III summarises some key figures about the top investors in the EU market. The so-called "Big Three" (BlackRock, State Street and Vanguard) are highlighted in bold.

Four large funds stand out with portfolios currently including more than 20% of the listed firms active in Europe, namely BlackRock, Dimensional Fund, Norway[xi] and Vanguard. In terms of time trend, both BlackRock and Vanguard show an increase in size over time, while Dimensional has been shrinking a little, and Norway is overall stable. Positioned only slightly behind are Axa, Deutsche Bank, Fidelity (FMR) and JP Morgan Chase, which started out above 20% at the beginning of the period of observation, but have decreased their number of firms held over time, currently holding between 12.5% and 16.2%. On a lower but stable level are Bank of New York Mellon, State Street and Teachers Insurance, with around 17%, while Credit Suisse, Goldman Sachs and Invesco show smaller declining portfolios, currently standing at 13%.

[xi]The term "Norway" (the state) is used as an abbreviation to indicate the Norwegian Sovereign Fund. The same is intended for the references to other states, where France or Sweden, for instance, refer to the respective sovereign funds.

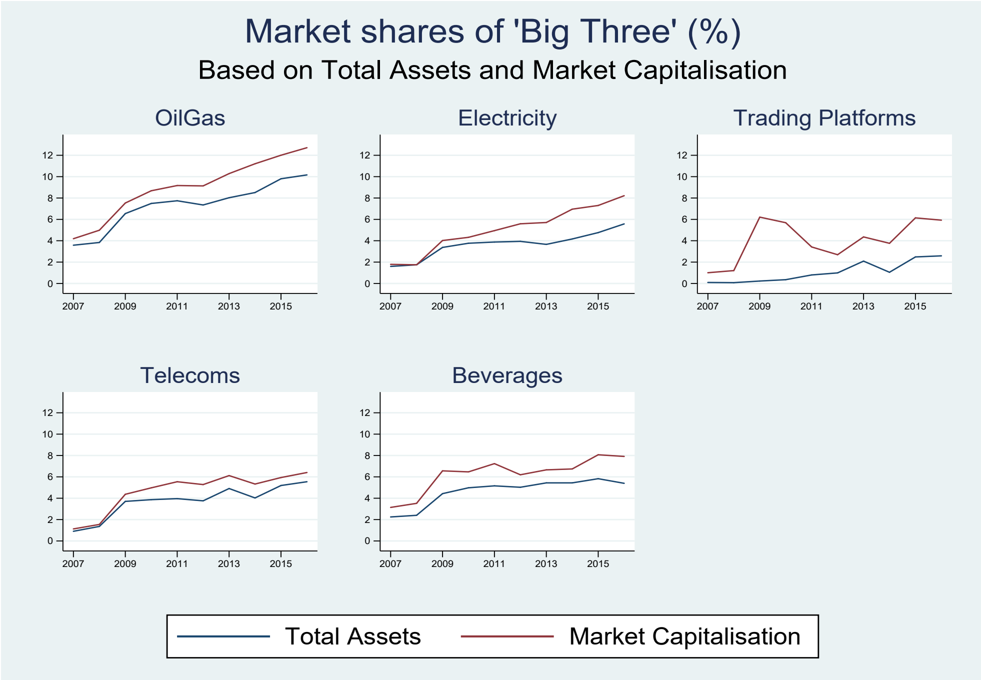
Table III: Top investors - size and intensity of portfolios of listed firms active in the EU in 2016 (ordered by % of TOAS held). "Big Three" highlighted in bold.
NOTE - Size of portfolios (number of listed firms active in the EU owned by each investor); Relative size of portfolios (% of listed firms active in the EU owned by each investor); Intensity of portfolio (Average participation shares); Proportion of TOAS held in portfolio (through participations in listed firms active in the EU); Proportion of MKT CAP held in portfolio (through participations in listed firms active in the EU).

Name	Country	No. Firms	% Firms	Avg. shares	% TOAS	% Mkt Cap
BLACKROCK	**US**	**6052**	**23.3**	**3.26**	**2.69**	**3.86**
VANGUARD	**US**	**6006**	**23.1**	**2.84**	**2.04**	**3.46**
STATE STREET	**US**	**4346**	**16.7**	**1.37**	**1.14**	**2.03**
NORWAY	NO	5316	20.5	1.27	0.89	1.05
FMR LLC	US	3378	13.0	2.87	0.68	1.44
JP MORGAN CHASE	US	4208	16.2	1.12	0.61	0.77
INVESCO	BM	3335	12.8	1.56	0.42	0.60
DIMENSIONAL FUND	US	6204	23.9	1.40	0.41	0.46
BANK OF NY MELLON	US	4289	16.5	0.83	0.39	0.74
UBS	CH	3331	12.6	0.85	0.37	0.47
NORTHERN TRUST	US	3081	11.9	0.83	0.32	0.57
TEACHERS INSURANCE	US	3885	15.0	0.60	0.26	0.52
DEUTSCHE BANK	DE	3474	13.4	0.70	0.26	0.40
AXA	FR	3261	12.5	0.97	0.23	0.35
MORGAN STANLEY	US	2976	11.5	0.74	0.22	0.41
GOLDMAN SACHS	US	3447	13.3	0.72	0.21	0.37
BNP PARIBAS	FR	2070	8.0	0.75	0.20	0.21
CREDIT SUISSE	CH	3378	13.0	0.46	0.18	0.26
ALLIANZ	DE	2651	10.2	1.00	0.15	0.24
BARCLAYS	UK	1841	7.1	0.82	0.10	0.09

Sectoral results

This report analyses in more detail five sectors: Oil&Gas, Electricity, Mobile Telecoms, Trading Platforms and Beverages. The relative concentration (limited number of firms with large market shares) and the existence of a topical expertise on market players (due to recent antitrust or merger investigations) motivated the choice. For these industries, common shareholding patterns more or less mirror the general trends found for the listed firms active in the EU. Portfolios of common shareholders continue to be very large in all five sectors, in some cases including between 30% to 40% of active companies (Electricity and Oil&Gas sectors). Again, in all studied sectors the inclusion of firms in the portfolios of common shareholders continues to be based on size, with excluded firms only representing around 10% of the industry Total Assets. Once weighted by the respective holdings, the top investors show joint ownership of large portions of the considered industries, as depicted in Figure I for the *Big Three* (BlackRock, State Street and Vanguard).

Figure I: Total market shares (%) held jointly by the "Big three" - BlackRock, State Street and Vanguard. Based on Total Assets and Market Capitalisation, over 2007-2016.

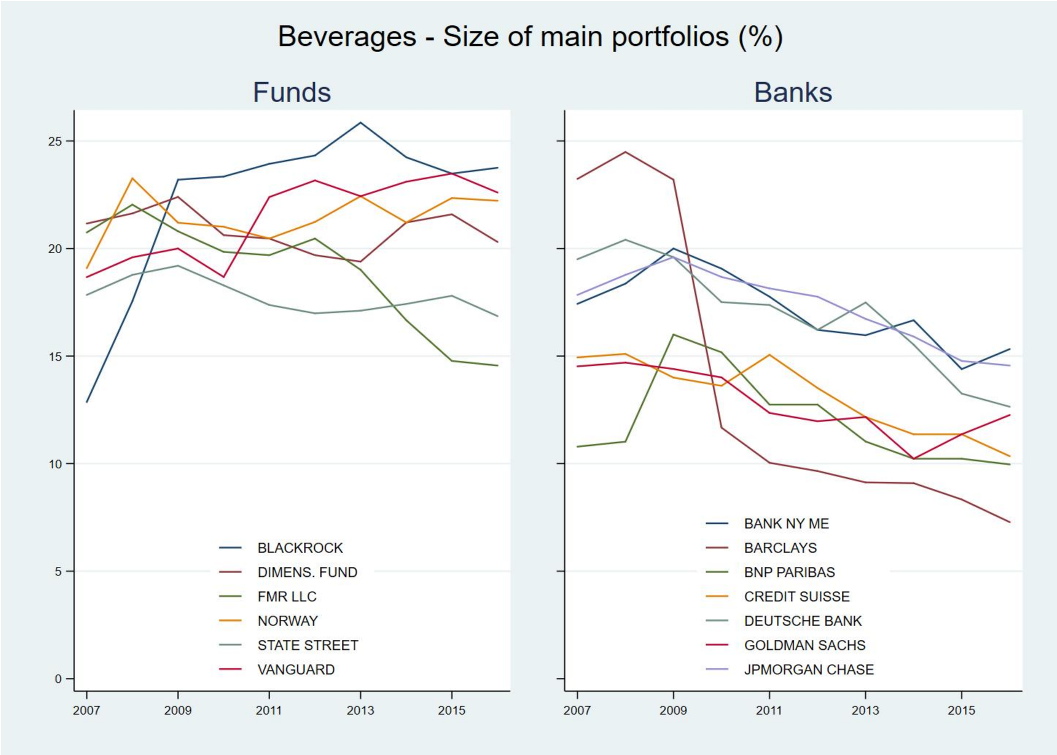


The comparison of portfolios of large investors also highlights:

- a wide overlap of strategies, in many cases without evidence of differential investments. The largest funds (BlackRock, Vanguard and State Street) show almost coincident portfolios, investing in the same companies, with correlations as high as 90% repeatedly over the years, in all considered sectors;
- State-owned funds also play a major role in the EU, especially in Norway and in Sweden, but also in France in the Oil&Gas, Electricity and Telecoms sectors;
- the Energy sectors see the appearance of further public players such as China, Russia and Korea, especially in Electricity.

As an example, Figure II reports the trend in portfolio sizes of top investors in the Beverages industry over the decade of observation. The funds steadily hold stakes in between 20 and 25% of the market players, while banks have been diminishing their holdings, initially reaching about 25% of the market, while currently down to 10-15% of the players. The acquisition of part of Barclays' portfolio under the BlackRock-Barclays Global Investors merger of 2009 emerges clearly from the picture.

Figure II: Beverages Manufacturers sector - Top investors. Relative size of portfolios over 2007-2016: proportion of firms in market owned by each investor (%).



Thresholds of holdings

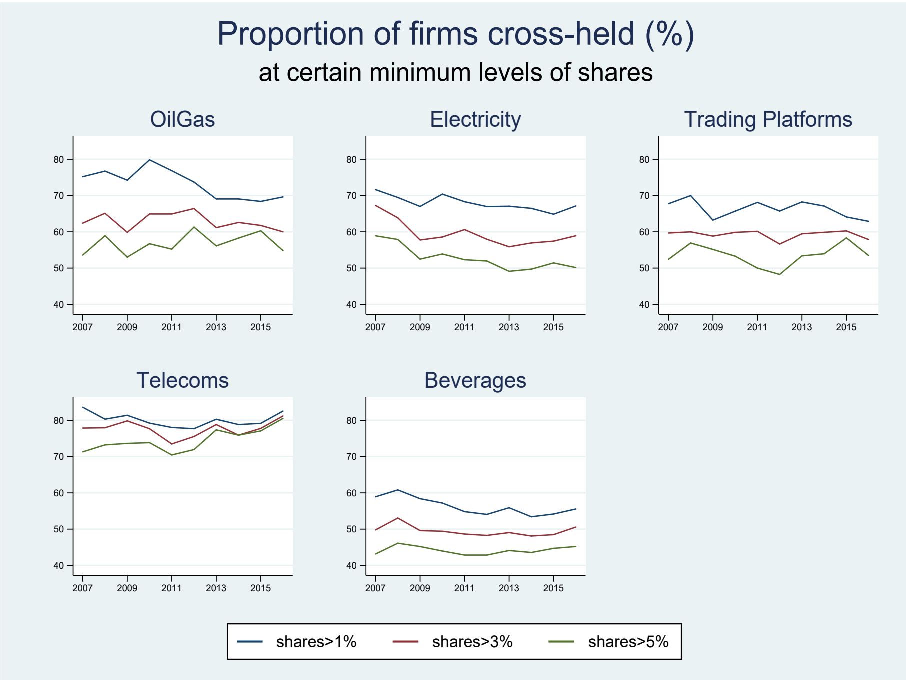
A final note examines the intensity of the investments, i.e. specific thresholds for the level of participation. Recent literature[xii] investigated the role of block-holders as effective monitors of the firms held. Particular attention has been given to investors whose portfolios present multiple block-holdings, suggesting strong links to the common shareholding investigation. The very few existing empirical studies on common shareholding, all based on non-EU firms, consider block-holding as defined by thresholds of 5%. This is mostly due to data availability and not to a specific economic meaning of the chosen value. In the interest of truly understanding the full extent of this phenomenon, particularly in the context of the EU, this report experiments with new thresholds in the definition of block-holders, namely using minimum equity investments of 1, 3 and 5 per cent. We perform the analysis only for the five sectoral studies.

[xii] Kang, J. K., Luo, J., and Na, H. S., 2018, "Are institutional investors with multiple blockholdings effective monitors?", *Journal of Financial Economics*, 128(3), pp. 576-602.

The proportion of firms cross-held in each of the markets, for different levels of minimum holding, continues to be very high, as in the case of the general analysis for the listed firms. Figure III shows that in most markets, more than half of the firms are connected to at least one competitor through a common shareholder holding 5% or more shares in both companies (this grows to 60-70% if we consider common holdings above 3%). Only in Beverages is this proportion slightly lower (about 45%), while in Telecoms we see higher interconnection of firms through corporate groups.

The general picture suggests a strong presence of common shareholding in all industries, and in particular the existence of a considerable number of investors with high-intensity portfolios, influencing a large number of firms even when applying higher holding thresholds.

Figure III: Proportion (%) of firms cross-held over 2007-2016 by one or more investors, relative to total number of firms in each market. Different thresholds of minimum holdings.



Linking common shareholding and market performance of companies

The investigation of a causal link between the presence of common shareholding in a market and its competitive outcomes poses several challenges. The first is the definition of a market of reference (i.e. the identification of companies belonging to that market). The official code of activity (NACE code) has proven to be insufficient in identifying the main players in all of the five analysed markets; the NACE code does not exist for specific activities, such as trading platforms or mobile telecoms, for example. Therefore, together with specialists, we have manually identified the relevant companies belonging to each of the five markets.

The second challenge has been the measurement of common shareholding itself. The most popular tool used in the academic literature to assess the effects of common shareholding is the so-called Modified Herfindahl-Hirschman Index (MHHI), which captures the increase in effective market concentration introduced by the presence of common shareholders. Nevertheless, it fails to measure directly the extent of common shareholding itself. As alternatives, the few existing empirical studies have generally limited the measurement of common shareholding to a small set of descriptive measures. Examples include the proportion of common shareholders among all the investors present in a market; or the proportion of firms that are cross-held by a common holder, for a certain level of ownership. Still, several other aspects of investors' behaviour and of portfolios' composition can help to draw a more precise picture of the phenomenon. The same applies to the analysis of the firms' shareholding structures, which can reveal interesting patterns of overlap in a given market. For these reasons, in the present investigation, we used techniques based on two main groups of methodologies, coming from the Sparsity and Network literature respectively, to derive new indicators for the overall investigation of common shareholding and for the econometric analysis.

The choice of an appropriate competition indicator has been another challenge in linking common shareholding to firms' performances. The ideal candidate would be the use of prices.[xiii] However, data (un)availability at product level, or the extremely high cost of these data, may compel the consideration of alternative measures of market power and/or market concentration based on balance sheet information at the firm level. Finally, additional issues need to be addressed in the specification of an econometric strategy that allows for the identification of a causal relationship.[xiv]

Although the economic literature finds some evidence of the existence of an effect of common shareholding on market performance in specific US industries, overall the results are mixed and difficult to generalise to other markets/countries. At the EU level, there are only a couple of studies looking at a few top players in specific industries, and a sector-wide analysis is still

[xiii] The seminal paper of Azar and co-authors use the airlines prices to show to what extent an increase in common shareholding influences competition.

[xiv] Among others: exogenous variation of common shareholding that can induce a shift in market competition; the assessment of the degree of exposure of firms active in the market to the common shareholding variation; and the choice of appropriate control variables to account for firms' and market characteristics.

missing. In this report a tentative empirical model is estimated based on Beverages data, in which a selection of the new common shareholding indicators is used.

An application: effects of the BlackRock-BGI merger on Beverages manufacturers

The study considers the exogenous shock in ownership that followed the BlackRock-Barclays Global Investors (BGI) merger of 2009. The impact of the change in common shareholding induced by the BlackRock-BGI merger is estimated using a difference-in-differences approach. We compare - before and after the event - the markup of firms exposed to the merger (treated group) to that of firms that did not have any pre-merger relations with BlackRock and/or BGI (control group). The markup is measured through the relative price-cost margin, also known as the Lerner Index.

The specific market under investigation is defined by the set of Beverages manufacturers active in the EU between 2007 and 2016, namely either through being registered in the EU, or holding shares in at least one firm in this geographic area. The study includes a set of selected beverages products, namely soft drinks, mineral waters, juices and beers. Observations over the two years before the merger permits the study of the degree of dependence of the firms on each of the two institutional investors, as well as the determination of analogies of behaviour between such firms and those not connected to any of the investors before 2009.

The estimations performed indicate that the merger between BlackRock and BGI did in fact have an effect on markups of the firms in their portfolios. After the merger, firms that were already held by BlackRock and/or BGI show - on average - a Lerner index 0.07 points higher than that of firms without any participation by BlackRock/BGI, suggesting that the merger triggered an increase in profitability of firms already exposed to BlackRock and/or BGI. Analogous results are obtained using an alternative competition measure as an outcome. We find that the increase in profitability seems to be driven more by an increase in revenues rather than a decrease in costs.

We also find that the impact of the merger seems to be positively related to time, as the Lerner Index significantly increases with the number of years. Two and three years on from the merger, treated firms show a Lerner Index approximately 0.06 points larger than that of control firms, reaching the maximum value of 0.08 difference after 7 years, while disappearing in the 8th year. The main intuition behind these findings is that the merger event prompted a sizable increase in the Lerner Index in treated firms during the first years, after which the market self-correction took place. We also explored the possibility that the degree of exposure to the merger may influence the actual extent of the effect. We find that the effect is larger for those companies which were only marginally part of the BlackRock or BGI portfolios before the merger, having benefitted most from the event. In particular, the impact of the merger for a firm held at 1% by BGI and/or BlackRock leads to an increase in the Lerner Index of

0.10 points on average. Such an impact significantly reduces to 0.05 if the pre-merger quota held increases to 4%. For firms with minority holdings of 5% or more, there seems to be no significant impact on the Lerner Index.

Our results would appear to suggest a positive association between common shareholding and the market power of firms. However, the findings of this study should be treated with caution; in particular, the following caveats should be considered. First, earlier data on the common shareholding structure of firms would help confirm that BlackRock and BGI in 2007 did not specifically target companies that would have performed well after the crisis. We do not find evidence of this, but our sample is limited. In a similar vein, multiple observations prior to the merger would strengthen the evidence of a common trend between treated and control firms - a key identifying assumption of the difference-in-differences design underlying the analysis. Second, the study focuses only on the beverages sector, however, while carefully accounting for other industries' specificities and potential data shortcomings, the present methodology could be applied to possible future investigations in other markets. Third, the Lerner Index is used, following the literature, as a proxy of market competition; however, data on prices or other outcome of the competitive process would help reinforce the evidence on common shareholding and competitive outcomes, as it would facilitate controlling for the heterogeneity of products sold by firms. Moreover, any country/product specific changes in the market could be factored in.

A final observation is due, concerning possible unobservable factors that may have affected profitability, other than the merger under consideration. There are a series of possible mechanisms of influence through which asset managers may affect a firm's competitive outcome. Typically, such mechanisms include network effects, general policy consensus between asset managers, or even a specific threshold in ownership that allows for effective leverage, under which a shareholder in practice does not have a strong impact. These factors were not directly observable in the present study and potentially could be further investigated, depending on the availability of additional specific data. In reality, the phenomenon of common shareholding proved to be particularly complex, and disentangling its various effects continues to be challenging. Given that the literature in this area has not yet investigated in depth the channels through which influence is exerted, this certainly constitutes a good candidate for future research.

Chapter 1

Introduction

Multiple academic papers point out to common shareholding as a new potential anticompetitive device, and policy makers acknowledge that the issue merits to be monitored. Scholars have raised concerns that common shareholding can have anticompetitive effects when the owners have majority control over at least one of the firms they own in the same competing market. Yet, little is known about common shareholding by institutional investors: their control seems to be limited to minority shareholdings; however, they collect the voting rights of their customers, therefore gaining some influence over the management decisions of the firms they are mandated to invest in. These funds have grown considerably both in total size and concentration. As a result, wealth fund managers have acquired substantial shares - always on behalf of their customers - in a large number of firms that are in many cases direct competitors, creating a new corporate governance setup.

As shown in the papers published recently by José Azar and Michael Schmalz,[1] a major concern is that these common shareholdings, though in minority shares, may create competition distortions in certain sectors. However, the possible effects of common shareholders on market efficiency and competition have only been investigated in a small number of specific industries, and no consensus has been reached concerning a more general effect on the economy.

Minority shareholders

The case that recently attracted the attention of scholars and policy makers typically refers to common shareholders of competing firms according to the following distinctive setting: (*i*) they legally own shares of stock in a public or private corporation, holding a minority of the given corporation's outstanding shares with less than 50% of the voting rights (also called minority

[1] See for example Azar et al. (2017, 2018, 2019), Schmalz (2017, 2018).

interest or non-controlling interest), and (*ii*) they adopt a passive engagement style. Minority shareholders can take the form of both individual retail investors, or institutional investors (for example pension funds, mutual funds, hedge funds, endowment funds, investment banks, insurance companies and commercial trusts).

There are a number of features differentiating institutional investors from individual shareholders. First, institutional shareholders account for half of the volume of trades on many Stock Exchanges, and - moving large blocks of shares - have an enormous influence on the stock market's movements and prices. Due to their substantial resources and specialised knowledge, institutional investors are able to extensively research a variety of investment options not directly accessible to retail investors. Second, the institutional players invest other people's financial resources not directly raised by themselves. In addition, being considered as knowledgeable by Securities and Stock Exchange Commissions, institutional investors are generally subject to fewer of the protective regulations usually applied to other individual financial players.

Due to their stakes positions and the power they exert on capital markets, institutional investors may influence management decisions, such as the election or removal of officers in the board of directors, or vote or veto against board decisions. In reality, asset management funds (AMF) are showing growing interest in taking further control over the decisions of firms they are mandated to invest in.[2] The boom in the amount of assets under management (AUMs) of these funds, together with the enhanced concentration of the industry, is a striking phenomenon taking place on stock markets.[3] As a side effect, the increasing share of international savings invested in stock markets and managed by a handful of institutional investors - together with their associated voting rights - has shaped a new landscape of corporate control, and the impact of AMFs on the corporate governance of listed firms has received growing attention. In particular, just as AMFs seek to influence listed firms' CEOs in favour of socially sensitive issues, one may wonder whether AMFs influence managerial decisions in other areas - deliberately or not.

AMFs are typically assumed to be passive shareholders. A passive shareholder is a shareholder who does *not actively* attempt to influence managerial decisions, but rather diversifies her portfolio and adopts a "vote with one's feet" attitude. A passive fund manager is subject to two major restrictions, however. First, she must invest in a pre-determined class of stocks stated in the statutes of the fund, e.g. geography, industry, firm size. Second, AMFs shares

[2] See, for instance, the statement issued by Laurence Fink, CEO of BlackRock, Inc., in his January 2018 *Letter to CEOs*: *"Society is demanding that companies, both public and private, serve a social purpose. [...] We must be active, engaged agents on behalf of the clients invested with BlackRock, who are the true owners of your company. This responsibility goes beyond casting proxy votes at annual meetings - it means investing the time and resources necessary to foster long-term value."*

[3] For instance BlackRock holding is estimated to ca. $7.4 trillion AUMs. In their latest report, BlackRock displays two-thirds of AUMs in stock markets, which would represent 5% of the estimated $90 trillion world market capitalization. Besides, ca. $2 trillion of the BlackRock AUMs are invested in active management funds, ten times as much as the fair value of stocks held by *Berkshire Hathaway* - ca. $200 billion as of December 31, 2019 - whose CEO and main owner Warren Buffet is renowned for his influence on financial markets.

must remain within the stated asset class, and derivatives instruments and short sales are typically disallowed. The so called passively managed funds are the index funds, whereby investments are distributed across companies in the same proportions as the stock index, whatever the amounts received from customers. On the other hand, managers of so-called "actively" managed funds may freely select firms within the predetermined class of stocks; their performance is eventually compared with the stock class' market benchmarks.[4] In particular, passively managed funds were assumed to be passive shareholders, however this statement is contradicted by the large passive funds such as BlackRock, Vanguard or States Street, which claim to be 'passive investors, but active owners'. For example, Glenn Booraem, controller of Vanguard, states in 2013: *"We believe that our active engagement on all manner of issues demonstrates that passive investors don't need to be passive owners"*.[5] Similar statements about active engagement have been made by other major funds.[6]

Possible effects of common shareholding

common shareholding may induce anticompetitive effects stemming from a number of mechanisms. First, reducing competition may be explicit, through personal engagement with managers. Softened competition allows common shareholders to extract consumers' utility through cartels and maximise corporate profits, just as monopolistic firms would do. Through a related, but non-explicit mechanism, AMFs may systematically vote in favour of less competitive dynamics because, as a diversified shareholder, they control votes across firms. José Azar and Martin Schmalz rather emphasise this latter mechanism (see for instance the chronicle in Azar et al., 2017).

Both mechanisms assume that the gains a firm may extract from additional market shares are taken away from another firm, and diversified AMFs would thus be even overall. For instance, the design and development of a new car model may be less relevant to diversified AMFs, since the new model would take away market shares from another car producer, rather than increasing the overall industry sales and enhancing shareholders' profits. CEOs know this, and thus expend less efforts in outperforming competitors. Evidence provided in the

[4] It is important to note that active management fund managers are not *shareholder activists*. Shareholder activists typically are unregulated hedge funds that publicly and "actively" demand changes in management decisions and take action through, e.g., media campaigns and proxy voting. Activists typically ask for short-term decisions including cash-holdings distribution and tender offer acceptance, even board members change. Activists are hostile to entrenched managers and enhance shareholder rights. Also, activists target a few companies and are little diversified. Examples of famous activists are Elliott Associates and Icahn Associates. Studies that looked at the effects of hedge fund attacks include Brav et al. (2008) and Bebchuk et al. (2015).

[5] See article "Passive Investors, Not Passive Owners" by Glenn Booraem in April 2013, available at Vanguard's corporate site `https://global.vanguard.com/portal/site/institutional/ch/en/articles/research-and-commentary/topical-insights/passive-investors-passive-owners-tlor`

[6] The Financial Times presented similar views by State Street on 6 April 2014 in the article "Passive investment, active ownership" and by Dimensional Fund on 16 March 2013 in "Challenging Management (but Not the Market)". For an overview, see Appel (2016).

literature, showing that CEOs compensation schemes are indexed to industry rather than firm performances, supports such a hypothesis.[7]

Another effect relates to the previously mentioned shareholder activists. By establishing a compact and stable pool of shareholders, AMFs may create a disincentive for shareholder activists. Activists are viewed as a major instrument against entrenched managers; AMFs may deter such attacks and reduce shareholders' rights, not just competition.

The literature on the effects of common shareholding finds its motivation in the theoretical papers on partial ownership developed by Bresnahan and Salop (1986) and O'Brien and Salop (2000) in which they design an economic framework for the analysis of the competitive effects of partial ownership of common shares. The analysis depends on two separate and distinct elements, i.e. financial interest and corporate control in determining a firms' pricing incentives. Compared to a merger analysis, which assumes that the acquiring firm automatically controls the acquired entity, in partial ownership the corporate control and financial interests are separable elements and their interplay may harm competition in a greater or lesser way than the case of a complete merger. As highlighted in O'Brien and Waehrer (2017), the theory of partial ownership in the above papers encompasses what this line of research calls "common ownership", as a case where two or more competing firms have a common shareholder that partially owns each of them.

The empirical literature usually refers to a set of papers that analyse the level of common shareholding of US publicly-listed companies in certain selected industries. For instance, the paper of Azar et al. (2018), henceforth "AST airline paper," analyses the effects of minority common shareholdings on airfares. Using fixed-effect panel regressions, they show a correlation between common shareholding concentration and an increase in airfares for some airlines routes of around 3-7% on average, compared to the case under separate ownership. Alongside higher prices, reduced incentives to compete due to common shareholding generate a lower output, with a large decrease in market efficiency and a transfer from consumers to firms.

Recently, Dennis et al. (2019) further tested the empirical evidence on the relationship between airfares and common shareholding in the airline industry documented in the AST paper. Adjusting for several aspects, such as (i) cash flow and control rights of equity holders, (ii) the measure of control rights to apply only to shares for which the institutions have unique voting rights, and (iii) accounting for the endogeneity of market concentration and prices, they found no relationship between common shareholding and prices in this industry.

The paper of Azar et al. (2019), henceforth "ARS banking paper", analyses whether variations in bank concentration due to common shareholding help to explain the variation of prices in the banking market. The authors use a dataset containing information on interest rates and fees on deposit accounts at branch-level in the US credit market from 2003 to 2013, finding that changes in the HHI do not correlate with changes in either fees, thresholds, or

[7] See for instance Antón et al. (2018), Gilje et al. (2019).

deposit spreads. In particular, they also show that monopsony power of depository institutions generated through common shareholding and cross-ownership links has a strong correlation with prices in the market for deposits.

In their paper, Antón et al. (2018) (henceforth, “AEGS paper”) examine variation in the extent to which different shareholders in the US industry have different economic incentives to induce their firms to compete, and whether managerial incentives reflect these shareholder preferences. The AEGS paper shows that the sensitivity between a top manager’s wealth and their firm’s performance is weaker when the firm’s largest shareholders are also large shareholders of competitors. The wealth-performance relationship for managers is steeper when firms are owned by shareholders without significant stakes in competitors.

In a related paper, Appel et al. (2016) examined whether passive institutional investors influenced firms’ governance structures and their performance. The study exploits variations in the ownership - by passive mutual funds - of US firms associated with stock assignments to the Russell 1000 and 2000 indexes. The authors show that passive institutional investors are not active owners in the traditional sense of buying or selling shares with the purpose of influencing management, but they are not passive owners either. In particular, ownership by passively-managed mutual funds was associated with more independent directors, fewer takeover defensive movements, and more equal voting rights. These funds are attentive to firms’ corporate governance, and they use their large voting blocks to exercise voice and exert influence. Companies with greater ownership by passive funds exert influence, exhibit improvements in long-term performance, and are less likely to be targeted for activism by active hedge funds.

These studies, however, have been subject to harsh criticism from wealth fund managers. In their *ViewPoint* document (BlackRock, 2017) BlackRock top management members explain that the wealth management business model hardly matches the mechanisms described above. The document highlights the complex mechanisms present in the voting decisions of AMFs. In particular, AMFs are composed of a variety of funds with various objectives. Bylaws of index funds constrain the latter to invest in index companies and represent long-term and stable shareholders. The authors emphasise how they differ from activists who are short-term investors. The document stresses that “*engagement is a way to influence and monitor firms on best practices in advance of using the ultimate sanctions – voting against particular proposals or directors – and consequently engagement and voting go hand-in-hand in carrying out an assert manager’s responsibilities*.” The authors argue that they promote corporate governance using engagement techniques rather than public hostility; similar arguments are found in Larry Fink’s 2018 *Letter to CEOs*.[8]

[8] In Fink (2018): *“Where activists do offer valuable ideas [...] we encourage companies to begin discussions early, to engage with shareholders like BlackRock, and to bring other critical shareholders to the table. But when a company waits until a proxy proposal to engage or fails to express its long-term strategy in a compelling manner, we believe the opportunity for meaningful dialogue has often already been missed.”*

The current debate

The debate on common shareholding - and its potential antitrust effects - is currently on the agenda of all major think tanks and institutions worldwide. In December 2017 Paris hosted an OECD Competition Policy Roundtable on "Common ownership by institutional investors and its impact on competition", which built on a previous roundtable held in 2008 entitled "Minority Shareholdings and Interlocking Directorates". According to the OECD event report,[9] in the last ten years several developments occurred, including a "*rapid growth in passively-managed investment funds, [which] has had a significant impact on the ownership structure of large firms in several industries*". It is also stated that "*Recent econometric studies have expressed differing views of the likely impact on competitive conditions of common ownership by institutional investors or other large financial firms. However, measuring the impact of common ownership and using competition policy to address any associated competition problems can be challenging*".

More recently, in May 2018, the European Corporate Governance Institute (ECGI) dedicated a focus panel of its Annual Members' Meeting to "Common Ownership: Antitrust Meets Corporate Governance". The session was open to the public and comprised interventions by Barbara Novick, BlackRock's Vice-Chairman; Greg Medcraft, Director of the OECD Directorate for Financial and Enterprise Affairs; and Xavier Vives, professor of Economics and Finance, Abertis Chair of Regulation, Competition and Public Policy, at IESE Business School. According to the ECGI Event Report,[10] "*The discussion brought out very clearly the tension between increased stewardship and governance involvement on the one hand, and concerns about potential collusion between competing firms having the same shareholders.*"

The last "Viewpoint" of the International Corporate Governance Network issued in October 2018 (see ICGN, 2018) states that "*the reality of common ownership is not in dispute, but its impacts are*".

Finally, in the US, the Federal Trade Commission (FTC) organised a public hearing on common shareholding in December 2018. While the representatives of relevant US federal agencies (the FTC and the Securities and Exchange Commissions) considered that changes in antitrust and corporate governance regulations would be premature at this stage, they declared nevertheless that the effects of common concentrated ownership on competition across the US economy deserve close and careful study.[11]

All discussions point to the increased need of sound studies that allow for the measurement of such potential impacts. The main existing empirical studies are limited to specific sectors such as airlines (Azar et al., 2018; Kennedy et al., 2017; Dennis et al., 2019; Schmalz, 2018),

[9] See `http://www.oecd.org/daf/competition/common-ownership-and-its-impact-on-competition.htm`

[10] See `https://ecgi.global/sites/default/files/events/2018_annual_members_meeting.pdf`

[11] US Federal Trade Commission public hearing on "Common ownership", 6 December 2018, see `https://www.ftc.gov/news-events/events-calendar/ftc-hearing-8-competition-consumer-protection-21st-century`.

banking (Azar et al., 2019; Schmalz, 2018) or pharmaceuticals (Newham et al., 2018). Some scholars also began to debate measurement issues in order to improve on the state-of-the-art Modified Herfindahl-Hirschman Index (MHHI) (see Gilje et al., 2019).

Data on ownership is generally limited to US publicly-listed firms. Nevertheless, European markets are equally in danger of a steep rise in passive investment. As stated by John Authers in the Financial Times[12] in September 2018: "*As passive is a far bigger share of the US markets than of any counterpart elsewhere in the world, this looks like an invitation for passive providers to pile into the rest of the world*". However, not much empirical evidence is currently available on institutional investments and common shareholding in Europe. Seldeslacht et al. (2017) present an overview of ownership of German companies by institutional investors in selected industries. Pagliari and Graham (2019) propose the analysis of a counter-shock in ownership, i.e. the case of two commonly held airports whose ownership was separated. Recent reports by the Monopolies Commission (2018) and by the European Parliament (2020) investigated the extent of common shareholding in Europe, however their investigation is limited in scope to specific geographic areas or industries.

The Monopolies Commission in Germany, an independent expert advisory body, analysed the situation of common shareholding at national level and across certain other Member States in its 2018 report.[13] The report indicates that many institutional investors hold several portfolio companies active in a given economic sector. Moreover, several companies can be found simultaneously in the portfolio of several of the largest institutional investors. The Monopolies Commission concluded that there is considerable potential for competition distortion and recommended a close monitoring of the situation at the European level.

The study on common shareholding commissioned by the European Parliament's Committee on Economic and Monetary Affairs (ECON) is aimed at providing supporting analysis for the ECON members.[14] The ECON study contains a brief case study describing common shareholdings in the banking sector, considering the first 15 largest shareholders for a sample of 25 of the largest publicly listed banks in Europe (in the time window 2012-2015). Contrary to the present report, the European Parliament study does not perform an econometric analysis of links between the levels of common shareholding and firms' competitive performance. It focuses, instead, on providing some measures of common shareholdings in the banking sector, together with a very brief description of voting and engagement policies of the main common shareholders. The study acknowledges that common shareholding is well present in the banking sector, with BlackRock being the largest common shareholder. The largest part of the ECON study is devoted to an overview of the key arguments in the debate about potential theories of harm relating to common shareholdings (unilateral and coordinated effects). The

[12] See Opinion "The long view" of 1st September 2018 entitled "Have we seen a peak in passive investing for the US?", https://www.ft.com/content/99d13606-ad2a-11e8-94bd-cba20d67390c

[13] Available at https://www.monopolkommission.de/images/HG22/Main_Report_XXII_Common_Ownership.pdf

[14] See Frazzani et al. (2020), available at https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652708/IPOL_STU(2020)652708_EN.pdf

study assesses how these potential effects could be captured by EU competition law (mergers control, but also application of Articles 101 and 102 TFEU) and recalls in particular the debate around possible modification of the EU Merger Regulation to capture non-controlling shareholdings. However, it is important to note that the study does not support any potential policy/legislative initiatives. The ECON study concludes that *"whether and in which circumstances common ownership is beneficial or deleterious for competition, innovation, and, ultimately, citizen welfare is still an open debate"* and that more research is needed to understand this. The authors caution that, *"unless there is evidence that common ownership does indeed negatively impact competition in the EU banking sector, amending the current competition law toolbox to address any as yet unproven competition law concerns about such a phenomenon could be premature"*.

The present report represents, to the best of our knowledge, the first comprehensive study on firms' ownership in the EU, shedding light upon the picture of common shareholding and identifying the main investors in all listed firms active in the EU[15] and in five strategic industries: Oil&Gas, Electricity, Telecommunications, Trading Platforms and Beverages Manufacturers.

The study of the five selected sectors is not limited to publicly listed companies, but includes all major players - public and private - active in the EU, i.e. either registered in the EU, or registered outside but holding participations in European firms. This includes major non-EU corporations that exert influence on the European markets, which in turn are influenced by several common minority shareholders. The role of such shareholders, therefore, is not enacted solely through direct participation in European firms, but also indirectly via foreign investments.

Additionally, the present report also includes an attempt to measure through an econometric model the possible effect of common shareholding on firms' profitability. Specifically, the study presents an empirical analysis of the effects of the BlackRock-Barclays Global Investors (BGI) merger on profitability of the manufacturers of beverages (soft drinks, waters, juices and beers) active in the EU during 2007-2016.

Report overview

The report starts by considering some possible methodological strategies for the measurement of common shareholding. We first review the current knowledge, together with its growing critiques. We then present a general framework for the analysis of common shareholding, where we define the assumptions underlying the market and the players under analysis, identifying the main measurement issues to be tackled.

[15]We recall that in this context the term EU comprises the 28 countries of the EU as of 2017, excluding candidate countries and countries which are simply associates of the European Economic Area (EEA).

A series of new indices of common shareholding are proposed, based on balance sheet and ownership firm-level data available for this study. The indicators are linked to two main sets of statistical methodologies, coming from the literature on sparsity and on networks, respectively. The new indices cover both the firm and the investor's perspectives, and are then aggregated at market level to obtain suitable industry indicators.

The proposed common shareholding measures are then applied to firm-level data to illustrate the picture of common shareholding in the EU. The availability and suitability of data to conduct the analysis is assessed. All firms' information - regarding their ownership, financial performance, area of activity, and other characteristics - is extracted from the Orbis commercial database, provided by Bureau van Dijk, covering the period 2007-2016. A first overview of the phenomenon is obtained considering all listed firms active in Europe in the given period, i.e. all those registered in the EU territory plus any listed firm that is registered elsewhere but holds shares in at least one firm registered in the EU. After the general picture, the analysis focuses on five specific industries: Oil&Gas, Electricity, Mobile Telecommunications, Trading Platforms and Beverages.

A series of indicators is presented, describing the investment behaviour of shareholders both at industry-level and at investor-level. The strength of relationships within the networks of firms and of investors is also studied. Special attention is devoted to the top investors within the EU overall and within each industry, and a brief overview of cross-investments within industries is also reported, when relevant. Finally, specific indicators are calculated for the 'Big Three' - BlackRock, State Street and Vanguard - whose investment behaviour is looked at in detail.

The sectoral studies continue with the analysis of the intensity of shareholders' investments (level of holdings), and its effects on various common shareholding indicators, both at investor and at market-level. The study considers different thresholds of a firm's ownership, namely holdings of minimum 1, 3, 5 and 10 percent of shares. New indicators of common shareholding based on thresholds are also constructed for individual investors and for the overall network of shareholders.

Several issues are then considered to test causality between common shareholding and competition, including suitable firms' competitive outcomes, and the calculation of alternative indicators. Various econometric strategies are proposed, following alternative choices of competition measures and of specifications of the possible anticompetitive effects. The five sectors are then compared as possible candidates for the econometric analysis, which aims to assess a possible causal link between common shareholding and competition.

The final part of the report presents an empirical analysis of the effects of the BlackRock-Barclays Global Investors (BGI) merger on the profitability of manufacturers of beverages (soft drinks, waters, juices and beers) active in the EU during 2007-2016. Besides changes in the ownership of firms as generated by the merger, several other characteristics of firms are taken into account, such as the shareholding structure, the interconnectedness with competitors through shareholders, the detailed industry classification, the size, and the pre- and post-merger listing status.

The remainder of the report is organised as follows: Chapter 2 discusses the main issues involved in the measurement of common shareholding, and proposes some new indicators. Chapter 3 presents the general picture of common shareholding in the EU, while Chapter 4 reports the five sectoral studies dedicated to common shareholding in Oil&Gas, Electricity, Telecommunications, Trading Platforms and Beverages. Chapter 5 looks at the intensity of ownership in the five sectors, analysing the presence of block-holdings in investors' portfolios. Chapter 6 discusses possible avenues to follow in order to analyse the link between common shareholding and competition. With the purpose of applying a thorough and solid econometric model to the EU data, alternative specifications of causal models are proposed; the five sectors are subsequently re-analysed as possible candidates for the empirical study. Finally, Chapter 7 presents the chosen econometric model, as well as its application to the EU Beverages sector.

Some further technical details are reported in the annexes, concerning, respectively, the database construction (Appendix A); the proposed framework for the measurement of common shareholding (Appendix B); the identification of the five industries for the sectoral studies (Appendix C); and finally some complements to the econometric analysis (Appendix D).

Chapter 2

Measuring Common shareholding

The most popular tool used in the academic literature to assess the effects of common shareholding is the so-called Modified Herfindahl-Hirschman Index (MHHI), which captures the distortion introduced in market competition by the presence of common shareholders. It does so by correcting the Herfindahl-Hirschman Index (HHI) of competition according to the ownership and control shares of common shareholders in competing companies. Nevertheless, it fails to measure directly the extent of common shareholding itself.

As alternatives, the few existing empirical studies have generally limited the measurement of common shareholding to a small set of descriptive measures. Examples are the proportion of common shareholders among all the investors present in a market; or the proportion of firms that are cross-held by a common holder, at a certain level of ownership. However, several other aspects of investors' behaviour and of portfolios' composition can help draw a more precise picture of the phenomenon. The same applies to the analysis of the firms' shareholding structures, which can reveal interesting patterns of overlap in a given market.

In the present investigation, a series of statistical techniques are analysed, with the objective of identifying new indices of the extent of common shareholding that explore the above dimensions.

The remainder of this Chapter is organised as follows: Section 2.1 reviews the existing measures of common shareholding used in the empirical analyses, highlighting limitations and critiques recently raised by scholars. Section 2.2 prepares the framework for the pursuit of a measure of the extent of common shareholding, defining working assumptions and pointing out the main measurement issues to be tackled. It also illustrates them through a simple market example. Section 2.3 describes briefly the firm-level information available for this study. A set of new indices of common shareholding, based upon the available firm variables, is proposed in Section 2.4. A full account of the database structure can be found in Appendix A, while more technical details about the construction of the indices are reported in Appendix B.

2.1 Existing measures of common shareholding

Studies investigating the effects of common shareholding have presented a series of descriptive measures of the phenomenon, such as the number of competitors linked through a common shareholder, the proportion of a firm's shares held by common shareholders, or still the shares held by common shareholders in a firm's competitors, and so on (see for instance, He and Huang, 2017). Such descriptive measures have been used as firm-level explanatory variables in models trying to capture the effect of common shareholding on markets, together with other measures capturing the corporate ownership structure, such as the proportion of atomistic shareholders of a firm.

One index which has become increasingly popular in the empirical studies on common shareholding is the so-called Modified Herfindahl-Hirschmann Index (MHHI), a modified version of the Herfindahl-Hirschmann Index (HHI). The MHHI is a measure of competition that controls for common shareholding across firms in the same industry. Its difference with respect to the HHI - called the "delta" MHHI - has often been used as a proxy for the measurement of common shareholding. As a matter of fact, it is not a direct measure of the level of common shareholding in an industry, but rather of the distortion that the common shareholding of competing firms may generate on competition in markets. Nevertheless, given its centrality and its widespread use in the empirical literature on common shareholding, the MHHI will be briefly presented here, together with its shortcomings.

The HHI assumes that market dispersion is a factor of competition, and equals the sum of squared market shares (s_j) of each firm j in a selected industry, i.e. $HHI = \sum_j s_j^2$. The HHI is constructed in a competition setting *à la* Cournot, where firms compete in the market by setting quantities. In such an environment, each firm j in the industry maximises the profit of the shareholder, which does not have any other financial stakes in rival firms, and the consequent markup - the ratio between the selling prices and cost prices - is proportional to the firms' HHI.

Under the assumption of constant marginal costs for competing firms in the industry - i.e., each firm bears constant additional costs to increment an additional unit of product - the formula predicts a positive correlation between greater concentration (high HHI) and higher prices in the market. However, there is mixed evidence of a correlation between higher concentration and prices. For instance, a firm may gain in production efficiency, while marginal costs decrease, yet eventually gain in market power; the HHI thus increases without an increase in prices. In addition, the correlation between the HHI and prices does not reliably identify the economic power of each player, leading to a possible bias in the assessment of the effective competition in the market.

The HHI suffers from many weaknesses, such as (*i*) a strong sensitivity to the market definition, (*ii*) the lack of assigning the appropriate weights to smaller firms in the market, (*iii*) the inability to make product market and quality distinctions among competitors, and more recently, and especially (*iv*) the failure to accurately reflect the real level of competition in the presence of common shareholding, where common shares of institutional investors in multiple competing firms are not accounted for. The consideration of shares held by a common shareholder in competing firms is crucial, since it may affect their incentives to compete, lessening competition in targeted markets and moving their equilibria closer to less competitive and less efficient models such as oligopoly or monopoly. In particular, the assignment of lower weights to firms having smaller market power but that are commonly owned by the same stockholder may underestimate the importance of such firms in potential anticompetitive behaviours.

To overcome the problem of common stockholders, Bresnahan and Salop (1986) proposed a modification of the HHI controlling for common shareholding across firms in the same industry. The modified index was named MHHI (Modified HHI), and was first proposed in a theoretical model to account for the change in competitive incentives of stockholders produced by an horizontal joint venture. When the profits of the joint venture are shared by parent stockholders, then parent's incentives to expand output by lowering prices would be reduced, under certain conditions. Later, O'Brien and Salop (2000) derived a formula to analyse the degree of market concentration in a setting where competing firms were partially acquired by competitors (cross-ownership). The general formula is given by:

$$\begin{aligned} MHHI &= \sum_j \sum_k s_j s_k \frac{\sum_i \gamma_i^j \cdot \beta_i^k}{\sum_i \gamma_i^j \cdot \beta_i^j} \\ &= \sum_j s_j^2 + \sum_j \sum_{k \neq j} s_j s_k \frac{\sum_i \gamma_i^j \cdot \beta_i^k}{\sum_i \gamma_i^j \cdot \beta_i^j} \\ &= HHI + \Delta MHHI \end{aligned} \tag{2.1}$$

Following the notation in the AST airline paper, coefficient β_i^j denotes the ownership shares of firm j held by shareholder i, and β_i^k the analogous quantity for firm $k \neq j$. On the other hand, γ_i^j is the control share in firm j held by shareholder i.

The MHHI breaks down the total market concentration into two parts (*i*) the standard industry concentration, as measured by HHI, capturing the number and the relative dimension of competitors; and (*ii*) the common shareholding concentration, called ΔMHHI, which captures how natural competitors are connected by common shareholding. The MHHI represents the level of concentration after the ownership' acquisitions by common shareholders, and the change of concentration "delta" is the difference between the post-ownership' acquisition MHHI and the pre-ownership' acquisition HHI.

The recent empirical literature uses mainly the ΔMHHI as a measure of the lower incentive of commonly-owned firms to compete. For example, assuming competing firms have distinct shareholders, then the ΔMHHI equals zero – the maximization of profits depends on the market share of each firm and $MHHI = HHI$. On the other hand, supposing firms are commonly owned, the ΔMHHI will then capture the difference in the level of concentration in the market due to changes in ownership shares (β_i^j) and the control shares of the shareholder i (γ_i^j) in each firm j, taking into account the ownership shares that the shareholder i owns in competitors (β_i^k). Just like the HHI, the MHHI assumes that firms maximise the profits of their shareholders. Yet, firms also maximise their profits taking into account the diversity among their shareholders and their respective stakes in competing firms. The larger the share of ownership held by common shareholders, the greater the financial interests of shareholders that a firm has to maximise.

Shareholders may influence the objective production function of controlled firms to pursue their financial interests by exerting their control shares and voting rights. Hence, ownership and voting shares have implications for the mechanisms of corporate governance and consequently for shareholders' incentives to compete.

One of the main instruments utilised by shareholders to exert influence over corporate governance is the so-called "voice." The investors can communicate their financial, investment and strategic plans regarding product markets to firms' management through private or public engagement meetings.[1] Although it is still not clear if these possible strategies come from engagement meetings of investors, or directly from members requested to sit on boards to determine such strategies, the "voice" is proportional to the degree of ownership (β_i^j) that the shareholder i holds in (partially) owned firms' j.

The last powerful instrument, or the last resort, utilised by shareholders to exert influence on corporate strategies is the "vote" against firm's management - as stated by the BlackRock proxy voting guidelines indicating that they vote against when direct engagement fails.[2] The higher is the share of shareholders voting rights (γ_i^j), the greater will be the influence of investors over management's strategies.

The above analysis of the structure of the MHHI highlights two difficulties that can be encountered in its calculation. First, computing the market shares of the firms is not a straightforward exercise, given that they can be based on different market variables, and that the definition of the market itself is sometimes blurred. Moreover, the control weights of shareholders in firms are also difficult to determine, due to the different possible assumptions on the type of control exerted by the shareholder, which is not always easy to assess.

[1] The active engagement approach is openly supported by the main investment funds, as discussed earlier in Chapter 1. See, for example, article "Passive Investors, Not Passive Owners" by Glenn Booraem in April 2013, available at Vanguard's corporate site `https://global.vanguard.com/portal/site/institutional/ch/en/articles/research-and-commentary/topical-insights/passive-investors-passive-owners-tlor`. The Financial Times presented similar views by State Street on 6 April 2014 in the article "Passive investment, active ownership" and by Dimensional Fund on 16 March 2013 in "Challenging Management (but Not the Market)". For an overview, see Appel (2016).

[2] See, for example, the document "BlackRock Investment Stewardship - Corporate governance and proxy voting guidelines for U.S. securities", January 2020, available at `https://www.blackrock.com/corporate/literature/fact-sheet/blk-responsible-investment-guidelines-us.pdf`.

Besides the problems in the calculation of the MHHI, the actual use of the index has also been subject to some criticism, especially by O'Brien and Waehrer (2017). The first major issue is the misspecification problem in the equations generally used in the empirical literature, which may generate a (positive) correlation between price and the adopted measure of common shareholding, even in the absence of a causal effect of common shareholding on price. Thus, a possible implication is that these correlations do not establish that common shareholding through minority shareholdings raises prices. Specifically, the MHHI depends on product market shares, which depend in turn on the same factors that drive prices. In that case, both market shares and the MHHI may be endogenous. If market shares and the MHHI are related to factors that affect price, but such factors are not included as explanatory variables, the estimated regressions are likely to cause a positive relationship between the MHHI and prices for reasons not directly related to common shareholding.

A second critique of the use of MHHI relates to the issue that some of the factors that drive prices may also affect institutional investors' stock purchasing decisions, and consequently the financial shares of investors. In their AST airline paper Azar et al. (2018) accounted for possible endogeneity of common shareholding, but not of the industry market shares. This is the main critique formulated by Kennedy et al. (2017) and O'Brien and Waeher (2017). By considering the industry shares as endogenous, the effect on prices becomes statistically insignificant. The above authors use instruments for common shareholding similar to the AST airline paper, namely the merger between BlackRock's acquisition of Barclays Global Investors in 2009, and add the number of airlines in the Russell 1000 index for each market quarter. Shares of airline companies that appear in the Russell 1000 stock market index are more likely to be held by passive investors. Kennedy et al. (2017) find evidence that instrumentalised common shareholding results in lower prices. This exercise demonstrates the complexity and high relevance of identifying the determinants of all components of the MHHI that are unrelated to the dependent variable, in this case product market prices.

The above considerations revealed several shortcomings in the existing common shareholding measures: the limitation of the descriptive measures of common shareholding, the difficulties in the calculation of the MHHI, the inadequacy of the MHHI as a measurement of the extent of common shareholding, and finally its controversial use in econometric models due to possible endogeneity and misspecification problems. This analysis suggests that measures of common shareholding are still incomplete and require further investigation. The next sections suggest new avenues for measuring common shareholding.

2.2 Towards new common shareholding indices

2.2.1 General framework

The identification of possible methodologies to be applied in order to construct an index of the extent of common shareholding is based on the assumptions outlined below, which both define the structure of common shareholding considered in the present study, as well as identify characteristics of the agents and markets involved in the analysis.

The assumptions have been inspired in part by the structure of the database that will be used in real-world applications of this project - the Bureau van Dijk Orbis historical ownership database. Nevertheless, they constitute a general framework applicable to any set of corporate ownership data. For more details about the Orbis database see Bureau van Dijk (2018a).

Assumptions underlying the common shareholding analysis

A.1 The index measuring the extent of common shareholding will be based on ownership shares alone, and will not consider other aspects of market structure of a given industry or economy.

A.2 We will consider the case of competing firms presenting the same shareholder that is a third entity, therefore excluding the case of cross-ownership.

A.3 The entities involved in the analysis belong to one and only one of two categories: either shareholders or firms owned.

A.4 The firms owned must be identified by a common characteristic, such as an industry or geographic area, which we will denote from now on as “market”. The measurement of common shareholding will be limited to the specified market.

A.5 The measurement of common shareholding will refer to a specific point in time, i.e. it will be of cross-sectional nature.

A.6 Independent firms, or firms with no recorded shareholders, will not be considered in the analysis of ownership structure. The same will apply to potential shareholders with no recorded shares in any of the market firms’. Their presence and characteristics in a given market will be considered separately from the common shareholding analysis, and integrated therein if applicable.

A.7 Possible relationships between shareholders are not considered in the common shareholding analysis, focussing only on the relationship between each shareholder and the firms in the given market. Possible links between shareholders will be considered separately from the common shareholding analysis, and integrated therein if applicable.

A.8 The shareholders' nature will not be limited to a given set of entity types, and can include, for instance, companies, institutions, states, individuals, and so on.

A.9 The ownership shares may be direct or indirect (total) shares, as applicable.

In this report, the identification and proposal of methodologies for the measurement of common shareholding will be based on these assumptions, some of which may be relaxed later if necessary.

The typical information available on ownership relationships between entities should include, at least, the identification of the firm, the shareholder and the existence of a link between the two. Ideally, the actual amount of ownership shares owned by the shareholder, either directly or indirectly, should also be available.

In many real-world databases, the reported shareholder structure is simplified, covering only the main shareholders. This is especially true for listed companies, where the long list of atomistic shareholders is often summarised into only one item (named "Public" in the Orbis database), whose value of shares corresponds to the sum of the shares owned by all atomistic shareholders together. The simplified ownership structure can also be due to lack of data, or to an explicit choice of the researcher, deciding to limit the study to shareholders owning at least a certain amount of shares. Given these possible scenarios, we will add an additional working assumption:

A.10 If reported direct ownership shares do not sum to 100%, we will assume that the remaining shares are either self-owned or are owned by atomistic shareholders, with a negligible individual ownership.

From assumptions A1-A10, a simplified representation of the ownership structure of a given market can be obtained through a table, where each row corresponds to a shareholder and each column to a firm. The elements of the table can either report the corresponding ownership share, in which case we name it **ownership matrix (OM)**, or simply report a value of one if a link exists between a firm and a shareholder, zero otherwise **(relation matrix - RM)**.

2.2.2 A simple example

This section presents a simple numerical example to help illustrate the common shareholding problem and highlight the different facets that might be of interest. This example will be used throughout the document to help illustrate the different methodologies, by applying them to the common shareholding context, and test the alternative measurement proposals.

Consider a fictitious "market" with four firms (denoted by F1-F4) and eight shareholders (denoted by O1-O8). According to assumption A3, the firms and the shareholders constitute two separate groups, i.e. there are twelve distinct players, and relationships are only possible across the two groups, and not within (assumptions A2 and A7). Table 2.1 reports the ownership information of the four firms active in the market, while Tables 2.2-2.3 display the corresponding ownership and relation matrices. Italics denote indirect ownership shares; "n.a." indicates information about the existence of a link between a shareholder and a firm, without knowledge of the actual percentage of ownership shares.

Table 2.1: Ownership structure displaying the links between the firms in a given market and their respective owners. Direct and indirect (total) ownership shares reported.

Firm	Owner	Direct share (%)	Indirect share (%)
F1	O1	13.1	-
F1	O2	8.6	-
F1	O3	-	*5.2*
F2	O3	-	*n.a.*
F2	O4	27.4	-
F3	O2	10.4	-
F3	O3	4.8	-
F3	O5	66.3	-
F3	O6	18.5	-
F4	O1	-	*1.6*
F4	O3	-	*6.8*
F4	O7	54.3	-
F4	O8	12.7	-

The ownership matrix in Table 2.2 shows immediately the presence of three common shareholders in the market, namely O1-O3, one of them (O3) creating a link between all four firms in the market. The remaining shareholders (O4-O8) only hold shares in one of the four firms, therefore are not common shareholders. Each column represents the ownership structure of the respective firm, with the total shown at the bottom. Notice that direct and indirect ownership shares are not summed, to avoid possible duplications.

The total amount of direct shares is the proportion of the firm directly held by the reported shareholders; according to assumption A10, the remaining proportion is either self-owned, or owned by atomistic shareholders with a negligible individual ownership, unlikely to have a large impact on the firm. Total indirect ownership represents the amount of shares of each firm owned by shareholders through some intermediate entities. It can be considered, besides direct ownership, as an index of the influence of a specific shareholder on the firm.

In each column, the sum of shares relative to O1-O3 corresponds to the proportion of the firm's shares held by common shareholders. For example, in the case of F3 common shareholders control 15.2% of the shares. On the other hand, in each line the total amount of shares held by a common shareholder in a firm's competitors can be identified. For instance, O2 holds 10.4% of F1's competitor F3, and holds 8.6% of F3's competitor F1.

Table 2.2: Ownership matrix (OM) of the market example from Table 2.1. Indirect ownership shares in italics.

	F1	F2	F3	F4
O1	13.1			*1.6*
O2	8.6		10.4	
O3	*5.2*	*n.a.*	4.8	*6.8*
O4		27.4		
O5			66.3	
O6			18.5	
O7				54.3
O8				12.7
Total	21.7	27.4	100	67
	5.2	*n.a.*		*8.4*

The relation matrix is shown in Table 2.3, reporting a value of one whenever a link is reported in the ownership information. Notice that, in the case of F2 and O3, the existence of a link was detected, although without the specification of the actual ownership share. In this case, the relation matrix still shows a value of one, even if the reported link had incomplete information.

The row totals of the relation matrix show how many firms in the market are owned by each shareholder, allowing for the immediate identification of the common shareholders (row total greater than one). The column total identifies the number of reported shareholders of each firm. The sum of rows O1-O3 counts the number of common shareholders present in each firm's ownership structure, indicating a degree of inter-dependence of each firm on the rest of the market. For example, F1 shows a strong presence of common shareholders (3/3), while F4 has only two of its four shareholders in common with other firms.

The overall total shows the number of links between shareholders and firms present in the economy, in this case thirteen. The minimum number of possible links, arising in a case with no common shareholders, would be eight; in this case, each shareholder only invests in one firm, so we would have only one link for each shareholder (eight in total). On the other hand, in the opposite extreme case where all shareholders own shares in all four firms, the total number of links would reach its maximum of $8 \times 4 = 32$, that is the number of shareholders times the number of firms.

2.2.3 Measurement issues

Through the construction of the ownership and relation matrices (OM and RM), it is possible to identify and compute some of the most common descriptive measures of the extent of common shareholding, as described above, comprising:

Table 2.3: Relation matrix (RM) of the market example from Table 2.1.

	F1	F2	F3	F4	Total
O1	1	0	0	1	2
O2	1	0	1	0	2
O3	1	1	1	1	4
O4	0	1	0	0	1
O5	0	0	1	0	1
O6	0	0	1	0	1
O7	0	0	0	1	1
O8	0	0	0	1	1
Total	3	2	4	4	13

1. Number of reported shareholders with shares in more than one firm of the given market (number of reported common shareholders)

2. For each common shareholder, number of competitors held

3. For each firm, number/proportion of common shareholders among its reported shareholders

4. For each firm, proportion of shares held by common shareholders

5. For each firm, shares of equity holders tail (atomistic shareholders)

6. For each firm, shares held by common shareholders in their competitors

As a matter of fact, these are the main measures used in the empirical studies on common shareholding outlined previously. They describe firms' and shareholders' characteristics with regard to common shareholding at an individual level, and are therefore helpful in a regression setting, in order to incorporate the structure of common shareholding when seeking to study the effects on a certain market measure such as prices.

However, these measures are unable to describe the overall extent of the phenomenon at market level, unless they are aggregated over agents according to certain criteria, for example computing sums or averages. Still, it is unclear which measure should be chosen over the others, and what would be the best aggregation strategy.

The representation of the ownership structure of a market through a matrix, be it ownership or relation matrix, suggests as a natural starting point the investigation of methods that characterise matrices' structures. Several different statistical techniques that extract patterns from given matrices are available, both for the case of numerical and of relational/binary matrices. Such techniques allow for the identification of matrices' characteristics, as well as for the calculation of indices quantifying specific aspects of the relationships represented in the matrix. Given the multiplicity of possible matrix aspects to be considered, we shall analyse in this work the measures related to the concept of sparsity (or sparseness) of a matrix, which is more directly linked to the common shareholding problem. In fact, the concept of sparsity has to do with the representation of a phenomenon where only a small number of coefficients contain a large proportion of the total information. The remaining elements of the representation are negligible, in most cases considered just noise. In matrix language, a sparse matrix or vector is such that most of its elements are zero, similar to the structure of the ownership and relation matrices introduced above.

The distance or similarity between matrices will also be analysed. The similarity between matrices is defined according to a specific metric used to determine the distance between two given matrices. If one of the two matrices is a benchmark - for example the most sparse matrix in a specific context - the distance or similarity measure can be used to identify the degree of a certain phenomenon with respect to the given benchmark. In the study of common shareholding, a specific benchmark matrix can be easily defined, representing for instance the absence of common shareholding, rather than total interconnection between shareholders and firms, or any other market structure of interest.

In the following sections, the aforementioned concepts and statistical methods will be reviewed, and their relevance in the context of common shareholding measurement analysed. Network methods will also be considered, given that many indices used in this context are derived from matrix methods, applied to the matrix representation of the network links. The discussion of the various methods will be illustrated based on the previous numerical example.

2.2.4 Assessing the extent of common shareholding

Describing the phenomenon of common shareholding through a unique indicator is somewhat a reductive exercise, given that the investment behaviour of shareholders in a specific market touches many different aspects. Of all the shortcomings of the existing common shareholding measures highlighted in the previous sections, particular attention will be devoted here to a specific issue, that is the pursuit of a measure of the mere *extent* of common shareholding in a market, before considering its possible effects on economic variables.

A first evaluation of the market ownership structure can be obtained through descriptive statistics such as the proportion of common shareholders (relative to the total number of shareholders), or the fraction of firms that are cross-held[3] (possibly defining a threshold of blockholding). Such statistics are an important quantification of the extent of common shareholding in a market, and can reveal interesting patterns over time. He and Huang (2017) apply these two measures to US data in the period 1980-2014, obtaining evidence of a large increase in

[3] An investor is considered to be a block-holder of a certain level - say, for example, at a 5% level - if she holds at least 5% of the shares of a company. Two firms are cross-held by the block-holder if the investor holds a block of at least 5% of shares in both firms.

the phenomenon since the beginning of the observation period until 2006, where a peak is reached, followed by a more stable period afterwards.

A general overview of the degree of connectedness of a market due to the presence of common shareholders is a starting point, but several other issues are of interest, stemming from the individual behaviour of the investors. First, the investment decisions are driven by a variety of objectives, which determine not only how many and which firms to include in an investor's portfolio, but also the amount to be held in each of the chosen companies. Furthermore, the distribution of investments within a portfolio can also vary, being more or less concentrated around few players rather than equally spread across all chosen firms. As a consequence, the degree of uniformity of a portfolio can reveal different shareholders' strategies. Another aspect of interest is the comparison of portfolios of concurrent investors. This allows for the analysis of possible market-level structures, in particular considering whether a market is split into segments allotted to different stakeholders or - on the opposite side - total access to any company is available to all potential investors. Finally, the consideration of the shareholders' type (such as industrial company, financial company, public authority, individual, etc.) is also of interest to investigate possible differentiation of investments across certain groups.

2.3 Data availability

Keeping all the above points in mind, the building of new measures should start with the careful consideration of the available data, in order to propose indicators that are feasible to be calculated. Orbis, a database compiled by Bureau van Dijk (BvD), was chosen as our main data source for several reasons. First, it provides standardised company information for most world countries, also allowing for historical analyses. The worldwide coverage is key to be able to analyse not only EU firms, but also their shareholders, which are many times registered outside the EU. Second, it constitutes a very rich source of firm-level data, collecting many different aspects of companies, such as legal information, industry classification, trade description, full historical reported ownership, and financial accounts. Third, Orbis is a well acknowledged database, widely used in the financial economics and corporate finance fields. Indeed, several empirical studies investigating firms' financial information are based on Orbis data.[4] Lastly, the representativeness of Orbis is generally considered satisfying both for the financial panel data and the historical ownership (See Kalemli-Oezcan et al., 2015).

An *ad hoc* dataset was extracted from Orbis on purpose for this study, including all firms' financial and ownership main variables, needed as building blocks for the common shareholding indices. Although balance sheet data are available for many years back in time, the ownership structure of companies only became available more recently. Hence, the *ad hoc* dataset

[4] See, for instance, Altomonte and Nicolini (2012), Gal (2013), Andrews et al. (2014), Asdrubali and Signore (2015), and Bravo-Biosca et al. (2016).

covers firm-level information from 2007 to 2016, all available years at the time of the study.

In order to build the common shareholding indices, two main sets of variables are necessary. On one side, a full account of the shareholders' structure of companies, allowing to describe in detail the relationships between investors and firms operating in the market. For instance, using this information it is possible to identify firms that are linked through a common shareholder. Orbis includes information on the percentage held by a shareholder, associated to each firm in its portfolio, as well as the name and country of registration of both parties. Moreover, the reported ownership shares come together with the date of validity, the source from which BvD has received the information, and, above all, the classification of the firm-shareholder type of relation.[5] Finally, Orbis differentiates between direct and total ownership shares, with the first documenting a direct participation of the shareholder in the firm, while the second also taking into account participations mediated through a third company.

On the other side, variables proxying firms' size are needed to adjust common shareholding measures for firms' value in the market. For example, we can calculate the value (in monetary terms) of the firms' shares in an investor's portfolio. Orbis historical financial information contains a large amount of variables coming from firms' accounts. To proxy firms' market size, we adopted two measures: *Total Assets (TOAS)* and *Market Capitalisation (MKT CAP)*. *TOAS* represents the total amount of assets owned by a firm expressed at its market value, including cash, marketable securities, inventory, fixed assets, intangibles and goodwill. *Market Capitalisation* is the value of a company that is traded on the stock market, calculated by the total number of shares times the present share price. While data on *Market Capitalization* is only available for listed firms, *Total Assets* figures are available for most of firms. Nevertheless, in principle both variables describe the size of the firm from the monetary perspective, hence will be alternatively used in the common shareholding analysis, also depending on the availability of data. Further financial variables related to firms' risk, performance, efficiency, profitability and growth are also retrieved.

The aforementioned two groups of variables constitute the basis for the construction of a measure of common shareholding. Nevertheless, the *ad hoc* dataset is complemented with other firms' characteristics, such as the listing status of the enterprise, or its sector of economic activity, identified through the NACE (*Nomenclature générale des Activités économiques dans les Communautés Européennes*) industry classification.[6] The identification of five broad groups of shareholders of interest is also considered, namely Funds, States, Banks, Insurance Companies and finally Cross-Investors, i.e. shareholders whose main activity falls within the same market under analysis.

We describe briefly below our main source of data and the characteristics of the final *ad hoc* dataset. Further details on the Orbis database and on the extraction of the relevant

[5] Such as Domestic or Global Ultimate Owner (DUO or GUO) – see detailed definitions in Appendix A.

[6] Section A.2.2 in Appendix A presents a discussion of different systems of industry classification, and a summary description of the NACE system. Full details about the NACE codes and classification can be found in Eurostat (2008).

information into the *ad hoc* dataset are described in Appendix A. There, we report a description of the data provider, the identification and selection of the companies of interest, all details about the variables enclosed in the dataset, the data organisation and cleaning, and some descriptive statistics of the dataset.

2.3.1 The Orbis database

Presentation of the database

The Orbis database comprises standardised company information compiled by Bureau van Dijk (BvD). According to the BvD official presentation:[7]

> *Orbis has information on more than 365 million companies across the globe. It's the resource for company data. And we make it simple to compare companies internationally. Use Orbis to find, analyse and compare companies for better decision making and increased efficiency.*
>
> *We go further than just providing information, we carefully capture a wide variety of data, then we treat, append and standardise it to make it richer, more powerful and easier to interrogate. In fact, we capture and treat data from more than 160 separate providers, and hundreds of our own sources, to create Orbis.*

Orbis provides data on firms' financial and production activity from balance sheets and income statements, together with all known firms' ownership information, as well as other company related information (intellectual property, auditors, etc.) A detailed list of all the services BvD provides can be found in their business presentation. Orbis has been designed as a commercial database focused mainly on business activities (such as the screening of new suppliers), and was not originally designed for academic research. Therefore, some characteristics of the database need to be carefully considered, when constructing a database for research purposes.

BvD collects part of the data itself, but mostly combines and harmonises the data provided by national information providers. An overview of the national information providers can be found in the BvD Orbis Brochure (Bureau van Dijk, 2018a). Not all of the providers cover a single country, but rather several (regional) countries. For example, the provider Cortera provides ownership information for the US and Canada, Creditreform is the provider for Austria, Germany and Luxembourg, and so on.

The financial and balance sheet information comes from the national Chambers of Commerce, to which the companies are obliged to file their accounting information (into the respective

[7] See `https://www.bvdinfo.com/en-gb/our-products/data/international/orbis`

business register). The information is then relayed to Orbis via one of its providers. It is BvD's declared goal to harmonise the respective information and make it internationally comparable. Hence, it provides the financial data in a so-called "global format", which has been derived from the prevailing formats used for the presentation of business accounts in Europe.

Orbis-based academic research

Several empirical studies use data coming from the Orbis database, mainly on the firms' financial information. Among others, Altomonte and Nicolini (2012), Gal (2013), Andrews et al. (2014), Asdrubali and Signore (2015), and Bravo-Biosca et al. (2016). Some of these studies develop a series of weights to correct the Orbis-based estimates for representativeness according to the objective of the study. Such analyses can be used as a benchmark for the specification of econometric models in the study of the effects of common shareholding on the markets. Altomonte et al. (2018) use Orbis to explore the structure of business groups.

Other papers describe and discuss methodological aspects of the use of Orbis data, like the aforementioned Kalemli-Oezcan et al. (2015), or Ribeiro et al. (2010), where some of the differences between Orbis administrative data and the methodological framework used by National Statistical Offices are discussed. Ragoussis and Gonnard (2012) and Schild (2016) describe methodologies used to extract from Orbis specific datasets for use in subsequent empirical studies. For example, the Ragoussis and Gonnard dataset is the basis for the study in Andrews et al. (2014) cited above. Harasztosi (2018) gives a thorough and updated account of the representativeness of the Orbis database according to employment and value added variables.

Since Kalemli-Oezcan et al. (2015) is a reference on Orbis included in many empirical studies, we summarise briefly here their main findings. First, they give a detailed description of the challenges and shortcomings of the Orbis database and concrete instructions regarding the download, the methodology and the cleaning process in the construction of panel datasets from Orbis.

Furthermore, the authors test the representativeness of the financial dataset and the ownership structure represented in Orbis with data from Eurostat and OECD, respectively. The firms contained in Orbis are set in comparison to the firms presented in the official statistics by Eurostat/ OECD based on

- the amount of gross output the respective firms represent in a given economy
- the number of firms
- and the size and the sector distribution of firms

The authors conclude that the representativeness of Orbis is satisfying for the financial panel data as well as the historic ownership file. In terms of gross output, the Orbis data covers

80-90% of the gross output represented in the Eurostat information. In all other cases the coverage of the Orbis data is at least higher than 50%. The results are confirmed when looking at a smaller subsample (the manufacturing sector).

2.3.2 The *ad hoc* dataset

A historical dataset containing all *listed companies active in the EU*[8] in the period 2007-2016 is constructed: this includes all listed firms registered in the EU, plus all listed companies registered elsewhere, but holding shares in at least one firm registered in the EU.[9] The average number of firms observed each year is 26,560 - as displayed in Table 2.4 - where about 57% are registered in the EU countries, the rest being registered outside the EU. The proportion of EU versus Non-EU registered companies remains roughly constant over time. The total number of observed firms increases slightly over the years, except for the last, where due to the reporting lag the number of covered firms is slightly smaller than in the previous year. Overall, a set of 31,864 different firms are observed.

Table 2.4: Sample composition by country of registration and year.

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EU	14,434	14,849	15,000	15,122	15,171	15,125	15,479	15,564	15,336	15,086
Non-EU	10,423	10,819	11,169	11,398	11,581	11,710	11,756	11,846	11,877	11,856
Total	24,857	25,668	26,169	26,520	26,752	26,835	27,235	27,410	27,213	26,942

The largest groups of EU companies are registered in the UK and Spain (around 20% in each country), followed by Romania (9%), Germany (8,5%), France (7,5%), Poland (5,5%) and Sweden (5%). Again, the distribution stays roughly constant over time. Most of the companies registered outside the EU are located in the US (30%), Japan (9.7%), Canada (6.78%) and Australia (6.6%), while 4,83% of the companies are from India.

Although not all companies are observed in all years, due to the natural life cycle of firms, generally the sample is rather stable. About 68% of the companies have complete records, i.e. they are present throughout the whole 10 years of the period under analysis, and 80% are observed during at least 7 years; a small percentage of firms (15%) were recorded maximum during half of the period, i.e. at most for 5 years.

The bulk of firms are concentrated in few industries. In Table 2.5 the proportion of firms active in the main NACE Sections are reported, with “Manufacturing” (Section C) and “Financial and

[8] In this context the term EU comprises the 28 countries of the EU as of 2017, excluding candidate countries and countries which are simply associates of the European Economic Area (EEA).

[9] More details about the selection procedure are reported in Section A.2.

insurance activities" (Section K) comprising the largest number of firms. Each one of the remaining unreported Sections represented less than 2.5% of the total sample.

Table 2.5: Proportion of firms active in the main NACE Sections

Section	**Description**	**No Firms**	**%**
C	Manufacturing	10,242	32.69
K	Financial and insurance activities	7,713	24.62
J	Information and communication	3,002	9.58
G	Wholesale and retail trade	1,889	6.03
M	Professional, scientific and technical activities	1,486	4.74
L	Real estate activities	1,151	3.67
B	Mining and quarrying	1,119	3.57

The dataset contains 6,070,111 ownership links. On average, each company has about 22 shareholders per year. However, 50% of the companies have at most 7 shareholders in a given year, while 9,5% of the companies even have only one shareholder. The number of total links per year rises slightly from 604,385 in 2007 to 617,353 in 2016.

Every year, on average over 87% of the companies report an ultimate owner of some type.[10] The percentage rises slightly over the sample period from 83.24% in 2007 to 88.49% in 2016. About 60% of companies have a domestic GUO50, with non-EU companies showing a larger share (70%) compared to EU (56%).

Overall, 64% of the firm-shareholder links are recorded between entities registered in the same country (domestic shareholders), the remaining cases denoting a shareholder located abroad. The proportion is rather similar in the case of EU or non-EU based companies.

2.4 Some new common shareholding indices

Some descriptive measures of the presence of common shareholding have been used in the past, as mentioned earlier, but a unifying index evaluating the overall extent of common shareholding is still to be investigated. Based on the considerations presented in the previous sections, a series of alternative indices of common shareholding is proposed. The chosen indicators are constructed on participation shares alone, considered as the main expression of a shareholder's influence on a firm.

[10] Such as Domestic or Global Ultimate Owner (DUO or GUO) – see detailed definitions in Appendix A.

The indices are derived through applying two different approaches to the common shareholding framework, coming from the Sparsity and Network literature, respectively. The first set of methods looks at the shareholder-firm relationships. The second one, instead, analyses only links between agents of the same type, i.e. firm-firm or investor-investor, looking separately at the respective networks. The relationships in these last two groups are not direct, but induced by the presence of an external agent making a connection – a common shareholder linking two firms, or a firm present in two investors' portfolios, creating an overlap.

Details about the derivation and properties of the sparsity and network indices are explained in Appendix B. There, the indices are applied to the appropriate matrices, following the simplified market example introduced earlier. In one case the matrices represent shareholders-firms relationships (sparsity methods), in the other case they correspond to the two separate groups of firms or shareholders (networks methods).

It follows that the set of indices calculated for the sectoral analyses is constituted by two groups of indices: the first is based on the analysis of each shareholders' portfolio, then aggregated at market level according to different criteria; the second set looks instead at similarities between portfolios of pairs of shareholders, or at overlaps of shareholders structures for pairs of firms. The market level aggregation of these last indicators gives rise to network indices, assessing the strength of connectedness of the networks of shareholders or firms, respectively.

Moreover, following examples in the literature (see for instance Seldeslachts et al., 2017, or Fichtner et al., 2017), some new indicators based on the number of block-holdings have been added, for different definitions of blocks (minimum 1%, 3%, 5% and 10% of shares held).

Some previous shareholders' indicators have also been aggregated at market level in new ways. For example, the joint market shares of the 'Big Three' portfolios (BlackRock, State Street and Vanguard) have been calculated based on Total Assets (TOAS) or Market Capitalisation (MKT CAP), aggregating the respective weighted densities.

The construction and meaning of all above indicators are briefly recalled in Tables 2.6 and 2.7. Their interpretation in the light of the current study is presented in the next Sections. For further details about their statistical derivation and properties please refer to Appendix B.

2.4.1 Shareholder indices

Assessing the size of an investor's portfolio is a crucial exercise; this is needed to understand the potential strength of connections induced by the shareholder in the commonly held firms present in her portfolio. We present below a series of indices capturing different aspects of portfolio size and strength, reflecting alternative measurements of the extent and strength of common shareholding induced in a market by the portfolio. In turn, the behaviour of specific shareholders, which dominate in some sense the industry, will characterise at market level the extent of common shareholding.

The first type of index used to study portfolios of investors is the so-called **density** of investments, representing the share of the market in the hands of a specific shareholder, according to different definitions. This index comes from the literature on sparsity of matrices, and is based on the *shareholder-firm relationships* represented through an ownership matrix or through an incidence/relation matrix.

The density can be calculated based on the headcount of firms in a portfolio, or according to their value, expressed in terms of some financial indicator of firm size. In this study, the value-based densities have referred to the total assets (TOAS), available for most firms, or to the market capitalisation (MKT CAP) - only for listed firms. Moreover, the density can also be weighted by the actual participation shares held by the shareholder in each firm, giving rise to a weighted density. All-together, this originates five different indicators as follows:

- **Density = Nsubs/Nfirms**
  No. of firms in a shareholder's portfolio over total no. of firms in the market

  Represents the share of the market to which an investor has access through shareholding. For example, a density of 12% means that a shareholder holds shares in 12% of the firms in the market under consideration. This index does not take into account the actual amount of participation, but only whether the investor is present in a certain firm or not.

- **TOAS density = Total TOAS subs/Total market TOAS**
  Sum of the TOAS of all firms in a shareholder's portfolio over sum of TOAS of all firms in the market

  Represents the relative weight of the firms chosen by a specific investor over the whole market. For instance, a value of 65% means that the firms chosen by the investor represent 65% of the market in terms of TOAS. Even if the density is low (i.e. the portfolio includes few companies), the TOAS density can still be high, if the chosen companies are all large enterprises. The opposite can also occur (high density with low TOAS density, in case the portfolio includes only small firms).

- **MKT CAP density = Total MKT CAP subs/Total market MKT CAP**
  Sum of the MKT CAP of all listed firms in a shareholder's portfolio over sum of MKT CAP of all listed firms in the market

  Interpretation is the same as above, but refers to market capitalisation. Notice that, since this variable is only available for listed companies, the index will include only listed firms, and the market total is computed only on listed firms.

- **TOAS weighted density = Sum weighted TOAS subs/Total market TOAS**
  Sum of the TOAS of firms in portfolio, each weighted by the actual ownership share of investor, over sum of TOAS of all firms in the market

  Represents the actual share of TOAS of the market in the hand of an investor through the specific ownership shares held. For example, if a shareholder has a weighted TOAS density of 2%, this means that the shares held in the various firms of the portfolio amount to 2% of the total market TOAS.

- **MKT CAP weighted density = Sum weighted MKT CAP subs/Total market MKT CAP**
  Sum of the MKT CAP of listed firms in portfolio, each weighted by the actual ownership share of investor, over sum of MKT CAP of all listed firms in the market

  Same as above, but refers to market capitalisation. Again computed only for listed firms (see note for MKT CAP density).

Shareholders scoring exceptional values in the above indicators (so-called *top investors*) are deemed to dominate the market in some respect, and therefore are subject to further analysis. Among them, a group of particular interest is that of companies active in the market itself, which hold shares in concurrent firms, therefore constituting a group. Such shareholders, in case they present high values of the above indices, are denoted *top cross investors*.

Another index describing the type of investment strategy is the so-called **uniformity** index:[11]

- **Uniformity = 1 -** $\frac{\sqrt{\sum \textbf{shares}^2}}{\sum \textbf{shares}}$
  One minus the following ratio: (Square root of the) Sum of the squares of the shares in portfolio, over sum of all shares in portfolio.

  The index is based on the shares held by an investor in each company in the market, and assesses the relative weight of larger participation shares over the shares total, showing smaller values for more concentrated distributions. A value of the index closer to one denotes an even distribution of investments within the portfolio (uniformity).[12]

In the limit, if the investor only holds shares in one company, and zero shares in all remaining companies, the uniformity index will have a value of zero. On the other hand, when an investor holds participation in all firms of the given market, and all with equal shares ("democratic" investor), the index attains its highest value, equal to one. The smaller the values of the index, the more concentrated the investment strategy of a shareholder, i.e. the more the shareholder discriminates between different companies and chooses only some, typically with large participation shares. A large value of uniformity instead generally corresponds to many firms, all held with small shares.

[11] This index is derived from the ℓ^2/ℓ^1 norm, as defined in Appendix B.
[12] For further details see Appendix B, and examples therein.

2.4.2 Market indices

Once we compute the above indices for each shareholder's portfolio, we can look at their distribution across the population of shareholders, identifying for instance the **average**, **median** or **maximum density**, or some **percentiles** of interest. Such values, and their evolution over time, will reveal some characteristics of the market ownership structure, leading to the subsequent analysis of specific cases of interest.

Further insight into the market structure comes from the analysis of the *shareholder-shareholder relationships*, which are explored through the network representation of the market. The projection of the two-mode links between firms and shareholders into the one-more network of shareholders allows us to implement network indices revealing the interconnectedness of portfolios. The main index used for this purpose is the **correlation** between pairs of portfolios, which reveals the level of overlap between two shareholders' investments.

Several market indices can be obtained from the above, such as the **proportion of non-zero correlations**, measuring the *overall degree of overlap* of portfolios; this proportion can only be calculated for shareholders with high densities, who hold a considerable number of firms in the market. The **proportion of highly correlated high-density portfolios** is a signal of the degree of overlap in the investment behaviour of top shareholders.

A similar analysis can be performed within the network of firms, through the projection of the ownership links into the *firm-firm relationships* induced by common shareholders. Here, the object of study is the shareholders' structure of a firm, and the assessment of the degree of overlap with other competitors' ownership information computed through their **correlation**.

The higher the correlation between two firms, the greater the similarity of the respective shareholders' structures, both in terms of the identity of the shareholders and of the quantities of participation they hold in each competitor. For example, even though two firms have several shareholders in common, if they choose to hold rather different amounts of shares in each company, the correlation between the two firms may not be very high. A value of 100% of correlation denotes total coincidence of the two ownership structures, both in terms of shareholders and of quantities held. On the opposite side, in a case where two firms are not cross-held, the correlation between their respective ownership structures is zero, therefore the **proportion of non-zero correlations** is again a useful indicator of the degree of connectedness of the firms' network.

In order to consider only relevant participations, the index above can be calculated only taking into consideration the main shareholders for each firm, i.e. investors that hold at least a certain percentage of shares - for example the threshold of 5%. In this case, the index is identical to a common shareholding measure presented in Chapter 6 of Azar (2012), based on the density of the network of firms, which computes the **proportion of firm-firm connections** existing between pairs of competitors in a given market, due to the presence of a common block-holder.

Notice that all proposed indices can only be computed if the amount of shares held by an investor is known, so it is thus crucial to have the maximum possible information about participation shares. Since there is a non-negligible fraction of recorded shareholder-firm links that do not specify the actual amount of participation, an imputation strategy has been adopted in order to fill in the missing information, where possible. Details on the imputation procedure are reported in Section A.4.

2.4.3 Indices based on block-holdings

A final note regards the **intensity of the investments**, i.e. specific thresholds for the level of participation. Recent literature investigated the role of block-holders as effective monitors of the firms held (see, for example, Kang et al., 2018). An investor is considered to be a block-holder of a certain level - say, for example, at a 5% level - if she holds at least 5% of the shares of a company. Particular attention has been given to investors whose portfolios present multiple block-holdings, suggesting strong links to the common shareholding investigation. It follows that the analysis of the intensity of investments by common shareholders, as represented by block-holdings, can shed further light on the common shareholding puzzle.

The very few existing empirical studies on common shareholding, all based on non-EU firms, consider block-holding as defined by thresholds of 5%. This is mostly due to data availability and not due to a specific economic meaning of the chosen value. In the interest of truly understanding the full extent of this phenomenon, particularly in the context of the EU, this study experiments with **new thresholds** in the definition of block-holders, namely using minimum equity investments of 1, 3, 5, and 10 percent. We present some new indicators of common shareholding based on thresholds of block-holdings.

A first group of indices computes the **number and proportion of firms cross-held by block-holders**, for different levels of holdings. Two firms are cross-held by a block-holder if the investor holds a block of at least x% of shares in both firms. When the threshold of 5% is used, we match the indicators used in the US-based research of He and Huang (2017). This threshold is used in the overview of listed firms active in the EU and in the sectoral studies, for ease of comparison with the cited literature. However, the same indicator is then reproposed with alternative thresholds.

New threshold-based versions of common shareholding indices

In the first part of the study, several common shareholding indices are developed based on all holdings in each market. Some of them are re-proposed here with a new definition, where only holdings above certain thresholds are considered. First, the **density of portfolios**, i.e. the proportion of market firms included in a single investor's portfolio, is computed looking at the most intensive holdings only, namely with minimum 1%, 3%, 5% and 10%. These indices represent the fraction of firms active in an industry which are held with a large participation by a single shareholder, i.e. measures the extent of cross-holding of competitors in blocks of certain value. They are also compared to the previous values based on all holdings.

As for the **network indices**, the interconnection between firms has been assessed looking only at the largest participations in each firm's shareholders structure. Looking at one pair of firms at a time, these indices quantify the degree of similarity between the shareholder structures of each pair, where the shareholders for the two firms are limited to the investors with more intensive participation, namely larger than x%. When two firms have no common block-holder, then they are not connected, and the index for the pair equals zero. According to this definition, the overall proportion of existing connections in the firms' network measures the density of links between firms, links induced by common shareholders that hold considerable participations in pairs of competitors. With a threshold of minimum 5% of shares, the index coincides with a common shareholding measure presented in Chapter 6 of Azar (2012) (density of the network of firms). In the present analysis, we compute the same indices for different levels of block-holding, namely at 1%, 3%, 5% and 10%.

In the case of the investors' network, the links between pairs of portfolios have been computed considering all firms held by an investor, regardless of the level of participation. Here we propose alternative definitions of the same index, where only the largest holdings are retained in each portfolio, in order to compare structures only of major investments.

Additional descriptive indicators of block-holding

In addition to the previous indicators, some new indices based on thresholds are proposed, following some recent studies. For example, Fichtner et al. (2017) presents the number of **block-holdings of top global investors** for holdings of minimum 3%, 5% and 10% respectively, highlighting specifically results for the **'Big Three'** - BlackRock, State Street and Vanguard. Similarly, Seldeslachts et al. (2017) present the number of block-holdings at 1% of selected institutional investors in German listed companies.

In accordance with these studies, we present the calculation of the number of block-holdings for the 'Big Three' in each market under analysis for 1%, 3% and 5% levels; we add the proportion of such block-holdings relative to the total portfolio of the investors in each industry. Finally, we compute the total number of block-holdings at 1%, 3%, 5% and 10% for all investors in each market. These indices reveal interesting patterns of industry-specific intensities of investment by shareholders.

Table 2.6: common shareholding indicators for shareholders' portfolios, and market level counterparts.

Indicator	Definition	Interpretation	Market level
Density	Nsubs/Nfirms	Number of firms in a shareholder's portfolio over total number of firms in the market. Represents the share of the market to which an investor has access through shareholding.	Average, median, maximum, percentiles
TOAS density	Total TOAS subs/Total market TOAS	Sum of the TOAS of all firms in a shareholder's portfolio over sum of TOAS of all firms in the market. Represents the relative weight of the firms chosen by a specific investor over the whole market.	Average, median, maximum, percentiles
TOAS weighted density	Sum weighted TOAS subs/Total market TOAS	Sum of the TOAS of firms in portfolio, each weighted by the actual ownership share of investor, over sum of TOAS of all firms in the market. Represents the actual share of TOAS of the market in the hand of an investor through the specific ownership shares held.	Average, median, maximum, percentiles, sum for 'Big 3'
MKT CAP density	Total MKT CAP subs/Total market MKT CAP	Sum of the MKT CAP of all listed firms in a shareholder's portfolio over sum of MKT CAP of all listed firms in the market. Interpretation is same as for TOAS density, but refers to market capitalisation. *Only listed firms in portfolio.*	Average, median, maximum, percentiles
MKT CAP weighted density	Sum weighted MKT CAP subs/Total market MKT CAP	Sum of the MKT CAP of listed firms in portfolio, each weighted by the actual ownership share of investor, over sum of MKT CAP of all listed firms in the market. Interpretation is same as for TOAS weighted density, but refers to market capitalisation. *Only listed firms in portfolio.*	Average, median, maximum, percentiles, sum for 'Big 3'
Uniformity	$1 - \frac{\sqrt{\sum \mathbf{shares^2}}}{\sum \mathbf{shares}}$	One minus the following ratio: (Square root of the) Sum of the squares of the shares in portfolio, over sum of all shares in portfolio. Index assesses the relative weight of larger participation shares over the shares total, showing smaller values for more concentrated distributions.	Average, median, maximum, percentiles
Number of Block-holdings	Number of holdings $> p\%$	Number of participations in portfolios with share value above a certain percentage p. Represents the number of more intensive investments of portfolio. Computed for $p = 3, 5, 10$.	Sum for 'Big 3', sum for all SH

Table 2.7: common shareholding indicators for shareholders' and firms' networks.

Shareholders' network

Indicator	Definition	Interpretation
Correlation	Pearson's ρ	Pearson's correlation coefficient ρ between pairs of portfolios. Reveals the level of overlap between two shareholders' investments.
Proportion of non-zero correlations	$\frac{\textbf{No. non-zero } \rho}{\mathbf{n(n-1)/2}}$	Number of non-zero correlations over total number of possible connections between pairs of portfolios. n is the total number of portfolios. Represents the proportion of existing links in the shareholders' network, i.e. the network's density.
Number of highly correlated high-density portfolios	No. of ρ >80%	Number of correlations higher than 80% between pairs of large (high density) portfolios (holding more than 10% of the market's firms). Counts the number of very strong links among large shareholders' portfolios.
Proportion of highly correlated high-density portfolios	$\frac{\textbf{No. } \rho \mathbf{>80\%}}{\mathbf{k(k-1)/2}}$	Number of correlations higher than 80%, over total number of possible connections between pairs of large (high density) portfolios (holding more than 10% of the market's firms). k is the total number of high density portfolios. Represents the proportion of very strong links among large shareholders' portfolios, i.e. the degree of similarity of their investments.

Firms' network (only block-holdings at min. 5%)

Indicator	Definition	Interpretation
Correlation	Pearson's ρ	Pearson's correlation coefficient ρ between pairs of SH structures of firms. Reveals the level of overlap between two firms' SH structures.
Proportion of non-zero correlations	$\frac{\textbf{No. non-zero } \rho}{\mathbf{n(n-1)/2}}$	Number of non-zero correlations over total number of possible connections between pairs of firms. n is the total number of firms. Represents the proportion of firms that are connected through some common shareholder, i.e. the firms' network density.
Number of highly correlated SH structures	No. of ρ>80%	Number of correlations higher than 80% between pairs of firms. Counts the number of very strong links among firms' SH structures.
Proportion of highly correlated SH structures	$\frac{\textbf{No. } \rho \mathbf{>80\%}}{\mathbf{k(k-1)/2}}$	Number of correlations higher than 80%, over total number of non-zero connections between pairs of firms. k is the total number of connected firms. Represents the proportion of very strong links among connected firms, i.e. the degree of similarity of SH structure.

Chapter 3

Common Shareholding in the EU

Before proceeding with the identification and analysis of the five industries of interest, we present here a brief overview of the overall structure of ownership in Europe. The figures are based on the dataset of all listed firms active in the EU,[1] introduced earlier.

Given the very large number of recorded shareholders in the EU (above a hundred thousand per year), the market indices based on networks – which compare two-by-two all possible pairs of agents – were not calculated, and will be left for the sectoral analyses. Therefore this first overview will present the indices based on density and uniformity, as well as some descriptive statistics of the ownership structure of Europe.[2]

The Chapter is organised as follows: Section 3.1 presents the overall results of common shareholding indicators for listed companies active in the EU between 2007 and 2016. Section 3.2 identifies the investors presenting top values of the common shareholding indices in the EU, while Section 3.3 outlines the summary statistics on the largest EU portfolios.

3.1 Results for listed firms active in the EU in 2007-2016

Table 3.1 presents an overview of the market structure, reporting the number of listed firms active in the EU in 2007-2016, and the number of their respective recorded shareholders. We recall that the definition of this set of firms includes two groups of companies: (i) listed firms registered in one of the EU countries, and (ii) listed firms registered elsewhere, but holding shares in firms registered in the EU territory. As for the shareholders, some types that are recorded collectively – and hence cannot be identified – were discarded in this analysis.[3]

[1] We recall that in this context the term EU comprises the 28 countries of the EU as of 2017, excluding candidate countries and countries which are simply associates of the European Economic Area (EEA).

[2] For the definition of the indicators, see Section 2.4.

[3] The discarded shareholder types correspond to the following categories, as classified in Bureau van Dijk's user guide to the ownership databases (see BvD, 2018b): Public (Shareholder type "Z"), and Aggregated unnamed share-

Table 3.1 highlights also the number and proportion of common shareholders, as well as of companies cross-held by block-holders. A common shareholder by definition is an investor holding participation in at least two firms in a given market, otherwise it is labelled as a "single" shareholder. As before, an investor is defined as being a block-holder of a firm if holding at least 5% of the shares of the firm. Two firms are cross-held by a block-holder if the investor holds at least 5% in both firms. This definition will be maintained also in the sectoral analyses.

Table 3.1: Summary statistics for listed firms active in the EU between 2007 and 2016: number of firms; number and percentage of firms cross-held by block-holders (BH) at minimum 5%; total number of shareholders; number and percentage of common shareholders (i.e. shareholders with more than one firm in their portfolio); number and percentage of single owners (holding shares only of one firm).

Year	Number Firms	Number (%) Firms Cross-held by BH	Number of SH	Number (%) Common SH	Number (%) Single SH
2007	23,624	15,454 (65.41)	97,578	14,570 (14.93)	83,008 (85.07)
2008	24,453	15,891 (64.99)	100,856	14,799 (14.67)	86,057 (85.33)
2009	24,910	15,883 (63.76)	101,190	14,959 (14.78)	86,231 (85.22)
2010	25,307	16,001 (63.23)	105,803	15,398 (14.55)	90,405 (85.45)
2011	25,493	16,059 (62.99)	104,798	14,772 (14.10)	90,026 (85.90)
2012	25,515	16,203 (63.50)	105,237	14,733 (14.00)	90,504 (86.00)
2013	26,090	17,800 (68.23)	107,430	14,991 (13.95)	92,439 (86.05)
2014	26,375	18,235 (69.14)	113,071	15,599 (13.80)	97,472 (86.20)
2015	26,282	17,678 (67.26)	120,307	16,196 (13.46)	104,111 (86.54)
2016	25,995	17,460 (67.17)	126,810	16,236 (12.80)	110,574 (87.20)

The figures show a slight increase in the number of listed firms over time (from less than 24,000 to about 26,000). The total number of reported shareholders is also increasing over the years, reaching a value of almost 127 thousand in 2016. However, the large majority of shareholders only hold participation in one of the listed firms, being therefore "single" shareholders (more than 85% of the cases). Although the number of common shareholders has been increasing in the ten years of observation, their proportion has been declining, from about 15% in 2007 to less than 13% in 2016.

Another interesting indicator of the extent of common shareholding is given by the quantification of the presence of common block-holders. The number of listed firms that are cross-held by block-holders has been increasing from about 15.5 thousand to about 17.5 thousand, and their proportion over the whole set of firms has been oscillating, but is now rather stable on higher values around 67%.

The above results are very close to US-based indicators calculated for the same period in He and Huang (2017). In their research, the two authors present a calculation of the above indices from 1980 to 2014, showing a noticeable increase in all indicators, reaching a peak in 2007,

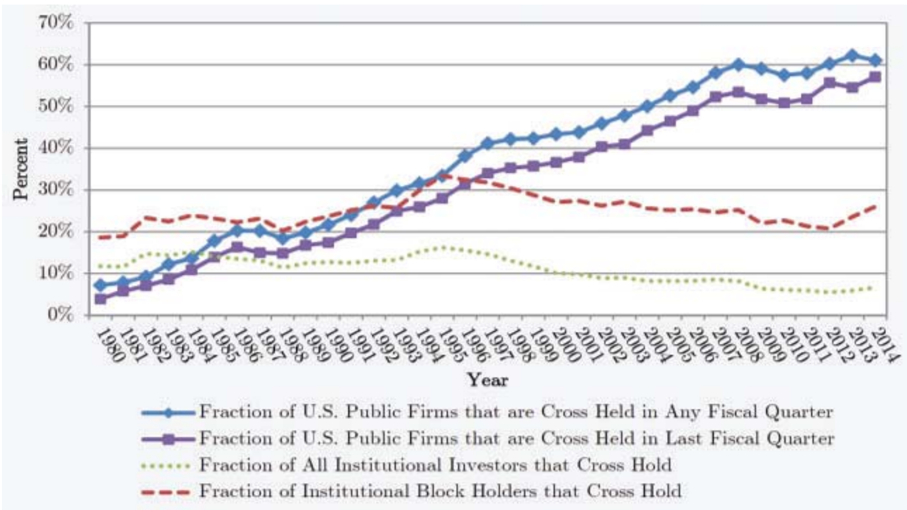
holders (types "L" and "D"). See Appendix A for details.

and stabilising afterwards with a minor upward trend. The graph summarising their results is reproduced in Figure 3.1 for easier comparison[4].

The definitions used for the calculation of the indices are slightly different. For example, He and Huang (2017) refer to "Institutional Investors" rather than all shareholders, but do not give a specific definition of how such a group of investors is chosen; in our analysis all shareholders are considered. Another difference in the definition of the indicators comes from the consideration, in He and Huang, of cross-holding only for firms within the same four-digit SIC industry; in our overall analysis we considered cross-holding for all firms, without splitting into industries. In the sectoral analysis that will be presented in Chapter 4, instead, we will calculate the indicators by industry.[5] Despite these slight differences, the overall results for the period 2007-2016 are very much in line with what was encountered in the EU analysis, both at overall level and in the sectoral analyses presented later.

After this initial overview and characterisation of the shareholders' structure of listed firms active in the EU, we now present the results obtained with the new common shareholding indicators as presented in Section 2.4. The uniformity and the five density indices (plain density and value-based densities) are calculated for each shareholder; their distribution across all shareholders is studied. For each index, the most significant statistics are reported in Tables 3.2-3.5, namely: average, percentiles 75 and 99, and the maximum value in the population.

Figure 3.1: Figure 1 from He and Huang (2017). Patterns of institutional cross-ownership over time in the US.



Reproduced under permission, Oxford University Press License Number 4874220513731

[4] Permission to reproduce Fig. 1 on p. 2675 of He and Huang (2017) was granted by Oxford University Press on Jul 22, 2020 by License Number 4874220513731.

[5] Notice, however, that sectors will not be identified through a code of Industry Classification, due to several shortfalls encountered in this approach. See Appendix C for further details.

The summary statistics for the plain density index are presented in Table 3.2. The average market share held by investors has declined over time, from about 0.025% in 2007 to 0.018% in 2016. However, such yearly averages are greatly influenced by some large values corresponding to the top investors, while in fact the majority of shareholders present much lower values. In fact, recalling that about 85% of the owners hold only one firm in their portfolio, and considering that there are about 26 thousand firms per year in the market, for most shareholders the density is extremely low ($\approx$ 0.004% = 1/26,000).

The portfolios have non-negligible sizes only for a very small fraction of investors: many of the portfolios in the top 1% of the distribution still do not even encompass as much as 0.5% of the firms (the 99th percentiles is around 0.2%), but the maximum density value shows that there are shareholders holding as many as 25% of the firms in the market, i.e. more than 6000 companies. Due to these very high values, the top shareholders will be briefly analysed later in Sections 3.2-3.3, looking at the sizes of their portfolios over time, their composition in terms of country of registration of the firms, and their weight as assessed by the average share value.

Table 3.2: Density of investments: Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Summary Statistics by year (percentage points): mean, 75th percentile (p75), 99th percentile (p99), maximum (max).

Year	Density			
	mean	p75	p99	max
2007	0.0252	0.0042	0.2751	25.2921
2008	0.0235	0.0041	0.2413	25.7923
2009	0.0225	0.0040	0.2369	25.4195
2010	0.0222	0.0040	0.2331	26.0205
2011	0.0216	0.0039	0.2197	25.8149
2012	0.0210	0.0039	0.2077	25.5928
2013	0.0204	0.0038	0.2108	24.8371
2014	0.0198	0.0038	0.2047	23.9166
2015	0.0189	0.0038	0.1940	23.8452
2016	0.0179	0.0038	0.1770	23.8661

In the case of uniformity, reported in Table 3.3, more than three quarters of the shareholders present a value of zero, given that they only own shares in one firm. This also justifies the very low mean value, showing high concentration of the investments of the shareholders.

However, the top values for this index are rather high, with the percentile 99 showing a uniformity above 80%, and the maximum observed value being about 99% throughout the years of observation. This shows that the shareholders with the larger portfolios tend to invest equally among the chosen firms, rather than giving priority to specific companies through buying higher shares. This is usually reflected by a low value for the average share, as will be seen later in the section dedicated to the top owners.

Table 3.3: Uniformity of investments: relative weight of larger participation shares over the shares total in the portfolio. Small values denote concentrated investment. Summary Statistics by year (percentage points, index values between 0 and 1): mean, 75th percentile (p75), 99th percentile (p99), maximum (max).

Year	Uniformity			
	mean	p75	p99	max
2007	6.8517	0.0000	82.5517	98.6362
2008	6.6227	0.0000	81.7706	98.6313
2009	6.4407	0.0000	81.2290	98.7472
2010	6.3770	0.0000	81.4345	98.7784
2011	6.1674	0.0000	81.0806	98.7048
2012	5.9699	0.0000	80.2010	98.6637
2013	6.0062	0.0000	80.3506	98.7083
2014	6.0396	0.0000	80.4744	98.8071
2015	5.9612	0.0000	80.0559	98.8045
2016	5.7440	0.0000	79.0219	98.7994

For the density indices based on financial variables, the distributions present a large amount of values very close to zero, as shown in Table 3.4 for values based on Total Assets, and Table 3.5 for indices calculated from Market Capitalisation. This is in line with the presence of a large number of single shareholders, but adds the information that the single firms in their portfolios are generally also small in size.

However, looking at the common shareholders, it is striking that the firms included in the largest portfolios represent a significant proportion of the total value of the market, reaching a coverage of above 80% of Total Assets and more than 90% of Market Capitalisation in almost all years. This means that the top investors not only hold shares in a considerable number of firms (we have seen values around 25% in Table 3.2), but also typically choose the largest enterprises, leaving out only minor players - which together do not account for more than 10-20% of the market value. Also of note is that both indices have been increasing steadily over time, showing that the preference for the largest players has become stronger over time.

Looking at the weighted indices, in the right panels of Tables 3.4 and 3.5, again we observe the majority of portfolios producing negligible values. However, the proportion of market value held by top investors through their participation shares is rather tangible, showing maximum values above 3% - and increasing - for Market Capitalisation. For Total Assets even higher maximum values are observed, with an average of about 4.3% and, also increasing, displaying a steep rise from 2012 onwards in particular.

Table 3.4: Density indices based on Total Assets of firms in portfolio. Left: TOAS density - proportion of total assets of the market represented by the firms in portfolio. Right: Weighted TOAS density - proportion of total assets of the market held by shareholder through participation shares. Summary Statistics by year (percentage points): mean, 75th percentile (p75), 99th percentile (p99), maximum (max).

Year	TOAS density			
	mean	p75	p99	max
2007	0.0843	0.0017	0.6643	75.8632
2008	0.0850	0.0014	0.6213	79.7778
2009	0.0745	0.0013	0.6136	79.0359
2010	0.0737	0.0012	0.6201	81.7066
2011	0.0784	0.0012	0.9931	83.9119
2012	0.0764	0.0012	1.0032	83.8338
2013	0.0707	0.0012	0.7367	85.0071
2014	0.0673	0.0013	0.7632	86.9724
2015	0.0640	0.0012	0.7076	87.6514
2016	0.0596	0.0012	0.7024	88.3695

Year	Weighted TOAS density			
	mean	p75	p99	max
2007	0.0011	0.0000	0.0145	2.2906
2008	0.0011	0.0000	0.0130	3.6192
2009	0.0012	0.0000	0.0130	4.1082
2010	0.0011	0.0000	0.0126	3.2133
2011	0.0012	0.0000	0.0139	2.8798
2012	0.0011	0.0000	0.0134	2.8715
2013	0.0012	0.0000	0.0132	5.5166
2014	0.0011	0.0000	0.0118	5.8217
2015	0.0011	0.0000	0.0116	6.2675
2016	0.0010	0.0000	0.0110	6.3193

Table 3.5: Density indices based on Market Capitalisation of firms in portfolio. Left: MKT CAP density - proportion of market capitalisation of the market represented by the firms in portfolio. Right: Weighted MKT CAP density - proportion of market capitalisation of the market held by shareholder through participation shares. Summary Statistics by year (percentage points): mean, 75th percentile (p75), 99th percentile (p99), maximum (max).

Year	MKT CAP density			
	mean	p75	p99	max
2007	0.0832	0.0009	0.6613	86.7368
2008	0.0833	0.0008	0.6335	85.9546
2009	0.0857	0.0011	0.6446	89.1957
2010	0.0882	0.0012	0.6664	91.1985
2011	0.0854	0.0012	0.6274	91.8413
2012	0.0841	0.0012	0.6629	90.3237
2013	0.0843	0.0015	0.7311	91.5006
2014	0.0806	0.0017	0.6475	91.1626
2015	0.0795	0.0021	0.6328	91.3758
2016	0.0754	0.0021	0.5716	92.5755

Year	Weighted MKT CAP density			
	mean	p75	p99	max
2007	0.0011	0.0000	0.0157	2.3374
2008	0.0010	0.0000	0.0134	2.3823
2009	0.0011	0.0000	0.0150	3.1114
2010	0.0010	0.0000	0.0137	3.3804
2011	0.0010	0.0000	0.0138	3.3270
2012	0.0010	0.0000	0.0135	3.1121
2013	0.0010	0.0000	0.0134	3.4228
2014	0.0010	0.0000	0.0127	3.4310
2015	0.0010	0.0000	0.0120	3.6713
2016	0.0009	0.0000	0.0112	3.8560

3.2 Top-ranking investors

After the consideration of the general results, it is worth having a closer look at the shareholders that present maximum values in the density-based indices presented earlier. In fact, although in many cases the investors scoring higher values in one index also score high in the remaining ones, there are some exceptions.

In particular, we observe cases of small portfolios that include very large enterprises with very large participation shares, therefore presenting top values for the weighted indices, even though their non-weighted indices are negligible. Given the possible strategic relevance of their investments, we summarise the main findings in Table 3.6.

The table presents, for each top-ranking investor, the country of registration and the number of listed firms active in the EU included in the respective portfolio; the last five columns report the number of years in 2007-2016 when the investor presented one of the top 20 values in the five indices. A blank corresponds to cases where the investor was never in the top 20 for the specific index.

The top panel summarises the information on the largest portfolios, most of which present top values for the Density index throughout the 10 years of observation. Given the large number of firms held and their size, the value-based indices also present very high values in most cases, both in terms of Total Assets and of Market Capitalisation. As was mentioned earlier, these large portfolios generally encompass all the largest companies, representing in many cases more than 80% of the market value.

As for the weighted indices, not all portfolios present high values, given that the average shares held are rather small in some cases, therefore producing a smaller value for these indices. Still, a good number of investors score very high also on the weighted indices for the entire period of 2007-2016, namely Bank of New York Mellon, BlackRock, Fidelity, JP Morgan Chase, Norway[6], State Street and Vanguard. From these preliminary figures, these large groups - mainly US-based (except Norway) - show a clear dominance over the set of listed firms active in Europe.

The bottom panel of Table 3.6 reports other portfolios, of generally smaller size, but still scoring high in one or more of the value-based indices. In many cases this is still due to the considerable number of firms held (hundreds or even thousands), but few investors hold a rather small portfolio (few dozens of firms). These few cases generally correspond to investors holding very high stakes of some large companies, therefore producing high weighted indices. The corresponding non-weighted indices are always negligible.

[6] We recall that the term "Norway" (the state) is used as an abbreviation to indicate the Norwegian Sovereign Fund. The same is intended for the references to other states, such as France or Sweden, meaning the respective sovereign funds.

Table 3.6: Top-ranking investors. Number of years in 2007-2016 an investor appears in the top 20 for the five density-based indices. Blanks correspond to cases where investor was never in the top 20.

Name	Country	No Subs 2016	Density	TOAS density	MKT CAP density	TOAS w density	MKT CAP w density
Largest portfolios			No years ranking in top 20				
ALLIANZ	DE	2651	9	10	8		
AXA	FR	3261	10	9	10	4	7
BANK OF NEW YORK MELLON	US	4289	10	10	10		10
BARCLAYS	UK	1841	5			4	5
BLACKROCK	US	6052	9	9	9	9	10
BNP PARIBAS	FR	2070	4	5	5		
CREDIT SUISSE	CH	3378	10		7		
DEUTSCHE BANK	DE	3474	10	10	10		
DIMENSIONAL FUND	US	6204	10	6			
FMR LLC	US	3378	10	10	10	10	10
GOLDMAN SACHS	US	3447	10	5			
INVESCO	BM	3335	9	9	9		7
JP MORGAN CHASE	US	4208	10	10	10	8	10
MORGAN STANLEY	US	2976	10		9		
NORTHERN TRUST	US	3081	5				7
NORWAY	NO	5316	10	10	10	9	10
STATE STREET	US	4346	10	10	10	10	10
TEACHERS INSURANCE	US	3885	9	10	10		
UBS	CH	n.a.	8	8	8		6
VANGUARD	US	6006	10	10	10	10	10
Other portfolios			No years ranking in top 20				
CAPITAL GROUP	US	1451		10	9	10	10
CENTRAL HUIJIN INVESTMENT	CN	47				8	
CHINA-PEOPLE'S REPUBLIC	CN	472				8	8
FRANKLIN RESOURCES	US	1748					10
HKSCC NOMINEES LIMITED	CN	52				7	
HSBC CUSTODY NOMINEES (AUSTRALIA)	AU	433				5	
ING GROEP	NL	380			6		
LLOYDS BANKING GROUP	UK	25				9	
REGERINGSKANSLIET - SWEDEN	SE	1872		8	10		
SCHRODERS	UK	2644		7			
STICHTING PENSIOENFONDS	NL	1790		9	10		
SUN LIFE FINANCIAL	CA	1447					5
T ROWE PRICE GROUP	US	1831					9
TEMASEK HOLDINGS	SG	39				5	
WELLINGTON MANAGEMENT	US	1929					10

3.3 Major Portfolios

Following the general overview of the shareholders' structure in the EU, this section gives a closer look at portfolios of the major common shareholders present in the area. Twenty shareholders were considered for this analysis, selected according to the size of their portfolio over the entire period of observation, and for their presence in the top ranks of all indices analysed earlier, i.e. they correspond to the largest portfolios presented in the top panel of Table 3.6.

The chosen shareholders all have in their portfolio more than 3000 listed companies active in the EU, for at least 5 years in the period 2007-2016.[7] The main results are presented in Tables 3.7 and 3.8, in which an outline of the characteristics of portfolios in terms of size and shares are reported, as well as the geographical area of registration of firms held in each portfolio.

From the top and middle panels of Table 3.7, four large funds stand out with portfolios currently including more than 20% of the listed firms active in Europe, namely BlackRock, Dimensional Fund, Norway and Vanguard. In terms of time trend, both BlackRock and Vanguard show an increase in size over time, while Dimensional has been shrinking a little, and Norway is overall stable.

Positioned only slightly behind are Axa, Deutsche Bank, Fidelity (FMR LLC) and JP Morgan Chase, which started out above 20% at the beginning of the period of observation, but have decreased their number of firms held over time, currently holding between 12.5% and 16.2%. On a lower but stable level are Bank of New York Mellon, State Street and Teachers Insurance, with around 17%, while Credit Suisse, Goldman Sachs and Invesco show smaller declining portfolios, currently standing at around 13%. The remaining investors hold smaller portfolios, generally having diminished in relative size over the years.

[7] The only exception is BNP PARIBAS, which has more than 3000 firms in portfolio only in three years.

Table 3.7: Summary indicators for portfolios of major common shareholders over 2007-2016.

Year	ALLIANZ	AXA	BANK OF NY MELLON	BARCLAYS	BLACKROCK	BNP PARIBAS	CREDIT SUISSE	DEUTSCHE BANK	DIMENSIONAL FUND	FMR LLC	GOLDMAN SACHS	INVESCO	JPMORGAN CHASE	MORGAN STANLEY	NORTHERN TRUST	NORWAY	STATE STREET	TEACHERS INSURANCE	UBS	VANGUARD
	Size of portfolios (number of listed firms active in the EU owned by each investor)																			
2007	3746	5431	3637	5975	3055	2242	4198	4841	5962	4913	3920	1804	4942	4107	3120	4095	3937	2990	4749	3852
2008	3809	5376	3837	6142	4038	2316	4141	4658	6307	4952	4092	3445	5173	3985	3133	5206	4232	3183	4586	4022
2009	3686	5484	4144	5512	5547	3359	3808	4464	6332	4880	3875	3663	5092	3660	3005	5242	4253	4017	4138	3993
2010	3679	5411	4329	3187	5927	3453	4044	4553	6585	5009	3897	3962	5191	3636	2966	5310	4502	4420	4162	4043
2011	3390	5001	4268	3042	6049	3159	3943	4246	6581	4915	3687	3948	4980	3352	2871	5252	4572	4682	3956	5947
2012	3231	4672	4208	2714	5910	2856	3747	4036	6530	4728	3524	3800	4682	3226	2767	5077	4657	4639	3656	5968
2013	3135	4201	4292	2278	6016	2637	3614	3924	6480	4576	3545	3705	4604	3108	2856	5305	4643	4688	3466	5820
2014	2897	3969	4384	2240	6187	2357	3581	3799	6308	4321	3663	3620	4582	3330	2943	5484	4772	4635	3331	5884
2015	2786	3630	4429	2044	6217	2254	3496	3693	6267	3592	3626	3491	4402	3180	3025	5469	4612	4495	n.a.	6008
2016	2651	3261	4289	1841	6052	2070	3378	3474	6204	3378	3447	3335	4208	2976	3081	5316	4346	3885	n.a.	6006
	Relative size of portfolios (% of listed firms active in the EU owned by each investor)																			
2007	15.9	23.0	15.4	25.3	12.9	9.5	17.8	20.5	25.2	20.8	16.6	7.6	20.9	17.4	13.2	17.3	16.7	12.7	20.1	16.3
2008	15.6	22.0	15.7	25.1	16.5	9.5	16.9	19.1	25.8	20.3	16.7	14.1	21.2	16.3	12.8	21.3	17.3	13.0	18.8	16.5
2009	14.8	22.0	16.6	22.1	22.3	13.5	15.3	17.9	25.4	19.6	15.6	14.7	20.4	14.7	12.1	21.0	17.1	16.1	16.6	16.0
2010	14.5	21.4	17.1	12.6	23.4	13.6	16.0	18.0	26.0	19.8	15.4	15.7	20.5	14.4	11.7	21.0	17.8	17.5	16.5	16.0
2011	13.3	19.6	16.7	11.9	23.7	12.4	15.5	16.7	25.8	19.3	14.5	15.5	19.5	13.2	11.3	20.6	17.9	18.4	15.5	23.3
2012	12.7	18.3	16.5	10.6	23.2	11.2	14.7	15.8	25.6	18.5	13.8	14.9	18.4	12.6	10.8	19.9	18.3	18.2	14.3	23.4
2013	12.0	16.1	16.5	8.7	23.1	10.1	13.9	15.0	24.8	17.5	13.6	14.2	17.7	11.9	11.0	20.3	17.8	18.0	13.3	22.3
2014	11.0	15.1	16.6	8.5	23.5	8.9	13.6	14.4	23.9	16.4	13.9	13.7	17.4	12.6	11.2	20.8	18.1	17.6	12.6	22.3
2015	10.6	13.8	16.9	7.8	23.7	8.6	13.3	14.1	23.9	13.7	13.8	13.3	16.8	12.1	11.5	20.8	17.6	17.1	n.a.	22.9
2016	10.2	12.5	16.5	7.1	23.3	8.0	13.0	13.4	23.9	13.0	13.3	12.8	16.2	11.5	11.9	20.5	16.7	15.0	n.a.	23.1
	Average participation shares																			
2007	1.01	1.78	1.01	2.53	1.43	0.74	0.95	1.25	1.18	3.31	1.40	1.68	1.37	1.23	0.75	0.46	1.30	0.63	1.17	1.56
2008	1.02	1.56	0.96	2.62	1.28	0.81	0.85	1.10	1.17	2.86	1.29	1.43	1.20	1.23	0.77	0.65	1.28	0.60	1.09	1.71
2009	0.94	1.30	1.02	2.18	3.25	1.22	0.66	0.95	1.14	2.93	0.86	1.30	1.11	1.01	0.95	0.80	1.33	0.52	0.88	1.97
2010	0.89	1.00	0.97	2.08	3.16	0.98	0.56	0.91	1.06	2.88	0.71	1.49	1.00	0.82	0.96	0.90	1.26	0.49	0.88	2.13
2011	0.97	0.94	0.99	1.41	3.04	0.83	0.51	0.82	1.07	2.73	0.67	1.37	1.02	0.72	1.02	1.00	1.26	0.47	0.83	1.68
2012	1.01	0.88	0.95	1.36	2.96	0.77	0.52	0.74	1.12	2.66	0.68	1.36	1.02	0.69	1.11	1.07	1.29	0.46	0.77	1.84
2013	1.00	0.87	0.98	0.92	3.13	0.81	0.49	0.69	1.18	2.70	0.65	1.43	1.08	0.63	1.07	1.19	1.31	0.46	0.80	1.97
2014	1.04	0.88	0.91	0.87	3.04	0.78	0.50	0.72	1.25	2.68	0.67	1.50	1.16	0.69	0.90	1.23	1.28	0.56	0.85	2.17
2015	1.07	0.90	0.90	0.91	3.09	0.76	0.49	0.80	1.36	2.96	0.71	1.58	1.11	0.74	0.88	1.21	1.30	0.56	n.a.	2.52
2016	1.00	0.97	0.83	0.82	3.26	0.75	0.46	0.70	1.40	2.87	0.72	1.56	1.12	0.74	0.83	1.27	1.37	0.60	n.a.	2.84

Considering the average quantities held (bottom panel of Table 3.7), the ranking is slightly different, with the average share of BlackRock and Fidelity consistently representing around 3%, followed by Vanguard with about 2% (increasing), and Invesco, Dimensional and State Street with about 1% to 1.5%. They are followed in turn by Allianz, Axa, Bank of New York Mellon, Norway and JP Morgan Chase, where the average share of annual portfolios is close to 1%, and slightly increasing. The remaining common shareholders currently present portfolios whose average share is below 1%.

In terms of the geographical composition of portfolios, Table 3.8 reports some overall statistics for the whole period of observation. Compared to the complete set of listed firms active in the EU during 2007-2016 - where roughly 43% of companies are registered outside Europe - the firms included in the portfolios of the top 20 shareholders show a much higher proportion of cases registered outside the EU (70%).

Looking at the countries of registration of the firms in the portfolios, we find that the most frequent ones are the US, the UK, Japan, Germany, France and Italy (in decreasing order). Depending on the investor, though, the proportion of firms in the portfolio coming from each of the mentioned countries varies largely. For example, Northern Trust invests almost uniquely in firms from the US ($\approx$ 70% of portfolio) and from the UK ($\approx$ 18%), almost disregarding Japan and the other EU countries.

On the other hand, Japan attracts large attention from many of the major common shareholders, covering in many cases more than one-tenth of their portfolio (Axa, Bank of New York Mellon, BlackRock, Dimensional, Fidelity, Goldman Sachs, JP Morgan Chase, Norway, State Street, Teachers Insurance and Vanguard).

UK-based firms have in general a large weight in all portfolios, second only to the US, but they are privileged by Barclays, where they represent about one-third of the chosen companies over the years.

As for the three remaining European countries, they are present in small proportions in all portfolios, but they are clearly preferred by home investors: Allianz and Deutsche Bank portfolios present, respectively, 6% and 5% of companies based in Germany, while 7.67% of firms held by BNP Paribas are French.

Table 3.8: Composition of portfolios of major common shareholders, by geographical area and country of registration. N = Number of links to listed firms active in the EU over 2007-2016; p = proportion of links (%) in portfolio related to listed firms active in the EU registered in indicated area/country.

Name of Shareholder		Area		Country of registration					
		Non-EU	EU	US	UK	JP	DE	FR	IT
ALLIANZ	N	19,215	13,795	11,488	3,518	1,433	1,965	2,016	865
	p (%)	58.21	41.79	34.80	10.66	4.34	5.95	6.11	2.62
AXA	N	30,152	16,284	17,140	7,335	4,670	1,352	1,752	993
	p (%)	64.93	35.07	36.91	15.80	10.06	2.91	3.77	2.14
BANK OF NY MELLON	N	32,553	9,264	19,984	4,376	3,817	801	756	550
	p (%)	77.85	22.15	47.79	10.46	9.13	1.92	1.81	1.32
BARCLAYS	N	21,563	13,412	14,905	10,331	1,369	469	545	287
	p (%)	61.65	38.35	42.62	29.54	3.91	1.34	1.56	0.82
BLACKROCK	N	40,342	14,656	20,269	7,043	5,419	1,209	1,174	714
	p (%)	73.35	26.65	36.85	12.81	9.85	2.20	2.13	1.30
BNP PARIBAS	N	13,364	13,339	7,278	4,949	1,330	840	2,048	712
	p (%)	50.05	49.95	27.26	18.53	4.98	3.15	7.67	2.67
CREDIT SUISSE	N	26,348	11,602	18,266	6,030	1,940	1,293	756	619
	p (%)	69.43	30.57	48.13	15.89	5.11	3.41	1.99	1.63
DEUTSCHE BANK	N	27,732	13,956	18,466	6,531	1,458	2,122	880	502
	p (%)	66.52	33.48	44.30	15.67	3.50	5.07	2.11	1.20
DIMENSIONAL FUND	N	45,848	17,708	18,433	4,661	6,584	2,107	1,957	1,298
	p (%)	72.14	27.86	29.00	7.33	10.36	3.32	3.08	2.04
FMR LLC	N	33,286	11,978	15,923	5,024	4,433	1,055	1,361	758
	p (%)	73.54	26.46	35.18	11.10	9.79	2.33	3.01	1.67
GOLDMAN SACHS	N	28,138	9,138	18,934	6,085	3,640	513	448	285
	p (%)	75.49	24.51	50.79	16.32	9.76	1.38	1.20	0.76
INVESCO	N	25,518	9,255	15,647	4,712	2,086	796	815	315
	p (%)	73.38	26.62	45.00	13.55	6.00	2.29	2.34	0.91
JPMORGAN CHASE	N	33,364	14,492	17,555	6,305	4,753	1,350	1,340	877
	p (%)	69.72	30.28	36.68	13.17	9.93	2.82	2.80	1.83
MORGAN STANLEY	N	26,349	8,211	19,188	5,229	1,185	485	464	224
	p (%)	76.24	23.76	55.52	15.13	3.43	1.40	1.34	0.65
NORTHERN TRUST	N	23,381	6,386	20,808	5,437	188	116	106	45
	p (%)	78.55	21.45	69.90	18.27	0.63	0.39	0.36	0.15
NORWAY	N	36,986	14,770	13,693	4,210	6,753	1,446	1,709	1,173
	p (%)	71.46	28.54	26.46	8.13	13.05	2.79	3.30	2.27
STATE STREET	N	33,530	10,996	19,398	4,850	4,976	903	1,002	647
	p (%)	75.30	24.70	43.57	10.89	11.18	2.03	2.25	1.45
TEACHERS INSURANCE	N	32,723	8,911	18,614	2,939	4,969	939	951	530
	p (%)	78.60	21.40	44.71	7.06	11.93	2.26	2.28	1.27
UBS	N	20,873	11,474	12,922	6,489	1,342	1,157	1,106	451
	p (%)	64.53	35.47	39.95	20.06	4.15	3.58	3.42	1.39
VANGUARD	N	40,853	10,690	21,225	3,304	5,401	1,012	1,208	744
	p (%)	79.26	20.74	41.18	6.41	10.48	1.96	2.34	1.44

Box 3.1: Main results of EU analysis - Overall evidence

- Baseline analysis is done on a historical dataset containing all listed companies active in the EU in the period 2007-2016: this includes all listed firms registered in the EU, plus all listed companies registered elsewhere, but holding participation in at least one firm registered in the EU. The average number of firms observed each year is 26,560 (from 24,857 in 2007 to 26,942 in 2016) - where about 57% are registered in EU countries, the rest being registered outside the EU. The proportion of EU versus Non-EU registered companies remains roughly constant over time.

- In 2016, 87.2% of all shareholders of companies in our dataset held participation in only one company (85.1% in 2007). Common shareholders therefore make up 12.8% of all shareholders (14.9% in 2007). The number of listed firms that are cross-held by block-holders (common shareholders with at least 5% participation in more than one company) has been increasing, growing from around 15.5 thousand in 2007 to around 17.5 thousand in 2016. Around 67% of the analysed companies are cross-held by block-holders with at least 5% participation.

- Looking at portfolios, the top common shareholders hold as many as 25% of the firms in the market, representing more than 6,000 companies overall. They tend to invest equally among the chosen firms, rather than prioritising specific companies through buying higher percentages of shares.

- The firms included in the largest portfolios represent a significant proportion of the total value of the market, reaching a coverage of above 80% of Total Assets and more than 90% of Market Capitalisation in almost all years. This means that the top investors not only hold shares in a considerable number of firms (around 25%), but also typically choose the largest enterprises, leaving out only minor players - which together do not account for more than 10-20% of the market value. The preference for the largest market players has become stronger over time.

- When both the Total Assets and Market Capitalisation are multiplied by the percentage of shares actually held, we find that in 2016 the top common shareholders holds within its grasp 3.8% of total Market Capitalisation and 6.6% of the Total Assets in the EU. These percentages were 2.3 and 3.6 respectively in 2008; An acceleration in the control of Total Assets or MarketCap can be observed as of 2012.

□

Box 3.2: Main results of EU analysis - Focus on big players

- Four large funds stand out with portfolios currently including more than 20% of the listed firms active in Europe, namely BlackRock, Dimensional Fund, Norway (short for The Norwegian Sovereign Fund) and Vanguard. In terms of time trend, both BlackRock and Vanguard show an increase in size over time, while Dimensional has been shrinking a little, and Norway is overall stable.
- Positioned only slightly behind are Axa, Deutsche Bank, Fidelity (FMR LLC) and JP Morgan Chase, which all started out holding above 20% of the listed firms active in Europe at the beginning of the period of observation, but have decreased their number of firms held over time, currently holding between 12.5% and 16.2% of listed firms. On a lower but stable level are Bank of New York Mellon, State Street and Teachers Insurance, with holdings in around 17% of listed firms active in Europe, while Credit Suisse, Goldman Sachs and Invesco show smaller declining portfolios, currently comprising at around 13% of the firms under analysis.
- Considering the quantities held in portfolio, BlackRock and Fidelity have average shares which consistently represent around 3%, followed by Vanguard with about 2% (increasing), and Invesco, Dimensional and State Street with about 1% to 1.5% average holdings. They are followed in turn by Allianz, Axa, Bank of New York Mellon, Norway and JP Morgan Chase, where the average share of annual portfolios is close to 1%, and slightly increasing. The remaining common shareholders currently present portfolios whose average share is below 1%.
- The top 20 common shareholders tend to invest in companies registered outside the EU (70% of the cases), mostly in the US and Japan. The top EU target countries in 2007-2016 were the UK, Germany, France and Italy. Some common shareholders show a clear geographical preference: for example, Northern Trust invests almost uniquely in firms from the US (≈ 70% of portfolio) and from the UK (≈ 18%), almost disregarding Japan and the other EU countries.

□

Chapter 4

Common Shareholding in Selected Industries

Following the general overview of all firms active in the EU, five industries of interest are considered, namely Oil&Gas, Electricity, Mobile Telecommunications, Trading Platforms and Beverages.[1] For each industry, the identification of the relevant companies representing the market followed an ad hoc process.

It should be noted that, similarly to the study on listed firms, the analysis of the five industries encompasses all firms active in the EU in the specified sectors of economic activity, regardless of their country of registration. In reality, a large proportion of companies active in these sectors are subsidiaries of mother companies registered outside the EU, mainly in the US, but also in countries such as Canada, Russia and China.

Starting from the comprehensive database of all listed companies active in the EU between 2007 and 2016, an initial selection of firms was conducted according to the international codes of industry classification. The industry classification used to identify the economic activity of firms followed the NACE system.[2] Each firm can present more than one NACE code of economic activity, classified as either "Core", "Primary" or "Secondary" activity. In many cases it was necessary to consider all levels of activity, given that many corporations are active in additional economic fields beyond their core business.

Unfortunately, this procedure did not manage to fully identify the set of relevant players in each market, calling for further refinements. Several non-listed firms of relevance were also integrated into each market. The final identification of each industry benefitted from the crucial input of specialist teams at DG COMP, which we gratefully acknowledge.

[1] The relative concentration (limited number of firms with large market shares) and the existence of a topical expertise on market players (due to recent antitrust or merger investigations) motivated the choice.

[2] NACE stands for Nomenclature générale des Activités économiques dans les Communautés Européennes (European Classification of Economic Activities). For further details see Eurostat (2008).

The selection procedure of each industry is briefly commented upon in each sectoral analysis. Full details are reported in Appendix C. Sections 4.1-4.5 report the results for each industry.

The relatively large time span of available observations, covering ten years between 2007 and 2016, enables the identification of a shift in investment behaviour among the top investors in some industries, both in terms of the size of portfolios and the amount of participation in individual firms. In particular, the increase in investment coming from Funds and States may raise some concerns in strategic sectors such as those considered in the present analysis. All aspects considered above are measured through the application of some of the indices presented in Chapter 2.

4.1 Energy sector - Oil&Gas

All companies that presented at least one NACE code in Section "D" (Electricity, gas, steam and air conditioning supply) among Core, Primary or Secondary activities were initially selected as potential candidates for the Energy sector. We noticed the importance of considering also the Secondary codes, especially in the Oil&Gas sector to capture relevant companies having their Core and Primary codes in Mining or Manufacturing.

After this first selection, firms were allocated to the "Electricity" or "Oil&Gas" sectors according to specific classifications appearing among Core or first three Primary codes (see Table C.1 in Appendix C for details). As suggested by our colleagues in DG COMP, we removed transmission system operators (TSOs) from the list, given that transmission is a highly regulated activity. Nearly a hundred unlisted firms were added to complement the dataset, based on expert opinion.

The Oil&Gas industry, identified according to the procedure described above, is composed by 153 distinct corporations active in the EU during the period 2007-2016. Of these, 73% are listed. All-together, in 2016 the Total Assets of the selected firms amount to 3309 Bn Euro, while the listed firms have a total value of Market Capitalisation of 1811 Bn Euro for the same year. Although most firms are active throughout the whole period of observation, some are recorded during a shorter period of time, either due to a later entry into the market or to exit due to M&A, dissolution or other reasons. Therefore the panel of firms is not constant over time, oscillating during the ten years of observation between 125 and 139 firms per year (on average 134).

An overview of the summary statistics is outlined in Table 4.1. The number of recorded shareholders varies little during 2007-2016, ranging between 1578 and 1884 per year, with the proportion of common shareholders rather stable around 33%, much higher than the overall figure of about 14%. On the other hand, the proportion of firms cross-held by block-holders is in line with the general picture of listed firms in the EU, i.e. rather stable around 63%.

Table 4.1: Summary statistics for firms active in the EU in the Oil&Gas sector between 2007 and 2016: number of firms; number and percentage of firms cross-held by block-holders (BH) at minimum 5%; total number of shareholders; number and percentage of common shareholders (i.e. shareholders with more than one firm in their portfolio); number and percentage of single owners (holding shares only of one firm).

Year	Number Firms	Number (%) Firms Cross-held by BH	Number of SH	Number (%) Common SH	Number (%) Single SH
2007	125	75 (60.00)	1,655	535 (32.33)	1,120 (67.67)
2008	129	84 (65.11)	1,639	535 (32.64)	1,104 (67.36)
2009	132	77 (58.33)	1,578	544 (34.47)	1,034 (65.53)
2010	134	87 (64.93)	1,802	621 (34.46)	1,181 (65.54)
2011	134	87 (64.93)	1,822	605 (33.21)	1,217 (66.79)
2012	137	90 (65.69)	1,659	617 (37.19)	1,042 (62.81)
2013	139	86 (61.87)	1,832	597 (32.59)	1,235 (67.41)
2014	139	86 (61.87)	1,835	606 (33.02)	1,229 (66.98)
2015	136	85 (62.50)	1,884	598 (31.74)	1,286 (68.26)
2016	135	82 (60.74)	1,741	565 (32.45)	1,176 (67.55)

About 46% of the firms are registered outside the EU, almost half of which are in the US, followed by Canada, Australia and a smaller number from China, Japan, Norway and Russia.

More than half of the firms (52%) report as their core activity the Nace code "3522: Distribution of gaseous fuels through mains", while 12% have as their principal classification "3513: Distribution of electricity", and another 12% present "1920: Manufacture of refined petroleum products". About 9% of firms are active in "610: Extraction of crude petroleum" and 5% in "3523: Trade of gas through mains". The remaining companies declare their main activities in Section D (Electricity, Gas and Steam Supply), or other related activities (wholesale of fuels or transport via pipeline). A summary of the main economic activities is reported in Table 4.2.

Table 4.2: Main areas of economic activity of firms active in the EU in the Oil&Gas sector between 2007 and 2016: Core Nace code, description of area of activity, and percentage of firms presenting such Core code.

Core Nace	Description	% firms
3522	Distribution of gaseous fuels through mains	52
1920	Manufacture of refined petroleum products	12
3513	Distribution of electricity	12
0610	Extraction of crude petroleum	9
3523	Trade of gas through mains	5
	Other: mainly from Section D (Electricity, Gas and Steam Supply), Wholesale of fuels or Transport via pipeline	10

Main players

Before looking at the overall results for the whole market, we report here some figures relative to the largest enterprises active in this sector. Table 4.3 reports the ten largest companies registered in the EU and the ten largest from outside, reporting their size in terms of Total Assets for 2016, the country of registration, and the percentage of shares held in 2016 by the four top institutional investors, namely BlackRock, Vanguard, State Street and Norway[3].

The size of the largest companies is comparable across the two groups, although those registered outside the EU 28 tend to show somewhat larger Total Assets for 2016. In terms of country of registration, the UK, France, Italy and Spain prevail in Europe, while outside most companies are based in North America (US or Canada), followed by Russia, Norway and Venezuela.

The presence of the four funds is widespread in both groups of firms, in some cases presenting very high participation (above 6%). In terms of shares, BlackRock dominates in the EU-based companies, with values generally much higher than the remaining three investors. State Street concentrates mainly on UK firms, while Norway and Vanguard invest more evenly in all top companies. Outside the EU, Vanguard's presence is of a similar level to Blackrock, although slightly higher in this case, followed at some distance by State Street. Norway marks its presence in almost all top firms, although with rather small shares. The only exception is Petroleos De Venezuela, where the funds are absent, being wholly owned by the State.

Density and uniformity

The first common shareholding indices to be presented are the shareholders indices derived from each investor's ownership information. Their respective distribution will be analysed to infer market-level indicators. The results for the Oil&Gas industry are displayed in Table 4.4. The six indices are those based on plain density, on the value-based densities calculated from Total Assets and Market Capitalisation, with their corresponding share-weighted versions, and finally the index of uniformity of investments portfolios.

On average, the portfolios of investors in this market hold about 2.5% of the firms, i.e. approximately 3 firms. However, given the very large number of single shareholders (about two thirds), the distribution of the size of portfolios is very asymmetric: the majority of investors (75%) only hold participation in 2 firms or less, that is 1.5% of the market, as we see from the 75th percentile. Things change dramatically for the largest portfolios, where the top 1% hold on average more than 38 firms ($\approx$ 28% of the market). All these figures are rather stable over the ten years of observation. The maximum size of portfolios is very large, with portfolios

[3] We recall that the term "Norway" (the state) is used as an abbreviation to indicate the Norwegian Sovereign Fund. The same is intended for the references to other states, such as France or Sweden, meaning the respective sovereign funds.

Table 4.3: Largest firms of Oil&Gas sector and selected ownership data on their main common shareholders. Top 10 largest enterprises in the EU and outside the EU, by country of registration. Size measured by Total Assets in 2016 (Bn Euros). Direct or indirect participation shares (%) held in 2016.

	Country	TOAS 2016 (Bn €)	BlackRock	Norway	State Street	Vanguard
Registered in the EU			Shares held in 2016 (%)			
ROYAL DUTCH SHELL PL	UK	390.17	6.92	2.35	3.38	2.73
BP PLC	UK	249.80	5.51	1.70	3.33	2.52
TOTAL S.A.	FR	128.17	5.07	1.67	0.74	1.92
ENI S.P.A.	IT	83.36	2.27	1.51	0.57	1.48
ENGIE	FR	80.56	1.74	1.46	0.49	1.28
GAS NATURAL SDG, S.A	ES	32.08	1.16	0.79	0.18	0.68
CENTRICA PLC	UK	25.55	6.75	1.91	2.52	2.44
REPSOL S.A.	ES	23.74	3.04	1.24	0.36	1.61
OMV AG	AT	17.35	1.07	1.57	0.51	0.99
HERA SPA	IT	6.17	0.42	1.75	0.90	0.97
Registered outside the EU			Shares held in 2016 (%)			
EXXON MOBIL CORP	US	313.36	5.87	0.87	4.63	6.83
CHEVRON CORP	US	246.73	6.41	0.98	6.04	6.97
GAZPROM PJSC	RU	216.66	1.25	0.47	0.11	1.46
PETROLEOS DE VENEZUELA	VE	179.93				
ROSNEFT OIL COM PJSC	RU	155.67	0.27	0.12		0.34
STATOIL ASA	NO	85.96	0.80	67.00	0.22	0.70
CONOCOPHILLIPS CO	US	85.16	6.55	0.96	4.84	6.91
KINDER MORGAN INC	US	76.18	4.78	0.64	3.99	5.80
ENERGY TRANSFER	US	66.59	0.19			
TRANSCANADA CORP	CA	62.21		0.60	0.11	2.06

encompassing 40% or more of the firms in the market being observed every year. This figure has been increasing over time, reaching a peak of 45% in 2016, i.e. about 60 competing companies.

As for the uniformity index, rather low average values are observed in all years (around 14%), showing that investors tend to distinguish between the firms in their portfolio through an uneven distribution of shares. However, the top values of the index are always above 85%, with a maximum above 90% and increasing, revealing that there are shareholders holding an almost equal amount of shares in all firms held.

The value-based indices are calculated from the Total Assets or the Market Capitalisation of the firms in a portfolio. Given that the last variable is only available for listed firms, the two indices present slightly different values, given that they are not calculated using the same pool of firms. However, the general trend is rather similar in the two cases. Looking first at the unweighted indices, we find that the firms in the portfolios represent on average about 6% of the market, but again this distribution is very skewed: the 75th percentile shows that three quarters of portfolios include firms that represent at most a minor share of the market value (a stable figure of about 3.5% of Market Capitalisation, and an increasing share of Total Assets, currently reaching 6.5%). This suggests that the majority of portfolios include either a limited number of medium firms, or a larger number of small firms, in either case not being very relevant for the overall market. When we move towards the upper end of the distribution, however, we see that the top portfolios include participation in almost all relevant firms, representing more than 70% of the market value in terms of Total Assets, and more than 85% of Market Capitalisation (on average over the ten years). The largest observed values are close to 90% for TOAS and almost 100% for MKT CAP, revealing that the largest portfolios hand-pick all firms with the largest value in the market.

Once we consider actual firm ownership, weighting the value of the firms by the respective participation shares, we find that 99% of portfolios hold less than 1% of the value of the market through their participation shares, both in terms of TOAS and of MKT CAP. However, there are top investors that hold in their hands large amounts of market value, given that the shares they hold in the firms in their portfolio amount to about 5-6% of the market TOAS or MKT CAP.

Table 4.4: Oil&Gas sector common shareholding indices. Summary Statistics by year (percentage points, index values between 0 and 100): mean, 75th percentile (p75), 99th percentile (p99), maximum (max). Density: Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Uniformity: Relative weight of larger participation shares over the shares total in the portfolio. Small values denote concentrated investment. TOAS density: Proportion of total assets of the market represented by the firms in portfolio. Weighted TOAS density: Proportion of total assets of the market held by shareholder through participation shares. MKT CAP density: Proportion of market capitalisation of the market represented by the firms in portfolio. Weighted MKT CAP density: Proportion of market capitalisation of the market held by shareholder through participation shares.

Year	Density			
	mean	p75	p99	max
2007	2.4933	1.6000	28.8000	40.8000
2008	2.5838	1.5504	31.0078	42.6357
2009	2.6256	1.5152	31.0606	41.6667
2010	2.5366	1.4925	28.3582	44.0299
2011	2.4780	1.4925	29.1045	44.0299
2012	2.5444	2.1898	27.7372	40.8759
2013	2.3334	1.4388	26.6187	43.1655
2014	2.4159	1.4388	27.3381	43.1655
2015	2.3409	1.4706	27.2059	44.1176
2016	2.4281	1.4815	25.9259	45.1852

Year	Uniformity			
	mean	p75	p99	max
2007	14.2029	28.9559	84.7759	88.65
2008	14.2989	28.7194	85.0252	89.68
2009	15.0344	29.8343	85.2258	90.12
2010	14.9557	30.3018	85.4537	90.50
2011	14.4327	29.1845	84.9744	90.52
2012	15.9969	31.7066	84.9540	90.37
2013	13.9317	28.2429	84.7570	90.97
2014	14.5752	29.9732	85.3394	90.97
2015	13.5395	27.3938	85.1052	90.60
2016	14.1145	28.4073	86.0875	91.01

Year	TOAS density			
	mean	p75	p99	max
2007	5.5368	3.0749	72.1366	84.9300
2008	5.8669	3.6807	74.1782	86.3755
2009	5.9431	3.7569	77.2302	86.2309
2010	5.8955	3.4620	78.6741	86.9212
2011	5.5879	2.7858	77.5357	87.9454
2012	5.7378	3.3057	72.9714	84.7497
2013	5.7177	4.6072	68.7842	85.1007
2014	5.7448	5.8130	69.8872	87.6938
2015	5.6280	5.2626	70.2692	88.7788
2016	5.9754	6.5469	68.6473	89.2991

Year	Weighted TOAS density			
	mean	p75	p99	max
2007	0.0536	0.0161	0.8886	4.1202
2008	0.0518	0.0160	0.8091	3.9701
2009	0.0576	0.0179	1.0858	5.1398
2010	0.0500	0.0148	0.8719	5.3173
2011	0.0467	0.0130	0.8057	5.5801
2012	0.0511	0.0148	0.8601	5.8139
2013	0.0524	0.0134	0.8213	6.3651
2014	0.0517	0.0149	0.7790	4.8745
2015	0.0543	0.0160	0.8331	4.7199
2016	0.0538	0.0163	0.9077	5.7510

Year	MKT CAP density			
	mean	p75	p99	max
2007	5.9102	3.0433	80.0996	97.8927
2008	6.4627	3.7682	89.2018	99.0173
2009	6.4209	4.2629	86.2573	99.3972
2010	6.3556	4.7061	91.0768	99.4750
2011	5.9074	3.7030	87.0212	99.4429
2012	6.0933	4.1428	84.1377	97.6022
2013	6.1213	4.6127	82.8554	97.4576
2014	6.3079	3.4487	84.0280	98.8587
2015	6.0392	3.3678	83.6435	98.7671
2016	6.3439	3.6858	82.1542	97.5925

Year	Weighted MKT CAP density			
	mean	p75	p99	max
2007	0.0542	0.0102	1.1636	5.5174
2008	0.0468	0.0086	1.0094	2.9745
2009	0.0597	0.0118	1.1059	6.2290
2010	0.0500	0.0095	0.9359	6.0684
2011	0.0445	0.0090	0.7262	5.1673
2012	0.0483	0.0117	0.8850	5.3693
2013	0.0463	0.0112	0.8567	4.4287
2014	0.0463	0.0133	0.8548	4.6792
2015	0.0474	0.0137	0.8731	4.7452
2016	0.0476	0.0136	0.8101	4.9134

Common shareholding indices for top investors

Given the asymmetries of the density indices observed above, it is worth investigating what happens at the top levels. For this reason, a group of investors has been selected according to the values scored in the various indices in 2007-2016, and their behaviour has been looked at in detail. The "Top Investors" are defined as being the shareholders that present, over the ten years of observation, at least five times a value of density, Weighted TOAS density or Weighted MKT CAP density in the top 20. This selection makes it possible to distinguish the largest portfolios, i.e. those holding the largest number of firms, or the most valuable ones, such as those portfolios with a limited number of large firms but each one held with a large participation share, thus securing a large overall share of market value into the hand of the investor.

In fact, the top investors tend to be the same over the entire period, therefore scoring the largest values in the indices across all years. Given that the MKT CAP variable is not available for all firms, Table 4.5 summarises, for the sake of the example, some figures concerning the shareholders with the top Weighted TOAS density. The Table reports the size of portfolios (number of firms in portfolio and density) in 2016, and the two TOAS-based indices, together with the largest firms held and respective participation shares reported in 2016.

In the first position we find the Russian Government, which holds almost 6% of the Total Assets of the market, given that it is the majority owner of two of the largest companies in Oil&Gas (Gazprom and Rosneft). The usual top three funds follow, respectively BlackRock, Vanguard and Norway, each having invested in more than 40% of the firms in the market; even with small participation, they hold approximately between 3% and 4% of the market value. State Street and Capital Group follow closely behind, again with numerous firms held, including most larger players. Last, Jupiter Dividend, with participations in only 3 firms, manages to control 1.56% of the market value, due to large shares in the largest firms.

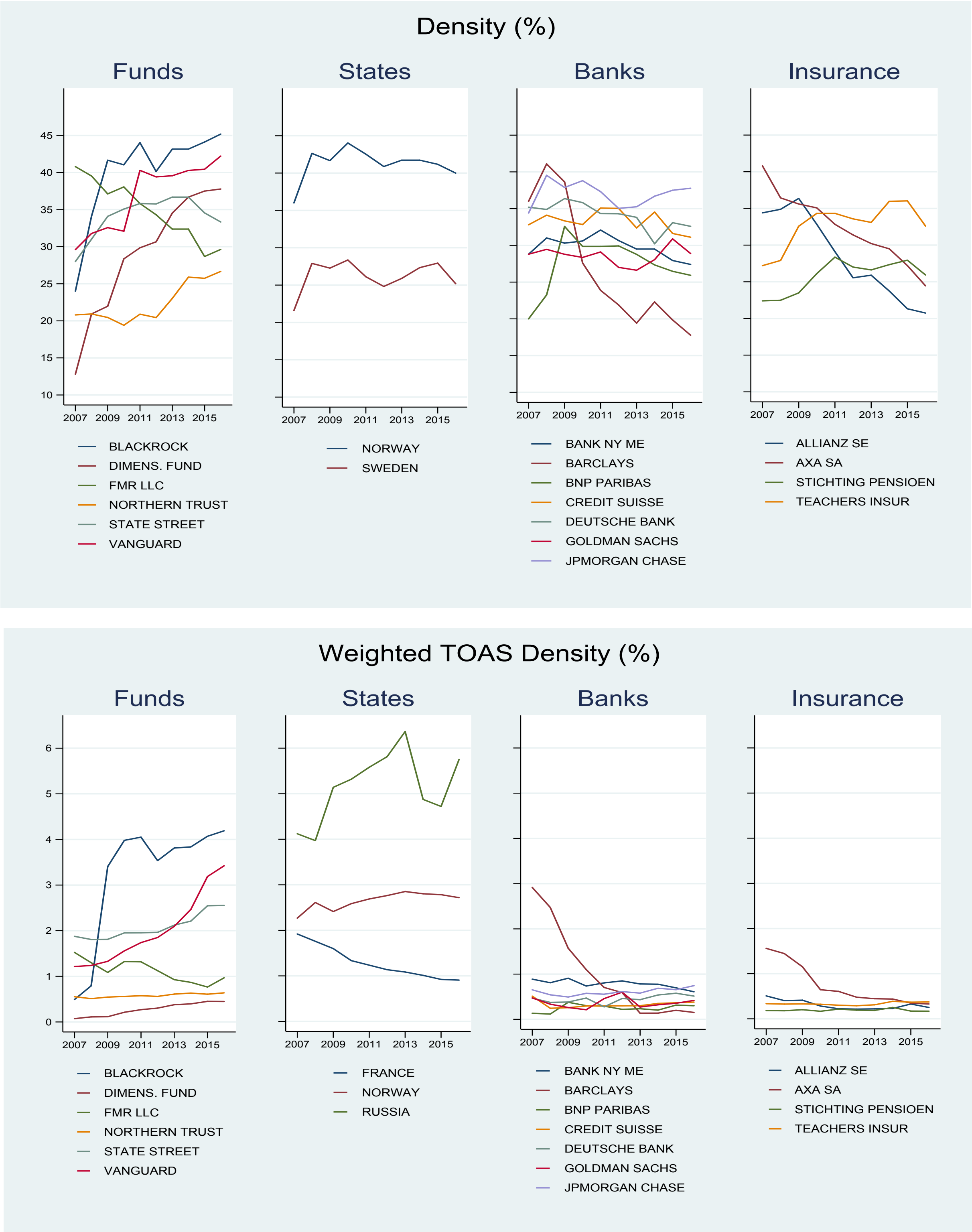
The evolution of the indices over 2007-2016 is reported for top investors in Figure 4.1, by investor type (Funds, States, Banks, Insurance). In general, over the years Banks and Insurance companies have maintained or decreased the number of firms held in the Oil&Gas industry. Yet, the proportion of firms in portfolio is rather high, constituting between 15% and 40% of companies active in the industry. The share of market value, both in terms of TOAS and of MKT CAP, is almost always below 1% throughout the period of observation for both types of investors.

States present more stable values, with Norway and Sweden holding the largest number of firms (about 42% and 28% on average respectively), but in terms of market value are beaten by Russia, as reported earlier. As for the funds, BlackRock, Vanguard and State Street dominate over all remaining investors of this type, showing increasing trends in all indicators during 2007-2016, and scoring the top three values in each index in 2016.

Table 4.5: Top Investors in Oil&Gas sector: Investors whose portfolios present the top values of the Weighted TOAS density index in 2016. Country of shareholder (SH); number of firms held in Oil&Gas industry; Density (share of firms held); TOAS density (share of market TOAS represented by firms held); Weighted TOAS density (share of market TOAS held through participation shares); firms with largest TOAS in portfolio and respective quantity of shares held, ordered by decreasing TOAS. All figures refer to the year 2016. MO = Majority Owner.

Shareholder Name	SH country	No. Firms Held	Density	TOAS density	Weighted TOAS density	Largest firms and shares held (%)
GOVERNMENT OF THE RUSSIAN FEDERATION	RU	7	5.19	11.51	5.75	GAZPROM (MO); ROSNEFT (MO)
BLACKROCK	US	61	45.19	89.21	4.19	ROYAL DUTCH SHELL (6.92); EXXON (5.87); BP PLC (5.51); CHEVRON (6.41); GAZPROM (1.25); ROSNEFT (0.27); TOTAL (5.07)
VANGUARD	US	57	42.22	87.51	3.42	ROYAL DUTCH SHELL (2.73); EXXON (6.83); BP (2.52); CHEVRON (6.97); GAZPROM (1.46); ROSNEFT (0.34); TOTAL (1.92)
NORWAY	NO	54	40.00	85.68	2.72	ROYAL DUTCH SHELL (2.35); EXXON (0.87); BP (1.7); CHEVRON (0.98); GAZPROM (0.47); ROSNEFT (0.12); TOTAL (1.67); STATOIL (67.00)
STATE STREET	US	45	33.33	80.21	2.55	ROYAL DUTCH SHELL (3.38); EXXON (4.63); BP (3.33); CHEVRON (6.04); GAZPROM (0.11); TOTAL (0.74)
CAPITAL GROUP	US	27	20.00	65.78	1.91	ROYAL DUTCH SHELL (5.45); EXXON (1.47); BP PLC (2.17); CHEVRON (3.79); TOTAL (2.49)
JUPITER DIVIDEND	UK	3	2.22	20.11	1.56	ROYAL DUTCH SHELL (7.1); BP PLC (9.2); CENTRICA(3.4)

Figure 4.1: Common shareholding indices for Top Investors in Oil Gas sector. Top panel: Density - Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Bottom panel: Weighted TOAS density - Proportion of total assets of the market held by shareholder through participation shares.



Network indices

This Section presents common shareholding indices calculated inside the two separate networks of Shareholders and Firms, measuring the strength of the relationships induced between actors of the same type due to a link with an actor of the other type. Namely, two firms can be linked by a common shareholder, while two shareholders are connected through ownership of shares in the same firm.

The higher the number of firms that two investors have in common, and the closer the amount of shares held in each of them, the stronger the link between the two investors. On the other hand, the higher the number of shareholders that appear in two firms' ownership structures, and the more similar the values of the shares held, the closer the firms will be considered to be. In both networks, the strength of the link is measured through the calculation of the coefficients of correlation between either portfolios (for shareholders) or ownership structures (in the case of firms).

In the shareholders' network, however, high correlations can be observed between two portfolios that comprise the same firms with similar shares, but with a very small number of firms. Given that in general the portfolios tend to be rather small,[4] it makes sense to select the most significant portfolios before looking at the strength of their link. For this industry, a threshold of at least 10% of density has been chosen, defining the so-called "high density portfolios".

In the case of the firms' network, no selection was necessary based on the number of shareholders, since the average ownership structure includes about 12 owners, giving rise to a reasonable number of links to analyse between any pair of firms. On the other hand, to avoid possible spurious links generated by very small participations, only block-holdings have been considered, i.e. links generated by ownership of at least 5% of shares. If the participation is below 5%, it is ignored for the calculation of these indices.

Tables 4.6 and 4.7 report the yearly results for the two networks. Only about 4% of all possible owner-owner connections are detected, i.e. the vast majority of shareholders have no firms in common. Such proportion is rather constant over time, slightly decreasing in the last years. Considering all existing links between large "high density" portfolios, less than 2% of connected high density shareholders have a strong correlation of investment behaviour (above 80%). Still, it is striking that some large portfolios show an almost coinciding behaviour; even though they are few, they cannot be ignored and should be further analysed.

In the firms' network, we observe an increasing proportion of connections of pairs of firms through block-holders present in their ownership structures. This fraction was below 2% in 2007, but has currently more than doubled to above 5%, witnessing an increase in extensive block-holding by large investors. Among the connected firms, above 10% show strong links, with correlations of more than 80% between their respective block-holding structures, con-

[4] We recall that 75% of portfolios hold at most 2 firms, and the average portfolio size is of 3 firms, as seen in earlier.

firming there is a large overlap of investment preferences among top investors. However, this indicator has not shown a particular pattern over time.

Table 4.6: Network indices for Oil&Gas sector. Shareholders' network. Total number of common shareholders; proportion of non-zero correlations between pairs of portfolios, i.e. proportion of connections between two shareholders induced by common shareholding of a same firm; number of high correlations (>80%) between pairs of high-density portfolios (both densities >10%); proportion of high correlations between pairs of high-density portfolios.

Year	Tot No. Comm SH	Prop Non-Zero Correlations	No. High Corr. High Dens.	Prop. High Corr. High Dens.
2007	535	3.87	69	1.78
2008	535	4.02	87	2.08
2009	544	4.35	97	2.23
2010	621	4.03	94	1.66
2011	605	3.96	96	1.90
2012	617	4.72	73	1.47
2013	597	3.59	73	1.50
2014	606	3.93	96	1.86
2015	598	3.45	63	1.30
2016	565	3.63	70	1.57

Table 4.7: Network indices for Oil&Gas sector. Firms' network. Total number of firms cross-held by blockholders (holding at least 5%); proportion of non-zero correlations between shareholders' structures of pairs of firms (only shares >5%); number of high correlations between shareholders' structures of pairs of firms (only shares >5%); proportion of high correlations (>80%) among the non-zero correlations.

Year	Tot. No. Firms Cross-Held by BH	Prop Non-Zero Correlations	No. of High Correlations	Prop. of High Correlations
2007	75	1.70	18	13.64
2008	84	2.24	28	15.14
2009	77	4.98	63	14.62
2010	87	4.65	59	14.25
2011	87	4.23	44	11.67
2012	90	3.57	50	15.02
2013	86	3.60	30	8.70
2014	86	4.09	39	9.95
2015	85	4.52	41	9.88
2016	82	5.40	69	14.14

4.2 Energy sector - Electricity

The Electricity sector has been selected according to the general procedure for the Energy sectors (see Section 4.1). This industry includes 396 firms active in the EU area, of which 39% are registered outside, mainly in the US, Canada, Switzerland and Russia. The number of active firms per year has been increasing steadily from 275 in 2007 to 353 in 2016, with an average of 325 firms per year. The large majority (89%) of the selected firms is listed. In 2016, the sector totaled 3330 Bn Euro of Total Assets, while the listed firms had a Market Capitalisation of 864 Bn Euro.

The number of shareholders has also been increasing over time, totalling 3596 investors in 2016 against the 2429 present in 2007. Although the number of common shareholders has been rather stable over time (on average about 690 per year), their proportion has been drastically diminishing, having observed a steep rise in single shareholders, which currently amount to 80% of the investors. In 2007, this proportion was as low as 71%. Table 4.8 presents some yearly statistics.

Although the number of firms cross-held by block investors has been increasing since 2007, their proportion had decreased around 7 percentage points (from 62.5 to 55.5) by the end of 2016, given the rapid growth of the size of this industry.

Table 4.8: Summary statistics for firms active in the EU in the Electricity sector between 2007 and 2016: number of firms; number and percentage of firms cross-held by block-holders (BH) at minimum 5%; total number of shareholders; number and percentage of common shareholders (i.e. shareholders with more than one firm in their portfolio); number and percentage of single owners (holding shares only of one firm).

Year	Number Firms	Number (%) Firms Cross-held by BH	Number of SH	Number (%) Common SH	Number (%) Single SH
2007	275	172 (62.55)	2,429	704 (28.98)	1,725 (71.02)
2008	285	177 (62.11)	2,545	722 (28.37)	1,823 (71.63)
2009	303	171 (56.44)	2,566	697 (27.16)	1,869 (72.84)
2010	321	188 (58.57)	2,925	759 (25.95)	2,166 (74.05)
2011	325	186 (57.23)	2,842	677 (23.82)	2,165 (76.18)
2012	333	191 (57.36)	2,732	644 (23.57)	2,088 (76.43)
2013	340	184 (54.12)	2,815	663 (23.55)	2,152 (76.45)
2014	346	194 (56.07)	2,975	645 (21.68)	2,330 (78.32)
2015	350	204 (58.29)	3,028	693 (22.89)	2,335 (77.11)
2016	353	196 (55.52)	3,596	712 (19.80)	2,884 (80.20)

All of the firms' economic activity falls within Group 35.1 of the Nace classification (Electric power generation, transmission and distribution), as shown in Table 4.9. The large majority of firms (73%) have as their main activity "Production of electricity" (Nace Core code 3511), followed by "3512: Transmission of electricity" (16%), "3513: Distribution of electricity" (7%) and "3514: Trade of electricity" (4%).

Table 4.9: Main areas of economic activity of firms active in the EU in the Electricity sector between 2007 and 2016: Core Nace code, description of area of activity, and percentage of firms presenting such Core code.

Core Nace	Description	% firms
3511	Production of electricity	73
3512	Transmission of electricity	16
3513	Distribution of electricity	7
3514	Trade of electricity	4

Main players

The picture of the main players as shown in Table 4.10 again indicates a strong presence of the four main funds. Additionally, France plays a major role in this market, holding very large stakes in three of the top ten EU-based corporations, together with a minor presence in some additional firms. Of the remaining four investors, BlackRock holds the highest shares, followed by Norway and Vanguard on similar levels, and finally by State Street. As for companies based outside the EU, all three American investors show very large participation, while Norway is present in most companies, but with low shares, and France is completely absent, having focused only on EU top players.

In this sector there are more companies which are totally State-owned: EnBW (Energie Baden-Württemberg), whose majority shareholders are the state of Baden-WÜrttemberg and the Oberschwäbischen Elektrizitätswerken - a municipal association of regional and local authorities; Vattenfall AB, wholly owned by Sweden; and China Huadian, wholly owned by China.

Density and uniformity

The shareholders' indices based on densities and uniformity present a picture of investors' portfolios which is rather different from the other Energy industry analysed in Section 4.1, namely the Oil&Gas market. In fact, the larger (and increasing) number of firms active in Electricity implies that even sizeable portfolios represent a smaller share of the market in terms of headcount. Besides the very large fraction of single shareholders (above 80% in 2016), we can see from Table 4.11 that only 1% of investors hold more than 9% of the firms active in the market in 2016, i.e. about 30 firms. This figure has been diminishing over time, as has the maximum density, which currently stands at around 28%; however, given the large number of firms in this industry, this apparently small fraction - when compared to the maximum density of 45% in Oil&Gas - amounts to about one hundred Electricity companies.

Compared to Oil&Gas, the lower average value of the uniformity index shows a more concentrated behaviour in terms of amount of shares held, that is to say that investors tend to

Table 4.10: Largest firms of Electricity sector and selected ownership data on their main common shareholders. Top 10 largest enterprises in the EU and outside the EU, by country of registration. Size measured by Total Assets in 2016 (Bn Euros). Direct or indirect participation shares (%) held in 2016.

	Country	TOAS 2016 (Bn €)	BlackRock	France	Norway	State Street	Vanguard
Registered in the EU				Shares held in 2016 (%)			
ELECTRICITE DE FRANCE	FR	198.93	0.25	84.50	0.57	0.14	0.30
ENEL SPA	IT	155.60	5.04		1.57	0.59	1.63
ENGIE	FR	80.56	1.74	36.10	1.46	0.49	1.28
E.ON SE	DE	63.70	6.03	0.15	2.03	1.84	2.05
ELECTRABEL	BE	52.08		25.01			
IBERDROLA SA	ES	48.31	3.00	0.11	3.21	0.75	1.92
RWE AG	DE	45.97	4.72	0.12	1.93	1.03	1.73
ENBW	DE	30.90					
SSE PLC	UK	27.86	2.93		2.95	2.62	2.56
VATTENFALL AB	SE	27.42					
Registered outside the EU				Shares held in 2016 (%)			
DUKE ENERGY CORP	US	125.95	5.97		0.60	4.93	6.74
EXELON CORP	US	109.01	7.68		0.90	5.92	6.25
CHINA HUADIAN	CN	106.36					
TOKYO ELECTRIC POWER	JP	92.03	0.76		0.52	0.13	0.90
KOREA ELECTRIC POWER	KR	82.73	1.18				0.84
AMERICAN ELECTRIC POWER	US	60.21	6.83			5.19	6.22
CENTRAIS ELETRICAS BRASILEIRAS	BR	49.64	0.98		1.01		0.52
THE KANSAI ELECTRIC POWER	JP	48.71	1.46		1.06	0.18	1.61
EDISON INTERNATIONAL	US	48.69	7.16		1.40	7.98	7.91
ENTERGY CORP	US	43.55	8.74		1.40	5.60	10.90

privilege a few companies in their portfolios, buying larger shares, while the remaining chosen firms are only held with minor participations. Even at the upper end of the distribution, we find values much lower than in the other Energy market, except for the maximum, which is rather similar around 90%. Notably, that the 75th percentile drops to zero in 2011, which is not surprising since the fraction of single owners exceeds three quarters from that year onwards (a single owner by definition has the maximum concentration of investments, i.e. a value of 0% uniformity).

If we look at the representativeness of the portfolios in terms of TOAS and MKT CAP, we see that even in the largest portfolios the chosen firms tend to cover smaller fractions of the market value: for example, looking at the TOAS density, we see that currently only 1% of portfolios hold firms whose value represents more than 30% of the market, the largest portfolios reaching a maximum just above 66%. The equivalent figures in Oil&Gas were of about 70% and 90% respectively in 2016, having increased over time, while in Electricity a drop in this indicator is evident. Again, this difference can be attributed to the fact that the number of firms active in Electricity has been increasing steadily over time, while in Oil&Gas it is rather constant.

As for the density based on market capital, we observe that on average portfolios hold listed firms that represent between 2% and 3% of the market value. Still, the top portfolios comprise as much as 90% of the market value, having clearly hand-picked the most relevant companies. Compared to the TOAS density, the index based on MKT CAP shows larger shares; this can partly depend on the reduced number of firms for which this last variable is available, but it could also be due to a mismatch between Assets and Market value in this industry. In fact, the same was not observed in the Oil&Gas, where the indicators based on both variables were almost identical.

Looking now at the weighted densities, we find portfolios holding large amount of participation in very large firms, therefore controlling a remarkable fraction of the market's Total Assets or Market Capitalisation. Although this is true only for the very largest portfolios (the 99th percentile is still very low, around 0.5%), in 2016 we observe investors holding about 7% of the market's Total Assets through their participation shares, and about 3.5% of Market Capitalisation. While for TOAS the values are rather stable over time, for MKT CAP we observe a decline, especially in recent years, but this could be due not only to changes in ownership, but also to possible changes in the listing status of large companies.

Table 4.11: Electricity sector common shareholding indices. Summary Statistics by year (percentage points, index values between 0 and 100): mean, 75th percentile (p75), 99th percentile (p99), maximum (max). Density: Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Uniformity: Relative weight of larger participation shares over the shares total in the portfolio. Small values denote concentrated investment. TOAS density: Proportion of total assets of the market represented by the firms in portfolio. Weighted TOAS density: Proportion of total assets of the market held by shareholder through participation shares. MKT CAP density: Proportion of market capitalisation of the market represented by the firms in portfolio. Weighted MKT CAP density: Proportion of market capitalisation of the market held by shareholder through participation shares.

Year	Density			
	mean	p75	p99	max
2007	1.0635	0.7273	14.5455	28.3636
2008	1.0495	0.7018	14.3860	32.9825
2009	0.9703	0.6601	14.8515	33.3333
2010	0.8840	0.6231	12.1495	33.6449
2011	0.8269	0.3077	11.0769	31.0769
2012	0.7699	0.3003	10.2102	27.9279
2013	0.7379	0.2941	9.1176	29.7059
2014	0.7189	0.2890	8.9595	29.1908
2015	0.7258	0.2857	9.7143	28.0000
2016	0.6520	0.2833	8.7819	28.6119

Year	Uniformity			
	mean	p75	p99	max
2007	11.4758	18.0206	79.7464	91.03
2008	11.3280	17.0530	79.9821	91.15
2009	10.9425	9.4204	79.7225	90.26
2010	10.3508	2.5943	78.3367	89.84
2011	9.6477	0.0000	77.3420	89.96
2012	9.3177	0.0000	77.7962	89.04
2013	9.1434	0.0000	76.4534	89.39
2014	8.5811	0.0000	76.1050	90.13
2015	8.8894	0.0000	76.9485	90.43
2016	7.6547	0.0000	75.4472	90.35

Year	TOAS density			
	mean	p75	p99	max
2007	2.1784	1.4514	38.8681	64.2994
2008	2.2075	1.5575	37.6497	73.7039
2009	1.9902	1.2598	35.7006	69.5548
2010	1.9819	1.7400	33.5341	75.1448
2011	1.8313	0.9804	32.9652	75.5721
2012	1.7416	0.9607	30.7829	69.8389
2013	1.4364	0.7711	25.1298	61.3229
2014	1.4196	0.6757	25.2061	60.8484
2015	1.4816	0.7645	27.9182	61.1137
2016	1.3715	0.5439	29.2677	66.8575

Year	Weighted TOAS density			
	mean	p75	p99	max
2007	0.0361	0.0091	0.6896	6.4523
2008	0.0340	0.0094	0.6419	5.4920
2009	0.0358	0.0087	0.5736	8.1448
2010	0.0332	0.0071	0.5625	8.0028
2011	0.0323	0.0073	0.5335	5.7006
2012	0.0336	0.0090	0.6108	7.8643
2013	0.0302	0.0077	0.5185	7.1067
2014	0.0283	0.0064	0.4660	6.5553
2015	0.0276	0.0066	0.4522	6.6746
2016	0.0259	0.0045	0.4230	6.6986

Year	MKT CAP density			
	mean	p75	p99	max
2007	2.8789	2.3382	52.7401	86.6605
2008	2.8798	1.8094	53.2521	93.7594
2009	2.7628	2.1126	53.4902	92.6958
2010	2.6516	2.4864	46.6519	93.8992
2011	2.5396	2.2393	45.7196	91.6545
2012	2.5180	1.5586	47.2062	88.3341
2013	2.3336	1.2352	40.1832	90.5733
2014	2.3432	0.9714	43.4761	90.8546
2015	2.3770	1.0705	45.4337	90.2871
2016	2.0593	0.7743	42.3846	92.9233

Year	Weighted MKT CAP density			
	mean	p75	p99	max
2007	0.0376	0.0074	0.5643	14.6561
2008	0.0348	0.0062	0.6301	8.9390
2009	0.0377	0.0077	0.6842	11.5364
2010	0.0368	0.0057	0.6988	8.7482
2011	0.0330	0.0062	0.7082	4.4305
2012	0.0350	0.0081	0.6466	5.5326
2013	0.0340	0.0079	0.6214	7.7576
2014	0.0301	0.0071	0.5407	6.4315
2015	0.0312	0.0080	0.5583	4.3989
2016	0.0279	0.0048	0.5063	3.4891

Common shareholding indices for top investors

Table 4.12 reports the major owners of this industry in 2016, in terms of share of market Total Assets held through participation shares (weighted TOAS density). The Electricity sector is characterised by a strong presence of state-owned companies, with States holding very large shares or in many cases even being the majority owners of their national providers, as in the case of France, Sweden, China and Korea. The usual US-based funds are still present as top investors, but rather for the large number of firms in their portfolios, each held with minority shares. The graphs in Figure 4.2 highlight the contrast between the large size of the portfolios of Funds and their relatively small fraction of market TOAS held. The opposite is true for States, especially France, presenting a small but very valuable portfolio.

The Banks are no longer important players in this market, having observed over time a shrinkage of the size of their portfolios, both in terms of number of firms and of TOAS held, as is evident from Figure 4.2. Similar findings, even at lower levels, are evident for the Insurance companies investing in this industry, currently playing a minor role.

Network indices

The indices of connectedness calculated on the two networks of shareholders and firms are shown in Tables 4.13 and 4.14 respectively. In both cases, we observe a much lower number of links between actors in each network compared to Oil&Gas, and with diminishing trends in time.

While in 2007 about 1.7% of possible connections between pairs of investors were active, in 2016 we observe only 0.65%, showing that the market has moved towards a structure with more independent investors. In Oil&Gas the degree of connectedness among shareholders was always above 3.5% throughout the whole period of observation. As for the strength of those links, the fraction of high correlations (above 80%) between large portfolios (at least 10% of firms held) is small, but increasing: starting at about 0.35%, it is currently at 2.15%, suggesting that the largest portfolios have experienced a convergence of investment strategies.

As for the firms' network, we observe few links derived from cross-ownership by block-holders, almost always below 1%, but a large proportion of them are strong: about 21% of the links existing in 2106 had a correlation larger than 80%.

Table 4.12: Top Investors in Electricity sector: Investors whose portfolios present the top values of the Weighted TOAS density index in 2016. Country of shareholder (SH); number of firms held in Electricity industry; Density (share of firms held); TOAS density (share of market TOAS represented by firms held); Weighted TOAS density (share of market TOAS held through participation shares); firms with largest TOAS in portfolio and respective quantity of shares held, ordered by decreasing TOAS. All figures refer to the year 2016.

SH Name	SH country	No. Firms Held	Density	TOAS density	W TOAS dens.	Largest firms and shares held (%)
FRANCE	FR	20	5.67	16.84	6.70	EDF (84.5); ENGIE (36.1); E.ON (0.15); ELECTRABEL (25.01); IBERDROLA (0.11); RWE (0.12)
CHINA-PEOPLE'S REPUBLIC	CN	6	1.70	6.54	3.23	CHINA HUADIAN CORP (100); SSE (0.84); SDIC POWER HOLDINGS (0.12); CENTRICA (0.83); EDP (3.02); SHANGHAI ELECT. POWER (1.62)
BLACKROCK	US	99	28.05	66.04	2.41	EDF (0.25); ENEL (5.04); DUKE ENERGY (5.97); EXELON (7.68); TOKYO ELECT. POWER (0.76); KOREA ELECT. POWER (1.18); ENGIE (1.74)
VANGUARD GROUP	US	101	28.61	66.86	1.98	EDF (0.3); ENEL (1.63); DUKE ENERGY (6.74); EXELON (6.25); TOKYO ELECT. POWER (0.9); KOREA ELECT. POWER (0.84); ENGIE (1.28)
REPUBLIC KOREA	KR	14	3.97	21.01	1.22	DUKE ENERGY (0.11); EXELON (0.23); KOREA ELECT. POWER (18.2); AMERICAN ELECTRIC (0.16); EDISON (0.15); ENTERGY (0.12); KOREA HYDRO & NUCLEAR POWER (50.01)
STATE STREET	US	69	19.55	58.22	1.18	EDF (0.14); ENEL (0.59); DUKE ENERGY (4.93); EXELON (5.92); TOKYO ELECT. POWER (0.13); ENGIE (0.49); E.ON (1.84)
NORWAY	NO	90	25.50	56.66	1.13	EDF (0.57); ENEL (1.57); DUKE ENERGY (0.6); EXELON (0.9); TOKYO ELECT. POWER (0.52); ENGIE (1.46); E.ON (2.03)
SWEDEN	SE	48	13.60	41.93	1.06	ENEL (0.18); DUKE ENERGY (0.17); EXELON (0.12); E.ON (0.11); AMERICAN ELECTRIC (0.14); KANSAI ELECTRIC (0.14); EDISON (0.19); VATTENFALL (100)
CAPITAL GROUP	US	23	6.52	32.19	0.82	EDF (0.2); ENEL (1.34); DUKE ENERGY (3.12); EXELON (3.9); ENGIE (1.82); AMERICAN ELECTRIC (0.29); IBERDROLA (2.39)

Figure 4.2: Common shareholding indices for Top Investors in Electricity sector. Top panel: Density - Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Bottom panel: Weighted TOAS density - Proportion of total assets of the market held by shareholder through participation shares.

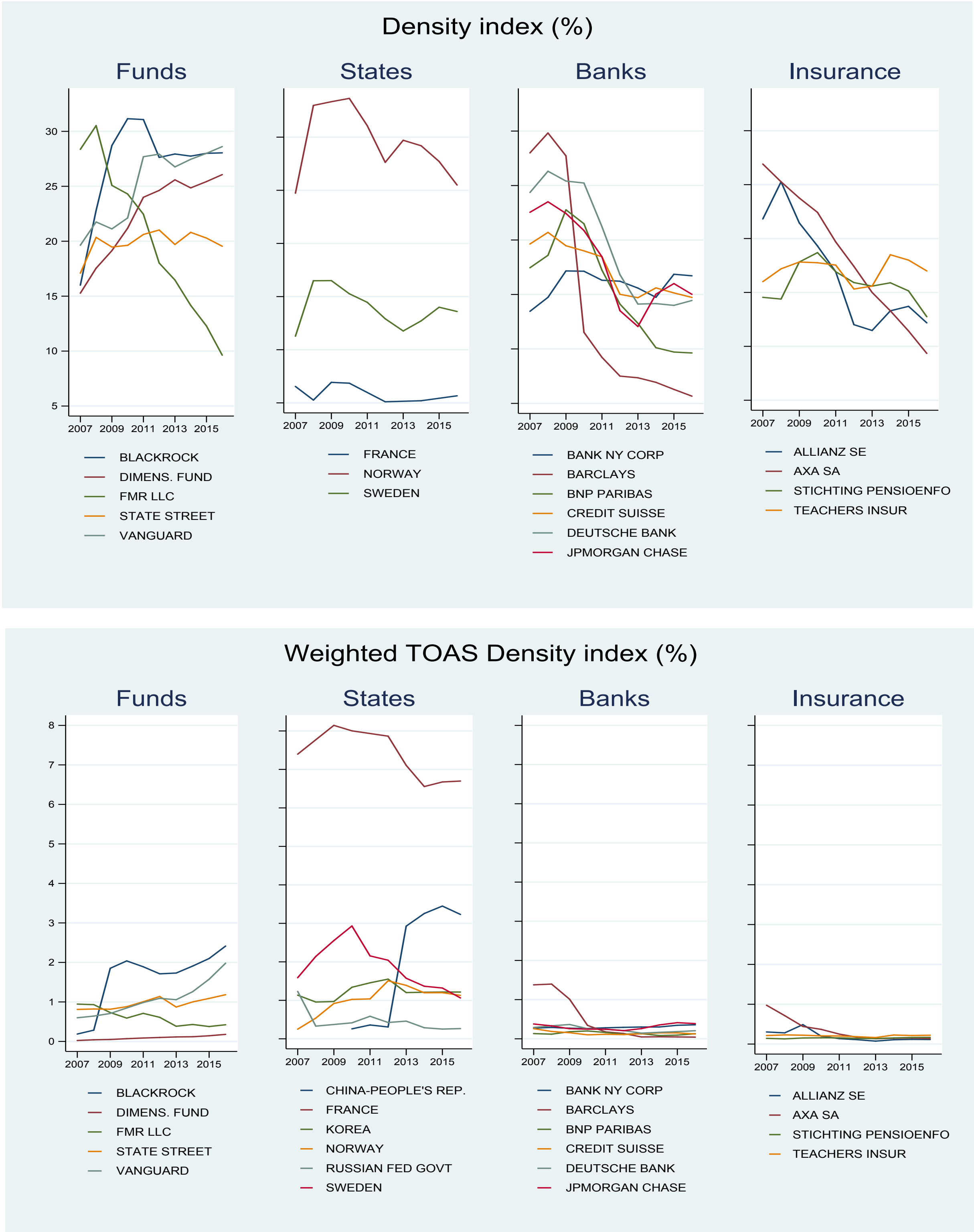


Table 4.13: Network indices for Electricity sector. Shareholders' network. Total number of common shareholders; proportion of non-zero correlations between pairs of portfolios, i.e. proportion of connections between two shareholders induced by common shareholding of a same firm; number of high correlations (>80%) between pairs of high-density portfolios (both densities >10%); proportion of high correlations between pairs of high-density portfolios.

Year	Tot No. Comm SH	Prop Non-Zero Correlations	No. High Corr. High Dens.	Prop. High Corr. High Dens.
2007	704	1.73	3	0.35
2008	722	1.66	2	0.27
2009	697	1.47	1	0.17
2010	759	1.26	2	0.32
2011	677	1.08	2	0.40
2012	644	1.03	5	1.42
2013	663	1.00	3	1.43
2014	645	0.94	4	1.45
2015	693	0.96	3	0.85
2016	712	0.65	7	2.15

Table 4.14: Network indices for Electricity sector. Firms' network. Total number of firms cross-held by block-holders (holding at least 5%); proportion of non-zero correlations between shareholders' structures of pairs of firms (only shares >5%); number of high correlations between shareholders' structures of pairs of firms (only shares >5%); proportion of high correlations (>80%) among the non-zero correlations.

Year	Tot. No. Firms Cross-Held	Prop Non-Zero Correlations	No. of High Correlations	Prop. of High Correlations
2007	172	1.31	93	18.79
2008	177	0.95	75	19.58
2009	171	1.27	86	14.75
2010	188	1.11	85	14.96
2011	186	0.91	96	20.13
2012	191	0.77	91	21.36
2013	184	0.72	81	19.61
2014	194	0.68	96	23.82
2015	204	0.81	96	19.47
2016	196	0.77	102	21.29

4.3 Trading Platforms for Financial Instruments sector - Trading Platforms operators

The initial attempt of capturing through NACE codes the industry of Trading Platforms for Financial Instruments (Trading Platforms for short) failed to identify the relevant companies. Given that a specific NACE code for Trading Platforms does not actually exist, possible codes have been selected based on what was reported by the main players of this sector. Unfortunately, such categories were either too broad ("Other credit granting"; "Other financial service activities, except insurance and pension funding n.e.c.") or too narrow ("Administration of financial markets"; "Security and commodity contracts brokerage"), and therefore were of no help for the identification of the other players in the industry.

As a consequence, the list of trading venues and systematic internalisers operating in the EU has been constructed manually using the list of markets maintained by the European Securities Market Authorities (ESMA). First, four separate lists for different categories of trading venues were compiled: regulated markets, multilateral trading facilities, organised trading facilities, and systematic internalisers. Then, together with colleagues in DG COMP, we identified a single list of 176 companies operating such platforms in EU. The Trading Platforms operators reflect the actual players active in this industry, and are hence considered the relevant companies for this sector. Only 27% of the selected operators are listed. The sector's Total Assets in 2016 amounted to 11729 Bn Euro, while the 2016 total Market Capitalisation for listed firms was 590 Bn Euro. The large majority (89%) of the operators are registered in one of the EU countries. Of the few operators registered outside, ten come from the US, six from Norway, two from Canada and two from Switzerland.

Table 4.15: Summary statistics for firms active in the EU in the Trading Platforms sector between 2007 and 2016: number of firms; number and percentage of firms cross-held by block-holders (BH) at minimum 5%; total number of shareholders; number and percentage of common shareholders (i.e. shareholders with more than one firm in their portfolio); number and percentage of single owners (holding shares only of one firm).

Year	Number Firms	Number (%) Firms Cross-held by BH	Number of SH	Number (%) Common SH	Number (%) Single SH
2007	124	80 (64.52)	1,584	425 (26.83)	1,159 (73.17)
2008	130	88 (67.69)	1,600	464 (29.00)	1,136 (71.00)
2009	136	86 (63.24)	1,630	403 (24.72)	1,227 (75.28)
2010	137	90 (65.69)	1,655	386 (23.32)	1,269 (76.68)
2011	138	90 (65.22)	1,594	373 (23.40)	1,221 (76.60)
2012	143	89 (62.24)	1,503	352 (23.42)	1,151 (76.58)
2013	148	103 (69.59)	1,433	366 (25.54)	1,067 (74.46)
2014	152	102 (67.11)	1,474	394 (26.73)	1,080 (73.27)
2015	156	104 (66.67)	1,607	401 (24.95)	1,206 (75.05)
2016	159	105 (66.04)	1,662	384 (23.10)	1,278 (76.90)

As shown in Table 4.15, on average there are 142 firms per year, constantly increasing from 124 in 2007 to 159 in 2016. The total number of shareholders, on the other hand, has been rather stable, with an average just below 1600 investors per year. The proportion of common shareholders has also shown a constant value of about 25%, again higher than the overall EU figure. In this sector, we observe a growth in both the number and the proportion of competitors commonly block-held by investors: currently about two thirds of the Trading Platforms operators have some shareholder in common with another operator, both with participations higher than 5%.

The classification of economic activity of the trading platform operators is summarised in Table 4.16. The largest group of firms (39%) present the Core Nace code "6419: Other monetary intermediation", followed by "6612: Security and commodity contracts brokerage" (19%), "6611: Administration of financial markets" (15%) and "6499: Other financial service activities, except insurance and pension funding n.e.c." (9%). Smaller groups are classified as "6420: Activities of holding companies" (5%) and "6619: Other activities auxiliary to financial services, except insurance and pension funding" (4%), the remaining companies having registered activities either in the Financial area, or as Head offices/Business support services (less than 2% each). Only three firms are classified in the field of Information and Communication.

Table 4.16: Main areas of economic activity of firms active in the EU in the Trading Platforms sector between 2007 and 2016: Core Nace code, description of area of activity, and percentage of firms presenting such Core code.

Core Nace	Description	% firms
6419	Other monetary intermediation	39
6612	Security and commodity contracts brokerage	19
6611	Administration of financial markets	15
6499	Other financial service activities n.e.c.	9
6420	Activities of holding companies	5
6619	Other activities auxiliary to financial services	4
	Other: mainly from Section K (Financial and Insurance Activities), Business support services or Information and communication	9

Main players

Of the set of 176 firms that operate Trading Platforms in the EU, the largest are banks or financial intermediaries devoted to auxiliary financial activities (Core Nace codes 6611 and 6612, see Table 4.16), whose names are reported in the first column of Table 4.17.

In many cases, even the operators that are registered in the EU are actually foreign companies wholly owned by homonymic firms based outside the EU area. In other cases, they are controlled subsidiaries of very large corporations, again mainly based outside Europe. If that is the case, looking at the shareholder structure of the firm in the first column is of no help, necessitating the investigation of the parent or controlling companies. As a consequence, Table 4.17 reports an additional column with the name of the parent, in case the operator is a controlled subsidiary or foreign company. For such cases, the reported shares held by the four funds are the participation shares of the controlling corporation, not of the original firm.

In general, a very strong participation of BlackRock and Vanguard is evident, followed closely by State Street and to a lesser extent Norway.

Density and uniformity

The Trading Platforms industry has some peculiarities that should be pointed out before proceeding to the analysis of the common shareholding indicators. The set of firms operating the Trading Platforms is rather heterogeneous, not only in terms of area of activity, as seen earlier, but also in terms of Total Assets and Market Capitalisation. For example, the Total Assets of a bank are incomparably higher than those of a stock exchange, and even more so than those of a digital platform or technology firm. On the other hand, even companies with little assets can have a large Market Cap, but overall the amount of listed firms in the identified set of operators is minor. This will cause a certain discrepancy between the TOAS and MKT CAP indicators, as will be highlighted later.

Table 4.17: Largest firms of Trading Platforms sector and selected ownership data on their main common shareholders. Top 10 largest enterprises in the EU and outside the EU, by country of registration. Size measured by Total Assets in 2016 (Bn Euros). Direct or indirect participation shares (%) held in 2016. In case a firm is controlled or is a foreign company, reported shares are those of the parent.

	Country	TOAS 2016 (Bn €)		BlackRock	Norway	State Street	Vanguard
Operators registered in the EU			Foreign company of/Controlled by	Shares held in 2016 (%)			
BANK OF AMERICA NA	UK	2069.37	BANK of AMERICA CORPORATION (US)	6.01	0.86	4.04	6.26
BARCLAYS BANK PLC	UK	1416.76	BARCLAYS PLC	5.45	3.00	2.40	2.47
CITYBANK N.A.	UK	1276.58	CITIGROUP INC (US)	6.34	0.86	4.10	5.82
LLOYDS BANK PLC	UK	969.74	LLOYDS BANKING GROUP PLC	5.14	3.01	2.04	2.29
GOLDMAN SACHS INTERNATIONAL	UK	883.78	GOLDMAN SACHS GROUP, INC (US)	5.79	0.63	4.78	5.41
LONDON STOCK EXCHANGE GROUP PLC	UK	659.15		8.66	1.49	3.05	2.59
AUSTRALIA AND NZ BANKING GROUP	UK	625.91	AUSTRALIA AND NZ BANKING GROUP (AU)	1.78	1.34	0.46	2.64
STANDARD CHARTERED BANK	UK	612.85	STANDARD CHARTERED PLC	5.04	1.81	1.93	1.98
BANCO SANTANDER SA	ES	461.24		5.03	0.94	0.45	1.09
BANCO BILBAO VIZCAYA	ES	418.45		5.00	1.52	0.93	2.16
Operators registered outside the EU			Foreign company of/Controlled by	Shares held in 2016 (%)			
JPMORGAN CHASE BANK	US	1975.91	JPMORGAN CHASE & CO	6.34	0.90	4.28	6.50
UBS AG	CH	873.37	UBS GROUP AG	4.89	3.17	0.82	2.00
TORONTO DOMINION BANK	CA	802.24		0.13	0.87	0.11	1.90
DNB BANK ASA	NO	258.44			25.01		
INTERCONTINENTAL EXCHANGE, INC.	US	77.79		6.06	0.71	3.87	5.74
RBC INVESTOR SERVICES TRUST	CA	17.26	ROYAL BANK of CANADA	0.34	0.82	0.11	1.88
NASDAQ, INC.	US	13.42		5.58	1.12	2.90	6.59
BGC PARTNERS INC	US	4.79		2.38	0.61	1.53	5.48
INVESTMENT TECHNOLOGY GROUP INC	US	0.74		9.68	1.78	2.23	8.06
MARKETAXESS HOLDINGS INC.	US	0.50		7.58	1.10	2.47	7.09

Another characteristic of this industry is that many of the companies active in this sector are controlled by large groups, presenting therefore a very concentrated ownership structure with large participation shares in the hands of few - or even only one - investor. This implies that in some cases the weighted indices show values very close to the unweighted ones, given that the shares can get very close to 100%.

Table 4.18 displays the results of the density and uniformity indices. The relative size of portfolios has been decreasing over time, not only in terms of mean but also at any other level of the distribution. The maximum firms' share declined from 26.6% in 2007 to 21.38% in 2016, corresponding to about 34 firms in the largest portfolio. The average investor holds about 1.5% of the firms in the industry, i.e. about two companies.

The average uniformity presents a small, stable value of about 8%, with the maximum uniformity reaching about 83% in the later years. This shows a rather "democratic" investment behaviour of top investors, holding in general similar minor shares in most companies in their portfolio.

As for the TOAS based densities, there are no investors whose portfolio represents a very large share of the market value, as in the other markets under analysis, given that some of the firms present extremely high values of TOAS as shown earlier in Table 4.17, thus the market total is extremely high. Overall, firms cross-held by the largest common shareholders represent at most about 30% of the market value; however, given that these companies are held with large participations, the weighted TOAS index is rather high, witnessing in some cases investors who hold as much as 20% of the market Total Assets through their shares. This is particularly true of some major investors, which will be analysed in more detail below.

Alternatively, in the case of Market Capitalisation, we observe a behaviour similar to the other industries, with the largest portfolios including all relevant players covering almost all the market value, however once we weight according to the shares held, we encounter at most about 3% of the market value in the hands of a single investor. The large difference, compared to the TOAS based indices, is principally due to the fact that the fraction of quoted firms is rather small in this industry (about 27%), so that the indices based on MKT CAP are calculated on a rather restricted set of operators. In particular, many large banks - whose Total Assets are huge - are not listed, since they are part of larger groups, wholly owned by listed parent companies. Therefore, many large players end up being excluded from the calculation of the MKT CAP indicators.

Table 4.18: Trading Platforms sector common shareholding indices. Summary Statistics by year (percentage points, index values between 0 and 100): mean, 75th percentile (p75), 99th percentile (p99), maximum (max). Density: Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Uniformity: Relative weight of larger participation shares over the shares total in the portfolio. Small values denote concentrated investment. TOAS density: Proportion of total assets of the market represented by the firms in portfolio. Weighted TOAS density: Proportion of total assets of the market held by shareholder through participation shares. MKT CAP density: Proportion of market capitalisation of the market represented by the firms in portfolio. Weighted MKT CAP density: Proportion of market capitalisation of the market held by shareholder through participation shares.

Year	Density			
	mean	p75	p99	max
2007	1.8136	1.6129	18.5484	26.6129
2008	1.7125	1.5385	17.6923	24.6154
2009	1.5327	0.7353	15.4412	22.7941
2010	1.5140	0.7299	15.3285	22.6277
2011	1.5009	0.7246	15.2174	23.1884
2012	1.4370	0.6993	14.6853	23.0769
2013	1.4970	1.3514	14.1892	23.6486
2014	1.4630	1.3158	15.7895	23.0263
2015	1.3786	0.6410	14.1026	21.7949
2016	1.3358	0.6289	13.8365	21.3836

Year	Uniformity			
	mean	p75	p99	max
2007	9.5876	6.2989	73.6539	83.68
2008	10.1073	11.3614	74.2729	82.81
2009	8.8353	0.0000	72.2638	81.78
2010	8.4081	0.0000	70.3008	82.89
2011	8.1140	0.0000	69.8677	80.79
2012	8.0586	0.0000	71.6145	80.98
2013	8.9990	0.0000	69.8792	83.25
2014	9.3877	0.9769	72.9298	81.71
2015	9.1083	0.0000	73.7728	84.14
2016	8.5076	0.0000	70.6782	83.85

Year	TOAS density			
	mean	p75	p99	max
2007	0.4389	0.0466	6.3910	29.6057
2008	0.4611	0.0994	6.2391	32.1952
2009	0.5860	0.0656	8.0627	37.5420
2010	0.7589	0.0916	10.1345	32.9129
2011	4.5037	6.7067	28.2688	39.1659
2012	3.4188	5.8499	24.6123	27.4766
2013	2.5138	4.9271	22.2890	25.8939
2014	1.9307	3.3851	18.2272	21.7242
2015	2.0172	3.3320	18.3522	22.8370
2016	1.7800	3.5675	17.1748	27.7510

Year	Weighted TOAS density			
	mean	p75	p99	max
2007	0.0750	0.0002	2.5414	22.4576
2008	0.0800	0.0002	2.3012	23.8047
2009	0.0916	0.0002	2.6735	23.8654
2010	0.1008	0.0004	2.9524	28.2308
2011	0.0942	0.0017	2.5829	21.8007
2012	0.0801	0.0018	1.9380	16.7944
2013	0.0933	0.0030	2.7622	17.6959
2014	0.0696	0.0024	1.5450	15.3982
2015	0.0949	0.0018	2.7502	16.8588
2016	0.0970	0.0012	2.3591	17.9481

Year	MKT CAP density			
	mean	p75	p99	max
2007	5.1203	6.4321	71.5485	84.8913
2008	5.1975	1.3291	88.6810	91.9205
2009	4.8121	1.0343	86.8470	90.1022
2010	4.8709	0.7086	88.0968	90.8747
2011	7.6239	12.5216	75.1979	97.4071
2012	7.1208	9.0928	74.4122	97.8364
2013	7.2721	11.4601	78.8032	99.6870
2014	7.0214	10.7205	74.9539	93.1160
2015	6.6428	8.7194	81.5364	99.5894
2016	6.3330	7.1437	76.3403	99.6206

Year	Weighted MKT CAP density			
	mean	p75	p99	max
2007	0.0522	0.0078	1.1656	6.4321
2008	0.0451	0.0023	1.1934	4.2842
2009	0.0409	0.0007	0.7801	5.3194
2010	0.0411	0.0016	0.7514	5.6036
2011	0.0486	0.0078	0.9468	4.2831
2012	0.0488	0.0079	0.9800	2.1674
2013	0.0547	0.0138	0.9872	2.8838
2014	0.0527	0.0163	0.9790	2.7234
2015	0.0515	0.0163	0.9384	3.2663
2016	0.0489	0.0109	0.9614	3.3583

Common shareholding indices for top investors

The picture of top investors in the Trading Platforms industry is largely dominated by banks, while funds tend to drop to lower positions in the ranking of shareholders. All top investors in 2016 (except Barclays) are registered outside the EU, but hold in turn foreign companies (FC) or controlled subsidiaries registered in Europe, as reported in Table 4.19.

To give a few examples, US-based Goldman Sachs Group Inc majority owns Goldman Sachs International and wholly owns Goldman Sachs International Bank, both registered in the UK; the Japanese Nomura Holdings Inc wholly owns UK-based Nomura International; finally, Morgan Stanley is registered in the US but is the majority owner of Morgan Stanley & Co. International PLC, which is based in the UK. The list could continue with several similar examples.

In 2016, the big funds tended to hold very similar portfolios in terms of firms held, but the level of participation varies. For example, BlackRock holds a large share (8.66%) of the London Stock Exchange, while State Street and Vanguard have about 3% each. On the other hand, State Street has a strong presence in the Spanish banks Santander (8.34%) and Banco Bilbao Vizcaya (10.87), while BlackRock holds about half of that and Vanguard even less (about 1% and 2% respectively).

It is worth commenting briefly on the results presented in Tables 4.17 and 4.19, since they seem to show - at first sight - some inconsistencies. Compared to the picture of the main players in Table 4.17, we see that some main operators based in the EU, such as Bank of America, Citibank or Lloyds, are not reported here among the largest firms held by top investors in Table 4.19. This is because, as previously reported, they are not held directly by such top investors, but are instead controlled by groups which are in turn held by top investors, according to the ownership displayed information; however, they do not in general have such large Total Assets, and therefore do not appear among the largest firms in portfolio in Table 4.19.

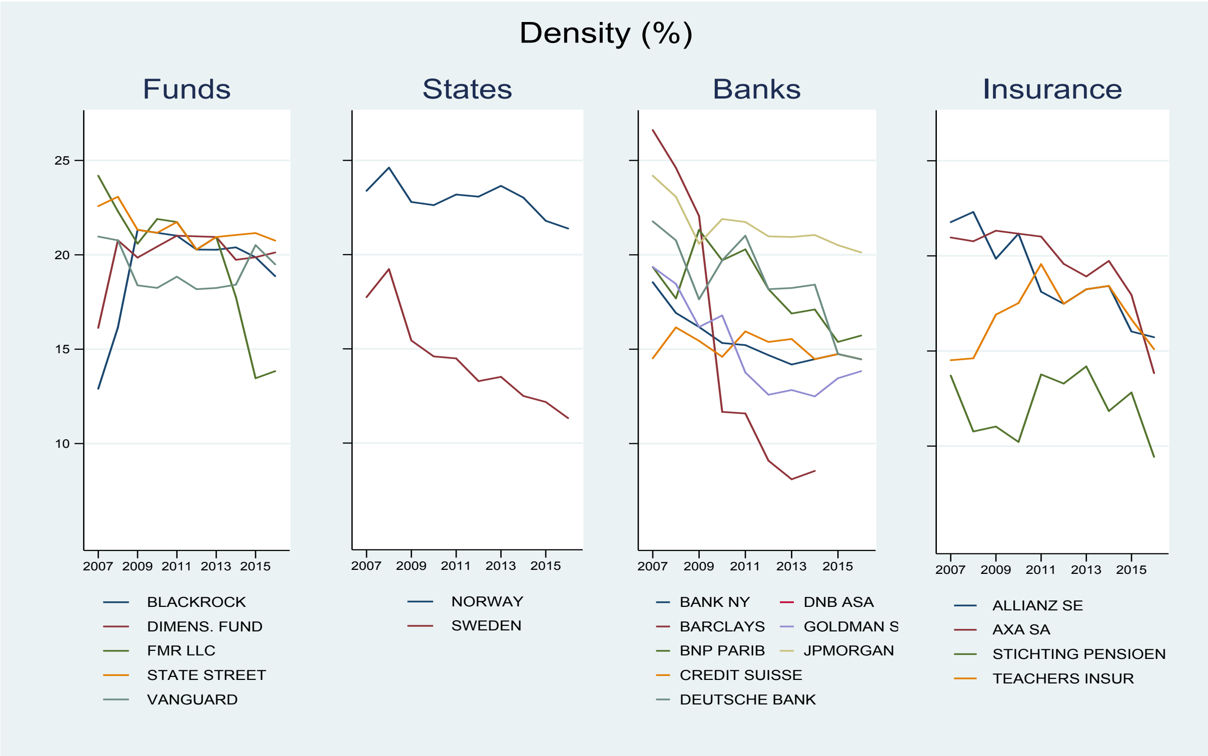
In terms of time trends of the indicators, Figure 4.3 reports the density and the weighted TOAS density indices. The decreasing trend of density for all types of investors shows an overall tendency to invest in a smaller proportion of firms over time. However, the shrinkage of such a proportion can be due to the increase in the number of firms active in this industry in 2007-2016, while the actual number of firms in each portfolio has remained stable. Overall, the size of the portfolios does not differ much across the four types of investors presented in the graphs, with Sweden, Funds, Banks and Insurance companies all fluctuating within the range of 15%-20%, while Norway highlights a consistently higher value of above 20%, holding the largest portfolio in 2016 (34 firms).

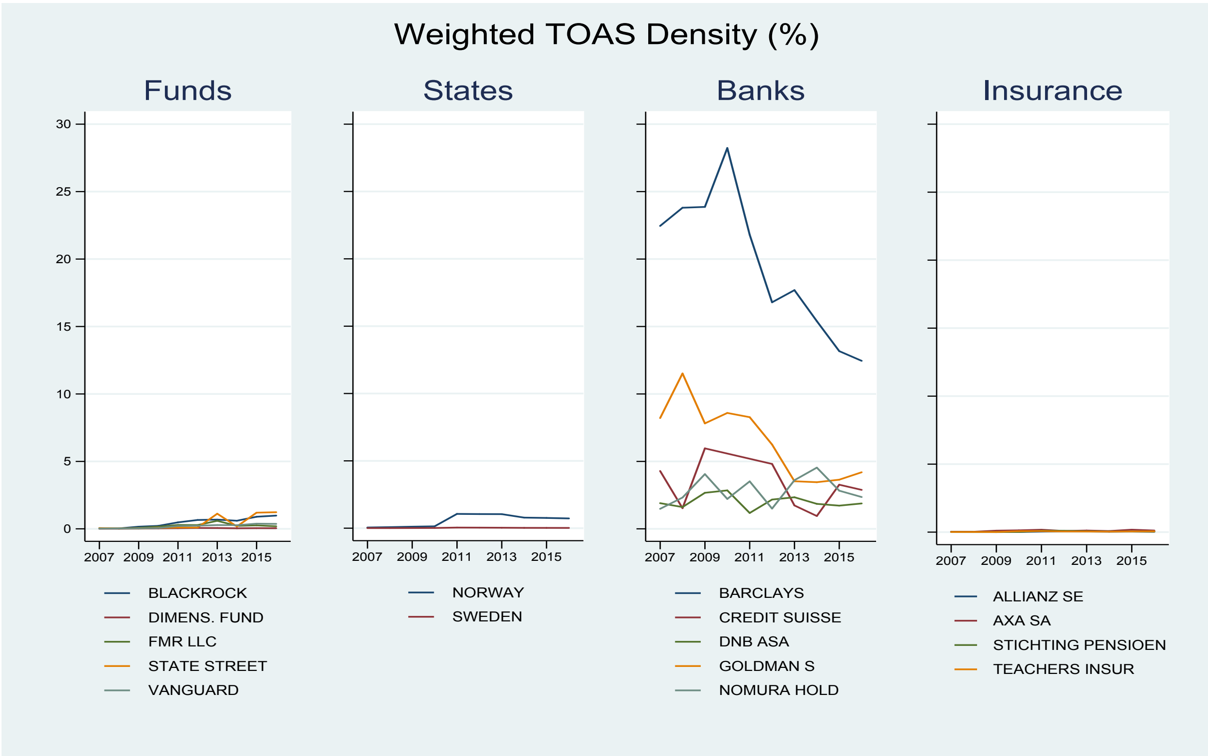
As for the Total Assets, the portfolios of Banks present values way above any other type of investor, due to both the large amount of Assets of the firms participated in, and to the high shares held. Still, we observe a certain decreasing trend over time, again potentially attributable to the enlargement of the market in recent years.

Table 4.19: Top Investors in Trading Platforms sector: Investors whose portfolios present the top values of the Weighted TOAS density index in 2016. Country of shareholder (SH); number of firms held in Trading Platforms industry; Density (share of firms held); TOAS density (share of market TOAS represented by firms held); Weighted TOAS density (share of market TOAS held through participation shares); firms with largest TOAS in portfolio and respective quantity of shares held, ordered by decreasing TOAS. All figures refer to the year 2016.

SH Name	SH country	No. Firms Held	Density	TOAS density	W TOAS den.	Largest firms and shares held (%)
BARCLAYS PLC	UK	9	5.66	19.50	12.46	BARCLAYS BANK PLC (98); LSE (0.32); INTERCONT. EXCH. (0.15); BARCLAYS CAPITAL SEC (100); TP ICAP (0.13); INVESTEC (0.15); DEUTSCHE BOERSE (0.52)
GOLDMAN SACHS	US	22	13.84	22.88	4.20	GOLDMAN SACHS INTERN. (50.01); LSE (1.09); SANTANDER (0.14); BANCO BILBAO VIZCAYA (0.11); INTERCONT. EXCH. (1.91); JYSKE BANK (0.11); GOLDMAN SACHS INTERN. BANK (100)
CREDIT SUISSE	CH	23	14.47	17.38	2.89	LSE (0.57); SANTANDER (2.87); BANCO BILBAO VIZCAYA (1.75); CREDIT SUISSE INTERN. (100); INTERCONT. EXCH. (0.23); TP ICAP (0.22); INVESTEC (0.27)
NOMURA HOLD.	JP	11	6.92	8.78	2.36	LSE (0.74); NOMURA INTERN. (100); INTERCONT. EXCH. (1.03); NASDAQ INC (0.11); DEUTSCHE BOERSE (0.13); INVESTM. TECHN. (0.12); MARKETAXESS HOLD. (1.32)
DNB ASA	NO	9	5.66	4.37	1.88	DANSKE BANK (0.13); DNB BANK (100); OSLO BORS (19.81); ABG SUNDAL COLLIER (0.21); SOCIETE GENERALE (0.12); SWEDBANK (0.19)
MORGAN STANLEY	US	14	8.81	17.39	1.76	LSE (0.78); SANTANDER (0.14); BANCO BILBAO VIZCAYA (0.11); MORGAN STANLEY INTERN. (50.01); INTERCONT. EXCH. (0.22); NASDAQ INC (0.44); DEUTSCHE BOERSE (0.17)
STATE STREET	US	33	20.75	19.49	1.23	LSE (3.05); SANTANDER (8.34); BANCO BILBAO VIZCAYA (10.87); DANSKE BANK (0.29); STATE STREET BANK FC - UK (100); INTERCONT. EXCH. (3.87); JYSKE BANK (0.11); OSLO BORS (4.16)
BLACKROCK	US	30	18.87	17.56	0.98	LSE (8.66); SANTANDER (5.03); BANCO BILBAO VIZCAYA (5.00); DANSKE BANK (2.02); INTERCONT. EXCH. (6.06); JYSKE BANK (0.54); TP ICAP (1.72)
NORWAY	NO	34	21.38	19.44	0.73	LSE (1.49); SANTANDER (0.94); BANCO BILBAO VIZCAYA (1.52); DANSKE BANK (2.13); DNB BANK (25.01); INTERCONT. EXCH. (0.71); JYSKE BANK (1.6)
BANK NY MELLON	US	23	14.47	14.78	0.44	LSE (0.27); SANTANDER (4.8); BANCO BILBAO VIZCAYA (4.19); INTERCONT. EXCH. (1.85); TP ICAP (0.18); INVESTEC (0.13); SYDBANK (0.18)
VANGUARD GROUP	US	31	19.50	17.56	0.37	LSE (2.59); SANTANDER (1.09); BANCO BILBAO VIZCAYA (2.16); DANSKE BANK (1.6); INTERCONT. EXCH. (5.74); JYSKE BANK (1.5); TP ICAP (0.97)
INVESCO	BM	25	15.72	13.35	0.31	LSE (4.84); BANCO BILBAO VIZCAYA (0.19); DANSKE BANK (0.68); INTERCONT. EXCH. (0.24); JYSKE BANK (0.38); TP ICAP (2.26); SYDBANK (0.11)

Figure 4.3: Common shareholding indices for Top Investors in Trading Platforms sector. Top panel: Density - Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Bottom panel: Weighted TOAS density - Proportion of total assets of the market held by shareholder through participation shares.





Network indices

The network indices show a weak connection among shareholders, where only about 2% of possible links are active, and among the connected large portfolios (density>10%), less than 1% show strong links with correlations above 80%. These results point toward a more fragmented market (compared for instance to the Energy cases), where shareholders tend to take hold of different parts of the industry, with little overlap in terms of investment strategies.

In the firms' network, the active links due to block-holdings are few (less than 1% all over 2008-2016), but the firms that are linked show in general a strong similarity of ownership structures, with more than 30% of cases recording a very high correlation (above 80%).

Table 4.20: Network indices for Trading Platforms sector. Shareholders' network. Total number of common shareholders; proportion of non-zero correlations between pairs of portfolios, i.e. proportion of connections between two shareholders induced by common shareholding of a same firm; number of high correlations (>80%) between pairs of high-density portfolios (both densities >10%); proportion of high correlations between pairs of high-density portfolios.

Year	Tot No. Comm SH	Prop Non-Zero Correlations	No. High Corr. High Dens.	Prop. High Corr. High Dens.
2007	425	2.48	7	0.55
2008	464	2.50	7	0.68
2009	403	1.99	5	0.64
2010	386	1.93	5	0.75
2011	373	1.91	2	0.36
2012	352	1.89	2	0.40
2013	366	2.22	2	0.49
2014	394	2.30	4	0.86
2015	401	2.02	3	0.60
2016	384	1.86	3	0.69

Table 4.21: Network indices for Trading Platforms. Firms' network. Total number of firms cross-held by block-holders (holding at least 5%); proportion of non-zero correlations between shareholders' structures of pairs of firms (only shares >5%); number of high correlations between shareholders' structures of pairs of firms (only shares >5%); proportion of high correlations (>80%) among the non-zero correlations.

Year	Tot. No. Firms Cross-Held	Prop Non-Zero Correlations	No. of High Correlations	Prop. of High Correlations
2007	80	1.19	20	21.98
2008	88	0.73	28	45.90
2009	86	0.87	24	30.00
2010	90	0.94	29	32.95
2011	90	0.84	34	43.04
2012	89	0.76	27	35.06
2013	103	0.84	30	32.97
2014	102	0.71	22	26.83
2015	104	0.79	28	29.47
2016	105	0.93	33	28.21

4.4 Telecommunication sector - Mobile Network Operators and their parents

The NACE industry classification does not supply a specific code for mobile telecommunications. The NACE codes "60: programming and broadcasting activities" and "61: telecommunications" have been used as base to select, in each EU country, the initial list of Mobile Network Operators (MNOs). Colleagues in DG COMP supplied an additional list of Mobile Virtual Network Operators (MVNOs) for each EU country. After some preliminary analyses,[5] the MVNOs were eventually left out given their small size. The parent companies of the MNOs were added to the list of firms defining the Mobile Telecoms market. This was considered advisable for at least two reasons. First, large telecoms companies often operate in the mobile sector through specialised subsidiaries dedicated to this segment of their activity. Therefore, they would not be included in the industry if merely looking at Mobile Operators.[6] Second, the large investors (and likely common shareholders) tend to show more interest in the parents of corporate groups, rather than in their controlled subsidiaries. Therefore, the ownership structure of Mobile Operators alone is likely to underestimate the actual influence of large investors in this industry, exerted indirectly through the parents.

Altogether, we identified 105 Mobile Network Operators (MNOs) active in the EU in the period 2007-2016, and additional 72 controlling parents. The parents are identified with the Orbis definition of "GUO50", i.e. the Global Ultimate Owner characterised by a minimum of 50% ownership shares in the path from the subsidiary to the ultimate owner.[7] These parents are partly companies active in the telecoms industry, partly holding or financial companies. Adding the parents to the list of MNOs, we obtain a final list of 177 companies that represent all firms active in or influencing mobile telecoms in the EU over 2007-2016. This set of firms in 2016 totaled 1236 Bn Euro in Total Assets and 521 Bn Euro in Market Capitalisation.

The large majority of the firms are registered in Europe (93%), with the largest share in Luxembourg (10%), followed by the Netherlands with about 8%. As shown in Table 4.22, most of the companies (70%) classify their core activity in the Nace Division "61: Telecommunications", mainly with codes "6190: Other telecommunications activities" (33%), "6120: Wireless telecommunications activities" (28%) and "6110: Wired telecommunications activities" (6%), the remaining 3% being classified generically as "6100: Telecommunications". Holding companies represent 11% of the sample. The remaining 19% of firms are scattered across a series of different activities, mainly in business support services or management consulting activities.

[5] Results available upon request. The identification process of the relevant MVNOs is described in Appendix C.

[6] For example, DEUTSCHE TELEKOM AG is not an MNO, but controls several mobile operators, such as T-MOBILE AUSTRIA GMB, T-MOBILE NETHERLANDS and TELEKOM DEUTSCHLAND. DEUTSCHE TELEKOM AG would be excluded from the list of firms active in the mobile sector, if merely selecting MNOs.

[7] For details about the GUO definition, see Appendix A.

Table 4.22: Main areas of economic activity of firms active in the EU in the Mobile Telecoms sector between 2007 and 2016: Core Nace code, description of area of activity, and percentage of firms presenting such Core code.

Core Nace	Description	% firms
6190	Other telecommunications activities	33
6120	Wireless telecommunications activities	28
6110	Wired telecommunications activities	6
6100	Telecommunications	3
6420	Activities of Holding Companies	11
	Other (mainly: Business support service activities, Business and other management consultancy activities, Other IT and computer service activities)	19

Brief figures on the shareholder structure of the industry are reported in Table 4.23. The number of firms in this industry has been increasing slightly, going from 122 in 2007 to 149 in 2016 (on average 134 firms per year). The number of shareholders has been rather stable, at an average of around 1160. The proportion of common vs single owners, however, has changed throughout the period of observation, with the initial proportion of roughly 25% vs 75% becoming around 30% vs 70%. The proportion of companies that share block-holders with competitors is slightly increasing - growing from about 75% to 82% throughout the decade of observation. These figures are much higher for this market, compared to the overall values observed for the listed firms active in the EU across all industries (always below 70%).

Table 4.23: Summary statistics for firms active in the EU in the Mobile Telecoms sector in 2007-2016: number of firms; number and percentage of firms cross-held by block-holders (BH) at minimum 5%; total number of shareholders; number and percentage of common shareholders (i.e. shareholders with more than one firm in their portfolio); number and percentage of single owners (holding shares only of one firm).

Year	Number Firms	Number (%) Firms Cross-held by BH	Number of SH	Number (%) Common SH	Number (%) Single SH
2007	122	92 (75.41)	1,220	307 (25.16)	913 (74.84)
2008	127	96 (75.59)	1,197	324 (27.07)	873 (72.93)
2009	129	98 (75.97)	1,235	343 (27.77)	892 (72.23)
2010	130	99 (76.15)	1,259	342 (27.16)	917 (72.84)
2011	132	99 (75.00)	1,113	334 (30.01)	779 (69.99)
2012	139	103 (74.10)	1,073	325 (30.29)	748 (69.71)
2013	137	108 (78.83)	1,120	339 (30.27)	781 (69.73)
2014	137	105 (76.64)	1,107	321 (29.00)	786 (71.00)
2015	144	112 (77.78)	1,120	337 (30.09)	783 (69.91)
2016	149	122 (81.88)	1,126	341 (30.28)	785 (69.72)

Main players

Most of the firms are registered in the EU, with only a few large players from outside. Therefore, in the analysis of the main firms active in this industry fourteen EU-based companies vs only four non-EU corporations will be considered. Summary information is displayed in Table 4.24.

BlackRock dominates this industry, with rather large shares in some of the top players; Vanguard and Norway lag behind, with relatively small participations, while State Street plays only a minor role. France is also present, with a large participation in the French company Orange, but also some smaller shares in other top competitors.

Table 4.24: Largest firms of Mobile Telecoms sector and selected ownership data on their main common shareholders. Top 14 largest enterprises in the EU and top 4 outside the EU, by country of registration. Size measured by Total Assets in 2016 (Bn Euros). Direct or indirect participation shares (%) held in 2016.

	Country	TOAS 2016 (Bn €)	BlackRock	France	Norway	State Street	Vanguard
Registered in the EU			Shares held in 2016 (%)				
VODAFONE GROUP PLC	UK	180.17	8.14	0.17	2.26	2.83	2.42
DEUTSCHE TELEKOM AG	DE	103.18	4.65	0.13	1.52	1.28	1.49
ORANGE	FR	92.59	1.98	21.00	1.51	0.53	1.57
TELEFONICA SA	ES	83.26	5.22	0.10	1.48	0.65	1.84
LIBERTY GLOBAL PLC	UK	65.16	3.06		0.75	1.98	1.53
TELECOM ITALIA S.P.A	IT	61.70	2.10		1.46	0.22	1.19
BT GROUP PLC	UK	49.35	6.72		1.38	1.80	2.1
VIVENDI	FR	27.01	3.94	3.12	1.62	2.12	1.83
TELIA COMPANY AB	SE	22.53	1.27		0.88	0.24	1.28
PROXIMUS SA	BE	16.49	2.60	0.21	0.79	0.31	0.92
KONINKLIJKE KPN NV	NL	14.74	6.53	0.19	2.01	0.29	1.59
BOUYGUES SA	FR	13.77	1.32	0.14	1.10	0.20	1.19
TELEFONICA DEUTSCHLAND	DE	10.88	0.84	0.43	0.70	0.11	0.50
TDC A/S	DK	8.64	2.05		2.76	0.44	2.10
Registered outside the EU			Shares held in 2016 (%)				
CK HUTCHISON HOLDING	KY	123.99	1.39		1.11	0.95	1.51
AMERICA MOVIL	MX	69.33	1.98		0.26	0.12	1.35
MTN GROUP LIMITED	ZA	18.63	1.78		0.30	0.36	2.88
TELENOR ASA	NO	13.62	0.82		5.55	0.58	0.99

Density and uniformity

The summary statistics on the density-based and uniformity indicators for Mobile Network Operators are reported in Table 4.25. The distribution of investors portfolios is heavily skewed, with the top 1% of portfolios having an equity interest in above 13% of the firms on the market in 2016, albeit in a declining trend with respect to previous years. Maximum values are also significantly high, around 24% on average for the period. This is again due to the presence, in this industry, of large groups mothered by Telecom giants such as Vodafone, Orange or Deutsche Telecom, which have little if no overlap in their portfolios, and have more or less partitioned the set of firms active in this industry into independent groups.

The presence of large global investors lowers the uniformity indices, where the maximum reaches 87% in 2016. This is because these investors have very widespread interests both in subsidiaries as well as in the mother groups themselves.

In terms of value-based indices, there are some differences in level between TOAS and MKT CAP results, given that the set of listed firms in this industry is rather reduced, and therefore the second set of indices is calculated on a very restricted part of the market. We see that the top 1% of investors hold firms that represent roughly 70% or more of the Total Assets of the industry, showing that such top investors tend to privilege the largest enterprises. The TOAS market shares, represented by the weighted TOAS, reach values of about 3% of the market Total Assets through their participation shares. As we will see further down in the analysis dedicated to top investors, it is mostly certain individual shareholders - alongside funds such as BlackRock - that control the largest amounts of assets weighted by their participation shares, while the telecom groups and other shareholders control smaller and smaller portions.

A similar picture holds for listed firms, where the largest portfolios (mainly the Funds) hold firms representing almost the entire market Market Capitalisation, and through their participations control about 3% of the market value.

Common shareholding indices for top investors

The final ownership in the Mobile Network Operators industry in 2016 is concentrated in the hands of select individuals and associated holding groups, alongside large investment management firms such as Blackrock or Vanguard Group. These global shareholders hold significant investments in large pan-European telecom groups such as Vodafone and Orange, as well as national providers. Together, these groups and providers compose almost the entirety of the European mobile telecommunication market. For example, Table 4.26 shows the reach of individuals such as Mr. Carlos Slim Helú in Mexico or Mr. Victor Li Tzar Kuoi on Hong Kong, with controlling interests in European national telecom providers, both directly and through their controlled holdings.

Table 4.25: Telecoms sector common shareholding indices. Summary Statistics by year (percentage points, index values between 0 and 100): mean, 75th percentile (p75), 99th percentile (p99), maximum (max). Density: Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Uniformity: Relative weight of larger participation shares over the shares total in the portfolio. Small values denote concentrated investment. TOAS density: Proportion of total assets of the market represented by the firms in portfolio. Weighted TOAS density: Proportion of total assets of the market held by shareholder through participation shares. MKT CAP density: Proportion of market capitalisation of the market represented by the firms in portfolio. Weighted MKT CAP density: Proportion of market capitalisation of the market held by shareholder through participation shares.

Year	Density			
	mean	p75	p99	max
2007	1.9793	1.6393	19.6721	22.1311
2008	2.0221	1.5748	19.6850	22.8346
2009	1.9521	1.5504	20.1550	23.2558
2010	1.9423	1.5385	19.2308	23.8462
2011	1.9392	1.5152	18.9394	23.4848
2012	1.7969	1.4388	17.2662	22.3022
2013	1.7596	1.4599	16.7883	24.0876
2014	1.7401	1.4599	16.7883	24.8175
2015	1.6778	1.3889	15.9722	24.3056
2016	1.5896	1.3423	13.4228	24.1611

Year	Uniformity			
	mean	p75	p99	max
2007	11.3223	0.0000	79.9896	83.35
2008	12.0384	15.3604	80.0174	85.50
2009	12.3053	20.5333	79.8603	84.99
2010	11.9752	16.3526	80.1282	83.88
2011	12.7353	25.9924	79.2355	85.53
2012	12.6269	26.2247	79.7097	85.14
2013	12.3826	26.2024	77.5718	86.93
2014	12.0850	23.2642	77.7652	87.12
2015	12.0788	24.5015	78.9143	87.51
2016	12.0780	23.6421	76.5931	87.34

Year	TOAS density			
	mean	p75	p99	max
2007	7.4309	7.4203	69.8989	78.4716
2008	8.3073	7.8860	74.8037	79.1696
2009	7.8094	7.5798	74.3395	78.9711
2010	7.9720	7.8477	71.1840	78.1884
2011	7.6715	7.7347	70.0327	75.6523
2012	7.8307	11.6326	67.1252	75.9208
2013	7.4921	7.9090	67.7414	77.8850
2014	7.7871	8.3077	68.4811	79.3806
2015	8.7723	9.5516	73.6521	81.9915
2016	8.1432	10.0338	69.7344	82.4209

Year	Weighted TOAS density			
	mean	p75	p99	max
2007	0.0860	0.0359	1.5411	4.5559
2008	0.0925	0.0426	1.6098	3.9637
2009	0.0879	0.0385	1.4706	3.0256
2010	0.0930	0.0406	1.4843	3.3877
2011	0.0926	0.0435	1.3986	3.1649
2012	0.1016	0.0474	1.7398	3.6171
2013	0.0952	0.0486	1.3742	3.5939
2014	0.1014	0.0497	1.4447	4.0498
2015	0.1042	0.0479	1.4203	4.0009
2016	0.1058	0.0490	1.5877	3.2686

Year	MKT CAP density			
	mean	p75	p99	max
2007	7.7725	6.2385	85.8200	96.7953
2008	10.4532	16.4621	92.7547	98.4306
2009	9.8064	17.0676	91.4586	98.1987
2010	9.7489	14.0196	91.2640	97.9573
2011	10.4767	12.4617	90.9646	98.2289
2012	10.6983	10.9133	87.2116	96.1643
2013	9.2160	11.3131	85.0667	99.3275
2014	9.4158	11.0683	85.5496	96.7283
2015	9.2643	11.8521	85.8330	99.3324
2016	8.7866	8.5342	83.3435	99.1699

Year	Weighted MKT CAP density			
	mean	p75	p99	max
2007	0.0750	0.0276	1.2486	4.1236
2008	0.0800	0.0291	1.3366	3.8236
2009	0.0788	0.0282	1.4514	3.3880
2010	0.0753	0.0313	1.2841	3.6704
2011	0.0853	0.0415	1.3257	4.3855
2012	0.0909	0.0433	1.3286	4.5546
2013	0.0811	0.0403	1.0815	4.2521
2014	0.0898	0.0452	1.4224	3.8289
2015	0.0916	0.0412	1.5243	3.5703
2016	0.0925	0.0377	1.7629	3.7309

Investment management groups such as Blackrock Inc are also major shareholders in European telecom groups such as Vodafone, where Blackrock holds 8.14%. Vodafone Group PLC is a major player in the market, holding more than 8% of undertakings active in the sector through its full ownership of subsidiaries in Spain, Italy, Romania, Check Republic, Hungary, Netherlands, Germany, and so on. Similarly, Orange controls subsidiaries in Spain, Poland, Belgium, Romania and Slovakia. Note that not all subsidiaries of these groups are shown for conciseness. As Table 4.26 shows, the top global shareholders in the sector often hold significant portions of Total Assets. In particular, the aforementioned Carlos Slim Helú, Victor Li Tzar Kuoi, and Blackrock each hold 3.26%, 3.09%, and 3.18% of weighted Total assets respectively.

Also rather important are the States, with France and Norway ranking amongst the top investors. While Total Assets are less significant in comparison to other shareholders (about 1% weighted Total Assets for the two), the number of undertakings invested in is significant, reaching 24.16% for Norway. Table 4.26 presents all these top shareholders, based on weighted Total Assets, reporting first the individuals and their associated holdings, and then the funds, telecom groups, and states.

The time trends of the common shareholding indices are reported for the usual four groups of shareholders' types (Funds, States, Banks and Insurance companies) as well as for the top cross investors, that is, the most important telecom groups with significant assets or subsidiaries active in the EU. Figures 4.4 and 4.5 report the results for density and weighted TOAS density for the top investors and top cross-investors, respectively.

We observe rather constant density for Funds and States, while Banks and Insurance companies seem to be divesting in this sector. The largest portfolios in terms of undertakings invested in remain those of Norway and Sweden. However, as Table 4.26 previously demonstrated, the biggest shareholders in terms of weighted Total Assets density remain the funds, in particular Blackrock with more than 3%, followed by the individuals mentioned in Table 4.26 but not shown here. In terms of Total Assets, Banks and Insurance confirm a decline in quantities held. The remaining Funds, such as Vanguard Group are located at much lower levels for the entire period, finishing just above 1% but steadily increasing.

Looking at cross-owners in Figure 4.5, we see that the relative size of the portfolios of the Telecom groups has been stable throughout the period (between 4% and 10%). Vodafone and Deutsche Telekom remain important players from this perspective, because of the number of national subsidiaries that are wholly or significantly owned. Looking at the share of total assets weighted by participation, however, the values have been converging to between 1% and 2% for all the groups. The shares of total assets are not very high, due to the fact that parent companies and large global shareholders are included, diluting the share of controlled total assets.

Table 4.26: Top Investors in Mobile Telecoms sector: Investors whose portfolios present the top values of the Weighted TOAS density index in 2016. Country of shareholder (SH); number of firms held in MNO industry; Density (share of firms held); TOAS density (share of market TOAS represented by firms held); Weighted TOAS density (share of market TOAS held through participation shares); firms with largest TOAS in portfolio and respective quantity of shares held, ordered by decreasing TOAS. All figures refer to the year 2016.

SH Name	SH country	No. Firms Held	Density	TOAS density	W TOAS den.	Largest firms and shares held (%)
Individuals						
CARLOS SLIM[1]	MX	5	3.35	6.53	3.26	AMERICA MOVIL (50.01); TELEKOM AUSTRIA (50.01); A1 TELEKOM AUSTRIA (50.01); A1 SLOVENIJA (50.01)
VICTOR LI[2]	HK	11	7.38	12.36	3.09	CK HUTCHISON HOLDING (25.01); WIND TRE S.P.A (25.01); HI3G HOLDINGS AB (25.01)
JOHN MALONE	US	4	2.68	7.53	2.01	LIBERTY GLOBAL PLC (27.5); CABLE AND WIRELESS LIMITED (25.01); TELENET GROUP (25.01); LIBERTY GLOBAL INC (35.3)
Corporate						
BLACKROCK	US	30	20.13	81.97	3.18	VODAFONE GROUP PLC (8.14); CK HUTCHINSON HOLDING (1.39); DEUTSCHE TELEKOM (4.65); ORANGE (1.98); TELEFONICA (5.22); AMERICA MOVIL (1.98); LIBERTY GLOBAL PLC (3.06)
CK-HUTCHISON HOLDING[3]	KY	6	2.83	3.90	2.23	WIND TRE (50.01); HI3G HOLDINGS (50.01); HUTCHISON DREI AUSTRIA (100); HI3G ACCESS (50.01); THREE IRELAND (100); HI3G DENMARK (50.01); VIP-CKH LUXEMBOURG (50)
FRANCE	FR	12	8.05	44.56	1.69	VIVENDI (3.12); VODAFONE GROUP PUBLIC (.17); ORANGE (21); DEUTSCHE TELEKOM (.13)
VODAFONE	UK	12	8.05	1.52	1.45	VODAFONE ESPANA (100); VODAFONE ITALIA (100); VODAFONE ENTERPR. (100); VODAFONE CZECH REP. (100); VODAFONE PORTUGAL (38.26)
VANGUARD	US	30	20.13	81.97	1.38	VODAFONE GROUP PLC (2.42); DEUTSCHE TELEKOM (1.49); ORANGE (1.57); TELEFONICA (1.84); LIBERTY GLOBAL PLC (1.53); AMERICA MOVIL (1.35); CK HUTCHISON HOLDING (1.51)
NORWAY	NO	36	24.16	82.42	1.34	VODAFONE GROUP PLC (2.26); ORANGE (1.51); DEUTSCHE TELEKOM (1.52); TELEFONICA (1.48); CK HUTCHISON HOLDING (1.11)
ORANGE	FR	8	5.36	5.51	1.31	ORANGE ESPAGNE (100); ORANGE POLSKA (50.67); ORANGE BELGIUM (50.01); ORANGE ROMANIA (97.75); ORANGE SLOVENSKO (100); HUTCHISON DREI AUSTRIA (35)
TELEFONICA	ES	4	2.68	2.2	1.23	02 HOLDINGS LIMITED (100); TELEFONICA DEUTSCHLAND (0.5); TELEFONICA MOVILES (100); O2 CZECH REPUBLIC (4.9)

[1] *Includes CARLOS SLIM HELU Y FAMILIA, FIDEICOMISO FAMILIAR and INVERSORA CARSO SA.* [2] *Includes VICTOR LI TZAR-KUOI, LI KA-SHING UNITY HOLDING and LI KA-SHING UNITY TRUST.* [3] *Held at > 25% by VICTOR LI TZAR-KUOI.*

Figure 4.4: Common shareholding indices for Top Investors in Mobile Telecoms sector. Top panel: Density - Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Bottom panel: Weighted TOAS density - Proportion of total assets of the market held by shareholder through participation shares.

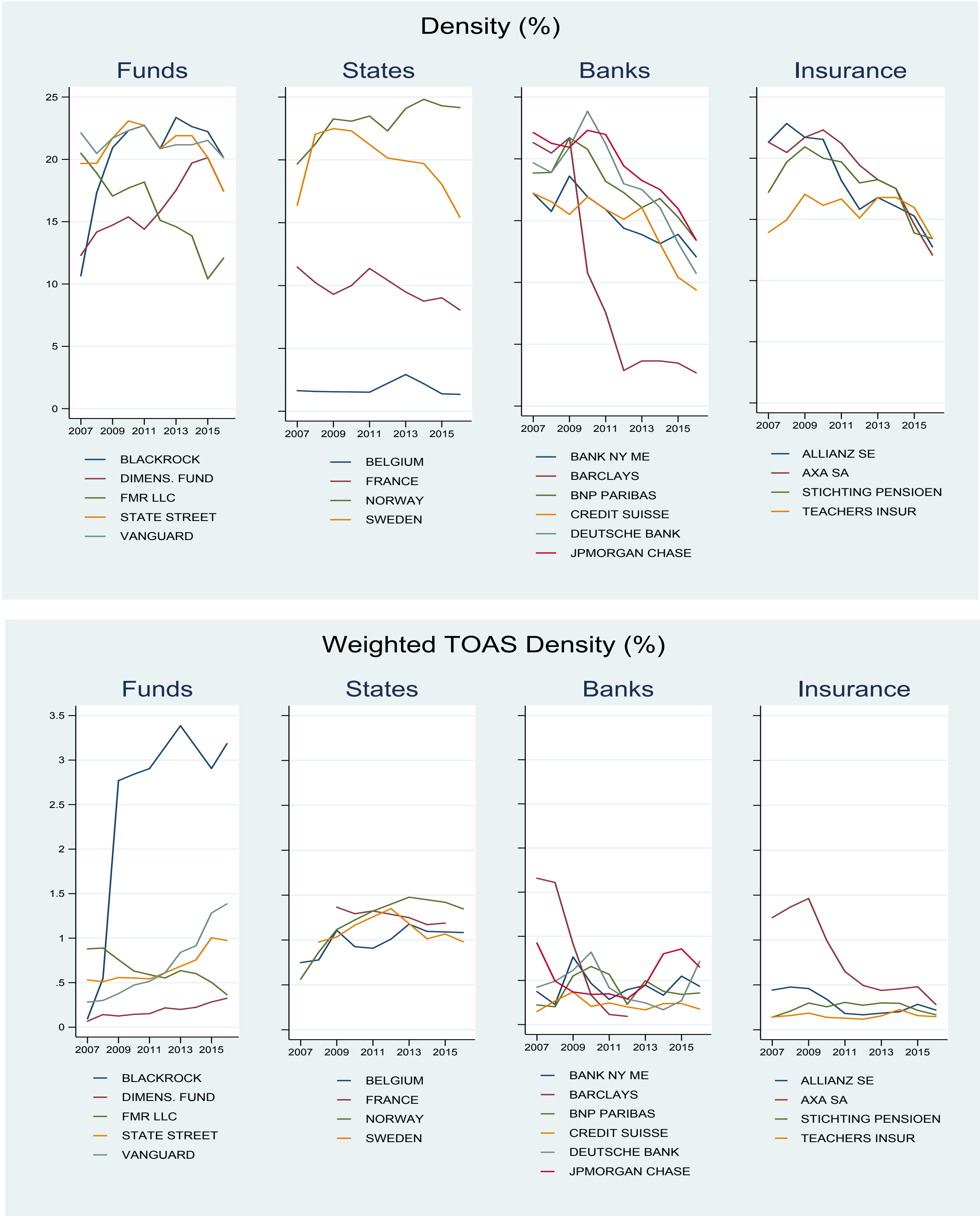
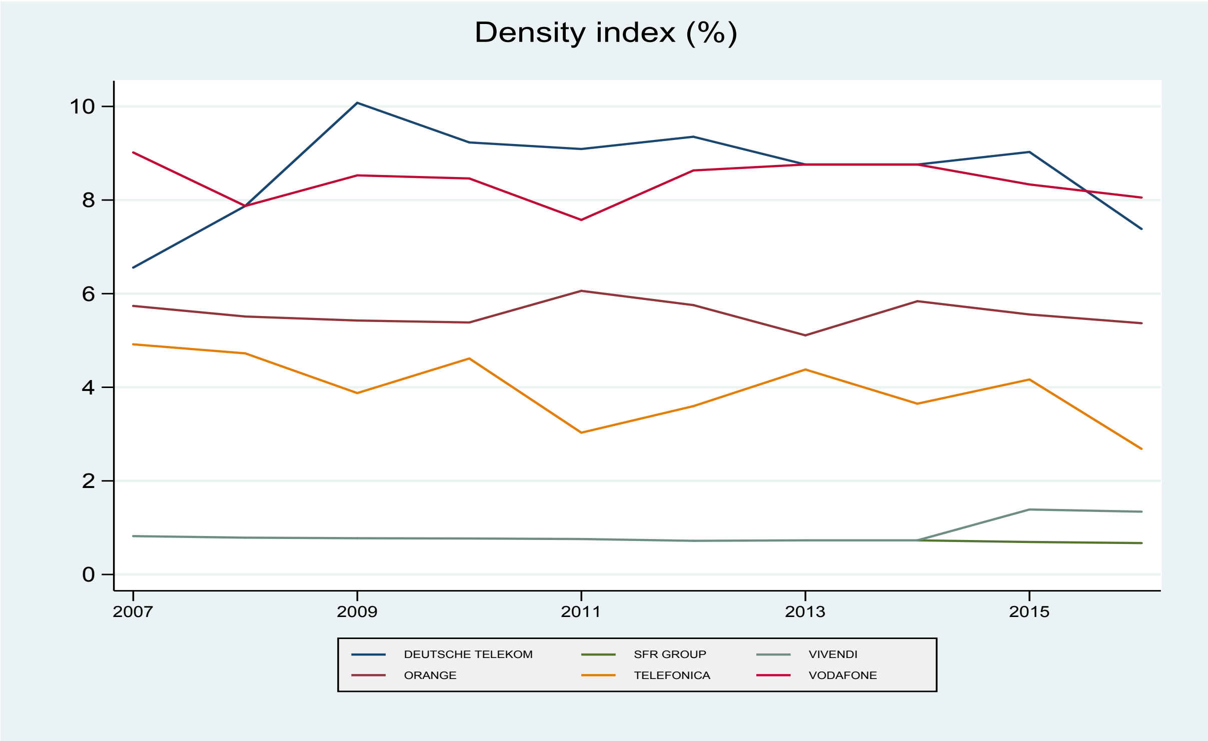
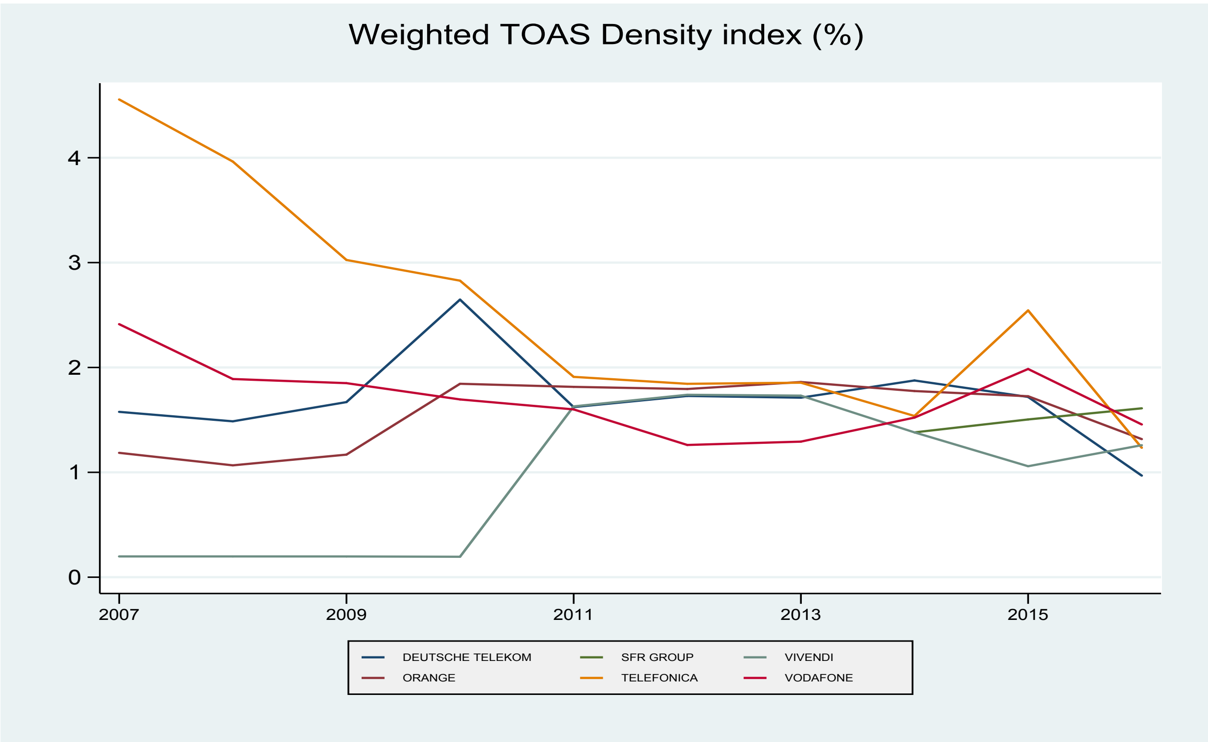


Figure 4.5: Common shareholding indices for Top Cross Investors in Mobile Telecoms sector. Top panel: Density - Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Bottom panel: Weighted TOAS density - Proportion of total assets of the market held by shareholder through participation shares.





Network indices

The Mobile Telecoms industry shows stronger interconnections between actors of the same type, comparable to the values observed in the Oil&Gas sector, evidently higher than the cases of Electricity or Trading Platforms. The results on shareholders' and firms' networks are reported in Tables 4.27 and 4.28, respectively.

The proportion of portfolios that are linked through commonly held firms has been increasing over time, from about 2.82% to 3.15%. On the other hand, among the large connected portfolios (density>10%) the links are weaker with respect to the previous definition of the sector, with about 1.99% of these owners showing a correlation of 80% or higher in 2106.

The firms' network is also highly interconnected through block-holders, with about 2.75% of active links in 2016, and of which about half present a high correlation of more than 80%. This very high fraction of highly-correlated ownership structures is likely the result of the presence of clusters of firms belonging to the large Telecoms groups, which are almost all wholly owned or at least controlled by the parent, showing therefore very similar shareholders' structures.

Table 4.27: Network indices for Mobile Telecoms sector. Shareholders' network. Total number of common shareholders; proportion of non-zero correlations between pairs of portfolios, i.e. proportion of connections between two shareholders induced by common shareholding of a same firm; number of high correlations (>80%) between pairs of high-density portfolios (both densities >10%); proportion of high correlations between pairs of high-density portfolios.

Year	Tot No. Comm SH	Prop Non-Zero Correlations	No. High Corr. High Dens.	Prop. High Corr. High Dens.
2007	324	2.82	16	1.25
2008	347	3.41	12	0.78
2009	367	3.29	12	0.98
2010	363	3.22	3	0.33
2011	360	3.83	6	0.70
2012	352	3.69	8	1.72
2013	365	3.41	2	0.53
2014	347	3.34	6	1.85
2015	358	3.27	11	3.13
2016	363	3.15	7	1.99

Table 4.28: Network indices for Mobile Telecoms sector. Firms' network. Total number of firms cross-held by block-holders (holding at least 5%); proportion of non-zero correlations between shareholders' structures of pairs of firms (only shares >5%); number of high correlations between shareholders' structures of pairs of firms (only shares >5%); proportion of high correlations (>80%) among the non-zero correlations.

Year	Tot. No. Firms Cross-Held	Prop Non-Zero Correlations	No. of High Correlations	Prop. of High Correlations
2007	92	2.76	99	48.53
2008	96	2.99	124	51.88
2009	98	3.19	129	49.05
2010	99	3.05	124	48.44
2011	99	2.96	117	45.70
2012	103	3.04	142	48.63
2013	108	2.82	134	50.95
2014	105	2.79	111	42.69
2015	112	2.82	118	40.69
2016	122	2.75	142	46.86

4.5 Beverages sector - Manufacturers

The focus is on the manufacture of beverages, rather than their wholesale, although some of the companies considered perform both types of activities. Only certain types of products were included, namely Soft Drinks, Waters, Juices and Beers.

The set of firms active in the sector was delineated according to two steps. First, a selection was made based on specific NACE codes of industry classification for beverages manufacturing: "Manufacture of beer", "Manufacture of soft drinks; production of mineral waters and other bottled waters", and "Manufacture of fruit and vegetable juice". All listed firms active in the EU which presented at least one of the above classifications as primary or secondary activity were included in the sample.

Following this initial selection, a number of unlisted relevant players was added based on the expert opinion of colleagues from DG COMP, representing unlisted companies with significant market share or presence in European countries. All-together, we obtain a list of 290 firms, of which 214 are listed manufacturers of Soft Drinks and/or Waters, Beer or Juices. The remaining 76 firms are the relevant unlisted players. The sector's Total Assets in 2016 were worth 1309 Bn Euro, while the Market Capitalisation totaled 1352 Bn Euro.

Roughly two-thirds of the firms are registered in the EU (69.15%), with Germany accounting for about 20%, then followed by France and United Kingdom at around 5%. Outside, the US is the largest country represented, with 8.81% of firms in the sample registered there.

As shown in Table 4.29, the majority of companies (69%) classify their core activity in the Nace Division "11: Manufacture of Beverages", divided evenly between codes "1105: Manufacture of beer" (33%) and "1107: Manufacture of soft drinks; production of mineral waters" (32%); a smaller percentage (4%) are occupied in "1102: Manufacture of wine from grape".

Table 4.29: Main areas of activity of firms active in the EU in the Beverages sector in 2007-2016: Core Nace code, description of area of activity, and percentage of firms presenting such Core code.

Core Nace	Description	% firms
1105	Manufacture of beer	33
1107	Manufacture of soft drinks; production of mineral waters	32
1102	Manufacture of wine from grape	4
1089	Manufacture of other food products n.e.c.	3
1032	Manufacture of fruit and vegetable juice	2
4634	Wholesale of beverages	3
	Other (mainly: Distilling, rectifying and blending of spirits, Other processing and preserving of fruit and vegetables, Activities of head offices)	23

Products such as fruit juices were also included in the sample, but they comprise a significantly smaller portion of the sector, just 5% between codes 1089 and 1032. Instead 26% of firms are scattered across a series of different but related activities under their core Nace, such as wholesale or distillation.

In terms of shareholder structure of the industry, some summary data is reported in Table 4.30. The number of firms in this industry has been increasing slightly, from 241 in 2007 to 261 in 2016. Similarly, the number of shareholders has been steadily increasing, albeit not drastically, over the same period. The initial proportion of common vs single shareholders, although slightly declining, has not changed much throughout the period (28% and 72% vs 26% and 74% roughly). A similar pattern can be observed when considering block-holdings of 5%, where the number (and proportion) of firms cross-held by a block-holder has remained rather stable, just below 45% throughout most of the period. These levels are slightly below the EU average observed for other sectors.

Table 4.30: Summary statistics for firms active in the EU in the Beverages sector between 2007 and 2016: number of firms; number and percentage of firms cross-held by block-holders (BH) at minimum 5%; total number of shareholders; number and percentage of common shareholders (i.e. shareholders with more than one firm in their portfolio); number and percentage of single owners (holding shares only of one firm).

Year	Number Firms	Number (%) Firms Cross-held by BH	Number of SH	Number (%) Common SH	Number (%) Single SH
2007	241	104 (43.15)	1,902	533 (28.02)	1,369 (71.98)
2008	245	113 (46.12)	1,874	563 (30.04)	1,311 (69.96)
2009	250	113 (45.20)	1,987	607 (30.55)	1,380 (69.45)
2010	257	113 (43.97)	2,058	610 (29.64)	1,448 (70.36)
2011	259	111 (42.86)	2,073	572 (27.59)	1,501 (72.41)
2012	259	111 (42.86)	2,035	574 (28.21)	1,461 (71.79)
2013	263	116 (44.11)	2,096	580 (27.67)	1,516 (72.33)
2014	264	115 (43.56)	2,079	567 (27.27)	1,512 (72.73)
2015	264	118 (44.70)	2,152	567 (26.35)	1,585 (73.65)
2016	261	118 (45.21)	2,152	561 (26.07)	1,591 (73.93)

Main players

Table 4.31 shows the main players in this sector, selected on the basis of their declared total assets (in billions of euros) in 2016, alongside some of the more relevant shareholders for the purpose of this exercise. As previously stated, about two-thirds of the firms in the sample are registered in the EU. Among these, the biggest of these firms, Anheuser-Busch InBev, is almost four times as big as its next largest competitor. The top 'international' competitors on the other hand, are far more similar in size and typically also larger than their EU counterparts.

Table 4.31: Largest firms active in the EU in the Beverages sector, and selected ownership data on their main common shareholders. Top 15 largest enterprises registered in the EU and top 15 registered outside the EU, by country of registration. Size measured by Total Assets in 2016 (Bn Euros). Direct or indirect participation shares (%) held in 2016.

	Country	TOAS 2016 (Bn €)	BlackRock	Norway	State Street	Vanguard
Registered in the EU			Shares held in 2016 (%)			
ANHEUSER-BUSCH INBEV	BE	192.99	0.76	0.95	1.05	0.85
GRAND METROPOLITAN LTD (DIAGEO PLC)	UK	55.41	7.09	1.58	2.59	2.49
DANONE	FR	40.96	5.40	1.50	0.69	1.88
HEINEKEN NV	NL	39.32	0.89	0.80	0.20	0.81
UNILEVER NV	NL	38.14	2.98	1.72	0.66	1.98
COCA-COLA EUROPEAN PARTNERS PLC	UK	18.57	0.15	0.48	0.44	0.28
CADBURY LIMITED (MONDELEZ)	UK	12.05	5.76	0.99	4.23	5.94
GREENE KING PLC	UK	7.19	2.87	1.98	0.86	2.39
CARLSBERG A/S	DK	6.27	4.99	1.24	0.20	1.48
MARSTON'S PLC	UK	3.25	2.25	1.45	0.76	2.31
DAVIDE CAMPARI	IT	3.18	0.71	1.08	0.13	0.99
NESTLE WATERS (NESTLE S.A.)	FR	2.41	3.70	2.56	0.50	2.12
REFRESCO GROUP N.V.	NL	1.96	0.46	5.67		1.25
BRITVIC PLC	UK	1.90	5.01	2.66	1.02	2.20
JERONIMO MARTINS SGP	PT	1.43	2.41	1.02	0.14	0.85
Registered outside the EU			Shares held in 2016 (%)			
NESTLE S.A.	CH	122.94	3.70	2.56	0.50	2.12
THE COCA-COLA COMPANY	US	82.79	5.42	0.87	3.93	6.37
PEPSICO INC	US	69.72	5.53	0.94	4.36	1.43
MONDELEZ INTERNATIONATIONAL	US	58.38	5.76	0.99	4.23	5.94
QUINENCO S.A.	CL	52.32		0.18		
SWIRE PACIFIC LIMITED	HK	45.70	0.98	0.82	0.49	0.75
MOLSON COORS BREWING	US	27.84	4.96	0.50	3.47	7.24
FOMENTO ECONOMICO MEXICANO	MX	24.97	0.83	0.16		0.32
SAN MIGUEL CORPORATION	PH	24.89				
AMBEV SA (ANHEUSER-BUSCH INBEV)	BR	24.41	1.28	0.30	0.13	0.98
GENERAL MILLS INC	US	19.47	6.69	0.92	5.96	5.80
BEIJING ENTERPRISES	HK	17.70	2.22	0.31	0.15	1.31
KIRIN HOLDINGS	JP	13.71	4.90	1.13	0.54	1.87
DR PEPPER SNAPPLE GROUP INC	US	9.29	8.82	1.01	4.57	9.35
ASAHI GROUP HOLDINGS	JP	9.01	2.19	1.07	0.59	1.62

The last four columns show the participation of the shareholders considered most relevant in terms of common shareholding positions. BlackRock dominates this industry, with rather large shares in most of the top players, reaching up to 8.82%. The others lag behind, with relatively small participations. State Street in particular is a minor player for the observed year.

Density and uniformity

The summary statistics on the density-based and uniformity indicators are reported in Table 4.32. Across all reported quantiles, the share of firms held by investors is declining. Even though the top investor holds almost 25% of all firms in the sector, the remaining investors are trimming their portfolio density. This pattern is evident when looking at the top 1% of investors, which in 2007 held above 14% of firms in the sector; in 2016 this declined to 11.2%. While the distribution of investors portfolios is still skewed, this is less so when compared to other sectors analysed earlier, showing at first a more diversified shareholder network.

On the other hand, the uniformity index remains more or less stable throughout the period, with the average (around 10%) indicating that most shareholders are concentrated on few firms in their investment decisions. The years 2015 and 2016 show a slightly larger number of investors with non-reported shares (about 1.3% compared to less than 1% in the previous years), yielding a slightly larger proportion of single owners (with zero uniformity index). For this reason the values of the 75^{th} percentile drop in these two years.

In terms of value-based indices, there are some differences in level between TOAS and MKT CAP results due to the fact that some firms in the sample are not listed. The table shows that the top 1% of investors hold firms that represent at least between 53% and 60% of the Total Assets of the industry depending on the year (declining trend), while the top investor per year has held an increasing share of the Total Assets of the sector, up to 82% in 2016. Such values are in line with expectations on investor behaviour, since top investors tend to privilege the largest enterprises. However, when this index is weighted according to the participation share of investors, the trend inverts, and it can be seen how the largest investor holds a slightly decreasing share of weighted Total Assets. Given the results from the unweighted Total Assets density, it would seem that top investors, and other investors in general, are diluting their investment concentration among more firms.

A similar picture holds for listed firms, where the largest portfolios hold firms representing almost the industry's entire Market Capitalisation, and through their participations control about 4% of the market value. In 2016, the top value for the Total Asset index corresponds to Stichting Anheuser-Busch InBev, which holds a large direct participation in only one firm, Anheuser-Busch InBev, the largest player in the market; this single participation amounts to 5% of the market total assets.[8]

[8] This investor did not appear in Table 4.33, since it is not a common shareholder.

Table 4.32: Beverages sector common shareholding indices. Summary Statistics by year (percentage points, index values between 0 and 100): mean, 75th percentile (p75), 99th percentile (p99), maximum (max). Density: Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Uniformity: Relative weight of larger participation shares over the shares total in the portfolio. Small values denote concentrated investment. TOAS density: Proportion of total assets of the market represented by the firms in portfolio. Weighted TOAS density: Proportion of total assets of the market held by shareholder through participation shares. MKT CAP density: Proportion of market capitalisation of the market represented by the firms in portfolio. Weighted MKT CAP density: Proportion of market capitalisation of the market held by shareholder through participation shares.

Year	Density			
	mean	p75	p99	max
2007	1.1737	0.8299	13.6929	23.2365
2008	1.2223	0.8163	14.6939	24.4898
2009	1.1539	0.8000	14.0000	23.2000
2010	1.0830	0.7782	13.6187	23.3463
2011	1.0464	0.7722	12.3552	23.9382
2012	1.0538	0.7722	12.7413	24.3243
2013	1.0148	0.7605	12.1673	25.8555
2014	1.0014	0.7576	11.3636	24.2424
2015	0.9827	0.7576	11.7424	23.4848
2016	0.9673	0.7663	11.1111	23.7548

Year	Uniformity			
	mean	p75	p99	max
2007	11.6126	18.0240	80.08	87.47
2008	12.6035	23.8995	80.39	88.87
2009	12.3630	23.2265	80.05	88.79
2010	11.9174	21.4334	78.82	88.87
2011	11.1801	13.8747	78.27	87.38
2012	11.3974	15.7820	78.49	88.69
2013	11.2386	15.1230	77.83	89.63
2014	11.1712	14.9939	78.38	89.18
2015	10.6359	4.7023	77.66	89.71
2016	10.3846	0.0000	77.26	88.44

Year	TOAS density			
	mean	p75	p99	max
2007	3.3957	1.8235	54.2706	68.7580
2008	3.6018	1.6250	59.4013	76.0763
2009	3.3997	1.7581	59.6992	75.3183
2010	3.4720	1.4321	59.4506	77.1518
2011	3.5727	2.1656	57.6684	77.6810
2012	3.4596	2.0395	55.4596	81.4382
2013	3.4603	3.1643	55.0004	81.9081
2014	3.3045	1.2180	54.8999	81.8191
2015	3.2564	1.7686	53.0278	79.7791
2016	3.4460	1.9012	55.0029	81.7071

Year	Weighted TOAS density			
	mean	p75	p99	max
2007	0.0526	0.0123	0.9355	9.7332
2008	0.0472	0.0115	0.9804	7.5868
2009	0.0453	0.0104	1.0497	6.8132
2010	0.0426	0.0094	0.8014	5.9034
2011	0.0451	0.0121	1.1049	5.1856
2012	0.0469	0.0121	0.9054	5.4738
2013	0.0522	0.0130	1.0894	5.4275
2014	0.0464	0.0100	1.0640	5.2338
2015	0.0481	0.0112	1.0125	4.9468
2016	0.0448	0.0090	0.9203	5.0550

Year	MKT CAP density			
	mean	p75	p99	max
2007	4.5776	0.6308	79.1511	91.6880
2008	4.7761	0.6713	80.9224	92.8885
2009	4.5231	0.9838	84.2562	92.5605
2010	4.3595	0.8348	81.4195	93.1819
2011	4.5801	1.0658	81.8512	94.3082
2012	4.0444	0.9599	69.3285	87.0125
2013	4.2028	1.3411	73.1618	94.3178
2014	4.0458	0.8432	72.3251	92.3230
2015	4.3344	1.0635	69.9960	94.7139
2016	4.5102	1.2788	69.6414	96.1065

Year	Weighted MKT CAP density			
	mean	p75	p99	max
2007	0.0404	0.0040	0.6531	5.7154
2008	0.0366	0.0049	0.6580	4.4177
2009	0.0380	0.0057	0.6928	4.2223
2010	0.0365	0.0049	0.6492	3.3666
2011	0.0393	0.0085	0.6704	3.7131
2012	0.0410	0.0089	0.5933	7.4080
2013	0.0489	0.0099	0.8511	7.4582
2014	0.0392	0.0056	0.7480	4.4457
2015	0.0423	0.0079	0.7056	4.7110
2016	0.0401	0.0077	0.6559	4.3167

Common shareholding indices for top investors

The list of top common investors[9] presented in Table 4.33 ranks these shareholders based on their weighted Total Assets density for 2016, i.e. the share of total market TOAS held through the stakes of firms in their portfolios. It is immediately evident that the main investors are the sector-specific corporate groups with many controlled subsidiaries. Diageo Plc, L'Arche Green, and Anheuser-Busch InBev are just three of those large corporate groups responsible for well-known brands, such as the case of L'Arche Green and Heineken. In fact, the table hints at the heterogeneity within the Beverage sector, where those groups or firms involved in the production and/or distribution of alcoholic products are structured in a similar manner to what was seen in Telecoms, with large corporate groups and many cross-holdings. The other beverage producers instead tend to be defined as smaller enterprises with local markets and a limited shareholder structure.

Alongside these corporate groups, the large investment management funds are also present as main investors. As will be highlighted in greater detail in the following sections, BlackRock leads among these funds under every observed metric. In terms of weighted total asset density, BlackRock in 2016 accounted for 2.33% of the market's total assets, not far off from one of the leading corporate groups, Anheuser-Busch InBev with 2.92%. Vanguard and State Street enter into the ranks of top investors, but fall short of these values. Observing the portfolio composition of these investment management funds, there is evidence of an appetite for investment in larger corporate groups or holdings as opposed to individual or smaller producers: some of the biggest corporate groups such as Anheuser-Busch InBev appear alongside some of the bigger producers of beverages such as The Coca-Cola Company.

Finally, it should be noted that other financial institutions are missing from the ranks of top investors. Large banks or insurance companies do not appear, a trend which is repeated over different sectors and can be confirmed when looking at the time series for ownership indices across different investor classes. State participation is also missing, excluding the Norwegian sovereign fund which presents a portfolio similar in composition to that of the other large funds mentioned earlier, with investments in corporate groups such as Anheuser-Busch InBev or Nestle SA.

As a final comment, there are several comparisons that can be drawn between the top investors of this sector and that of Mobile Telecoms, when defined as Mobile Network Operators and Parents (see Section 4.4). In particular, cross-investing is prevalent in both these sectors.

The time trends of the common shareholding indices are reported for the usual four groups of shareholders' types (Funds, States, Banks and Insurance companies). Figure 4.6 reports the results for density and weighted TOAS density for the top investors.

[9] Only investors with more than one firm in portfolio are reported.

Table 4.33: Top Common Investors in Beverages sector: Investors with more than one firm in portfolio, whose portfolios present the top values of the Weighted TOAS density index in 2016. Country of shareholder (SH); number of firms held in MNO industry; Density (share of firms held); TOAS density (share of market TOAS represented by firms held); Weighted TOAS density (share of market TOAS held through participation shares); firms with largest TOAS in portfolio and respective quantity of shares held, ordered by decreasing TOAS. All figures refer to the year 2016.

SH Name	SH country	No. Firms Held	Density	TOAS density	W TOAS den.	Largest firms and shares held (%)
DIAGEO PLC	UK	3	1.15	4.28	4.25	GRAND METROPOLITAN LTD (100); EAST AFRICAN BREWERIES LTD (50.03)
L'ARCHE GREEN	NL	6	2.30	6.71	3.40	HEINEKEN HOLDING NV (51.71); HEINEKEN NV (50.01); SCOTTISH & NEWCASTLE (50.01); HEINEKEN ASIA PACIFIC (50.01)
ANHEUSER-BUSCH INBEV	BE	10	3.83	3.89	2.92	AMBEV SA (61.95); ABI SAB GROUP HOLDING (100); ANADOLU EFES BIRACIL (24); SUN INTERBREW PLC (99.95); BANKS HOLDINGS LTD (34.09); FOSTER'S GROUP (100); LÖWENBRÄU AG (100)
BLACKROCK	US	62	23.75	78.29	2.33	ANHEUSER-BUSCH INBEV (0.76); NESTLE S.A. (3.70); THE COCA-COLA COMPANY (5.42); PEPSICO INC (5.53); MONDELEZ INTERNATIONAL (5.76); SWIRE PACIFIC LTD (0.98); DANONE (5.4)
VANGUARD	US	59	22.61	78.06	1.86	ANHEUSER-BUSCH INBEV (0.85); NESTLE S.A. (2.12); THE COCA-COLA COMPANY (6.73); PEPSICO INC (1.43); MONDELEZ INTERNATIONAL (5.94); SWIRE PACIFIC LTD (0.75); DANONE (1.88)
FOMENTO ECONOMICO	MX	3	1.15	6.98	1.44	HEINEKEN HOLDING NV (14.94); HEINEKEN NV (12.53); COCA-COLA FEMSA SAB (63)
STATE STREET	US	44	16.86	72.04	1.21	ANHEUSER-BUSCH INBEV (1.05); NESTLE S.A. (0.50); THE COCA-COLA COMPANY (3.93); PEPSICO INC (4.36); MONDELEZ INTERNATIONAL (4.23); SWIRE PACIFIC LTD (0.49); DANONE (0.69)
CAPITAL GROUP	US	22	8.43	42.86	0.95	NESTLE S.A. (1.98); THE COCA-COLA COMPANY (5.51); PEPSICO INC (0.65); MONDELEZ INTERNATIONAL (1.65); DANONE (0.30); UNILEVER NV (0.61); AMBEV SA (0.12)
NORWAY	NO	58	22.22	81.71	0.89	ANHEUSER-BUSCH INBEV (0.95); NESTLE S.A. (2.56); THE COCA-COLA COMPANY (0.87); PEPSICO INC (0.94); MONDELEZ INTERNATIONAL (0.99); QUINENCO S.A. (0.18); SWIRE PACIFIC LTD (0.82)
FMR LLC	US	38	14.56	65.81	0.69	ANHEUSER-BUSCH INBEV (0.77); NESTLE S.A. (0.64); THE COCA-COLA COMPANY (1.57); PEPSICO INC (0.59); MONDELEZ INTERNATIONAL (1.38); QUINENCO S.A. (0.15); DANONE (0.15)

As previously noted in other sectors, Funds and States (only Norway in this case) remain relatively stable in the share of total firms held in their portfolios, while Banks and Insurance companies seem to be divesting in this sector. The largest portfolios in terms of undertakings invested in remains that of BlackRock, which peaked above 25%. Indeed, BlackRock has consistently appeared among the funds as the investor with the greatest reach. Even when considering the weighted Total Assets density, BlackRock is still considerably ahead of its competitors, holding more than 2.5% of weighted total assets from 2009 to 2016. Table 4.33 also confirms these findings. In terms of Total Assets, Banks and Insurance confirm a decline to levels well below BlackRock. The remaining Funds, such as Vanguard Group, are located at much lower levels for the entire period, finishing just above 2% but steadily increasing.

As mentioned previously, cross-investment - that is the participation of corporate groups or ultimate owners among each other - defines investment behaviour in this sector. Figure 4.7 therefore looks at the top cross-investors for this sector. When considering the proportion of firms that a top investor holds in its portfolio for the observed year, corporate groups such as Anheuser-Busch InBev (also known as AB InBev) and L'Arche Green - which control brands such as Becks and Heineken respectively - dominate the market with respect to competitors. In 2016, AB InBev boasts participations in almost 4% of total firms.

However, when considering a weighted measure of total assets controlled, there are new players in the market to consider, such as Diageo Plc, responsible for the production of alcoholic beverages, especially liquors and spirits (with Guinness, Baileys and Johnnie Walker among the main brands). While the Diageo group boasted almost 10% of weighted total assets at the beginning of the period, this value has been declining and converging towards values more in line with other top cross-investors. When considering weighted total assets density, these top cross-investors account for a greater share of the market with respect to funds or other financial institutions. For example, both AB InBev and Diageo Plc account for roughly 4% of weighted total assets in 2016, while BlackRock (the biggest of the funds) peaks at 2.5%. This is the result of a sector, as stated before, characterised on one end by large corporate groups with many subsidiaries.

Figure 4.6: Common shareholding indices for Top Investors in Beverages sector. Top panel: Density - Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Bottom panel: Weighted TOAS density - Proportion of total assets of the market held by shareholder through participation shares.

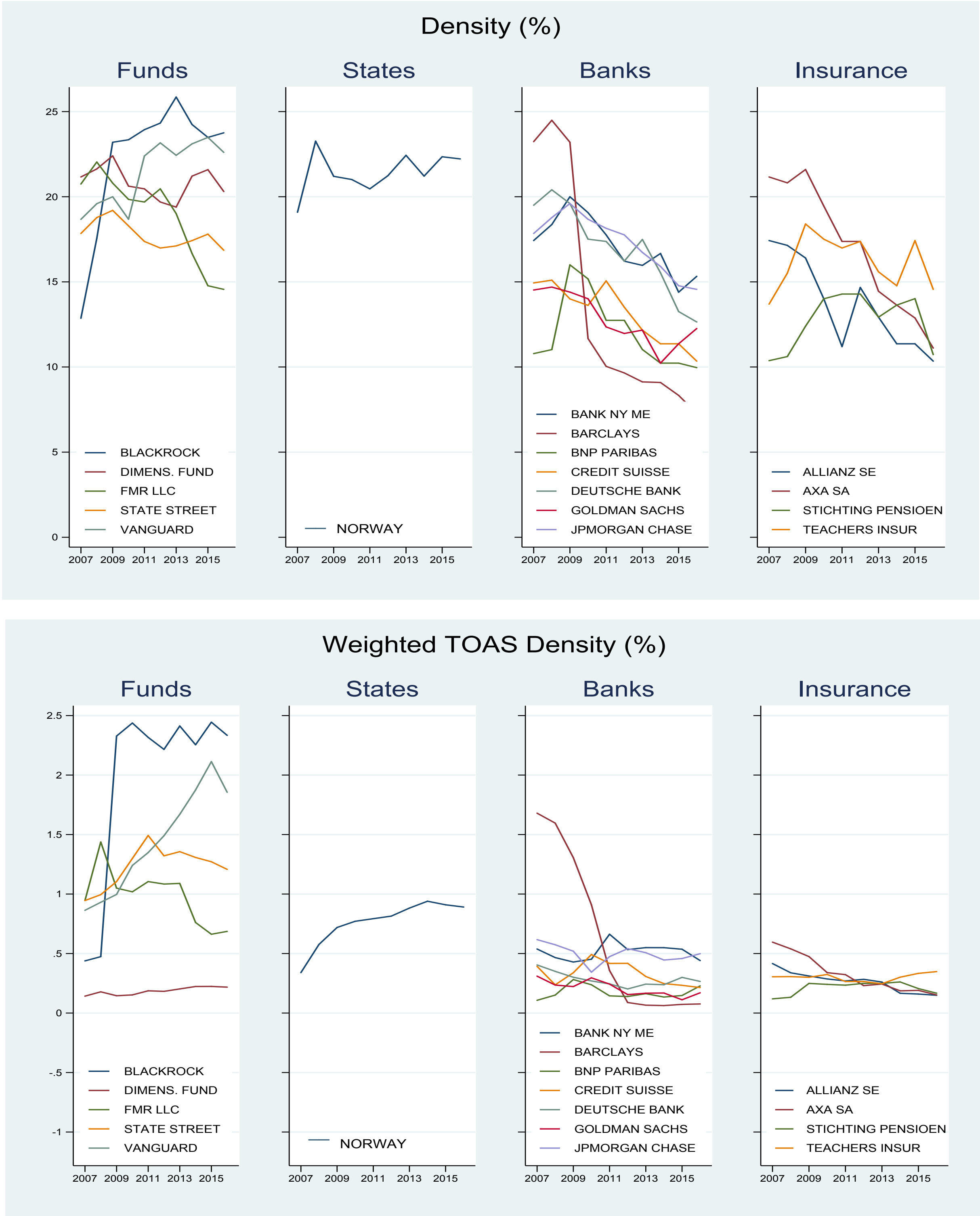
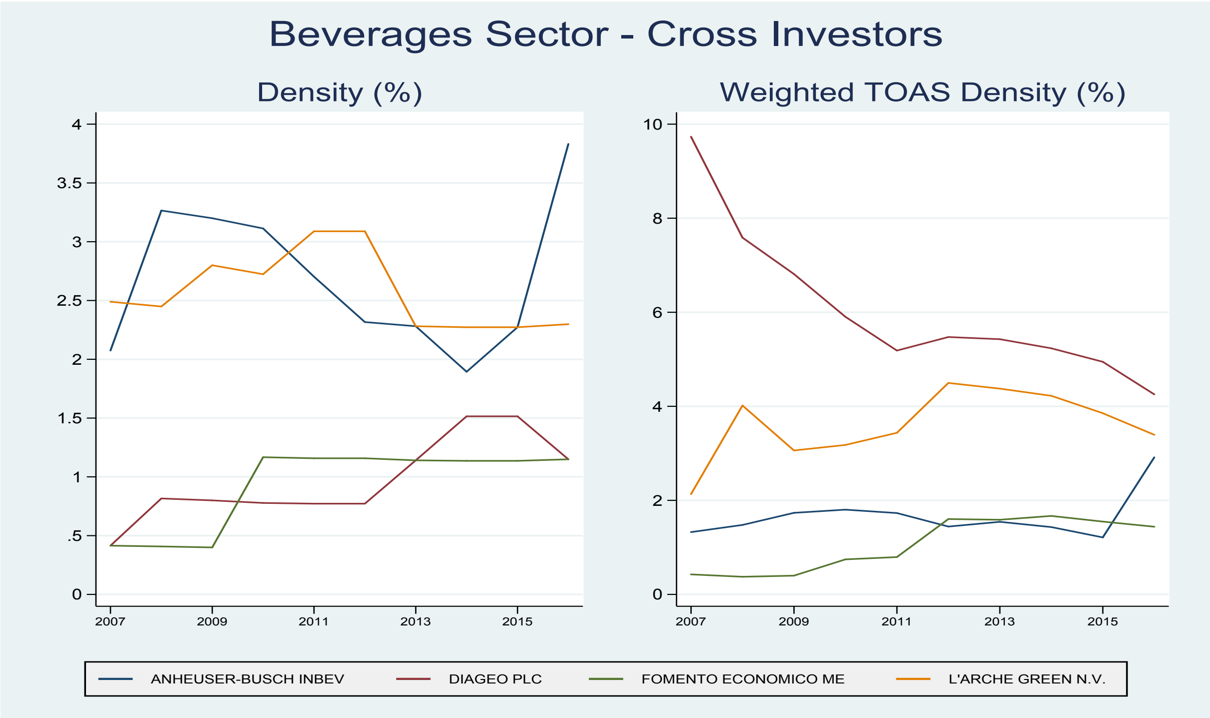


Figure 4.7: Common shareholding indices for Top Cross Investors in Beverages sector. Left panel: Density - Proportion of firms in a shareholder's portfolio relative to the total number of firms in the market. Right panel: Weighted TOAS density - Proportion of total assets of the market held by shareholder through participation shares.



Network indices

The summary statistics regarding shareholders' and firms' networks are presented in Tables 4.34 and 4.35, respectively. Several key details should be pointed out regarding these tables.

In the shareholders' network, only the largest portfolios are considered for the calculation of correlations, to avoid obtaining very high irrelevant values. For example, if we consider two coincident small portfolios, both holding the same amount of shares in two very small firms, their correlation would be maximum, but the two investors are not interesting players. Therefore, we look at correlations only for investors whose portfolios hold at least 10% of the firms active in the market.

Applying a similar reasoning, in the case of the firms' network a minimum value of 5% investment by the shareholder is used in calculating the correlations among shareholding structures of firms. Fundamentally, the attention is restricted only to those investors with more intensive presence in the firm, with block-holdings of minimum 5%. An analysis of alternative levels of block-holding is reported later in Chapter 5.

Due to the heterogeneity of firms, with large corporate groups mixed among smaller regional producers, the strength of the shareholders' network is less evident. For this reason as well, the proportion of portfolios that are linked through commonly held firms has been decreasing over time, from about 2.34% to 1.83%. On the other hand, among those high-density portfolios (density>10%), the number of high correlations between said portfolios is small and decreasing over time. This could be due to those corporate groups such as AB InBev with large portfolios consisting of fully controlled subsidiaries.

At the given level of block-holdings (5%), the firms' network is less interconnected in comparison to other sectors, with less than 1% of possible connections between shareholder structures presenting some correlation. In turn, the proportion of these correlations that could be considered high (>80%) was only 23.53% in 2016. The presence of many regional firms with niche markets in this sample helps explain some of these lower correlations in the networks, but equally the presence of corporate groups with large vertical investments results in weaker correlations across the shareholder structures.

Table 4.34: Network indices for Beverages sector. Shareholders' network. Total number of common shareholders; proportion of non-zero correlations between pairs of portfolios, i.e. proportion of connections between two shareholders induced by common shareholding of a same firm; number of high correlations (>80%) between pairs of high-density portfolios (both densities >10%); proportion of high correlations between pairs of high-density portfolios.

Year	Tot No. Comm SH	Prop Non-Zero Correlations	No. High Corr. High Dens.	Prop. High Corr. High Dens.
2007	552	2.34	4	0.63
2008	587	2.69	6	0.63
2009	627	2.57	5	0.58
2010	629	2.53	4	0.67
2011	590	2.48	4	0.92
2012	594	2.52	2	0.49
2013	599	2.38	1	0.26
2014	588	2.20	3	0.79
2015	590	1.95	2	0.36
2016	582	1.83	2	0.49

Table 4.35: Network indices for Beverages sector. Firms' network. Total number of firms cross-held by block-holders (holding at least 5%); proportion of non-zero correlations between shareholders' structures of pairs of firms (only shares >5%); number of high correlations between shareholders' structures of pairs of firms (only shares >5%); proportion of high correlations (>80%) among the non-zero correlations.

Year	Tot. No. Firms Cross-Held	Prop Non-Zero Correlations	No. of High Correlations	Prop. of High Correlations
2007	115	0.77	59	26.58
2008	124	0.69	74	35.75
2009	123	0.88	87	31.75
2010	123	0.86	78	27.56
2011	126	0.74	76	30.77
2012	128	0.85	72	25.35
2013	130	0.79	65	23.99
2014	125	0.71	68	27.53
2015	128	0.72	75	30.00
2016	129	0.80	64	23.53

Box 4.1: Focus on markets - Oil&Gas

- The Oil&Gas industry is composed of 153 distinct corporations active in the EU during the period 2007-2016, of which 73% are listed. Although most firms are active throughout the whole period of observation, some are active for a shorter period of time, either due to a later entry into the market or to an exit resulting from M&A, dissolution or other reasons. Therefore, the set of firms is not constant over time, oscillating between 125 and 139 firms per year (on average 134) during the ten years of observation. About 46% of the firms are registered outside the EU, almost half of which are in the US, followed by Canada and Australia, with yet a smaller proportion coming from China, Japan, Norway and Russia.

- The proportion of firms cross-held by block-holders is in line with the general picture of listed firms in the EU, i.e. rather stable at around 63%.

- The majority of investors (75%) in companies in the Oil&Gas sector only hold participation in 2 firms or less. This changes dramatically when looking at the largest portfolios, where the top 1% of common shareholders hold more than 38 firms on average ($\approx$ 28% of the market). All these figures remain rather stable over the ten years of observation. The maximum size of portfolios is very large, with portfolios encompassing 40% or more of the firms in the market being observed in every year. This figure has been increasing over time, reaching a peak of 45% in 2016, i.e. about 60 competing companies (out of the 135 composing the market).

- The largest (top 1%) common shareholders include participation in almost all relevant firms, representing more than 70% of the market value in terms of Total Assets (TOAS is roughly 3309 Bn Euro in 2016), and more than 85% of Market Capitalisation (roughly 1811 Bn Euro in 2016), on average over the ten years. The most comprehensive portfolio holds participations in firms which represent close to 90% of TOAS and almost 100% of MKT CAP, revealing that the largest investors hand-pick all the firms with the largest value in the market.

- Once we consider the percentage of shares actually owned by common shareholders, we find that 99% of portfolios hold less than 1% of the value of the market through their participation shares, both in terms of TOAS and of MKT CAP.

- However, top common shareholders BlackRock, Vanguard, State Street and Norway (short for the Norwegian Sovereign Fund) hold large amounts of market value within their grasp: in 2016 their shares in companies in portfolio amounted to about 12.88% of the TOAS (approximately 426 Bn Euro).

Cont. next page

Box 4.1 (cont.): Focus on markets - Oil&Gas

- In terms of shares, BlackRock dominates with investments in the largest EU-registered companies, with participated values up to 6.9% in 2016, generally much higher than the remaining three investors (Vanguard, State Street and Norway). In 2016, the firms participated in by BlackRock constituted roughly 90% of Total Assets of the Oil&Gas market (about 3309 Bn), with about 4.2% of TOAS also controlled by BlackRock through its participations.

- Among firms registered in the EU, State Street principally concentrates its investments in UK companies, with participations between 0.18% and 3.38% in 2016. However, it holds larger stakes in top US-based companies, such as Exxon and Chevron, with approximately 5-6% holdings. The companies in its portfolio represent 80.2% of the TOAS in the market, and State Street controls approximately 2.55% of the market TOAS.

- In the last year of observation (2016), Norway only holds minority stakes in EU-based firms (between 0.79% and 2.35%), but controls national Statoil with a participation of 67%, whilst also holding stakes in several US giants. Overall, this amounts to controlling about 2.72% of the TOAS, with firms in the portfolio representing 86% of the market value. Vanguard has small participations in EU firms (between 0.68% and 2.73%), and holds several larger stakes (around 7%) in top US-based Oil companies; it controls 3.42% of the TOAS of the Oil&Gas market.

- A peculiar case is the Russian Government, which holds almost 6% of the Total Assets of the market in 2016 via its subsidiaries Gazprom and Rosneft, but has little if no participations in other companies.

□

Box 4.2: Focus on markets - Electricity

- The Electricity sector includes 396 firms active in the EU, of which 39% are registered outside, mainly in the US, Canada, Switzerland and Russia. Most firms are listed (89%). In 2016, the selected firms totaled 3330 Bn Euro of Total Assets, while the listed firms had a Market Capitalisation of 864 Bn Euro.

- The number of active firms per year has been increasing steadily, going from 275 in 2007 to 353 in 2016, with an average of 325 firms per year. The Electricity sector is characterised by the strong presence of state-owned companies, with Sovereign Funds holding very large shares in their national providers - in many cases even being the majority owners - as in the case of France, China, Korea and Sweden.

- Although the absolute number of firms cross-held by block investors has been increasing since 2007, their proportion had decreased about 7 percentage points (from 62.5 in 2007 to 55.5 in 2016), given the rapid growth of the size of this industry. In 2016, the largest shareholders (top 1%) held more than 30 firms active in the market (corresponding to 9% of the total number of firms). The top portfolio had participations in 29% of the firms, approximately 100 companies.

- The top 1% of portfolios hold shares in firms whose value represents more than 30% of the market (in terms of Total Assets) and more than 42% in terms of Market Capitalisation. This is a much lower percentage than in the Oil&Gas sector, and is due to the larger number of firms active in the Electricity sector, and their steady increase over time (comparatively, in Oil&Gas the number of companies is less than half that observed in Electricity, and rather constant across time). The largest portfolio encompasses firms covering more than 66% of TOAS and roughly 93% of MKT CAP. The top portfolio holds about 7% of the market's Total Assets through its participation shares, and about 3.5% of Market Capitalisation.

- France plays a major role in this market, holding very large stakes in three of the top ten EU-based companies, and minor participations in some additional firms. Overall in 2016 the French Sovereign Fund controlled about 6.7% of the Total Assets of this market.

- China, mainly via its subsidiary CHINA HUADIAN, controls 3.23% of market TOAS in 2016.

- The usual US-based funds (BlackRock, State Street and Vanguard) are still present as top investors, but rather for the large number of firms in their portfolios (around one hundred for BlackRock and Vanguard), each held with minority shares. Altogether, they control 5.57% of market TOAS in 2016.

- In 2016, Norway held minority stakes in 90 firms active in the market, controlling 1.13% of the market TOAS.

□

Box 4.3: Focus on markets - Trading Platforms for Financial Instruments

- This sector is defined by the companies that *operate* Trading Platforms. The selection of such operators led to the identification of 176 distinct firms active in the EU between 2007 and 2016 (increasing from 124 in 2007 to 159 in 2016), 89% of which are registered in one of the EU countries. Of the few operators registered outside, ten come from the US, six from Norway, two from Canada and two from Switzerland. Of the set of 176 firms that operate Trading Platforms in the EU, the largest are banks or financial intermediaries devoted to auxiliary financial activities. Only 27% of the operators are listed.

- The Trading Platforms sector has some peculiarities that should be highlighted. The set of firms operating the Trading Platforms is rather heterogeneous, both in terms of area of activity, but equally in terms of Total Assets and Market Capitalisation. For example, the Total Assets of a bank are incomparably higher than those of a stock exchange, and even more so than those of a digital platform or technology firm. On the other hand, even companies with few assets can have a large Market Cap, even if the amount of listed firms in the identified set of operators is minor. Many of the companies active in this sector are controlled by large groups, thus presenting a very concentrated ownership structure with large participation shares in the hands of few - or even only one - investor.

- In 2016, about two thirds of the Trading Platforms operators have some shareholder in common with another operator, both with participations higher than 5%.

- The largest portfolio invests in 26.6% of the companies in the market in 2007; due to the increase in operators over time, the share of the largest portfolio declines to 21.38% by 2016, corresponding to about 34 firms. The average investor holds about 1.5% of the firms in the industry, i.e. about two companies. The top investors show a rather "democratic" investment behaviour, generally holding similar minority shares in most companies in their portfolio.

- Taking into account the Total Assets, there are no investors whose portfolio represents a very large share of the market value (11729 Bn Euro in 2016), in contrast to the other markets under analysis. In fact, firms cross-held by the largest common shareholders represent altogether at most around 30% of the market value.

- This market is characterised by the presence of highly intensive portfolios, for example large banking groups, which can control through their shares as much as 20% of the market value.

Cont. next page

Box 4.3 (cont.): Focus on markets - Trading Platforms for Financial Instruments

- The picture of top investors in the Trading Platforms industry is largely dominated by banks, while funds tend to drop to lower positions in the ranking of common shareholders. In 2016, the top common shareholder in terms of TOAS control is Barclays: through participations in only nine firms it controls 12.5% of the market TOAS. All other top investors in 2016 (except Barclays) are registered outside the EU.

- In 2016, the big funds tended to hold very similar portfolios in terms of firms held, but the level of participation varies. For example, BlackRock holds a large share (8.66%) in the London Stock Exchange, while State Street and Vanguard have about 3% each. On the other hand, State Street has a strong presence in the Spanish banks Santander (8.34%) and Banco Bilbao Vizcaya (10.87), while BlackRock holds about half of that and Vanguard even less (about 1% and 2% respectively).

- Overall, the size of the portfolios - in terms of number of firms held - does not differ much across top investors. Portfolios held by Sweden, Funds, Banks and Insurance companies include approximately 15% to 20% of the firms active in this market, while Norway displays a consistently higher value, of above 20%, holding the largest portfolio in 2016 (34 firms).

□

Box 4.4: Focus on markets - Mobile Telecoms: MNOs and their parents

- Overall, in 2007-2016 we identified 105 Mobile Network Operators (MNOs) active in the EU, and an additional 72 controlling parent companies. The parents are either companies active in the telecoms industry, or holding/financial companies. They have been included in the set of firms defining this industry because: (i) they have a strong influence on the mobile market through their controlled subsidiaries and (ii) large investors often reach the subsidiaries active in this market indirectly through their parents. In adding the parents to the initial list of MNOs, we obtain a final list of 177 companies that represent all firms *active in* or *influencing* mobile telecoms in the EU during 2007-2016.
- The number of firms in this industry has been increasing slightly, going from 122 in 2007 to 149 in 2016. The large majority of the firms are registered in Europe (93%), mostly in Luxembourg (10%), followed by the Netherlands with about 8%. The sector is characterised by large groups mothered by telecom giants such as Vodafone, Orange or Deutsche Telecom, which have little if no overlap in their portfolios, and have more or less partitioned the set of firms active in this industry into independent domains.
- The proportion of common vs single owners has changed throughout the period of observation, with the initial proportion of roughly 25% vs 75% becoming roughly 30% vs 70%. The proportion of companies that share block-holders with competitors is increasing, growing from about 75% to 82% through the decade of observation.
- The ownership in the Mobile Telecoms industry at the end of the observation period in 2016 is concentrated in the hands of select individuals and associated holding groups, alongside large investment management firms such as Blackrock or Vanguard. These global shareholders hold significant investments in large pan-European telecom groups such as Vodafone and Orange, as well as in national providers. Together, these groups and providers compose almost the entirety of the European mobile telecoms market.
- In 2016, individuals such as Carlos Slim Helú (Mexico), Victor Li Tzar Kuoi (Hong Kong/China), and J. Malone (US) controlled - directly or indirectly - 3.26%, 3.09% and 2.01% of the Total Assets in the market, respectively (1236 Bn Euro).
- Besides individuals, BlackRock dominates this industry, with rather large shares in some of the top players (over 8% in Vodafone, almost 7% in BT GROUP PLC and about 6% in KONINKLIJKE KPN NV). Overall BlackRock controlled about 3.18% of Total Assets in 2016.
- Vanguard and Norway lag behind, with relatively small participations, while State Street plays only a minor role. France is also present, with a large participation in the French company Orange, but also some smaller shares in other top competitors. This industry is also characterised by cross-ownership of the companies in the market, with Vodafone, Orange and Telefonica appearing among the top common shareholders.

□

Box 4.5: Focus on markets - Beverages Manufacturers

- The focus is on the *manufacture* of beverages, rather than their wholesale, although some of the companies considered conduct both types of activity. Only some types of products were included, namely Soft Drinks, Waters, Juices and Beers.

- Altogether, we identified 290 distinct firms active in the EU in the manufacturing of Soft Drinks and/or Waters, Beer or Juices, over the period 2007-2016. Of these, 214 are listed and the remaining are the relevant unlisted players (76 firms).

- In this industry, the number of firms has been increasing slightly, going from 241 in 2007 to 261 in 2016. Roughly two-thirds of the firms are registered in the EU (69.15%), with Germany accounting for about 20%, followed by France and the United Kingdom at around 5%. Outside, the US is the largest country represented, with 8.81% of firms in the sample registered there.

- The Beverages market is rather heterogeneous, with a set of large firms are involved in the production and/or distribution of alcoholic products structured in a similar manner to what was seen in Telecoms, with large corporate groups and many cross-holdings. Comparatively, the other beverage producers tend to be smaller enterprises with local markets and a limited shareholder structure.

- The initial proportion of common vs single shareholders, although slightly declining, has not changed much throughout the period (28% and 72% in 2007 vs 26% and 74% roughly in 2016). A similar pattern can be observed when considering block-holdings of 5%, where the number (and proportion) of firms cross-held by a block-holder has remained rather stable, just below 45% throughout most of the period. These levels are slightly below the EU average observed for other sectors.

- The top 1% of investors in 2007 held more than 14% of firms in the sector; by 2016 this number declined to 11.2%. These investors hold firms that represent between 53% and 60% of the Total Assets of the industry, depending on the year (declining trend). The top common shareholder has invested in companies representing up to 82% of the TOAS of the sector in 2016 (1309 Bn Euro). Such values are in line with expectations, since the top investors tend to privilege the largest enterprises. However, when this index is weighted according to the participation share of investors, the trend inverts, demonstrating that the largest investor holds a slightly decreasing share of weighted Total Assets. It would seem that top investors (but this holds for other investors in general) are diluting their investment concentration among more firms.

Cont. next page

Box 4.5 (cont.): Focus on markets - Beverages Manufacturers

- Cross-investment - that is, the participation of corporate groups or ultimate owners among each other - defines investment behavior in this sector. The first three common shareholders in terms of weighted total assets in the beverages are also part of the market: DIAGEO PLC (UK) with 4.25% of the market TOAS, L'ARCHE GREEN (NL) with 3.40% and ANHEUSER-BUSCH INBEV (BE) with 2.92%.

- BlackRock is the first common shareholder external to the market, with rather large shares in most of the top players, reaching up to 8.82% shares in a single firm. Overall BlackRock's portfolio accounted for 2.33% of the market's total assets in 2016. Vanguard and State Street lag behind, with relatively small participations. State Street in particular is a minor player for the observed year. The portfolio composition of these investment management funds would indicate evidence of an appetite for investment in larger corporate groups or holdings, as opposed to individual or smaller producers: some of the biggest corporate groups such as Anheuser-Busch InBev appear alongside some of the bigger producers of beverages such as The Coca-Cola Company.

- Other financial institutions, such as large banks or insurance companies, are missing from the ranks of top common shareholders. State participation is also missing, with the exception of the Norwegian sovereign fund which presents a portfolio similar in composition to that of the other large funds.

□

Chapter 5

Block-holdings in Investors' Portfolios in the EU

An investor is defined as a block-holder of a firm if holding at least a certain percentage of the shares of the firm (block). The threshold defining the block is an indicator of the "intensity"[1] of the investment of the shareholder in a given firm. Kang et al. (2018) study the relationship between holding blocks in investors' portfolios and their monitoring effectiveness on firms held. Their results, based on US data, suggest that "*information advantages and governance experience obtained from multiple block-holdings are important channels through which institutions perform effective monitoring*". The authors also state that "*these results are particularly evident when institutions have multiple block-holdings in the same industry*". Using a threshold for ownership blocks at minimum 5%, they find that in 1993-2010 an institutional investor on average holds blocks in five competing firms.[2]

Such evidence is closely linked to the common shareholding debate; hence a careful consideration of block-holdings in investors' portfolios in the EU provides a more detailed picture of the phenomenon of common shareholding in Europe.

The EU-level analyses and the sectoral studies reported in the previous chapters presented some common shareholding indices with a threshold of block-holding of minimum 5%, to allow for comparison with existing literature. The same common shareholding indicators are re-calculated here, utilizing different levels of block-holdings, namely thresholds of 1, 3, 5, and 10 percent equity holdings by the investors. Moreover, some common shareholding indicators that were previously calculated over all holdings are proposed here in new versions, where only larger block-holdings are considered. Finally, new threshold-based measures of

[1] Throughout this report, we have often referred to the magnitude of an investment using the term "intensity", namely the level of shares held by an investor in a specific firm.

[2] Based on Thomson Reuters Institutional Holdings (13F) data.

common shareholding are presented, following some recent academic studies. The main features of the threshold-based common shareholding indices used for the sectoral analyses are briefly summarised in Chapter 2, Section 2.4.3, where the link with existing literature is also highlighted. More details on their interpretation and implications for the measurement of common shareholding will be provided during the presentation of the empirical results on the five industries.

The remainder of this Chapter is organised as follows: Section 5.1 presents the summary statistics on average holdings and block-holdings during 2007-2016 in the five industries under analysis. Section 5.2 presents the empirical results on the common shareholding threshold-based indices for firm-investor market relations, while Section 5.3 analyses links between agents in the two separate networks of firms and of shareholders. Section 5.4 looks at the dynamics of the portfolios of the ’Big three’ (BlackRock, State Street and Vanguard) over the period of observation, looking at average holdings and at the trends in block-holdings for different threshold levels. Not only is the total number of firms block-held in each industry analysed, but equally the proportion that they represent in terms of the overall portfolio of firms held in each market by such investors.

5.1 Outline of holdings in the five sectors

The identification of the Oil&Gas, Electricity, Trading Platforms, Telecoms and Beverages sectors has been discussed earlier.[3] However, one aspect should be underlined here: the Electricity sector is much larger than the remaining industries, both in terms of number of firms and number of investors. This difference should be taken into account when interpreting some of the empirical results, and will be recalled later, where appropriate.

Table 5.1 reports the summary statistics on the average participation shares per portfolio, by market, where the statistics are calculated on the portfolios of all investors present in each market. Such average holdings reflect the level of intensity of each portfolio in the markets.[4]

In all industries the median intensity is below 1% throughout 2007-2016, showing that more than half of investors hold portfolios of very little intensity, with average holdings of less than 1%. The mean portfolio holds about 5-6% shares on average in its firms; only Oil&Gas shows lower levels, while Telecoms stands on slightly higher values, given the strong presence of high-participation corporate groups.

[3] An overview can be found in the sectoral analyses of Chapter 4. Full details in Appendix C, where the main features of the five markets are recalled in Table C.1.

[4] We recall that a portfolio is defined by the set of firms where an investor holds shares in a specific market. The size of a portfolio reflects the number of included firms, while the intensity is determined by the amount of shares held in each firm.

Table 5.1: Average participation shares in investors' portfolios. All investors, by market and year.

Oil&Gas				
Year	mean	median	p90	p99
2007	2.66	0.52	2.57	62.05
2008	2.56	0.51	2.56	60.00
2009	2.66	0.51	2.56	63.05
2010	2.50	0.49	2.36	59.45
2011	2.46	0.47	2.34	59.45
2012	2.60	0.50	2.56	62.05
2013	2.66	0.51	2.56	67.49
2014	2.57	0.51	2.56	66.13
2015	2.68	0.52	3.01	69.70
2016	2.67	0.51	2.89	70.01

Electricity				
Year	mean	median	p90	p99
2007	3.97	0.70	5.67	78.85
2008	3.97	0.70	5.65	77.95
2009	4.26	0.70	5.98	77.95
2010	4.43	0.70	6.29	78.65
2011	4.70	0.70	7.23	80.52
2012	5.29	0.76	10.90	82.57
2013	5.41	0.74	10.47	87.91
2014	5.15	0.76	9.89	87.91
2015	5.17	0.76	9.89	89.38
2016	5.20	0.74	9.18	89.94

Trading Platforms				
Year	mean	median	p90	p99
2007	5.30	0.95	11.45	89.20
2008	5.47	0.84	11.59	91.00
2009	5.46	0.77	10.08	98.00
2010	5.63	0.81	10.49	98.00
2011	5.87	0.87	11.59	98.00
2012	6.16	0.90	11.59	98.25
2013	6.18	0.83	11.59	98.80
2014	6.51	0.89	11.59	99.43
2015	6.38	0.85	11.59	99.43
2016	6.57	0.89	11.74	99.43

Telecoms				
Year	mean	median	p90	p99
2007	6.21	0.51	4.99	100.00
2008	6.37	0.48	5.24	100.00
2009	6.44	0.50	5.32	100.00
2010	6.35	0.49	5.28	100.00
2011	7.16	0.52	7.79	100.00
2012	8.19	0.55	15.60	100.00
2013	8.09	0.54	14.72	100.00
2014	8.35	0.55	17.11	100.00
2015	8.85	0.54	24.81	100.00
2016	9.73	0.54	36.46	100.00

Beverages				
Year	mean	median	p90	p99
2007	4.67	0.64	5.01	96.14
2008	4.61	0.63	4.70	95.53
2009	4.85	0.65	5.01	96.95
2010	4.93	0.64	5.75	96.95
2011	5.09	0.65	5.99	97.21
2012	5.14	0.66	6.39	98.54
2013	5.41	0.67	7.05	99.53
2014	5.41	0.67	7.00	99.23
2015	5.51	0.67	7.23	99.33
2016	5.60	0.67	7.05	98.99

Looking at the 90th percentile, we still find that in most industries 90% of investors barely reach an investment intensity of 10% of average holdings (in Oil&Gas it is actually remarkably lower, with values around 3% average shareholdings). Overall this pattern is rather stable, except for the Telecoms sector, where we observe a sudden rise after 2012; the increase in investment intensity may be due to the upsurge in large corporate groups with large participations in their subsidiaries. Moreover, with the partial exception of the Oil&Gas sector, a clear trend emerges among shareholders to increase the intensity of investments in their portfolios. The distribution of average shares in this table reflects the usual composition of the shareholder structure: many small investors and few investors with larger participation.

All the distributions of (average) shareholdings are very skewed, and we observe at the top end some very intensive portfolios. Such top investors are normally linked to corporate groups, where the parent company controls or even wholly owns the respective subsidiaries. This pattern is consistent across sectors and throughout the period of observation. In some cases, such as the Telecoms sector, the presence of large corporate groups with many fully owned subsidiaries amplifies this. It is likely that other large average participations are investors with small but 'intensive' portfolios. This initial portrait demonstrates how, in reality, the majority of investors favour small shareholdings.

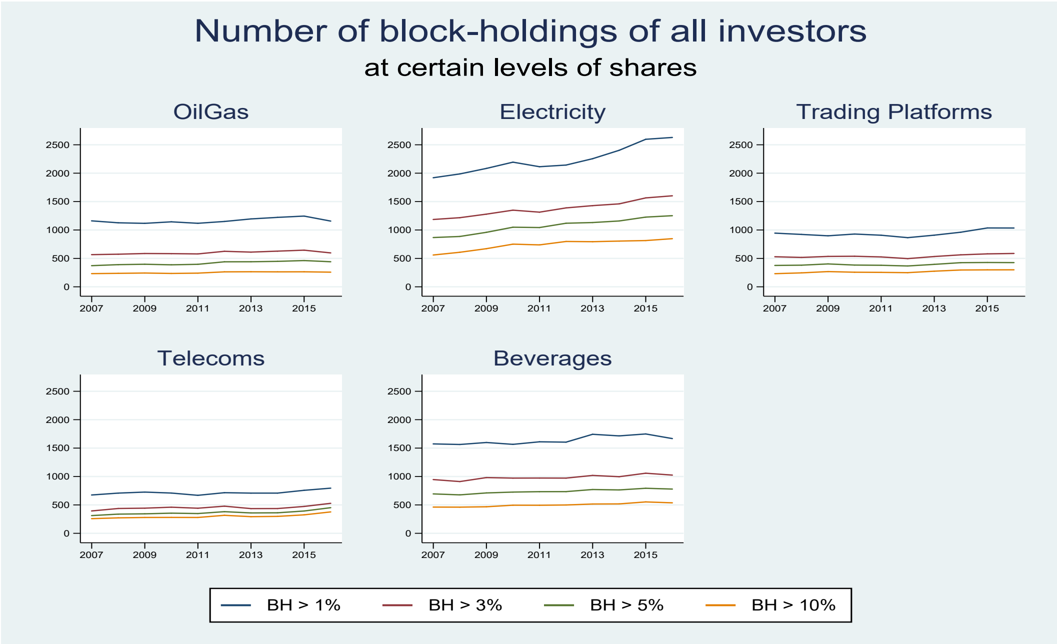
Figure 5.1 shows the block-holdings of all investors active in each market. The total number of block-holdings for all investors in an industry is an index of the intensity of investments among the sector's active firms. Given that the total number of firms is rather stable in all sectors, an increase in the number of block-holdings reveals either more intensive investment in each company, or an increase in the number of investors holding blocks of shares in the market.

The levels in the Electricity sector are higher due to the greater (and increasing) number of firms in the sample. Here the large differences in the indicators for the chosen thresholds suggest that the investments in this industry vary in intensity. For example, the number of block-holdings at 1% level are around double those for a 3% threshold, and about four times more than those at 10%.

In the Oil&Gas and Trading Platforms industries, although the number of active firms has been slightly increasing throughout 2007-2016, the overall number of block-holdings has remained rather stable over the years, for all levels of shares considered. Again, the intensity of investments varies, with about a 4:1 ratio of block-holdings at 1% vs. those at 10%, in both sectors.

Overall, the Telecoms sector shows lower numbers of block-holdings for small values of participation; there is also little variation across thresholds, indicating that in general the investments in this sector are rather intensive. The block-holdings at 1% are around double those of the 10% counterpart, confirming a much lower dispersion than in the other industries. Still, the 10% blocks are as numerous as in the other industries (except Electricity, for the reasons explained above).

Figure 5.1: Number of block-holdings for all investors at different thresholds.



Lastly, in the Beverages Manufacturers sector, the levels remain stable throughout the period in two respects: on the one hand, the number of firms remains relatively stable, and on the other hand, the intensity of the investment does not change significantly. In fact, the ratio between block-holdings at 1% and 10% remains almost the same from 2007 to 2016.

5.2 Effects of thresholds on firms-investors relations

The application of thresholds to the indices based on firm-investor relations limits the observation only to stronger links between the two groups of agents, therefore considering all low-intensity connections negligible.

The identification of the firms that are cross-held by a block-holder, i.e. where the investor has a high intensity of holding in both companies, was performed in previous analyses at a level of 5%. Here we extend it to lower levels of holdings, namely 1 and 3 percent.

Besides this indicator, we propose here an additional new index, measuring the weight of intensive investments of each shareholder's portfolio. This new index is a threshold-based version of the density of investments presented in the previous sectoral analyses, and represents the proportion of firms in a shareholder's portfolio that are block-held with a minimum amount of shares, relative to the total number of firms in the market. The index is presented for several block-holding thresholds, as well as for all the holdings, i.e. the original density index, for the sake of comparison.

5.2.1 Firms cross-held by block-holders

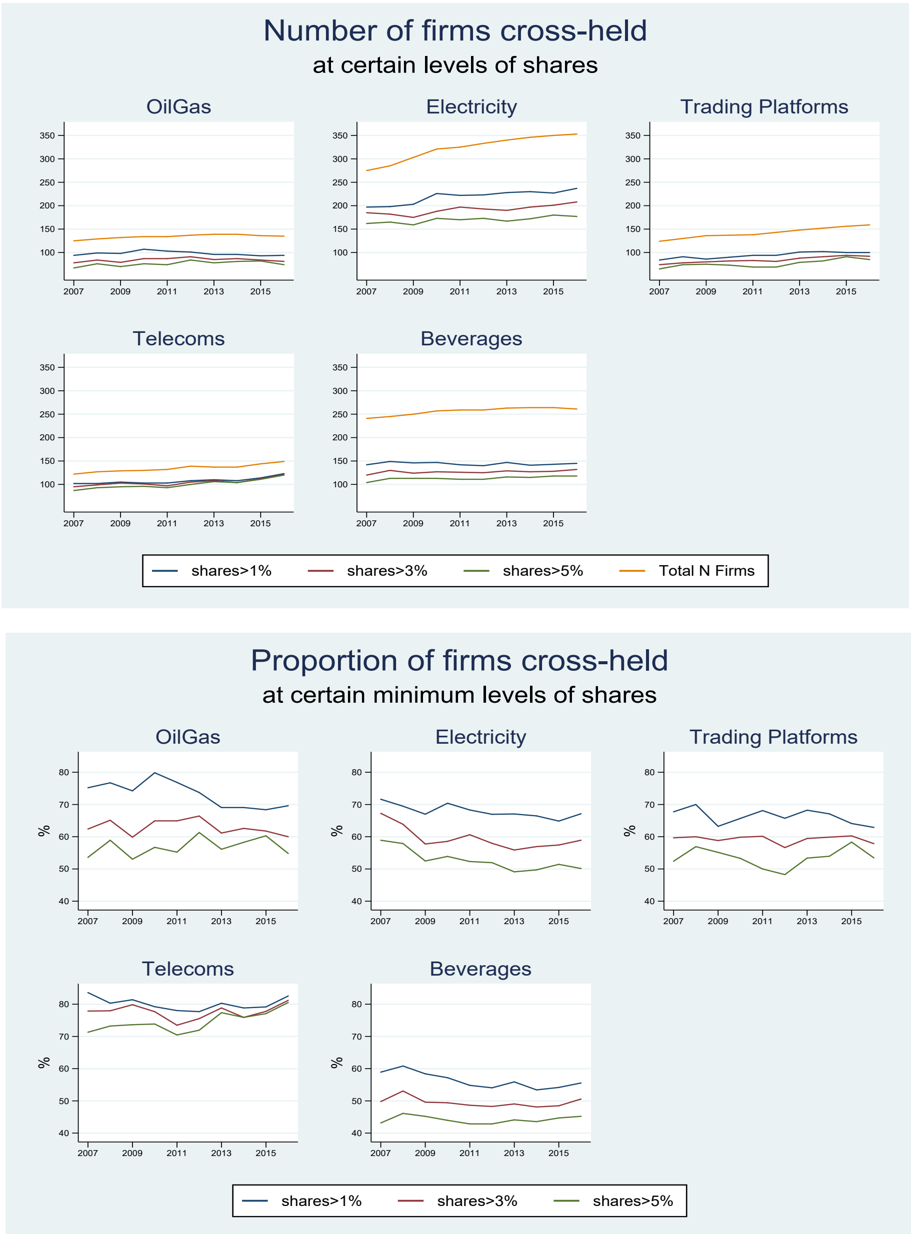
Figure 5.2 presents the results on the number and proportion of cross-held firms (CHF), for different levels of block-holding. In all sectors, the number of CHF remains very stable and similar across the different levels, over the whole period of observation. The slight exception is the Telecoms sector, where the presence of a few, large corporate groups with many subsidiaries drives up the proportion of CHF in the market. This can be seen both in the bottom (proportion of CHF) and in the top (number of CHF) panels, where the differential between the number of cross-held firms for different thresholds of block-holdings is minimal in Telecoms. The number of cross-held firms in this sector where the block-holder held minimum 1%, 3%, or 5% of equity in both firms was almost as high as the number of total CHF, indicating that cross-holders in this sector have much larger equity interests spread out among firms with respect to other sectors.

On the opposite side stands the case of the Electricity sector, where the ratio of the total number of firms to the number of CHF where the equity held is 5% or above is roughly 2:1. For example, in 2009 there were about 300 CHF in the sector, of which about 150 have common shareholders with shares of at least 5% in both firms. The large number of firms in this sector also helps to explain the greater number of CHF, but in terms of proportion the values are dropping over the period to levels closer to those seen in the other sectors. Similar results emerge for the Beverages Manufacturers sector. Indeed, considering all active firms - compared to those cross-held with shares greater than or equal to 5% - the ratio stands at about 2.5 times on average throughout the period. Compared to the results of threshold analysis for the other sectors, this difference is significantly larger than in sectors such as Oil&Gas or Telecoms, showing that in beverages there is a smaller proportion of cross-holdings at a high intensity of investment.

When looking at the proportion of firms cross-held by block-holders, the values are significant across the sectors. On average, more than 50% of firms in each sector are cross-held by one or more investor with shares greater than 5%. The proportion of cross-held firms reaches up to 80% when considering lower thresholds of equity investments. Nevertheless, the Beverages Manufacturers sector shows a slightly different performance from the average. In fact, for block-holdings of 5%, the proportion of CHF as a share of total active firms peaks at 45% in 2016, while for all other sectors this figure was steadily above 50% throughout the period of observation. Moreover, for block-holdings of 1%, the proportion is in decline, going from a high of 61% in 2008 to about 55% in 2016. This is an indication that the links existing between shareholder structures are likely constituted through smaller block-holdings than those used in the reference literature, and in general this is in line with the presence of clusters of firms represented by corporate groups with little or no interconnections.

Despite these slightly different levels, the overall trends are very similar in all sectors, showing a flat pattern over time, with a rather stable level throughout the period of observation.

Figure 5.2: Firms cross-held at different thresholds of block-holdings. Top panel: Total number of cross-held firms per year. Bottom panel: Proportion of firms cross-held by one or more investors, relative to total number of firms in each market.



5.2.2 Densities of block-holdings

The densities of block-holdings represent the proportion of companies in a shareholder's portfolio corresponding to a certain threshold of holding (no threshold, 1, 3, 5, 10 percent), relative to the total number of firms in the market, thus evaluating the market share of firms held with a certain intensity by a given shareholder. Figure 5.3 shows the results on the top 1% of more "intensive" portfolios (top panel), as well as the maximum value attained by the most intensive investor for the various thresholds (bottom panel).

Looking at the top 1% of portfolios holdings, across all sectors the proportion of block-holdings per portfolio is declining or stable over the period, irrespective of the threshold of equity investment considered. In general, portfolio densities are below 20% for all levels of investment, but the differential between non-threshold (all holdings) and threshold densities is large, suggesting that this cohort of investors concentrate their investments in a limited number of firms where they block-hold at larger values, the remainder of the portfolio presenting smaller participations. The exception is the Oil&Gas sector where, considering all equity investments held, portfolio densities reach noticeably higher levels, illustrating that investors with the largest portfolios spread out their investments across more firms, even with large intensities.

Observing instead the investors with the maximum values for portfolio density, the trends are slightly different. Here the maximum value refers to the portfolio holding the largest proportion of block-holdings in the market, relative to the total number of firms. This top portfolio represents the most 'intensive' investor in the market; for example, if we look at the 5% threshold (yellow line), we see in Oil&Gas that the top investor holds a minimum of 5% of shares in almost 20% of the market firms. The levels of density are clearly higher than in the top panel of Figure 5.3, but are also slightly increasing, particularly in Oil&Gas. In the other sectors values are not as high, with the top portfolio including between 5 and 10% of firms at a block-holding level of 5% shares. Across sectors the distribution of investors measured by the size of their portfolios is highly skewed, with a very small share of investors increasing their presence in the market. The same is applicable even when considering different thresholds for block-holdings. A case in point is the Telecoms sector, where the investor with the maximum (largest) portfolio density holds at least a 10% equity investment in close to 10% of the firms in the sample over the period. Still, what is common to all sectors is the flat pattern across the ten years, where the values for 2007 remain almost unchanged until 2016.

It should be noted that this 'top investor' described above is not necessarily the same across years or for different thresholds of block-holdings. Observing for example the Oil&Gas sector, the top - most "intensive" - investor holds shares equal to or above 10% for roughly 5% of the firms in the market (light blue line); this is likely to be a corporate group or a holding company with very sector-specific interests. Instead, the top investor who holds shares of 3% or above for about 20% of the firms in the market (green line) is likely to be a fund or investment group with a more diversified portfolio across the sector. For example, looking at the Beverages Manufacturers sector - as reported in Table 4.33 - funds such as BlackRock have a specific interest in larger corporate groups, but the top-scoring investor may vary across years. Other larger investors, such as Morgan Stanley or certain insurance groups, have smaller participations but have a greater presence across corporate groups as well as in smaller firms in the market, and thus might in turn overtake the top funds in specific periods in terms of block-holdings. Among those investors that have significant block-holdings (>10%) for a share of the firms in the sample, such as those represented by the light blue line, corporate groups with fully-owned subsidiaries are likely to fall below them.

In conclusion, taking into consideration the different levels of block-holdings, the density of portfolios has remained relatively stable throughout the period and across the sectors, following a decline with respect to initial values. Nevertheless, these figures confirm the presence of investors with large shares across a wide section of firms in the sectors.

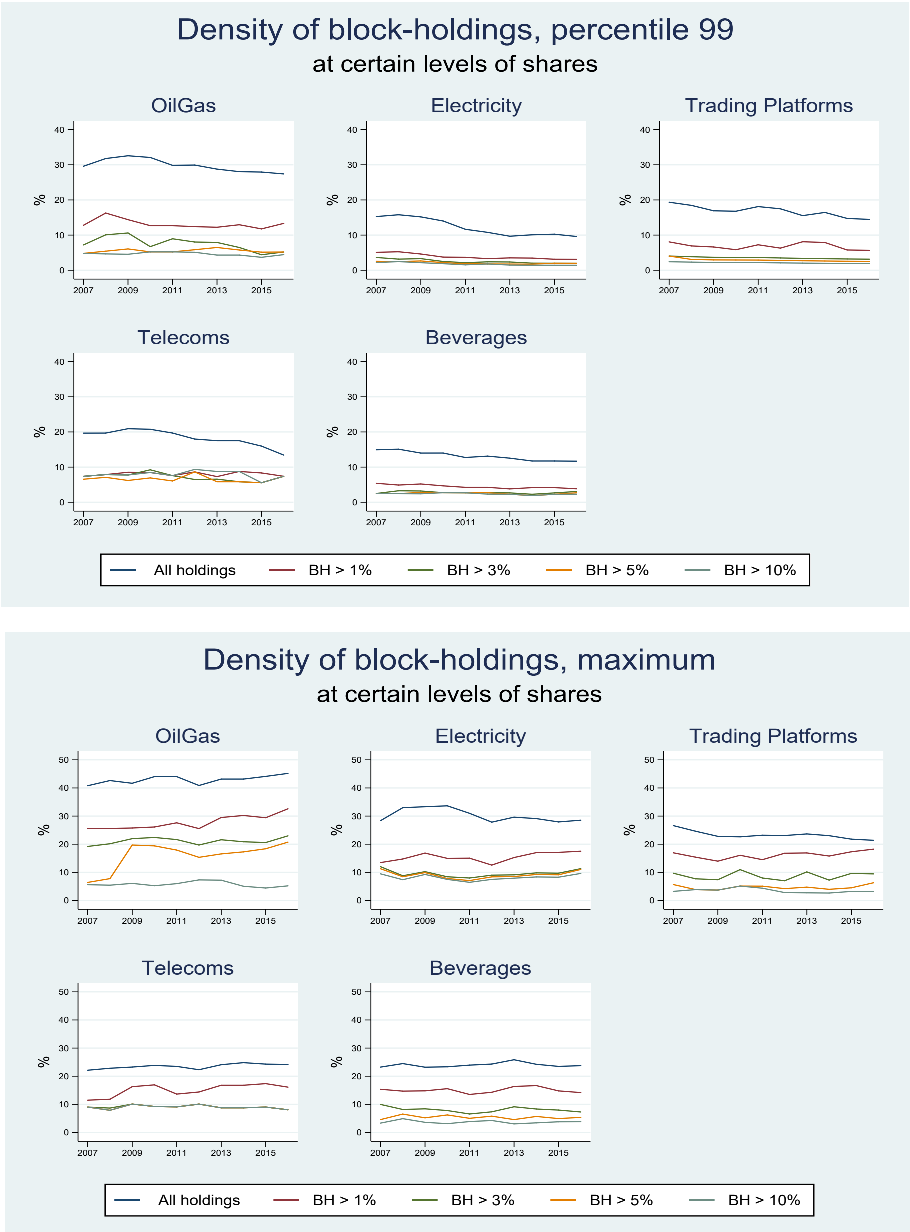
5.3 Thresholds in networks relations

The following sections revisit the shareholder and firms' network common shareholding indices used in the previous chapters, allowing for different thresholds of equity investments. The application of a threshold for block-holding has different effects in the two networks. In the firms' case, it limits the shareholding structure of each company only to the most intensive investments, i.e. only to the most "present" shareholders. On the other hand, in the investors' network the companies in each portfolio are restricted according to the respective holding intensity. This exercise substantially resizes the larger portfolios, which usually have a more dispersed holding structure, while smaller intensive portfolios become more relevant. This difference in the two networks' nature must be kept in mind throughout the analysis, in order to correctly interpret the results.

For each network, four indicators are presented: the number and proportion of links between each pair of agents in a network, assessing the extent of connectedness of each group; the total number of strong links, i.e. those presenting a correlation above 80%; and finally the proportion of strong links over the total number of existing connections, assessing the strength of the network's cohesion.

In the case of the firms, the four indicators replicate those used in previous sectoral analyses with a 5% threshold, adding two further block-holding levels; this allows for different selections of investors to be considered for the analysis of similarities between firms' shareholder structures. In the case of the shareholders' network, all indices are new, in the sense that they have never previously been calculated using a threshold, but rather considering all holdings in each portfolio. Here only the largest holdings of an investor are retained for each threshold instead.

Figure 5.3: Summary statistics of portfolio density; proportion of block-held firms in a shareholder's portfolio relative to the total number of firms in the market, considering different thresholds for block-holdings. Top panel: 99th percentile (top 1% of investors). Bottom panel: maximum value (top investor).



Another important difference with respect to previous sectoral studies is that the analysis of high correlations between portfolios is now extended to all pairs of portfolios, and not only to larger ones. Previous analyses only considered portfolios encompassing at least 10% of the firms in each market, to avoid picking cases of non-relevant high correlations. For example, two very small portfolios with very low participations in a limited number of coinciding firms would present a very high correlation, given their strong similarity, but in reality do not represent relevant investors in the market. Once we apply minimum thresholds for the holdings, this is no longer a concern, because low-intensity investments are automatically dropped and there is no need to restrict them further. Therefore, in the present analysis for the shareholders' network we keep all portfolios for all levels of block-holdings, so that the reference pool of portfolios is constant throughout the calculations.

In order to allow for a clear interpretation of the effects of a change in thresholds, four reference values are initially calculated on all holdings and held fixed as the thresholds are moved: the total number of firms per sector/year, representing the size of the firms' network; the total number of investors per sector/year, representing the size of the shareholders' network; the number of firms in a shareholders' portfolio, representing the shareholder-firm connections that generate overlaps between investors; and finally the number of shareholders in a firm's ownership structure, generating connections with other firms in the market.

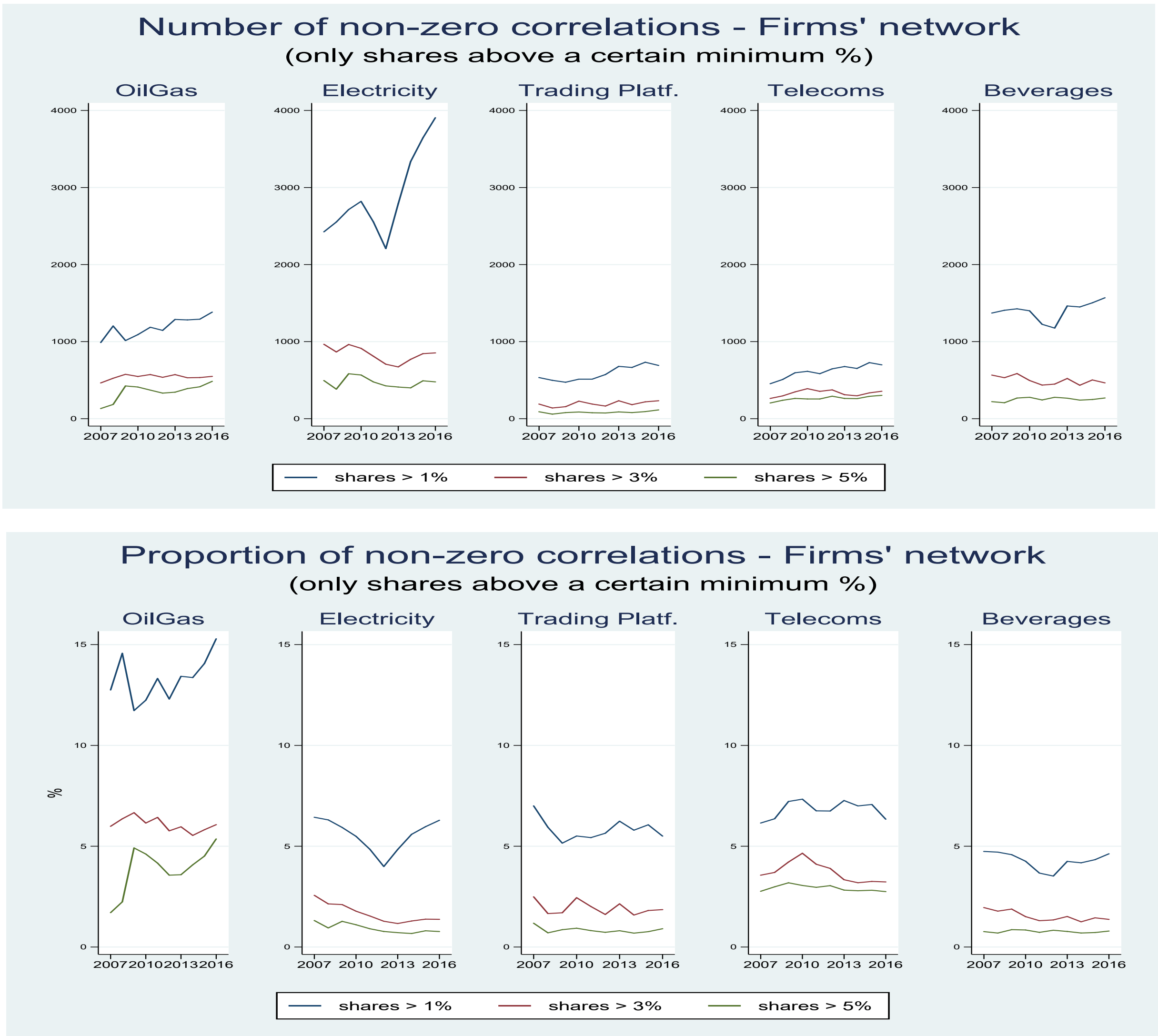
5.3.1 Network indices for firms

The firms' network reveals the correlations between the ownership structures of the firms in a sector. Figures 5.4 and 5.5 display these correlations across the period for all five sectors, looking both at non-zero and only high correlations. Non-zero total correlations represents the overall degree of connectedness of the firms by their shareholders in the given market. High correlations instead represent correlations of 80% or above between the ownership structures of firms, only considering shareholders with shares above 1, 3, or 5 percent. This sheds light upon the most connected firms in each sector. Since in previous calculations of the firms' network only shareholders with block-holdings of 5% minimum were used, this study expands on this by considering values of 1% and 3% as alternative thresholds.

Observing the number of non-zero correlations in the top panel of Figure 5.4, the results show that the total overlaps between firms' shareholder structures remain relatively stable over the period across sectors (except Electricity at 1%), with only slightly increasing trends. In the case of the Oil&Gas sector, the overall degree of connectedness among firms remains generally higher than other sectors; in this industry, the share of non-zero correlations over total correlations stays consistently above 12% (see bottom panel of Figure 5.4), highlighting that there are numerous links between firms induced by common shareholders.

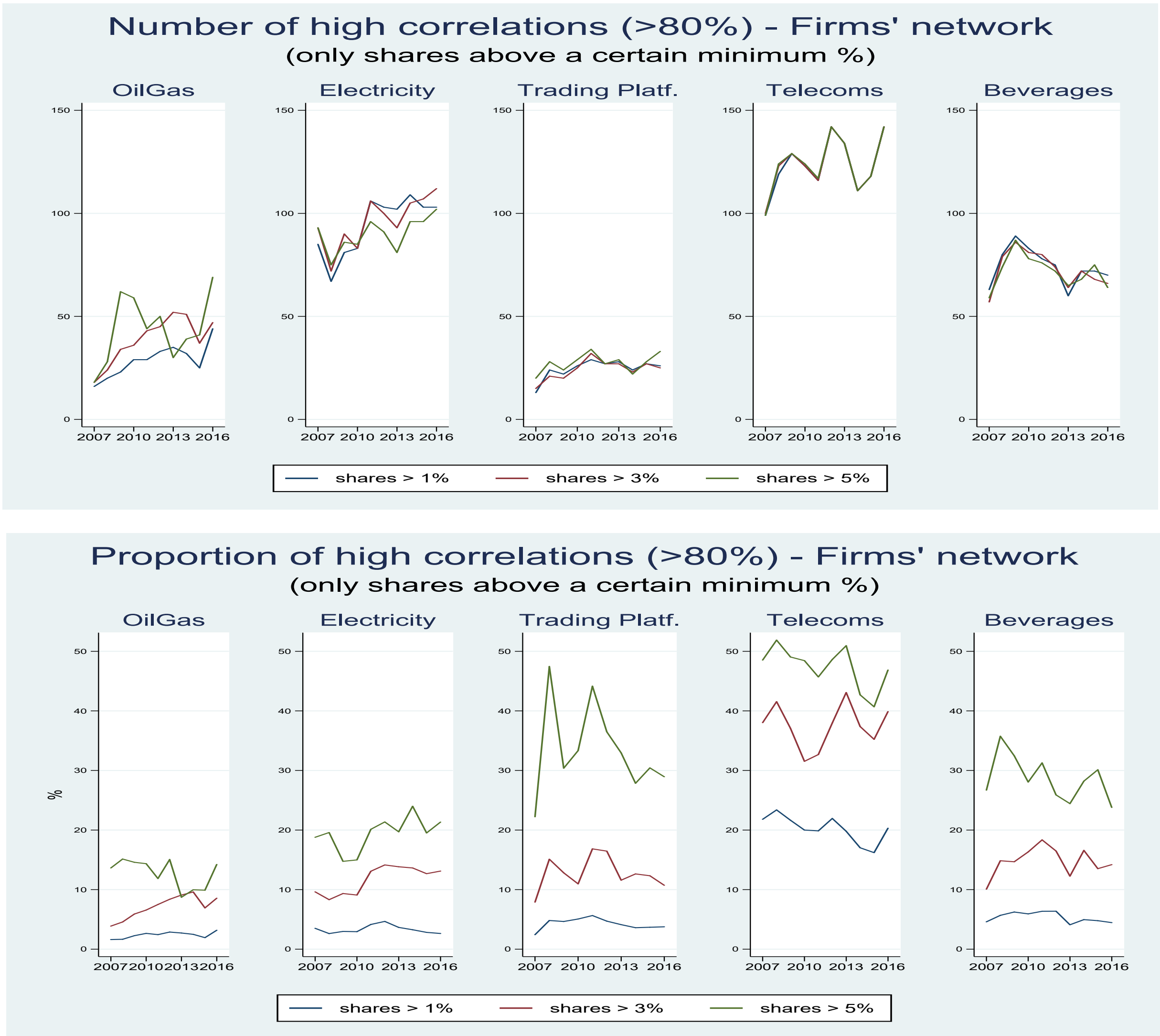
For the remaining sectors, correlations between shareholder structures remain close to or below 5%, depending on the threshold for minimum investment used. Within the Beverages Manufacturers sector the values are slightly lower than in the others. Even at the minimum investment of 1%, the share of non-zero correlations never rises above 5% of total possible connections. For more significant investments, such as 5%, the share is never above 1%.

Figure 5.4: Non-zero correlations between shareholder structures of pairs of firms, considering only investments with shares above certain minimums. Top panel: Number of non-zero correlations for different thresholds. Bottom panel: Proportion of non-zero correlations relative to the total number of possible connections between pairs of firms for different thresholds.



This limited linkage between the shareholder structures is likely due, as previously mentioned, to the type of firms in the sample - a mixture of large corporate groups with fully-owned subsidiaries and small local enterprises with few owners. The overall result is that of a sector with many ’vertical’ investments and few horizontal investors.

Figure 5.5: High correlations between shareholders structures of pairs of firms, considering only investments with shares above certain minimums. Top panel: Number of high correlations for different thresholds. Bottom panel: Proportion of high correlations relative to the total number of non-zero correlations between pairs of firms for different thresholds.



Concerning the proportion of high correlations among the shareholder structures (see bottom panel of Figure 5.5), Telecoms is again the outlier because of the presence of large corporate groups with fully owned subsidiaries. The time series for Trading Platforms, although more volatile, also shows that the proportion of high correlations over total correlations reaches peaks comparable to Telecoms. This suggests that the top shareholders in this sector are also further concentrating their investments. As the considered intensity of investment increases, the proportion of high correlations between connected firms rises substantially, meaning that those firms that are connected at higher investment intensity more frequently show a stronger overlap of shareholding structures. In terms of total number of strong links (top panel), Electricity also present some higher figures, but mainly due to the larger size of its network.

5.3.2 Network indices for investors

Figure 5.6 and Figure 5.7 present indices related to the shareholders' network, which demonstrates the correlations between the portfolio structure of investors. The interpretation is analogous to that of the firms' network, and in general confirms a strong connectedness in all markets.

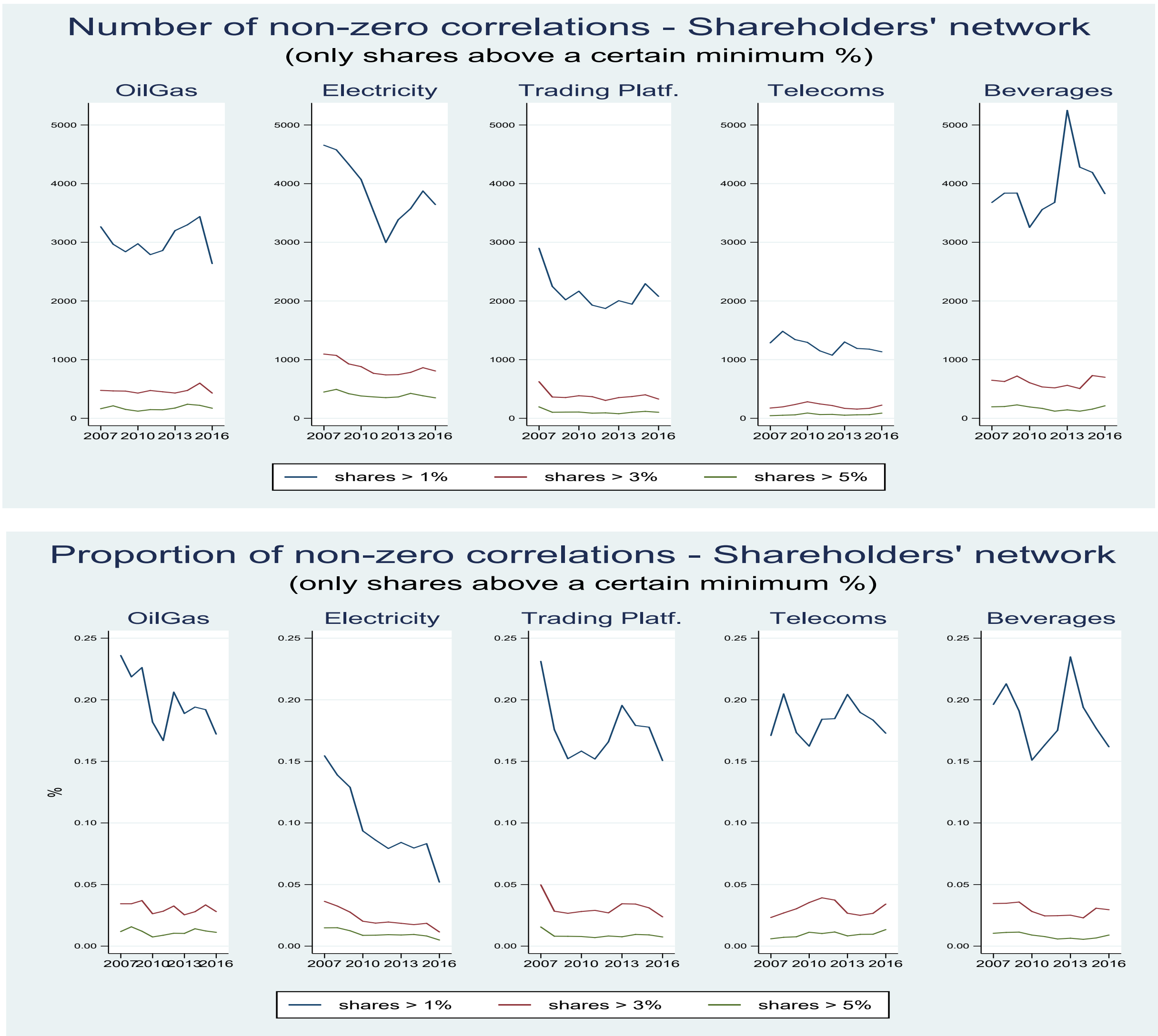
When considering very low thresholds such as 1%, the number of non-zero correlations indicates a high overall degree of overlap between investor portfolios (top panel of Figure 5.6), but with a tendency to decline over the period of observation.

As the threshold becomes more stringent, the number of connections becomes more stable over the period, but exhibits a dramatic drop; about ten-fold if comparing the 1% to the 5% figures. This may again be due, as in the Telecoms sector, to large corporate groups that fully own many subsidiaries and do not cross invest as much. Therefore, the likelihood of correlations between portfolios decreases, and depends mostly on the cross-investments of institutional investors such as funds, which in general hold smaller shares.

As for the proportion of connections existing in the shareholders' network, the trends are very similar to those of the absolute figures, the only difference being in the 1% threshold, where a more evident decline is observed. It is important to note that the proportion of connections is calculated over the total number of potential shareholder-shareholder links; considering that each market has thousands of investors per year, the possible two-by-two links are in the order of several millions, which yields very small proportions even when the number of non-zero correlations is high. This was not the case in the firms network, of much smaller size, where the possible links were a few thousand, even in the largest market (Electricity).

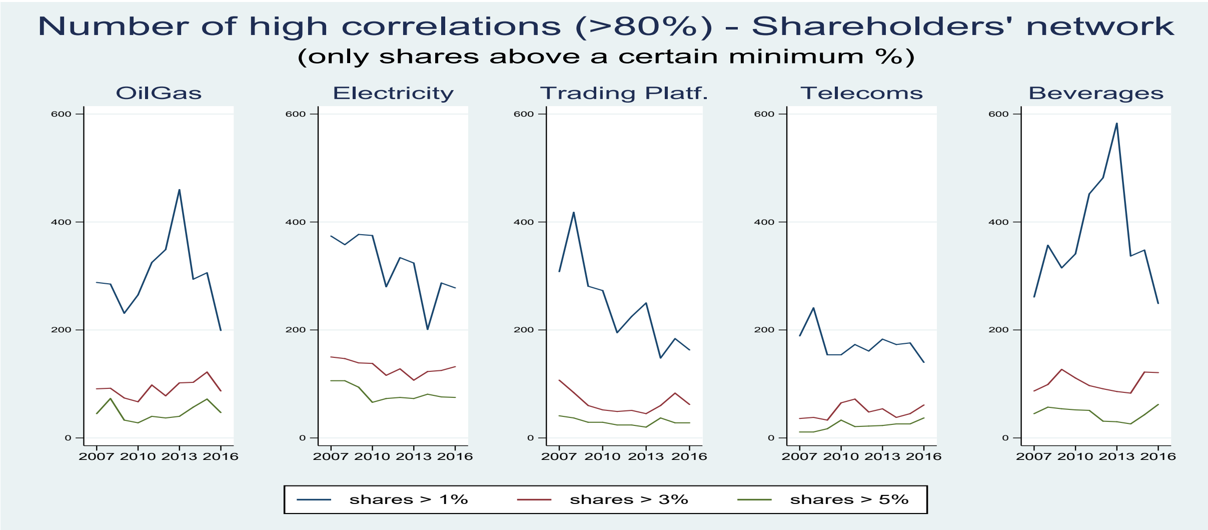
Alternatively, Figure 5.7 shows the high correlations between investor portfolios, where the proportion of high correlations is now calculated over the total number of existing investor-investor connections. The index therefore highlights on the most strongly connected investors per sector. As the threshold for block-holdings increases, this proportion increases, because these top investors with significant equity investments have interests in many of the same firms, therefore displaying an increasingly strong overlap of portfolios. Overall, across sectors we observe as many as 30% of the connected investors having almost coincident portfolios when looking at the most intensive investments, the only exception being Electricity on slightly lower levels.

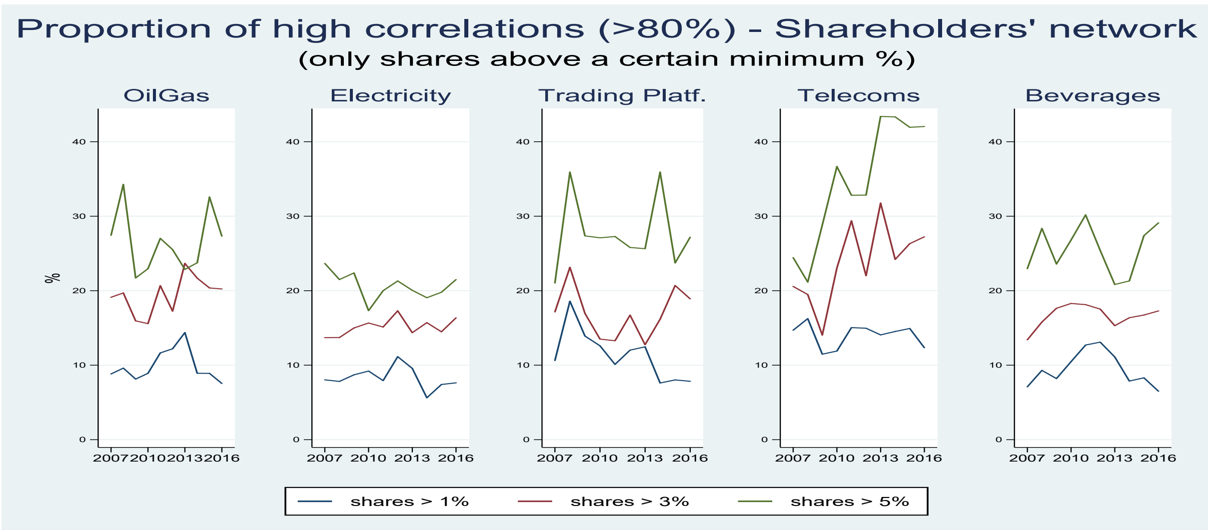
Figure 5.6: Non-zero correlations between pairs of investors' portfolios, considering only investments above certain minimums. Top panel: Number of non-zero correlations for different thresholds. Bottom panel: Proportion of non-zero correlations relative to the total number of possible connections between pairs of portfolios for different thresholds.



Looking only at the sheer number, high correlations occur less often when the thresholds for block-holding become more stringent. Even at 1%, the number of high correlations is usually between 200 and 400, only a fraction of all the non-zero correlations. This suggests that many of the existing links between shareholder portfolios are driven by small equity holdings by investors.

Figure 5.7: High correlations between pairs of investors' portfolios, considering only investments with shares above certain minimums. Top panel: Number of high correlations for different thresholds. Bottom panel: Proportion of high correlations relative to the total number of non-zero correlations between pairs of portfolios for different thresholds.





5.4 The ’Big Three’

In the interest of understanding how certain big investors, that is those with wide portfolios, have increased their common shareholding across the sectors of interest over the years, Table 5.2 presents statistics on average participation shares for BlackRock Inc., The Vanguard Group, and State Street Corporation, referred to as the ’Big Three’. BlackRock in particular stands out since, following the 2009 merger with Barclays Global Investors, its average ownership increased dramatically across sectors. This stylised fact can also be seen in the time series showing the evolution of block-holdings for the ’Big Three’ in Figures 5.8 and 5.9.

In the Oil&Gas industry, all these funds hold average participation shares that are close to or above a 3% level of block-holding, making them very relevant actors in the market. BlackRock and Vanguard have a similar behaviour in Trading Platforms, but State Street is left behind in this sector, with average holdings just above 1% throughout the period. The investment intensity in Electricity is rather uniform for the three funds, at around 1.5%, with only BlackRock at slightly higher levels, around 2%. The Telecoms sector presents the lowest intensity in investments of all considered industries, with both State Street and Vanguard well below 1% average holdings. BlackRock stands at a higher level, with around 2% average. In the Beverages Manufacturers sector, BlackRock experiences a significant jump after its acquisition of Barclays Global Investors in 2009. Vanguard similarly increases its average participation, but not due to capital operations. State Street remains the laggard again with respect to its competitors. This trend is comparable to the other sectors of interest, with BlackRock and Vanguard always edging out State Street in terms of average participation size.

Figures 5.8 and 5.9 show the number of firms block-held by each fund and the proportion of their portfolios composed by block-holdings. These are reported as usual for block-holding levels of 1, 3, and 5 percent. Of these ’Big Three’ investors, BlackRock is the most active across sectors and over the period. A large part of this is again due to the 2009 acquisition of Barclays Global Investors, which created a money management juggernaut and vastly increased the portfolio holdings of BlackRock.

The levels of block-holdings are comparable across the sectors for these top investors, with BlackRock and Vanguard increasing their block-holdings over the period while State Street remains steady but well below. In certain sectors, such as Telecoms, the presence of large corporate groups (for example Vodafone) with many fully owned subsidiaries pushes down the number of block-holdings for other investors, while in Electricity the large number of firms in the sample with respect to the other sectors results in an increased number of block-holdings. Due to these circumstances, the ’Big Three’ lean towards a block-holding style of investment in the energy sectors (Oil&Gas, and Electricity), while maintaining smaller equity holdings in Trading Platforms or Telecoms.

Table 5.2: Average participation shares in investors' portfolios. Results for 'Big three': BlackRock, State Street and Vanguard, by market and year.

Oil&Gas				Electricity			
Year	BlackRock	State Street	Vanguard	Year	BlackRock	State Street	Vanguard
2007	0.96	2.24	1.86	2007	1.05	1.48	1.08
2008	0.82	1.98	1.90	2008	1.03	1.28	1.03
2009	3.97	2.00	2.01	2009	2.55	1.38	1.20
2010	3.85	2.12	2.23	2010	2.24	1.28	1.26
2011	3.52	1.96	2.05	2011	2.10	1.36	1.18
2012	3.32	2.17	2.20	2012	1.90	1.25	1.18
2013	3.43	2.34	2.58	2013	2.06	1.20	1.34
2014	3.51	2.32	2.81	2014	2.31	1.20	1.52
2015	3.54	2.64	3.44	2015	2.32	1.24	1.77
2016	3.91	2.98	3.87	2016	2.40	1.30	2.00

Trading Platforms				Telecoms			
Year	BlackRock	State Street	Vanguard	Year	BlackRock	State Street	Vanguard
2007	0.61	1.04	0.76	2007	0.29	0.50	0.40
2008	0.73	0.71	0.89	2008	0.45	0.51	0.43
2009	2.44	0.64	0.96	2009	2.65	0.54	0.54
2010	2.95	0.81	1.11	2010	2.84	0.54	0.72
2011	2.69	0.71	1.19	2011	2.49	0.51	0.80
2012	2.46	0.71	1.41	2012	1.99	0.58	0.86
2013	3.54	0.92	1.74	2013	2.57	0.57	0.92
2014	2.76	1.00	1.94	2014	1.90	0.54	0.98
2015	3.17	1.13	2.26	2015	1.99	0.60	1.23
2016	3.46	1.03	2.43	2016	2.29	0.63	1.38

Beverages			
Year	BlackRock	State Street	Vanguard
2007	1.07	1.38	1.14
2008	0.65	1.33	1.31
2009	2.64	1.36	1.37
2010	2.78	1.29	1.48
2011	2.41	1.51	1.36
2012	2.48	1.68	1.63
2013	2.52	1.46	1.79
2014	2.72	1.46	1.90
2015	2.73	1.38	2.21
2016	2.59	1.26	2.38

The proportion of block-holdings in the total investments (overall investor's portfolio) per sector by each of the 'Big Three' is presented in Figure 5.9. These stylised facts show the preference for intensity of investment by these top funds. Indeed, in certain sectors such as Oil&Gas, over 40% of BlackRock's equity holdings are of 5% or greater during the entire period analysed. This preference for intensity of investment is very sector specific; in other markets such as Telecoms, the majority of shares held in the portfolios of each of the 'Big Three' is smaller. BlackRock for example, has between 60% and 80% of its equity investments in Telecoms greater than or equal to 1%, while its remaining shares held in Telecom firms are therefore smaller than 1%. State Street is in a reverse situation, with only just below 20% of shares in its Telecoms portfolio being greater than or equal to 1%, and the vast majority of its share holdings in the sector being below 1%. In this specific sector, only BlackRock holds shares above the other thresholds. Lastly, in the Beverages Manufacturers sector, when considering conventional levels of 5%, almost 20% of BlackRock and Vanguard's portfolios in 2016 are composed by block-holdings, values higher than in the others sectors with the exception of Oil&Gas.

Figure 5.8: Number of block-holdings for the 'Big Three' at different thresholds.

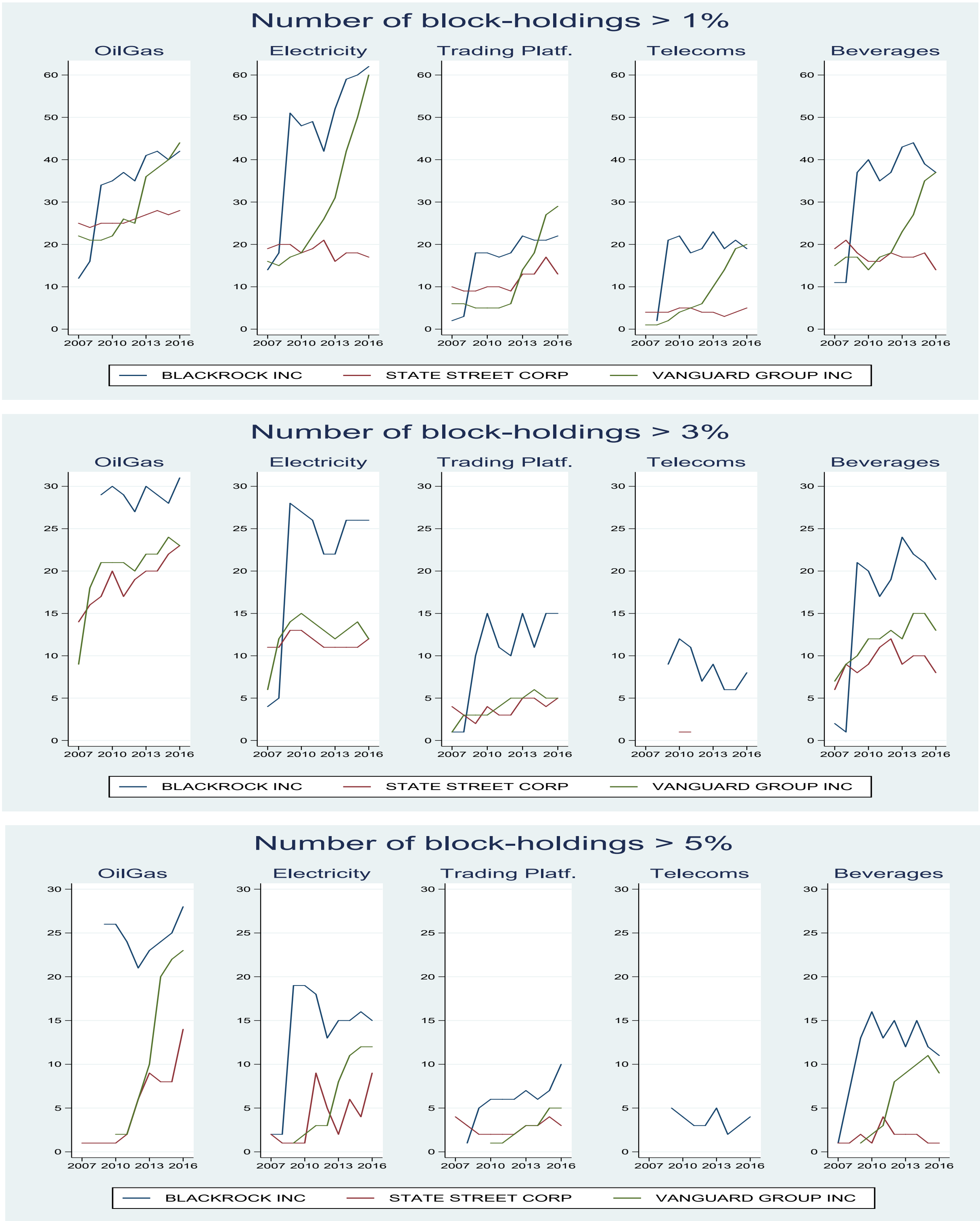
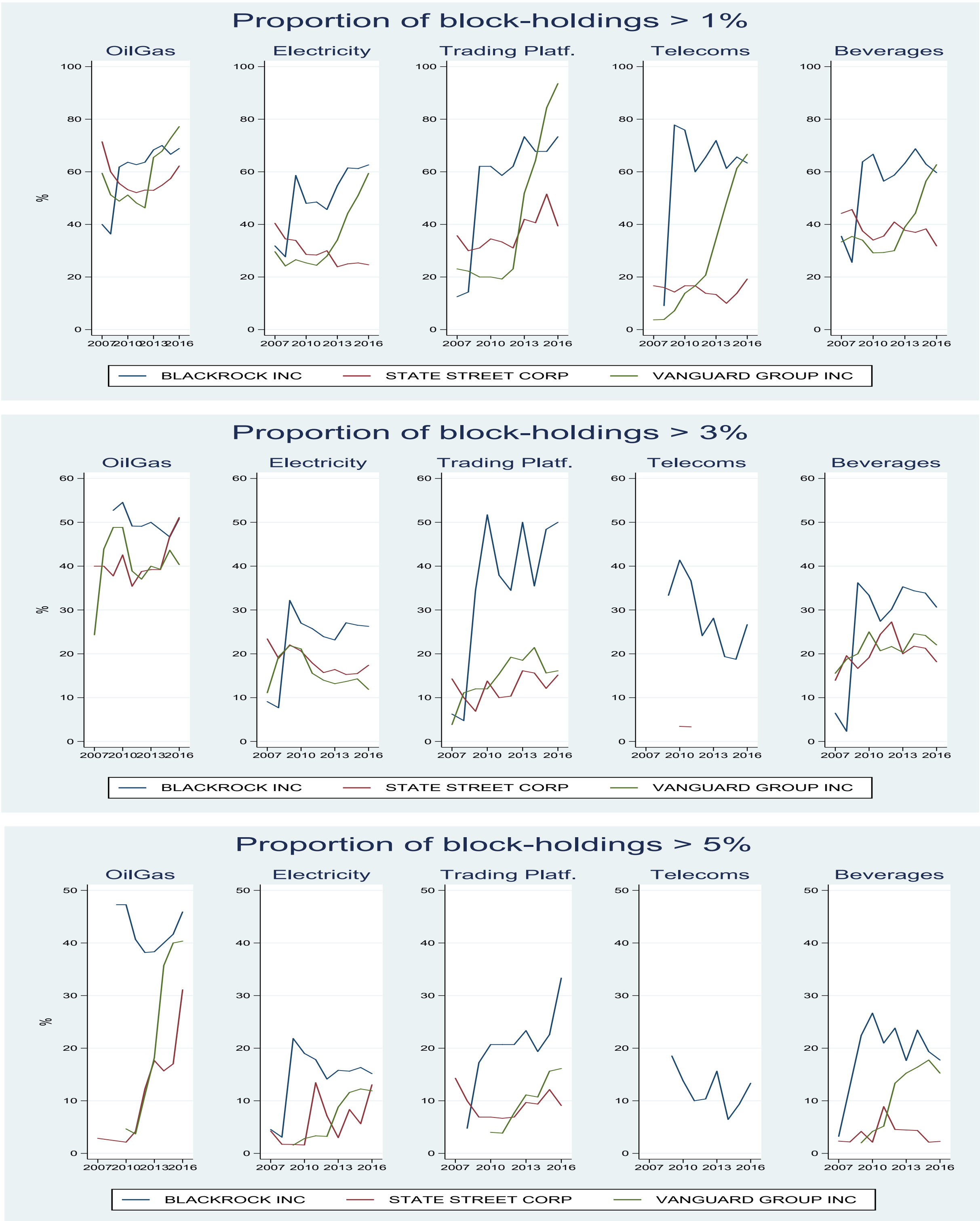


Figure 5.9: Proportion of block-holdings in portfolios of ’Big Three’ at different thresholds.



Chapter 6

Linking Common Shareholding and Competition

The link between common shareholding and competition is related to a firm's objective function. As noticed by Azar et al. (2018), if a firm acts in the interest of its main shareholder, then what should be maximised is not the firm's own value but the shareholder's utility. With institutional investors, this corresponds to the maximization of their portfolio value. Clearly, firms' profit maximization and portfolio maximization do not always coincide; in particular, an aggressive price behaviour could benefit a firm's own profit but reduce the value of common shareholders' portfolios.

To what extent common shareholders possessing small fractions of shares in many firms of the same market are able to actually influence market outcome is still an open question. O'Brien and Salop (2000) show that if a firm maximises its shareholders' portfolio profits (and not its own profit), industry markup[1] is proportional to a modified Herfindahl-Hirschman Index (HHI), where the markup depends on the density of the network of ownership and control of the firms in the considered market. When this is the case, higher markup should be observed in markets with higher common shareholding (Azar et al., 2018).

Previous chapters have discussed in detail the various measures of common shareholding that were developed for the purpose of this exercise.[2] The different firm and market level indices, aside from offering viable alternatives to the standard literature indices such as the HHI or the modified HHI, also gave valuable insight into the structure of the five sectors considered for the analysis, namely Oil&Gas, Electricity, Mobile Telecoms, Trading Platforms and Beverages.[3]

[1] Markup is given by (price - marginal costs)/price.
[2] See Chapter 2 for a general overview and Appendix B for more technical details.
[3] See sectoral results in Chapters 4 and 5.

This chapter deals with the measurement, data and econometric issues arising when assessing the link between common shareholding and competition. In what follows, rather than reviewing thoroughly the research on this topic, we will briefly detail the requirements and possible way forward for an empirical measurement of such possible effect. It is worth recalling, though, that the econometric modelling still has several challenges ahead, principally the lack of an established theory showing how common shareholding affects managers, and from there competitive outcomes.

Section 6.1 recalls the main modelling challenges. Section 6.2 discusses measurement and data issues related to market identification, the measurement of common shareholding and of competitive outcomes. Section 6.3 presents and discusses different market power indicators of competition, while Section 6.4 proposes an econometric strategy for the test of causality between common shareholding and competition. Finally, Section 6.5 recalls the main sectoral results, to help choose a suitable candidate industry for the econometric analysis.

6.1 Modelling the link

The first ingredient of the recipe linking competition to common shareholding is how the relationship is actually modelled.

One could look at markets where common shareholders are not present and compare them with markets where common shareholding is observed (He and Huang, 2017). Azar (2012) uses a panel of 210 industries to regress average industry markup on the density of common shareholders (plus controls, including industry fixed effects). He finds a significant and positive relation between markup and within-industry density. Cross-industry comparison, while appealing in theory, has limited utility as very different aspects - e.g. the different cost-structures, different nature of activity, and so on - might play a crucial role in shaping causal effects (Schmalz, 2018).

An additional difficulty in industry comparisons is the amount of data and effort needed to define market boundaries and proximity. On the other hand, the analysis of common shareholding in vertically linked markets could be worth exploring, since there common shareholding could have a beneficial effects on markups (Azar's results go in this direction).

Given the theoretical and empirical problems in working with many markets, the analysis of a single market has been the choice mostly followed by the literature (Schmalz, 2018). Ideally, to measure the effect of common shareholding within the same market one would need a change in market conditions with the emergence of a set of common shareholders either previously not there, or present but with different percentages of shares. One could then analyse the pre and post margins for the whole industry - or for the affected firms - and see if common shareholding has indeed influenced markups.

Our data span from 2007 to 2016, and in that period we never observe the switch between the absence and the presence of common shareholders in the EU overall and in any of the five analysed markets.[4] We observe, instead, changes in the identity of common shareholders (for example, evidence suggests that large funds substitute banks as common shareholders of the electricity market from 2009-2010), or in the proportion of the market assets held.

Within markets, the literature usually looks at variables such as market share or profitability of companies with common shareholders (He and Huang, 2017, among others). Changes in profits or margins are associated to common shareholding also by Azar (2012), once confounding factors are accounted for. Notice that sharp empirical evidence for efficiency gains arising from common shareholding is still lacking (Schmalz, 2017).

Finally, the effects of common shareholding on variables other than competition, such as innovation, have been also analysed (López and Vives, 2017; Antón et al., 2018; Shelegia and Spiegel, 2017), showing that common shareholding can also be welfare improving. The link between common shareholding and investments is explored by Gutierrez and Philippon (2017).

6.2 Measurement and data issues

No matter the model chosen, the empirical testing of the relation between common shareholding and competition is not straightforward, due to several measurement and data issues. Here we discuss the main points, including concerns related to the market identification and the measurement of common shareholding. The choice of possible measures of competition is also discussed, looking at both market power and market concentration indicators.

6.2.1 Market identification

First the definition of **market boundaries**. The literature has used official codes of economic activity (NACE for Europe, NAICS, SIC for the US[5]) to define market boundaries. The main issue is that this classification is not precise for all firms and markets. In Europe, NACE codes are assigned according to the value added produced by the company and this classification is generally quite stable in time, reflecting changes in company's activity only with delay. This is crucial for firms and sectors where technological progress is rapidly changing production and products. An additional complication is the presence of large conglomerates with multiple and very different activities (thus uncertain industrial classification) which operate in different markets. Finally, for certain types of activities there is no correspondence to a specific code,

[4] See overall picture of common shareholding in the EU in Chapter 3 and sectoral results in Chapters 4 and 5.

[5] The codes of economic activity are referred to, respectively, as the NACE (Nomenclature générale des Activités économiques dans les Communautés Européennes - European Classification of Economic Activities), the NAICS (North American Industry Classification System), and the SIC (Standard Industrial Classification).

and even looking at the main players they tend to be classified according to a variety of different activities. For example, in the definition of the Trading Platforms industry presented in Chapter 4, the companies that operate the trading platforms are classified not only as developing financial services activities or administration of financial markets, but also as banking (monetary intermediation), holding activities, business support services or even IT services.

An underestimated complication resides in the fact that the availability of NACE classification for firms depends on national legislation. In some countries, like Denmark, firms are given the option to indicate 'no sectoral code' when producing their accounts and this inflated the number of firms for which the NACE code is not available. Other countries foresee simplified accounting rules (without the indication of NACE) for certain categories of firms. Non-exhaustive examples are, in France, Société en nom collectif (SNC), Affaires Personnelles, Coopératives, Administration, Associations, GIE (groupement d'intérêt économique); in Luxembourg, enterprise individual, SECS (Société en commandite simple), SNC, Etablissement public, foundation, GIE; in the Netherlands Sole Traders, Federations, Foundations and participations, which are consolidated in holdings. Two countries - UK and Cyprus - explicitly mention exceptions to NACE declaration related to foreign controlled firms. UK grants exceptions for NACE declaration to Unlimited, LP, Royal Charter, European Economic Interest Grouping, and foreign companies. Cyprus grants exceptions to partnerships and business names, and to overseas companies (branches of foreign companies) if not taxed in Cyprus.

A further issue, when dealing with data coming from different classifications (typically NACE for Europe and NAICS or SIC for US) is that the correspondence of sectors at 4 (or even 3) digit level is not assured. For example, in the Electricity sector the US-SIC classification presents a rather comprehensive category of "Electric Services" (code 4911), while the NACE distinguishes between Production (code 3511), Transmission (3512), Distribution (3513) and Trade (3514) of Electricity. Similar, but not identical detailed classification can be encountered in the NAICS system, where different codes identify Electric Power Generation (22111), Electric Bulk Power Transmission and Control (221121) and Electric Power Distribution (221122), but none refers to trade.

6.2.2 Measures of common shareholding

An empirical testing of the link between common shareholding and competition requires usable variables for the measurement of both phenomena.

The literature has so far mainly recurred to the modified HHI *delta* as a measure of common shareholding (HHI *delta* is the additional variation in concentration arising because of common shareholding). This implies several challenges. Firstly, data challenges, with the need to have firm-level and market-level data. Secondly, endogeneity problems (see discussion in O'Brien and Waehrer, 2017). Finally, a logical issue also exists: common shareholding is measured with the MHHI, an endogenous measure of concentration that depends on common shareholding and market share.

To solve the endogeneity problem, Azar et al. (2018) use changes in route-level prices and the purchase of Barclays Global Investors in 2009 by BlackRock as an instrument to estimate the impact of enhanced concentration on specific airfares. The use of prices, while extremely appealing to measure competitive pressure, is rather challenging in practice. It requires the identification of a homogeneous good supplied by all (most of) the companies in the market, for which the price-company data is actually observed and collected for a sufficiently long period to allow meaningful quantitative analysis. While standard surveys on product-market-price data and quantities typically take years to be conducted and validated, the use of web-scrapers to record on-line prices could constitute a possible alternative.[6]

Azar (2012) offers an alternative to the modified HHI, constructing a measure of density of common shareholders in a market. Azar's defines density as

$$Density = \frac{\sum_{i=1}^{n} \sum_{j<i} y_{ij}}{n(n-1)/2}$$

where y_{ij} is equal to 1 if firms i and j are connected by a block-holder (i.e. if they have a common shareholder holding at least 5% shares in each firm), zero otherwise. He and Huang (2017) also offer measures of intensity of common shareholding based on the number of firms, within a market, that are cross-held. These indicators are firm-centred in the sense that they look at the ownership structure of firms, identifying possible shareholders' overlaps with their competitors. On the other hand, additional owner-oriented common shareholding indicators have been developed in Chapter 2 (and applied to the EU in Chapters 3-5), adding a new dimension to the measurement of the phenomenon. The new indices analyse the portfolio structure of investors, and the overlap between investment strategies of different owners active in a given market, highlighting whether the common shareholders tend to target the same companies or rather split the market into selected ownership subsets.

Another (unavoidable) limitation of all the analyses of common shareholding resides in the use of shares to infer control. The percentage of the shares held is only an imperfect substitute for the control exercised, when e.g. dual-class share or golden shares are present. Data issues complicate this point. To the best of our knowledge, no firm-level data (not Orbis, nor Dun & Bradstreet[7] or Compustat[8] for listed firms) distinguish explicitly shareholders in terms of the type of shares they hold. Therefore, we are obliged to assume a 1:1 correspondence between control rights and percentage of shares.[9]

[6] An example of web scrapers to infer prices is The billion prices project (`http://www.thebillionpricesproject.com/our-research/`). Notice that the Commission developed a tool, the European media monitor (EMM - `https://ec.europa.eu/jrc/en/scientific-tool/europe-media-monitor-newsbrief`), that could be adapted to the purpose. EMM scrapes the web in 70 languages according to given keywords and runs sentiment analysis in 14 languages.

[7] See `https://www.dnb.com/`

[8] See `https://www.spglobal.com/marketintelligence/en/campaigns/i-need-data-to-make-informed-decisions`

[9] An additional issue with papers using US data (e.g. all the papers by Azar and Schmalz) is that they rely on data

Schmalz (2018) suggests associating also the number of board seats to the percentage of shareholding. Orbis contains information on board members obtained from balance sheet data, hence with a delay of about 2 years, but does not contain information on which company/shareholder each board member represents. The dataset BoardEx[10] contains updated biographical information on board members and senior executives for about 1.7 million companies around the world, but it requires manual matching of companies when it is used in tandem with financial statements from Orbis (or from other datasets).

6.2.3 Measures of competition

A third challenge is the measurement of competition. Structural forces at play in the global economy, including the ICT revolution, globalization, and delocalisation of supply chains, are uprooting industrial organization in many countries. Policymakers, and for this purpose those worried about consumer welfare, need to adjust their policy objectives to capture the new possible anticompetitive effects resulting from these changes. For these reasons, it is crucial to choose an appropriate measure of competition. In order to establish a causal relationship between common shareholding and competition, the options explored include measures of market power or market concentration, as well as considering directly the effect on prices. Prices remain the preferred indicator for changes in competitive forces on the market, however obtaining data on prices at the required level of specificity is still a challenge.

The literature on common shareholding offers two possibilities, either a measure of market power or a measure of market concentration. **Market power** refers to the ability of a company to raise and maintain the price above the level that would prevail under perfect competition (see OECD, 1993). The indicator mostly used in practical measures is the Lerner index based on industry markup, i.e. the wedge between prices and marginal costs. As neither prices nor marginal costs are actually observed in firm-level data, the Lerner index is approximated by a profitability index either based on the difference between sales and variable costs or the difference between operating profits and financial costs, to account for fixed costs (for a summary of the measures see Santos et al., 2018). Still, this approach has pros and cons. The major limitation is that it is based on average costs rather than on costs at the margin. The advantage is that they can be calculated using standard accounting data. Although not perfect, the Orbis dataset remains the best possible option for an empirical analysis when accompanied by a correct definition of the reference market and its main players. Orbis variables from balance sheet and profit-loss accounts are widely used in the literature to approximate markups and are good candidates for empirical testing.[11]

coming from the 13F filings (a quarterly report filed by institutional managers to the Security Exchange Commission), thus limited to equity assets under management of at least 100 million US$ in value. Azar et al. (2018) complement these data with hand-collected non-institutional ownership data for owners with a stake above 5% of outstanding shares.

[10] See `http://corp.boardex.com/data/`

[11] See Appendix A, and specifically definitions of available balance sheet and profit&loss account variables in Tables

Market concentration relates to the idea that a limited number of players may implicitly control the market, while a larger number of players is likely to increase the competitive pressure on competitors. The HHI is the common measure of concentration used in the literature (Hallak and Rosati, 2018), as it computes the relative size of a firm in an industry in terms of the proportion of total output (see OECD, 1993, and OECD, 2012). Sales are generally used as a proxy of firms' economic activity, as they are a standard measure in product market strength literature and are less subject to manipulation than reported earnings (He and Huang, 2017).

A major empirical shortcoming of both approaches is related to the use of accounting data from consolidated (versus unconsolidated) accounts. Consolidated sales refer to the entire activity of the company, regardless of the sector in which it is undertaken. Apportioning sales/value added to sectors is not an easy task and is subject to ad hoc assumptions. An additional shortcoming of using consolidated accounts is that even if one assumed that a company is active in a single sector, multinational firms will report all international sales within a single consolidated account; this is likely to artificially inflate the share of multinational firms if compared to the shares of domestic ones.

As the typology of balance sheet produced (unconsolidated vs consolidated) depends on legal requirements (hence also on national legislation), in some cases consolidated balance sheet is the only available option within firm-level datasets. The Orbis database allows differentiating between consolidated and unconsolidated accounts, and accounting for ownership. By using as much as possible unconsolidated country-level firms' accounts, we are able to be more precise in sector and geographic area.[12] Furthermore, we avoid inflating the data with international sales or sales of the group in other markets. Whenever unconsolidated accounts are not available, we consider consolidated accounts without apportioning sales or assets to single markets to avoid ad hoc assumptions.[13]

6.3 Markup

Through a survey of the relevant literature and a recap of the main terminology, we discuss more in detail the potential indicators for competition, in particular linking them to the importance of new policy objectives. We focus mainly on the firm markup, and present the methodology for how it is calculated.[14]

Over the past 20 years, economies in the Western world have seen major structural shifts driven by the rapid diffusion of ICT, the globalization of supply chains, or the delocalization

A.8 and A.9.

[12] See Hallak and Rosati (2018) and discussion therein.

[13] Notice that in the case of the listed firms included in the initial database, most of the accounts (70%) are consolidated (see Section A.5 in Appendix A for further details). In the case of the unlisted firms - added manually to integrate the definition of the five industries - the large majority of accounts are unconsolidated.

[14] Concentration measures are not explored further for being at market rather than at firm level.

of production, for example. These forces are responsible for market outcomes that now command attention from academics and policymakers alike. No market trend, however, has garnered as much attention in recent years as the apparent increase in industry concentration and the corresponding decline in competition. Both U.S and European antitrust authorities - arguably the two most influential entities of their kind in the world - have brought (or begun) in recent years antitrust actions against major market players such as Google, Facebook, or Amazon.

The evidence seems to back up the claims of the authorities. Reports by the OECD (2018) find that markups and profits, especially in the U.S, have increased globally. Others such as Gutiérrez and Philippon (2017), Baqaee and Farh (2020), and Diez et al. (2019) have found similar results. This last work calculates that global markups have increased by 6% between 2000 and 2015, driven by high-markup firms in advanced countries. Again, De Loecker et al. (2020) report similar findings, where the upper tail of the distribution drives increasing markups in the U.S. There is therefore consensus in the literature on the evolution of industry concentration, but less so when it comes to concentration and its effects on competition for a specific market within an industry. The authors mentioned above, alongside others such as Gutiérrez and Philippon (2018), conclude that, while competition has declined in the U.S, the trend in Europe is less evident. Because of the structural changes mentioned above, observed changes such as increasing industry concentration do not necessarily lead to greater market concentration, and hence lower competition. Properly assessing the economic outcomes due to changes in common shareholding requires that the policymaker focuses instead on more specific indicators such as prices, profits, or markups (OECD, 2018).

In Europe, Weche and Wambach (2018) have also observed increasing markups in the years after the financial crisis of 2007. The distinguishing factor is that the authors observed increasing markups along the entire distribution - as opposed to the U.S, where the large firms with higher markups gained more market share. The results also showed heterogeneity among European countries, with some experiencing this increase in markups more than others.

These stylised facts could be indicators of anticompetitive behaviour going on in the market. Several authors, such as Kwoka (2013) and Blonigen and Pierce (2016), have shown that arrangements like mergers, which result in increased market concentration, are correlated to increasing markups or declining competition. It is therefore possible that through these mergers or other similar agreements, firms are extending their market power with anticompetitive behavior or conduct. This includes not only price setting, but also rent-seeking behaviour through intense lobbying for regulatory protection or favoritism. Even where anticompetitive mergers are not observed, increasing markups should still be of concern to policymakers. As outlined before, structural changes are weakening the link between concentration and higher profits. For example, superstar firms such as Google or Facebook operate in sectors with exceptionally low marginal costs with respect to their revenue, something seen among all new emerging digital firms. Based on this, evidence suggests that regulatory agencies should be less focused on market shares or concentrations in their decisions, but should instead pay attention to how markups are evolving, and whether they increase the incentive or ability to exclude rivals.

6.3.1 Calculation of markup

The theoretical and applied literature has developed different methodologies for computing markup both at microeconomic, and at sectoral/macroeconomic level. Estimating markups is generally not straightforward, as some of the variables entering theoretical formulas are not directly observable.

The literature presents four main methods that can be applied in the empirical analysis to compute markups. The first is the basic approach that starts from the assumption of constant short-run marginal cost (Tybout, 2003). An alternative method by Hall (1988) is also largely used in the literature, even though its implementation is not always feasible with standard datasets, as it requires the availability of appropriate instrumental variables. Some of the difficulties associated to this method are solved by Roeger (1995), who develops a methodology that allows the computation of markups with a minimal set of variables. More recently, a robust methodology for computing firm-level markups has been proposed by De Loecker and Warzynski (2012), the main advantage being that it does not require the estimation of the user cost of capital.

As a first step of the analysis, we use a rather standard approach to compute markups of individual firms, following Tybout (2003). We define markup as the ratio between output price (p) and marginal cost (c), that is:

$$\mu = \frac{p}{c} = \frac{\eta}{\eta - 1} \tag{6.1}$$

where η is the elasticity of demand faced by the firm.

From equation (6.1), it follows that computing markups requires the knowledge of prices and marginal costs, which generally are not observable. Therefore, many methodologies have been developed to infer markups indirectly. The most common approach is based on the price-cost margin (PCM), and it assumes that marginal unitary costs do not depend on the level of output. Under this assumption, we have:

$$\frac{\mu - 1}{\mu} = PCM = \frac{pq - cq}{pq} \tag{6.2}$$

where q is the physical output. In order to estimate markups, it suffices to dispose of data on sales (pq), and costs (cq) both at current prices, where all the economic costs have to be included in the computation, including the user cost of capital.

In detail, once the costs associated to capital are taken into account, the price-cost margin of firm i at date t - and thus the markup - can be estimated as follows:

$$PCM_{it} = \frac{\pi_{it}}{p_{it}\ q_{it}} + \frac{(r_t + \delta)\ k_{it}}{p_{it}\ q_{it}} \tag{6.3}$$

where π_{it} is the profit of firm i at date t, r_t is the interest rate at date t, δ is the depreciation rate of capital, and k_{it} is the stock of capital of firm i at time t. This computation is relatively straightforward within the ORBIS dataset. Indeed, the database includes firm-level data on the revenues $p_{it}q_{it}$, and on the costs associated to labour and intermediate inputs, which determine the level of current profit π_{it}. Moreover, ORBIS reports the stock of tangible assets k_{it}. The only elements missing in the computation are the interest rate and the depreciation rate of capital, which can be obtained from other statistical sources.

The interest rate can be computed as the difference between the nominal interest rate and the inflation rate, to get a proxy of the real ex-ante interest rate. The series are available, for example, from the Statistical Data Warehouse of the European Central Bank. With regards to the depreciation rate, Konigs and Vandenbussche (2005) assume a fixed parameter, and find that their results are not significantly affected by its value.

Applying equation (6.3), it is possible thus to estimate the markup level of each firm included in the ORBIS dataset year by year, provided data on the four key variables are available: sales (*TURN*), cost of labour (*STAF*), cost of intermediate inputs (*MATE*) and stock of assets (*TFAS*). Tables A.8 and A.9 in Appendix A report the detailed definition of these variables, as well as of other main financial variables present in the Orbis dataset.

6.3.2 Lerner index

An alternative measure of markets' competition, largely used in the literature (see, among others, Aghion et al., 2005; Grullon et al., 2019; and Gutiérrez and Philippon, 2017) is given by the Lerner index. This index is in practice a monotone transformation of the markup, the main difference being the expression of their respective formulas, which allow their calculation starting from different items of the balance sheet and profit & loss account. The Lerner Index was formalised by Abba Lerner in 1934, and is defined as follows:

$$L = \frac{P - MC}{P} \tag{6.4}$$

where P are prices and MC are marginal costs for a given firm. The indicator varies from zero to one, with zero being the situation of perfect competition in which prices are equal to marginal costs.

The interpretation of the two alternative measures is the following: while the markup gives the percentage amount for which prices exceed marginal costs (and should be equal to one under perfect competition), the Lerner Index is a normalised measure that varies between zero and one. The value zero - as mentioned above - represents the case of perfect competition, while the index takes value one in the extreme situation where the monopolist faces zero marginal costs and it is able to charge a positive price. In this sense, the Lerner index is a measure of how much the discretion in firm's price setting is far away from the social optimum.[15]

Nevertheless, as for the markup, prices and marginal costs are not observable. Hence, to overcome this problem, it is possible to compute the index at firm level as the ratio between the earnings before interests and taxes ($EBIT$) and the amount of sales ($TURN$).[16] While this indicator can be considered as a good proxy of the firms' market power, it does not contain the cost of capital,[17] which can be subtracted from the $EBIT$ to obtain a more realistic measure of markets' competition.

6.4 Econometric approach

Building on the previous discussion, the purpose of this Section is to propose a model at the sector level that shows the causal relationship of common shareholding on competitive outcomes. The most straightforward way is by leveraging exogenous events that occur in the market that affect the degree of common shareholding. However, as commented earlier, there are no clear occurrences where the market passes from an absence to a presence of common shareholding in the period under observation (2007-2016). In fact, the phenomenon of common shareholding in this period is already quite widespread across the EU, and its intensity is rather stable throughout the period.[18] On the other hand, as mentioned earlier, we observe substitutions among the classes of common shareholders, as funds tend to replace banks along the observation period, especially driven by the BlackRock-BGI merger. We recall also that, with the data at hand, cross-industry regressions are not suitable for establishing a causal link between common shareholding and competitive outcomes, since there are too many sectoral differentiating factors that are difficult to control for. The analyses of the previous Chapters will help choose one of such sectors for the application of the econometric analysis.

Keeping these issues in mind, a possible sectoral model can be built on the large literature that uses the Difference-in-Differences (DiD) method to investigate the net impact of a policy/programme on given outcomes. The standard case for applying the DiD is when a change in regulation/law (treatment) affects only a group of units (the treated units) and there is an-

[15] See Lerner (1934).
[16] For detailed definition of these and other variables, see Tables A.8 and A.9 in Appendix A.
[17] A comprehensive review of the main strengths and weaknesses in using the Lerner Index as a measure of competitiveness is provided by Elzinga et al. (2011).
[18] See overall picture of common shareholding in the EU in Chapter 3.

other group (the control) which is similar in all respects but is not affected by the policy. Both groups are observed over a period of time which includes the year of the adoption of the policy. Then, it is natural to measure the policy effect by comparing the change in the mean outcome of the treated cases with the change in the mean outcome for the untreated. This approach can, under some conditions, identify the causal effect of the policy on the outcome of interest.

In this specific case, there is no clear shock affecting common shareholding, namely neither a regulation, nor an intervention that has affected common shareholding at the European level in the period of observation. As a consequence, it is also not straightforward to identify possible treated and control units.

Hence, to overcome these issues, and in order to induce a sort of "exogenous" variation in the common shareholding, we exploit the decision of BlackRock to acquire Barclays Global Investors (BGI) in 2009. The presence of this merger event not only allows a pre and a post period to be defined, but also permits the identification of treated and control groups. That is, we can create a measure of a firm's exposure to the merger event based on their dependency on BlackRock and BGI before the merger. The intuition being that the more a firm was held by BlackRock and/or BGI, the more a firm is expected to be "exposed" to the merger and, hence, the higher the impact. Of course, firms that did not have any relations with BlackRock and/or BGI would not be directly affected by the merger, and hence would act as control units.

The simplest exposure indicator can be a dummy variable assessing whether a firm was part of BlackRock or BGI portfolios before the merger. A more sophisticated indicator, measuring different degrees of exposure, is given by the relative share held by BlackRock and BGI in each firm. It follows that the impact of common shareholding is estimated, under the two alternative exposure indicators, by comparing changes in the markup of firms (more) exposed to the merger to those that are not (less) affected, before and after the merger.

Markup can be influenced by country-specific macroeconomic shocks, such as changes in institutional setting and/or consumer tastes. However, financial variables are in general not country-specific,[19] so they do not allow to account for country effects. Similarly, heterogeneity of the products in a given sector cannot be captured by a firm's aggregate balance sheet, hence product-specific unobserved effects cannot be factored in.

An alternative solution would be relying on product-level data on consumption (prices and quantities) in each country. This data can then be linked to firms, providing information on the average quantities and prices of the products sold by each firm in each country. In this case, the analysis would be based on the measure of exposure and its interaction with the average quantities sold, so as to capture the relative weight of each firm in the market. Moreover, this type of data would allow to add other combinations of fixed effects to eliminate any remaining source of bias due to correlation between unobserved factors that are constant over time (firms, products, country and year fixed effects) and our exposure variable.

[19] See discussion about consolidated vs unconsolidated financial accounts in Section 6.2.3.

Several options for price data for the five sectors were investigated, unfortunately with no success. In some cases there was an additional challenge related to the identification of a "product" itself (e.g. in the Trading Platforms case), and hence the definition of a possible price. In other cases, wholesale prices could have been retrieved (e.g. in Electricity markets), but not retail prices, which are those more likely to be affected in case of harmed market competition. For the Beverages sector, where a product was more easily identified, unfortunately product-level data covering the pre- and post-merger periods were not available, at the time of the study. For these reasons, the empirical analysis is kept at the firm level.

6.5 Candidate sectors for the econometric analysis

Five sectoral studies have been reported in Chapter 4, analysing respectively the Oil&Gas, Electricity, Mobile Telecoms, Trading Platforms and Beverages industries. Specifically, results on market definition and shareholding structure were presented, with a detailed identification of main corporations and top investors, with respective portfolio information. Special attention has been devoted to minority shareholders and their role as block-holders, in particular to the so-called 'Big Three', the largest US-based funds BlackRock, State Street and Vanguard; the analyses looked at their portfolios, at trends of investment 'intensity' (amount of shares held in firms in portfolio), as well as changes in portfolio size and number of block-holdings. Evidence on the interconnections within each market has been investigated looking at a series of common shareholding indices based on firm-shareholder relations; moreover, the networks of firms and shareholders have been studied separately, identifying the presence and strength of links between firms (induced by common shareholders), and connections across shareholders (due to partially overlapping portfolios). Lastly, a comparative analysis of some of the indices above has been presented for all the sectors in Chapter 5, with the assessment of the effect of holding thresholds on the chosen indices.

The objective of this section is to analyse various ownership patterns in the five sectors, in order to identify suitable variation in the common shareholding indicators that can help capture the possible effects on competition. Besides the relevant earlier findings on the five sectors, here we discuss two new types of variations of ownership that can be of particular value in the development of the econometric analysis. First, evidence is presented on the BlackRock-BGI merger in 2009, accompanied by the contemporaneous analysis of the investment behaviour of close players, namely State Street, Vanguard and Barclays PLC. Second, additional significant ownership changes between investors in the period of observation are considered, looking at both increase and decrease in participation of top investors in 'secondary' investors - which can be likely targets of M&As strategy from the large institutional investors.

6.5.1 The 'Big Three' and the BlackRock-BGI merger

The overall results from the sectoral analyses do not show a very specific trend over the period of observation. As already commented earlier, at first sight this seems to signal a lack of dynamics in the ownership structure of the sectors. However, looking at a selection of top investors, the sectoral studies revealed that, while the top values of common shareholding indicators were stable in the last decade, a change in the identity of the main players took place. In particular, it was witnessed the rising of the large investment funds and a contemporaneous drop in the participation of banks and insurance companies.[20]

In Chapter 5 additional indices have been computed for the 'Big Three' (BlackRock, State Street and Vanguard), looking at both their market shares (in terms of Total Assets and Market Capitalisation) and the intensity of their investments (number of block-holdings). Here such indices are recalled for all five sectors, while analogous figures are shown also for Barclays Global Investors (BGI) and Barclays PLC. The reason why these two investors are added is to monitor the effect of the 2009 merger of BlackRock with BGI, which is the largest 'substitution' event between funds and banks. This event had unprecedented proportions in the history of mergers between asset management funds, and has therefore played a crucial role in shaping the various studies on common shareholding.

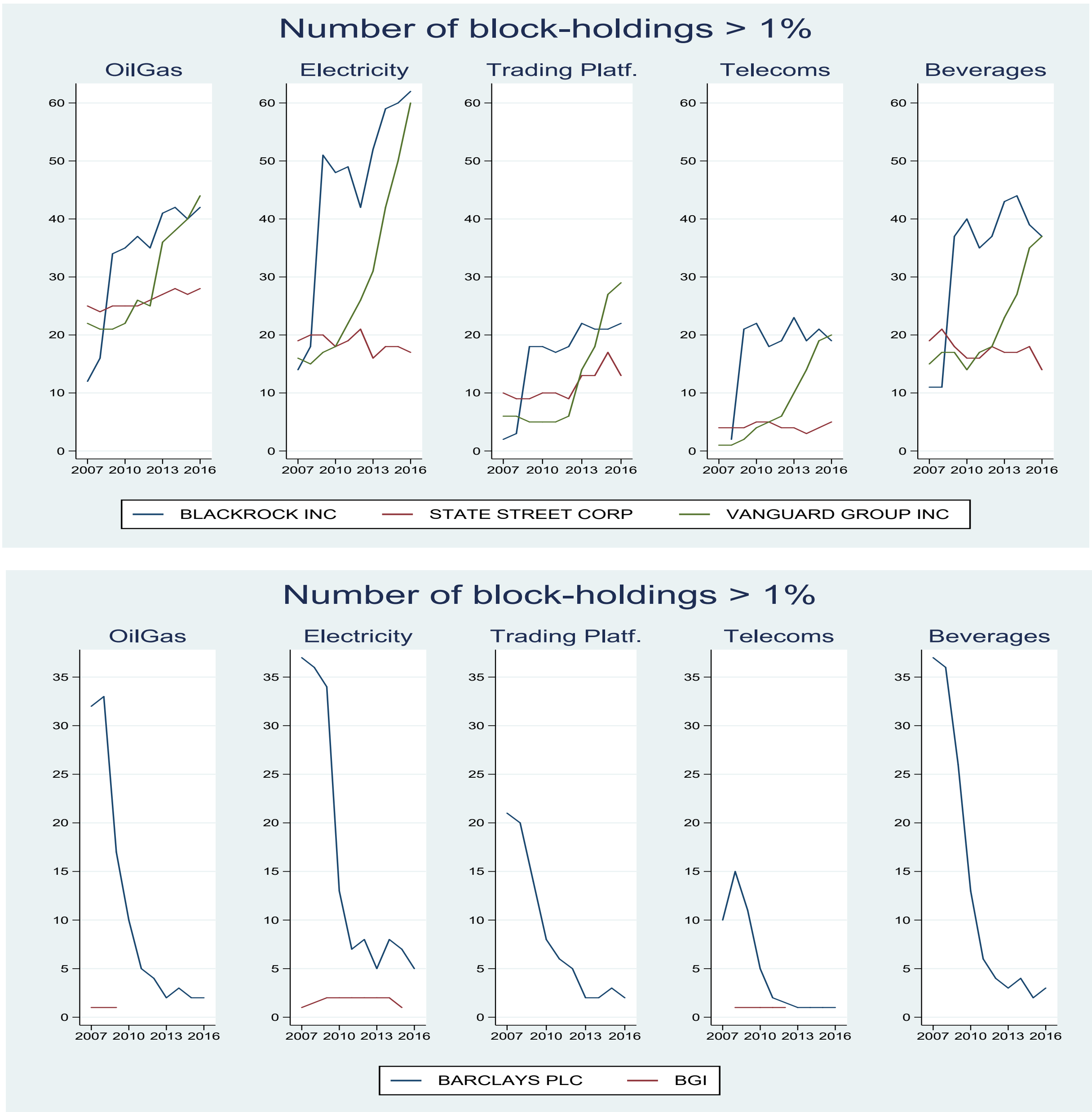
The BlackRock acquisition of Barclays Global Investors was announced 10 years ago to date, propelling the asset management fund to the top of global rankings, ahead of its competitors such as State Street and Fidelity Investments. It created what was at the time a behemoth of almost $3 trillion in assets, in what was just the latest in a series of acquisitions beginning with Merrill Lynch Investment Management. The sheer magnitude and speed at which BlackRock expanded has made it an interesting case study as well as instrument in impact evaluation models. Often these acquisitions do not occur independently of other events. In fact, the sale of BGI to BlackRock by Barclays was used to finance the acquisition of Lehman Brother's assets. In the meanwhile, BlackRock has grown to be the largest asset management fund in the world, and has gone from being a primarily fixed income business to a diversified business with interests in exchange traded funds, government consulting, and even a provider of risk and operations platforms for others in the industry.

The effects of the BlackRock-BGI merger are clearly visible in the databases of the five sectors. For the sake of comparison, Figure 6.1 presents the number of block-holdings at minimum 1% of participation in the portfolio of the 'Big Three' and of both BGI and Barclays PLC. The reason why Barclays PLC is also object of this investigation is because BGI has few links to the firms in each sector, while most of the participation of the group appears through Barclays PLC.

Table 6.1 compares the average participation shares in the portfolios of BlackRock and Bar-

[20] See in Chapter 4 the specific sections analysing the common shareholding indices for top investors, where evidence of this substitution effects between funds and banks is reported.

Figure 6.1: Number of block-holdings for the 'Big Three' (top) and Barclays/BGI (bottom) at 1% level.



clays PLC,[21] while Figure 6.2 reports the total market shares held jointly by BlackRock, State Street and Vanguard against the Barclays/BGI joint market shares. Market shares are based on the Total Assets or Market Capitalisation[22] of the firms in each portfolio, weighted by the respective participation shares. At the time of the merger, all dimensions - the number of firms in portfolio, the intensity of the participation and the market shares - dropped dramatically for BGI/Barclays PLC.

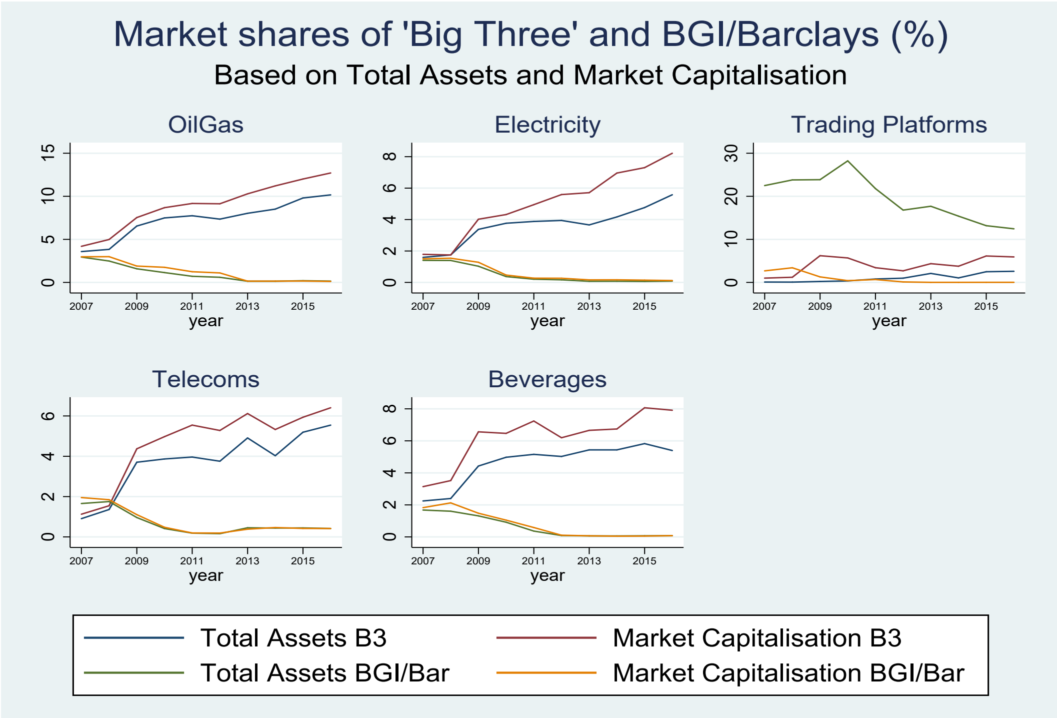
Table 6.1: Average participation shares in investors' portfolios. Results for Barclays PLC (BARC) and BlackRock (BR), by market and year.

		2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
Oil&Gas	BARC	3.02	2.96	1.79	1.38	0.85	0.80	0.52	0.48	0.55	0.65
	BR	0.96	0.82	3.97	3.85	3.52	3.32	3.43	3.51	3.54	3.91
Electricity	BARC	1.75	1.63	1.39	1.14	0.82	0.81	0.85	0.75	1.08	1.07
	BR	1.05	1.03	2.55	2.24	2.10	1.90	2.06	2.31	2.32	2.40
Stock Mkts	BARC	2.16	1.89	1.37	1.59	1.37	1.41	0.26	0.28	0.77	0.23
	BR	0.61	0.73	2.44	2.95	2.69	2.46	3.54	2.76	3.17	3.46
Telecoms	BARC	1.51	1.54	1.08	1.50	0.47	0.43	1.29	1.25	1.19	1.39
	BR	0.29	0.45	2.65	2.84	2.49	1.99	2.57	1.90	1.99	2.29
Beverages	BARC	2.68	2.10	1.70	1.44	0.85	0.62	0.66	0.71	0.63	0.67
	BR	1.07	0.65	2.64	2.78	2.41	2.48	2.52	2.72	2.73	2.59

[21] Analogous figures for State Street and Vanguard have already been presented in Table 5.2 in the previous Chapter. As for BGI, the ownership of this fund is often reported under Barclays PLC, hence its specific information is rather limited.

[22] For listed firms only.

Figure 6.2: Total market shares held jointly by BlackRock, State Street and Vanguard vs Barclays/BGI joint market shares.



6.5.2 Ownership changes between primary and secondary investors

Given that the BlackRock-BGI merger represented a once-in-a-lifetime event, we investigated the possible existence of other minor changes in ownership at the investors' level, which in turn may have provoked a relevant change in the degree of common shareholding of the firms active in each sector.

In each of the five markets, besides the usual set of top global investors,[23] a second group of relevant shareholders holding slightly smaller portfolios has been identified; this second group of investors represents a possible target of M&A from the largest investors, therefore being likely candidates of changes in ownership events. Overall, the patterns of ownership changes are similar to those already seen in the discussion specific to the 'Big Three' and the BlackRock-BGI merger. In almost every sector there is a sharp increase in ownership jumps of BlackRock in the sector, driven by its acquisition of BGI, and in turn a sharp sell-off on behalf of Barclays as they sell their division. By far these ownership jumps are the most significant in each sector.

[23] See Chapter 3.

This evidence is in line with the results of a similar investigation presented in Massa et al. (2018), where a series of asset management mergers is considered besides the BlackRock-BGI case. The authors comment that *“While these other mergers are considerably smaller in magnitude and scale, the analysis is helpful for at least two reasons. First, it clarifies to what extent the results from the BlackRock-BGI merger generalise to a broader setting. Second, it addresses any residual concern that the results we document are impacted by the financial crisis of 2008, the subsequent market recovery that took place during the BlackRock-BGI merger period, or any long-term trends around that time.”* Their empirical analysis finds that the statistical and economic significance of the effects of these minor mergers is *“an order of magnitude smaller”* than that of the BlackRock-BGI event. The authors argue that *“this was to be expected, as no other merger led to the same increase in ownership concentration.”*

For these reasons, no other ownership changes between investors are pursued further, concentrating our econometric analysis on the BlackRock-BGI merger. The selection procedure of the ’secondary top investors’ is reported in Appendix D, together with an investigation of ownership changes between primary and secondary investors during the period of observation.

6.5.3 Towards an application

This Chapter analysed several features of a possible causal model linking common shareholding and competition, and considered specific aspects of the five sectors, with the purpose of assessing their suitability as candidates for the econometric analysis.

The overall picture of ownership and common shareholding indicators is rather similar across sectors. The evidence of the BlackRock-BGI merger is also strongly present in all considered industries, which were all equally affected. Hence, the choice of the sector for the application of the econometric model is based rather on an overall interest, than on empirical grounds.

The food sector has been the object of much competition concern in the past decade, having seen many Commission initiatives investigating the food supply chain. Therefore, it seemed interesting to investigate further the Beverages sector. The next Chapter presents the application of the causal model to the industry of Beverages manufacturers. Section 7.1 describes in detail this market, and the various aspects which led to its choice for the econometric analysis. The empirical results are then reported, together with a series of robustness checks.

Chapter 7

Effects of the BlackRock-BGI Merger on Beverages Manufacturers

The merger between BlackRock and Barclays Global Investors (BGI) in 2009 generated an unprecedented shock in ownership of large corporations worldwide, having exogenously increased common shareholding of competitors across several industries. The effect of the merger on airlines has been analysed in the reference study of Azar et al. (2018), which generated a lively discussion and a number of additional studies in response.[1] This series of research, based on US data, has raised several antitrust concerns related to the potential distortion introduced by common shareholding. The present analysis falls within the above framework, providing one of the first attempts at assessing the possible anticompetitive effects of common shareholding in the EU.

To date, there are very few studies looking at common shareholding in Europe. Seldeslacht et al. (2017) present an overview of ownership of German companies, in particular looking at the presence of institutional investors and of their growing role in selected industries, both in terms of value held and of number of block-holdings. Recent reports by the Monopolies Commission (2018) and by the European Parliament (2020) investigate the extent of common shareholding in Europe, however their investigation is limited in scope to specific geographic areas or industries, and is kept at a descriptive level.[2] Pagliari and Graham (2019) propose the analysis of a counter-shock in ownership, i.e. the case of two commonly held airports whose ownership was separated; the authors provide evidence on how this change in ownership has affected the competition between the two airports, in terms of traffic, charges, prices,

[1] See, for example, the literature cited in the Introduction to the report.
[2] See more details in Chapter 1.

strategy, and other performance indicators. However, no market-level impact of the split in ownership can be gauged from this analysis.

Furthermore, all above studies remain at a descriptive level, and do not propose an econometric model for the measurement of potential causality between common shareholding and competition. Therefore, to the best of our knowledge, this is the first investigation of such potential antitrust effect based on firm-level data in the EU. The chosen industry for the analysis is the Beverages sector, constituted by the manufacturers of soft drinks, mineral waters, juices and beers active in the EU between 2007 and 2016.

Section 7.1 describes in detail the Beverages market, and the reasons behind its choice for the econometric analysis. Section 7.2 presents the main econometric model chosen to investigate causality between common shareholding and competition. Section 7.3 illustrates the main variables (outcomes and treatments), and the firm-level controls used in the analysis. Section 7.4 discusses the availability of the required variables in the observed sample, highlighting some structural limitations. Section 7.5 presents and discusses the main empirical results, while Section 7.6 reports alternative specifications used to test the robustness of the main model. The presence of heterogeneous effects is investigated in Section 7.7, and Section 7.8 reports some final remarks. Appendix D includes some complements to the econometric analysis.

7.1 The Beverages manufacturing industry

The monitoring of the food sector has raised several competition concerns in the past decade, with a number of actions taken towards antitrust enforcement in this area. The European Commission launched several initiatives to investigate the food supply chain. Some of the main points are summarised below; for further details please refer to Schmidt (2013), Cassels and Whiddingtion (2012), Collinson and Woodward-Carlton (2012) and European Commission press release (2018).

Starting as back as 2008, we witness the publication of the communication "Tackling the Challenge of Rising Food Prices" in May,[3] followed in December by the interim report "Food Prices in Europe".[4] In the same year the High Level Group on the Agro-Food Industry was formed, whose first findings gave basis for the Communication "A Better Functioning Food Supply Chain in Europe" in October 2009,[5] accompanied by the "Staff Working Document on Competition in the Food Supply Chain" issued by DG COMP.[6]

[3]Commission Communication on "Tackling the challenge of rising food prices - Directions for EU action", COM (2008) 321, May 20, 2008.

[4]Commission Communication on "Food Prices in Europe", COM (2008) 821, December 9, 2008.

[5]Commission Communication "A better functioning food supply chain in Europe", COM(2009) 591, October 28, 2009

[6]Commission Staff Working Document, "Competition in the food supply chain", accompanying document to the Communication "A better functioning food supply chain in Europe", October 28, 2009

In 2010 the High Level Forum for a Better Functioning Food Supply Chain was set up; within the Forum, the "Business to Business (B2B) Platform" proposed in 2011 and 2013 principles of good practice in B2B relationships in the whole food supply chain.[7,8] In January 2012 a Task Force was established within DG COMP to oversee competition within the food sector.

In May 2012 the European Competition Network publishes the "Report on competition law enforcement and market monitoring activities by European competition authorities in the food sector", a compilation of contributions from national competition authorities of the EU and DG COMP, describing antitrust investigations for the period 2004-2011. The following years (2012-2017) are covered in the recently released report "The application of the Union competition rules to the agricultural sector" (October 2018), accompanied by the Commission Staff Working Document with additional information on the investigations.

In 2012 DG COMP commissioned a study on the economic impact of modern retail on choice and innovation in the EU food sector. The study was conducted between May 2013 and September 2014 by EY, together with Arcadia International and Cambridge Econometrics. The results were published by the Commission in the "modern retail study" in 2014 (see EC, 2104), highlighting the presence and power of large retailers, with growing concentration. Their role in the food supply chain, and their interplay with the other parts of the chain, are discussed in Chauve et al. (2014) and Chauve and Renkens (2015), where several competition issues are analysed. In particular, the authors suggest that "innovation is more likely to be hampered by highly concentrated food manufacturers than by powerful retailers" , and that "the spotlight of competition enforcement is on retailers but the processing and manufacturing part of the chain is the largest source of antitrust cases", pointing to the need of more attention on the manufacturing part of the food supply chain.

The present analysis focuses precisely on manufacturers and their ownership structure, looking at both common and cross-ownership. Within the broader food sector, the study investigates the Beverages industry, more specifically looking at manufacturers of Soft Drinks, Bottled Waters, Juices and Beers, active in the EU territory. In the soft drinks category all carbonated (cola and non-cola) drinks are included, as well as sports drinks and energy drinks. The brewery industry has been included given its role as potential entry point in the soft drinks market. Manufacturers of other alcoholic drinks such as wine or spirits are not object of the present investigation. The wholesalers of Beverages have also been excluded, being active at a different level of the supply chain.

The choice of the Beverages industry within the food sector has been based on the consideration of several aspects, in cooperation with DG COMP. On the one hand the market is very dynamic - the entry into the segment is technically rather straightforward (although strong

[7] Core Members of B2B Platform: “Vertical relationships in the Food Supply Chain: Principles of Good Practice”, November 29, 2011.

[8] B2B Platform (industry and retailers without farmers): “Framework for the implementation and enforcement of the principles of good practice in vertical relations in the food supply chain”, January 25, 2013.

brands are present) - and has experienced several changes during 2007-2016: the share of bottled waters has been increasing over total consumption, with a gradual uptake of flavoured and sweetened waters; changes in consumers' preferences are visible in growth of consumption of smoothies and juices, with a clear consumers' trend toward healthier food/drinks; the popularity of energy drinks largely increased;[9] changes in regulation about beverages (e.g. "sugar tax") or related issues such as packaging materials and food information took place during the period of observation.[10]

On the other hand, looking at concentration and common shareholding structures,[11] several points are of interest in this industry, among which the following: there is very high market concentration, with the top three soft drinks champions (CocaCola, Pepsico and Mondelez) covering the main part of world market in soda; the top players present major common shareholding by institutional investors; there are quite significant changes, both in relative and in absolute terms, in the shares owned by key institutional shareholders, such as BlackRock and Vanguard, in the period of observation; cross-ownership is also widely present, due to several large corporate groups; there are many companies active in the EU, but registered outside, with a strong foreign ownership structure; and, finally, common shareholding is also present where manufacturing of soft drinks is a secondary activity (e.g. Danone).

The "intensity" of investments is also quite high in this industry, with the average participation shares in all investors' portfolios growing over time during the decade of observation. In 2016, the top 10% of investors held on average stakes of about 7% or more in the firms in their portfolios. This is in line with the presence of large corporate group, where the participation level in the subsidiaries is very high. Even the investments of the 'Big Three' (BlackRock, State Street and Vanguard) reach high and increasing levels, with BlackRock and Vanguard holding in 2016 stakes of 5% or more in about one fifth of firms in their EU Beverages portfolio. The joint market share of the 'Big Three' also increases steadily over time, in 2016 amounting to more than 5% of the industry's Total Assets.

Overall, the proximity of portfolios among institutional investors is very high, giving rise to strong interconnections between shareholders. At the same time, most of the firms are linked through common shareholders that invest intensely in them, about 45% of firms being cross-held by block-holders with minimum 5% stakes, steadily through the whole period of observation.

[9] "Globally, the energy drink industry has gone from a $3.8-billion business in 1999, to a $27.5-billion business" in 2013. Source: Ferdman (2014).

[10] For example: Commission Regulation (EC) No 282/2008 on recycled plastic materials and articles intended to come into contact with foodstuffs; Directive 2009/54/EC of the European Parliament and of the Council of 18 June 2009 on the exploitation and marketing of natural mineral waters; Commission Regulation (EU) No 115/2010 laying down the conditions for use of activated alumina for the removal of fluoride from natural mineral waters and spring waters; Regulation (EU) No 1169/2011 of the European Parliament and of the Council of 25 October 2011 on the provision of food information to consumers (e.g. the mandatory nutrition declaration).

[11] See dedicated sectoral analysis in Chapter 4.

7.1.1 Data description

The set of firms investigated in the present study has been identified following an ad-hoc process that benefitted from crucial input from DG COMP.[12] The selected period of analysis is dictated by data availability: all firms' information - regarding their ownership, financial performance, area of activity, and other characteristics - is extracted from the Orbis commercial database provided by Bureau van Dijk, covering the period 2007-2016. The main features of the dataset are recalled below.

The set of manufacturers in the Beverages market relevant for the present analysis is composed by all listed firms active[13] in the EU between 2007 and 2016, classified with the following NACE codes[14] of industrial activity: manufacture of beer (1105); manufacture of soft drinks, production of mineral waters and other bottled waters (1107); manufacture of fruit and vegetable juice (1032). Few dozens of extra unlisted firms were added based on expert opinion. All-together, we obtain a list of 290 firms, of which 214 are listed (or delisted[15]) manufacturers. The remaining 76 firms are the relevant unlisted players. Of the selected firms, 33% are classified as manufacturers of beer (as core activity), 32% of soft drinks and mineral waters, and 2% of juices. The remaining firms present a core activity of other nature, including wholesale of beverages, distilling, rectifying and blending of spirits, other processing and preserving of fruit and vegetables, activities of head offices, and so on.[16]

Roughly two-thirds of the firms are registered in the EU (69.15%), with Germany accounting for about 20% of the sample, followed by France and the United Kingdom at around 5%. Outside EU, the US are the largest country represented, with 8.81% of firms in the sample registered there.

The selected firms present different types of shareholding structures. Along the ten years of observation, there are 5498 different reported shareholders, on average around two thousand per year. Among these, roughly 30% are common shareholders steadily throughout the period. Looking at investors' portfolios, the average participation shares increased continuously from 4.67% in 2007 to 5.60% in 2016, and the number of block-holdings also increases in the decade of observation for all considered levels of participation (minimum 1, 3, 5 and 10 percent).

[12] For further details see Appendix C.

[13] Firm active in the EU: either registered in the EU, or registered outside the EU but holding shares in at least one firm registered in the EU.

[14] Among Core, or first four Primary codes, or first twenty Secondary codes.

[15] The term "delisted" indicates firms that were listed at some point during the period of observation, but were later delisted.

[16] In these cases the beverages manufacturing activity will appear not as a core, but as primary or secondary activity.

7.2 The main causal model

Looking for an appropriate model to establish causal effects of market structure on competition, the choice was ultimately narrowed down to a Difference-in-Differences (DiD) approach (see full discussion in Section 6.4).

Despite being the most suitable model for the purpose of this exercise, there are certain considerations to be taken into account if a DiD approach is to be used. First, there is no clear policy shock or regulation that would directly affect common shareholding; second - as a consequence - the splitting of the sample between treated and control units is not as straightforward in the present context as in a standard DiD policy exercise.

The event of a merger, and in particular the 2009 BlackRock-BGI merger, has been used before in a similar setting by Azar et al. (2018), as recalled earlier. In a similar fashion, in our application the treatment group will consist of the firms exposed to (i.e. held by) BGI or BlackRock before 2009. Therefore, we can leverage the 2009 merger between the two investors as the exogenous policy event that introduces variation to the indices of common shareholding in the market.[17] The control group will include all firms which were held neither by BlackRock nor by BGI prior to the merger.

In terms of econometric strategy, this merger allows both to define a "pre" and a "post" period, as well as to identify a treated and a control group, therefore establishing the essential items for a DiD approach. The main DiD model estimated in this study is specified as follows:

$$y_{ft} = \alpha + \gamma \; treated_{f2007} \times post_t + \delta \; x_{ft} + f_t + f_f + u_{ft} \tag{7.1}$$

where y_{ft} is the markup of firm f in year t; $treated_{f2007}$ is a dummy variable that equals one if a firm f, in year 2007, was held by BlackRock and/or Barclays BGI, and zero otherwise; since the merger was announced on June 11, 2009 we define $post_t$ as a binary variable that is equal to one from 2009 onwards and zero otherwise; x_{ft} is a vector of firm-level explanatory variables; f_t are time fixed effects that capture macroeconomic shocks common to all firms in year t, and f_f are firms fixed effects that control for unobserved heterogeneity between firms. Finally, u_{ft} is the error term, clustered at the firm level to control for the impact of residual unobservable shocks.

The model presented above represents the baseline econometric approach for studying the causal effects of common shareholding. In particular, the impact of the change in common shareholding induced by the merger is estimated by comparing the markup - before and after the event - of firms exposed to the merger to that of firms that did not have any relations with BlackRock and/or BGI. In terms of Eq. (7.1), such an effect is measured by the coefficient γ: a positive sign of this parameter would indicate that the merger led to a higher markup in firms

[17] See Massa et al., (2018) for a discussion of the exogeneity of the BlackRock/BGI merger event.

dependent on BlackRock and/or BGI as compared to those not dependent on either investor.

Furthermore, it is worth noting that we measure the treatment indicator in 2007, and keep the value fixed for all periods in the sample. The use of a pre-determined treatment variable assures that such an indicator does not vary with common and unobservable shocks which could simultaneously impact the firms' markup, generating reverse-causality type of issues.

Finally, notwithstanding that the BlackRock-BGI merger can be considered as a quasi-natural experiment, a remaining concern is that the treatment status is not randomly allocated across firms. In other words, the status could be correlated with other firm's characteristics that in turn are influenced by the merger event. If this were the case, the exogeneity conditions of the included control variables would be violated after the merger, leading to biased estimates (Lechner, 2011). Hence, to overcome this concern, besides the inclusion of time-varying firm characteristics (x_{ft}), we allow for interactions between the variables in x_{ft} and the $post_t$ event indicator. This helps ruling out that results are driven by changes in observable firm characteristics and not by the merger event itself (see a similar approach in Massa et al., 2018).

7.3 Model variables

Measures to assess common shareholding and the level of competition in our sample were extensively discussed in previous Chapters. Different firm and market level indices were constructed, offering viable alternatives to the indices commonly used in the literature, such as the Herfindahl-Hirschman Index. In our empirical model, some of these new indices are used to pursue the econometric strategy.

Regarding the dependent variable, prices were the first choice for an indicator of changes in the competitive forces on the market. However, due to the difficulty in gathering the data on prices at the required level of specificity, other suitable measures of competition were developed. The discussion of the various measures was outlined in Chapter 6, and the Lerner Index was established as the best alternative. The model specification uses a series of firm-level control variables and fixed effects, as well as other ownership-based indices; some of these have been employed previously in the literature as relevant factors to discern potential causal effects of the 'policy' experiment under consideration.

Both outcome and control variables related to firms' financial statements refer to end-of-year accounts; for example, data points labelled "2010" correspond to 31.12.2010. Furthermore, the financial database reports one account per firm, reflecting global operations. In fact, each firm corresponds to one legal entity, whose balancesheet is presented to local authorities without geographical or activity break-down, regardless of its corporate organizational structure. In some cases, we could wish more disaggregated information, such as in the case of multinationals or large multi-activity corporations, but also for smaller enterprises producing a series of different products. However, this level of detail is not available, since the global format reflects the actual reporting of financial statements in the official records of the Business Registers. Notice also that the accounts are harmonised according to international standards, hence providing a good term of comparison across firms.

7.3.1 Competitive outcomes

In order to gauge variations in competitiveness, and as a way to calculate the markup of firms, we adopt the Lerner Index. In the literature, this index is frequently considered as replacement of the markup, because it bypasses many of the impracticalities associated to calculating the markup directly (see IMF, 2019).

Estimating markups from a theoretical point of view would require variables that are often not directly observable, such as prices or marginal costs. The Lerner Index is in practice a monotone transformation of the markup, and can be constructed using different items of the balance sheet and profit & loss account. Specifically:

$$\text{Lerner Index} = \frac{\text{Operating profits and losses}}{\text{Operating revenues}}$$

where: "operating revenues" (Orbis variable[18] *OPRE*) include net sales, other operating revenues and stock variations; while "operating profits and losses" are given by variable *EBIT*. This definition of the index is consistent with that of IMF (2019), also based on Orbis firm-level financial variables. The advantage is that a viable index is obtained using available data.

As a robustness check, an adjusted Lerner Index is also constructed, defined as:

$$\text{Adjusted Lerner Index} = \frac{\text{Operating profits and losses} - \text{Cost of capital}}{\text{Operating revenues}}$$

which accounts for the cost of capital. The latter has been computed by multiplying all tangible assets (Orbis *TFAS*) with the nominal interest rate, and subtracting the average expected inflation of 2% (following Konigs and Vandenbussche, 2005).

7.3.2 Treatment variables

The treatment is defined in different ways according to the various specifications of the DiD model, and can be summarised as follows:

- **Treated**: dummy variable that equals one if a firm was held by BlackRock and/or Barclays BGI in 2007, zero otherwise;

[18] For this and other Orbis variables, see definition in Appendix A.

- **BGI&BR**: dummy variable that equals one if a firm was *jointly* held in 2007 by *both* BlackRock and Barclays BGI, zero otherwise;
- **Shares owned**: the amount of shares of a firm held by BlackRock or Barclays BGI in 2007 (or their sum if the firm was jointly held); the purpose is to capture the degree of exposure to BlackRock and/or Barclays BGI before the merger.

7.3.3 Firm-level controls

Several controls have been used to explicitly account for heterogeneity of firm-level characteristics, besides what captured by the fixed effects. Their definition is as follows:

- **Total assets**: total assets (fixed assets + current assets);
- **Shareholders′ HHI**: index of concentration of the shareholders' structure of a firm; it is obtained as an Herfindahl-Hirschman Index (HHI) computed on the set of shares held by recorded shareholders with *direct* participation;
- **Shares top 4 owners**: total shares held by the four recorded shareholders with largest direct participation (excluding aggregated shareholders);
- **Shares owned by Big2**: total shares held jointly by State Street and Vanguard (Big2);
- **Firm′s integration**: degree of integration of firm with remaining firms in the market through owners (average correlation between shareholding structures of given firm with competitors).

While the Total Assets are the usual proxy for firm size, the remaining controls are worth a short note. The link between shareholding structure and corporate performance has been investigated in the past, for example in Demsetz and Villalonga (2001); in such work, based on 511 US firms from all sectors of economy observed in 1976-1980, no significant relation is found, mainly due to the presence of diffuse ownership. Nevertheless the period of observation is rather back in time, and is based on different geographical and industry references, hence we believe that the issue is still worth investigating in our current dataset. For the effect, we choose three indicators, namely two indices of concentration of ownership (Shareholders' HHI and Shares top 4 owners, as defined above), and an index of presence of other main institutional investors among the shareholders (total shares held jointly by State Street and Vanguard). Similar indices have been investigated in Seldeslacht et al. (2017) and in Fichtner et al. (2017), among others.

The last control variable accounts for the cross-links in shareholding structures between a firm and its competitors, a measure of the firm's integration in the market through its owners.

Although the measure is computed in a different manner, the logic behind this indicator is similar to that of Backus et al. (2018), where "profit weights" are computed for each pair of firms, starting from their shareholding structures. Such weights give rise to some "cooperation matrices" reflecting the interactions of pairs of firms generated by their ownership overlaps.

7.4 Sample description

The ownership information is complete for almost all the sample and over the entire period of the analysis. However, the requirements on balance sheet reporting vary according to differing country legal frameworks and firms' listing status. In some cases this leads to absence of financial information for given corporations. For this reason, part of the selected sample cannot be included in the econometric analysis due to missing data. The issue of missing financial data and how this may influence the econometric strategy is discussed in further detail below.

Table 7.1 reports the number of cases excluded from the analysis, out of the total number of available firms per year.[19] The second column shows that there are 664 observations for which financial data are missing, either on the dependent or on control variables. This amounts to 66 firms per year, on average.

Table 7.1: Summary of dropped observations due to non-reported financial variables (Missing financials) or Lerner Index outside the [-1, 1] interval (Trimmed Lerner Ind.), by year.

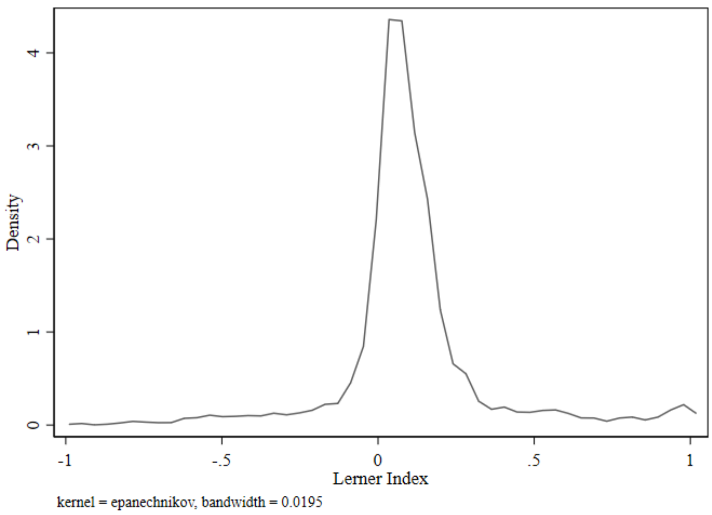
Year	Number of obs.	Missing financials	Trimmed Lerner Ind.	Final sample
2007	241	63	7	171
2008	245	63	12	170
2009	250	64	13	173
2010	257	66	8	183
2011	259	66	6	187
2012	259	59	5	195
2013	263	62	8	193
2014	264	66	8	190
2015	264	70	7	187
2016	261	85	4	172
Total	2563	664	78	1821

[19] Notice that in general not all 290 firms in the overall sample are available each year, due to their natural life-cycle. Moreover, given that the individual firm we refer to is a unique legal entity, a company may appear as "absent" from the sample after a change its legal identity - for example due to a restructuring (e.g. takeover) - even if not ceasing to exist in practice.

Moreover, sometimes there are outlying values among those companies that have complete information. In particular, in the case of the main outcome variable a limited number of abnormal values were observed (Lerner Index outside the $[-1, 1]$ interval); such values were excluded following the IMF procedure.[20] As a result of the trimming procedure, an additional 78 observations are excluded over the period 2007-2016. This implies that a company drops out of the sample in a year when it presents an abnormal value, but is kept in the remaining years of observation. The reason why extraordinary values of the Lerner Index are recorded can vary from a simple reporting error to more extreme cases where firms experience severe shocks. In any case, it is impossible to determine what is the cause of the non-plausible values; given that a correction is not feasible, outliers are dropped.

The distribution of the trimmed Lerner Index is depicted in Figure 7.1. While the distribution before the trimming is not very informative, after removing the few observations above 1 and below -1, the variable seems normally distributed.

Figure 7.1: Distribution of the Lerner Index After Trimming



Finally, we have excluded eight observations from treated firms for which no before-after comparison was possible - data were available only before (or during) the year of the merger.[21]

Overall, we have 1,813 observations between 2007 and 2016, related to 233 distinct firms. Around 85% of the observations present non negative values of the Lerner Index, while the remaining ones display negative values due to operating expenses exceeding operating revenues. Summary statistics are shown in Table 7.2.

For a correct interpretation of the results, however, it is crucial to identify and characterise the

[20]In the IMF procedure only values between -1 and 1 are kept. See International Monetary Fund (2019).

[21]The eight dropped observations refer to the following cases: CHRIST WATER TECHNOL, 2007; ANHEUSER-BUSCH COMPANY, 2007; PEPSI BOTTLING GROUP, 2007-2008-2009; PEPSIAMERICAS INC 2007-2008-2009. None of these companies are observed after 2009. Results do not change if these observations are included in the sample.

companies that are excluded or that drop out occasionally due to outliers. Appendix D presents and discusses summary statistics on the excluded firms, and characterises them in terms of country of registration and listing status, in order to capture possible distortions introduced by these specificities. As shown in Appendix D, it can be observed that a large proportion of companies with missing financial information belong in general to countries with less stringent reporting requirements (such as Germany). On the other hand, the presence of outliers in the outcome variables seems to be more randomly spread in terms of country and NACE codes, even if most of the companies trimmed on the basis of outliers are non-listed.

Table 7.2: Summary statistics over the entire period of observation

	No. obs.	mean	sd	min	max
Lerner Index	1813	0.10	0.24	-0.97	1.00
Treated	1813	0.27	0.44	0.00	1.00
Post	1813	0.82	0.39	0.00	1.00
(log) Total assets	1813	19.28	2.74	9.20	25.99
Shareholders’ HHI	1813	3807.55	3580.25	0.00	10000
Shares top 4 owners	1813	62.66	34.27	0.00	100
Firm’s Integration	1813	0.26	0.36	0.00	1.00
Shares owned by Big2	1813	0.76	2.13	0.00	15.68

Finally, Table 7.3 reports the composition of the treated firms in the final sample. Of the firms observed in 2007, 53 are treated; among these, three firms are held only by BlackRock (the average share owned is equal to 0.37), 27 are held only by BGI (with average shares of 1.99%) and 23 are held by both BlackRock and BGI (the average total share is 4.15%).

Table 7.3: Average shares owned by BGI and/or BlackRock (BR) in 2007 in different sets of firms

	Obs.	Held by BR	Held by BGI	Held by BR & BGI
Treated firms	53			
of which:		3	27	23
Shares held by BR/BGI		0.37	1.99	4.15

To complement the above baseline information, the evolution of ownership of the treated and control groups over the following years is inspected. Figures 7.2 and 7.3 report the average shares owned by Barclays/BGI and BlackRock, respectively, in three sub-groups over the time frame under analysis: firms jointly owned by the two investors, firms owned only by either of them, and firms owned by neither. While in the first figure the importance of BGI in the shareholders’ composition decreases, BlackRock appears to gain a larger share, especially among the firms that in 2007 where jointly held by both investors. It is also noteworthy that companies that were not owned by neither BGI nor BlackRock in 2007 do not experience large acquisitions by the two in the following 9 years. Detailed results on ownership of key players of the market can be found in Appendix D.

Figure 7.2: Average shares owned by Barclays/BGI

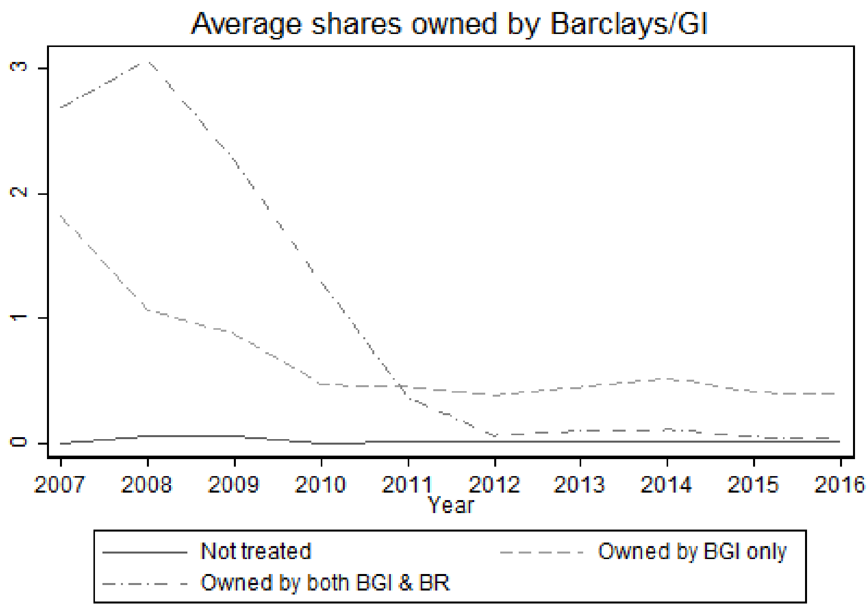
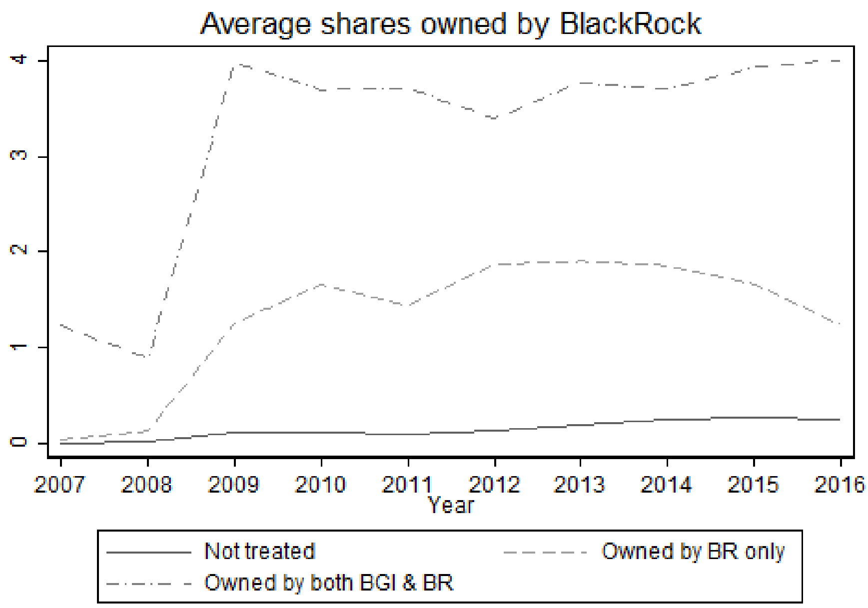


Figure 7.3: Average shares owned by BlackRock



7.5 Empirical results

7.5.1 Preliminary evidence

As already mentioned, the main dependent variable used as a proxy for the market power is the Lerner Index. As a preliminary piece of evidence, Table 7.4 compares the average value of the Lerner Index observed for treated firms with the average value in non-treated firms, over the period 2007-2008 (before the merger) and for the years 2009-2016 (after the merger). In particular, it is worth noting that before the merger, the average Lerner Index is higher in the group of treated firms (0.14) than in that of control firms (0.06), and such a difference (0.08) is statistically significant at 1%. The same comparison for the years after the merger gives, instead, a difference of 0.12, statistically significant at 1%, that is treated firms show, on average, an higher Lerner Index compared to non-treated units. Finally, it emerges that the difference in the differences (0.04 = 0.12 – 0.08) is positive and very close to be statistically significant at the conventional level (p-value = 0.130). While descriptive, this evidence seems to suggest that the merger has allowed firms already exposed to BlackRock and BGI to increase their market power. However, before moving to a more rigorous analysis, there are two key issues that must be carefully considered.

Table 7.4: Preliminary DiD evidence

Lerner Index	Treated	Controls	Difference (Treated — controls)
Before	0.14 (0.02)	0.06 (0.01)	0.08*** (0.04)
After	0.20 (0.01)	0.08 (0.01)	0.12*** (0.01)
Difference (After — Before)	0.06** (0.03)	0.02 (0.01)	**0.04** (0.03)

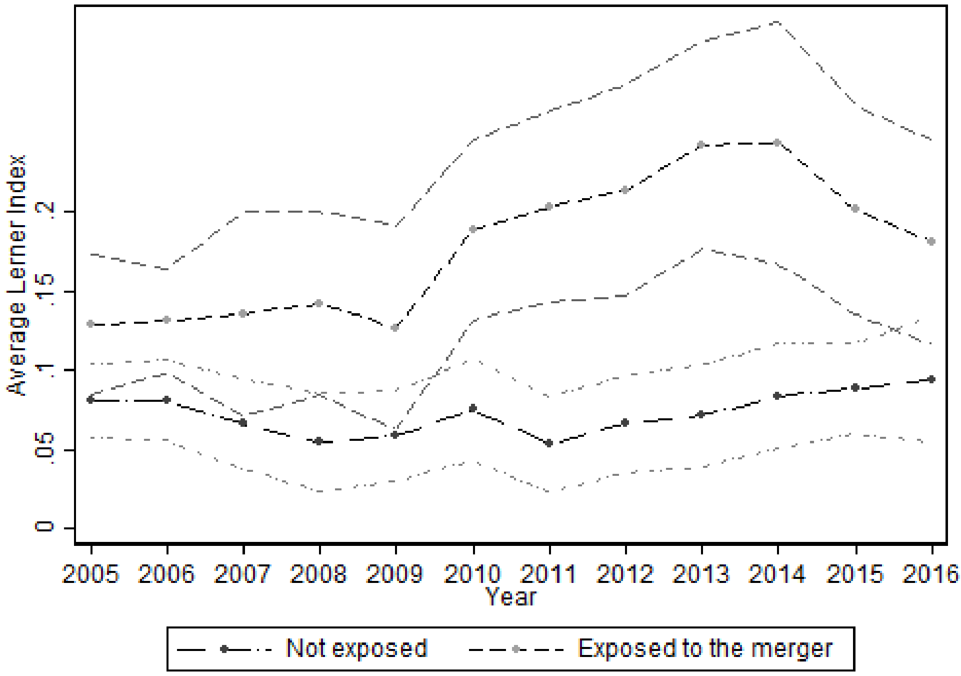
*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

On the one hand, one of the main assumption for the validity of the DiD method is the presence of pre-treatment common trends for treated and control firms, that is treated firms would have experienced the same trend in their potential outcomes as the control firms in the absence of the merger. Figure 7.4 depicts the evolution[22] of the average Lerner Index for treated and

[22] Notice that the series of the Lerner Index are shown also for 2005 and 2006, given that financial reports are available in those years. However, the definition of treated and control groups remains the same as before, i.e. is still based on ownership data for 2007, which is the first available year.

non-treated firms. Although purely suggestive, it can be noticed that trends look similar before the merger, since the confidence intervals overlap, while differ after the merger was in place, with the value of Lerner Index being particularly pronounced for treated firms in the years 2013 and 2014.

Figure 7.4: Naive evidence of the common trend: average Lerner Index (±2*SD*) in treated (*exposed*) and control (*not exposed*) groups.



On the other hand, since the assignment to the treatment group is not random, there might be firms' observable characteristics that determine the probability of being treated. In other words, the treated firms, namely those held by BGI and/or BlackRock in 2007, could be very different in terms of observable characteristics, such as size, turnover, etc., from those in the control group, thus any observed effects on the Lerner Index might be simply due to these different characteristics rather than the merger event. Were it the case, the exclusion of these characteristics from the regression would lead to biased estimates.

To account for this, a mean comparison test between treated and control firms is carried out on pre-treatment data[23] for the observable characteristics described in the previous section. Results are shown in Table 7.5, showing that the level of total assets and total share owned

[23]For most firms, the ownership and financial values used for the tests are those from the year 2007. However, for four treated firms and 10 control firms, financial data are only present from 2008. It follows that they are included in the empirical analyses only from 2008, and that for these cases the tests presented in Table 7.5 are run on 2007 ownership data but on 2008 financial data.

by the "big two" (State Street and Vanguard) are significantly larger on average for treated firms as compared to control units. On the contrary, control units show a higher HHI index and share of top 4 owners with respect to treated firms. It seems that there is no difference in terms of integration between treated and control firms. Finally, while the initial level of the Lerner Index for treated firms appears to be larger than that observed for control firms, such a difference is weakly statistically significant (p-value = 0.071).

Table 7.5: Pre-treatment comparison between treated and control units

Variable	Treated	Controls	Difference (Treated−controls)
Lerner Index	0.14	0.06	0.08 *
	(0.04)	(0.02)	(0.04)
(log) Total assets	21.73	18.24	3.49 ***
	(0.23)	(0.19)	(0.30)
Shareholders' HHI	1021.98	4542.58	-3520.60 ***
	(178.94)	(315.10)	(362.37)
Shares top 4 owners	35.59	69.04	-33.45 ***
	(3.75)	(2.86)	(4.71)
Firm's Integration	0.26	0.27	-0.01
	(0.04)	(0.03)	(0.05)
Shares owned by Big2	1.67	0.02	1.65 ***
	(0.33)	(0.02)	(0.33)
Number of firms	53	128	

*Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

7.5.2 Results from Difference-in-Differences model

The first round of DiD results is reported in Table 7.6. Here, the results of the estimation of Eq. (7.1) are displayed under different specifications: column (1) reports the model without control variables; in columns (2) and (3) the analysis is replicated by including controls and their interaction with the *post* indicator, respectively. Central to the issues at hand is the coefficient of $treated \times post$, which is positive (0.069) and statistically significant at 5% level in the specification in col. (1), and it is very similar (0.072) when controls are included. When we interact controls with *post* (col. 3), the coefficient of interest is larger than those in the previous specifications[24] (0.113), and it statistically different form zero at a 5% level.

[24] Such an increase in the size of the coefficient might indicate that estimations in col. (2) are affected by a negative correlation between $treated \times post$ and the control variables observed after the merger. Furthermore, it is worth

While for column (2) the implicit assumption is that the dummy for post years has a different effect only for the treated, in column (3) we postulate that all covariates might have different effects after the merger, compared to their effect before, which remains the reference point. In other words, the coefficient for each non-interacted firm characteristic has to be interpreted as the marginal effect for that variable only for the reference years before the merger.

Table 7.6: Main results

Dep. var.: Lerner Index	(1)	(2)	(3)
Treated*post	0.069**	0.072**	0.113**
	(0.034)	(0.035)	(0.049)
(log) Total assets		-0.007	-0.007
		(0.009)	(0.011)
Shareholders' HHI		0.004	-0.006
		(0.007)	(0.008)
Shares top 4 owners		0.010	0.049
		(0.049)	(0.079)
Firm's Integration		0.007	-0.003
		(0.035)	(0.044)
Shares owned by Big2		-0.501	0.631
		(0.664)	(1.105)
(log) Total assets*post			0.001
			(0.007)
Shareholders' HHI*post			0.012**
			(0.005)
Shares top 4 owners*post			-0.042
			(0.077)
Firm's Integration*post			0.015
			(0.036)
Shares owned by Big2*post			-0.952
			(0.777)
Observations	1,813	1,813	1,813
Treated	483	483	483
Controls	1,330	1,330	1,330
Year fixed effects	yes	yes	yes
Firm fixed effects	yes	yes	yes
R-squared within	0.015	0.019	0.026
R-squared overall	0.614	0.615	0.618

Robust standard errors, clustered at the firm levels, in parentheses
**** p<0.01, ** p<0.05, * p<0.1*

noting that, although the estimated coefficient of *treated* × *post* in col. (3) is larger than the one estimated in col. (2), its 95% confidence interval ranges from 0.02 to 0.21 which includes 0.72, the point estimate of the specification reported in col. (2).

As usual, the interaction term between post and each predictor represents the difference in the coefficients between the reference period and the post period.[25]

None of the control variables is statistically significant in the specification of col. (2). When the controls are interacted with *post*, only *Shareholders' HHI* is statistically significant, indicating that firms with more concentrated shareholders' structures experience a positive impact on the Lerner Index after the merger.

The results indicate that firms held by BlackRock and/or BGI in 2007 show a Lerner Index on average 0.07 points higher than control firms after the merger, suggesting that the merger triggered an increase in profitability of firms already exposed to BlackRock and/or BGI.

Analogous results are obtained using as outcome the alternative competition measure described earlier, i.e. the Lerner Index adjusted for cost of capital. Results are presented in Appendix D. Notice that in this case the sample is slightly more reduced, given that not all firms report the necessary financial variables for the calculation of this adjusted outcome.

While the results indicate an increase of the Lerner Index associated with the merger, nothing is said on whether such an effect is driven by changes in revenues and/or costs.[26] To closely inspect which component of the Lerner Index pushes more the effect, we plot the (average) evolution of revenues and costs for treated (Figure 7.5a) and control (Figure 7.5b) firms, before and after the merger. In the case of treated firms, both revenues and costs move along the same path before the merger, and immediately after we observe a sharper increase in revenues as compared to costs, while moving again along a similar trend from 2010 onwards. Regarding control firms, both revenues and costs follow a similar – almost identical – path, before and after the merger. What emerges is that the increase in the Lerner Index seems to be driven more by a marked increase in revenues rather than a decrease in costs.

While this exercise represents a first attempt to link common shareholding with a measure of firm's competitive outcome, other ex-post studies evaluated the impact of merger decisions on prices. Kwoka (2013) collects 46 merger cases in the US and presents the average price effects estimated by this sample of studies. It turns out that in 38 cases the merger led to a price increase of approximately 9.85%, while in only 8 cases a decrease in prices was found (around 4.83%). Turning to Europe, a recent report commissioned by the European Commission to a team of academics at the Centre for Competition Policy, University of East Anglia, reviews ex-post evaluations of the impact of merger decisions by EU competition authorities.[27] According to the report, it emerged that post-merger prices increased in 14 studies, with such an effect being estimated at around 8.24%, while, on the contrary, in 7 studies a decrease in the level

[25] Note that estimating a fully interacted model is very similar to estimating two separate models - the so-called split sample - one before and one after the treatment, and it would be perfectly equivalent if we did not include fixed effects. However, we prefer to run the interacted estimation rather than the split sample estimator because the p-value for each interaction term provides a significance test for the difference in those coefficients.

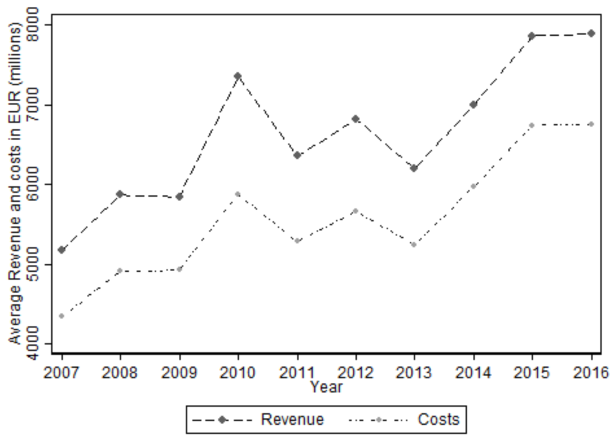
[26] The revenues variable corresponds to the *OPRE* variable from Orbis, while the costs are obtained by subtracting revenues (*OPRE*) from the *EBIT* variable.

[27] See Ormosi et al. (2015).

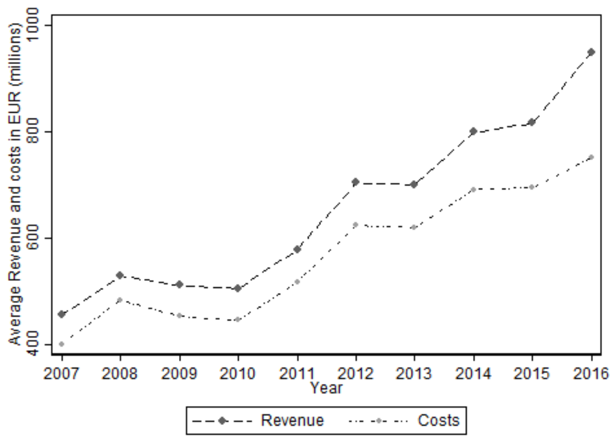
of prices was detected (-4.20%). It is worth noting that all these studies have investigated the impact of several merger events occurring in different industries, but none of them has looked at the specific BlackRock-BGI merger. The latter has been exploited in a quasi-natural experimental setting only by Azar et al. (2018), who find that airline ticket prices, after the merger, are 10% to 12% higher due to the common shareholding.[28]

In any case, the large majority of studies surveyed in the above-mentioned literature uses the level of prices as a proxy of market competition, so our results can reconcile with such findings only to a certain extent, given that prices are not observed in our data.[29]

Figure 7.5: Revenues and costs



(a) Treated firms



(b) Control firms

[28]A recent paper, Massa et al., 2018, exploits the merger between BlackRock and Barclays BGI to understand how the change in common shareholding affects the investment behaviour of funds.

[29]Being very cautions against any comparison beyond the descriptive evidence, one could provide a rough and indirect estimate of the price increase by looking at the change in revenues induced by the merger. Yet, in order to do this, further hypotheses should be made about the trends in costs, which can invalidate the whole exercise.

7.5.3 Who drives the effect?

In the figures below, a visual overview of the relevance of each treated firm in the baseline estimation is provided. In Figure 7.6, firms held in 2007 either by BlackRock (the first three data points from the left) or by Barclays/BGI (the remaining from the fourth onwards) are dropped from the sample one at a time. The same exercise is conducted in Figure 7.7 focusing on firms held in 2007 by both BGI and BlackRock.

In case a deviation from the main trend is observed, this signals that the specific dropped firm played a pivotal role in driving the estimates of our original baseline specification. For instance, this might be due to an exceptionally high or low Lerner Index. Overall, the value of the impact is rather constant and does not suffer from notable changes when single firms are dropped from the sample.

Figure 7.6: Effect of treatment excluding, one at a time, firms owned by either BGI or BlackRock. First three firms on the left are held by BlackRock; firms on the right, are held by BGI.

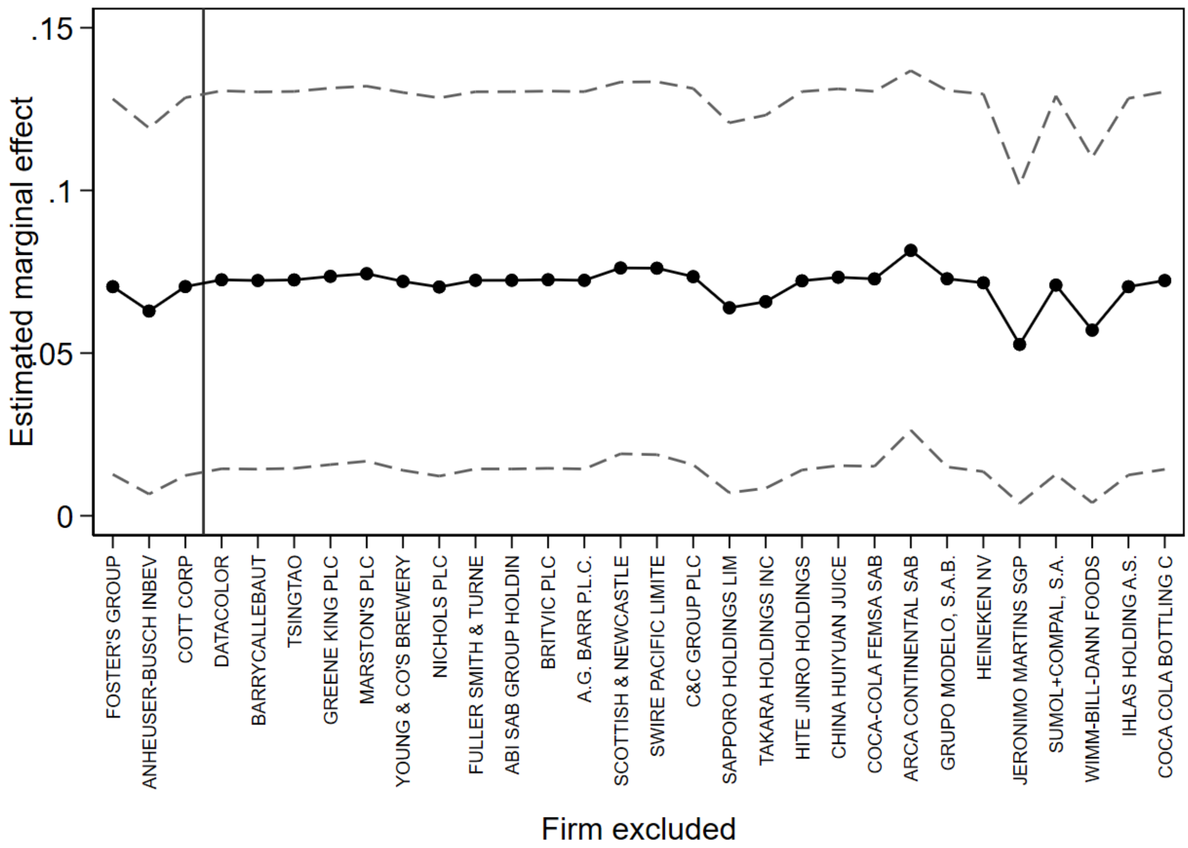
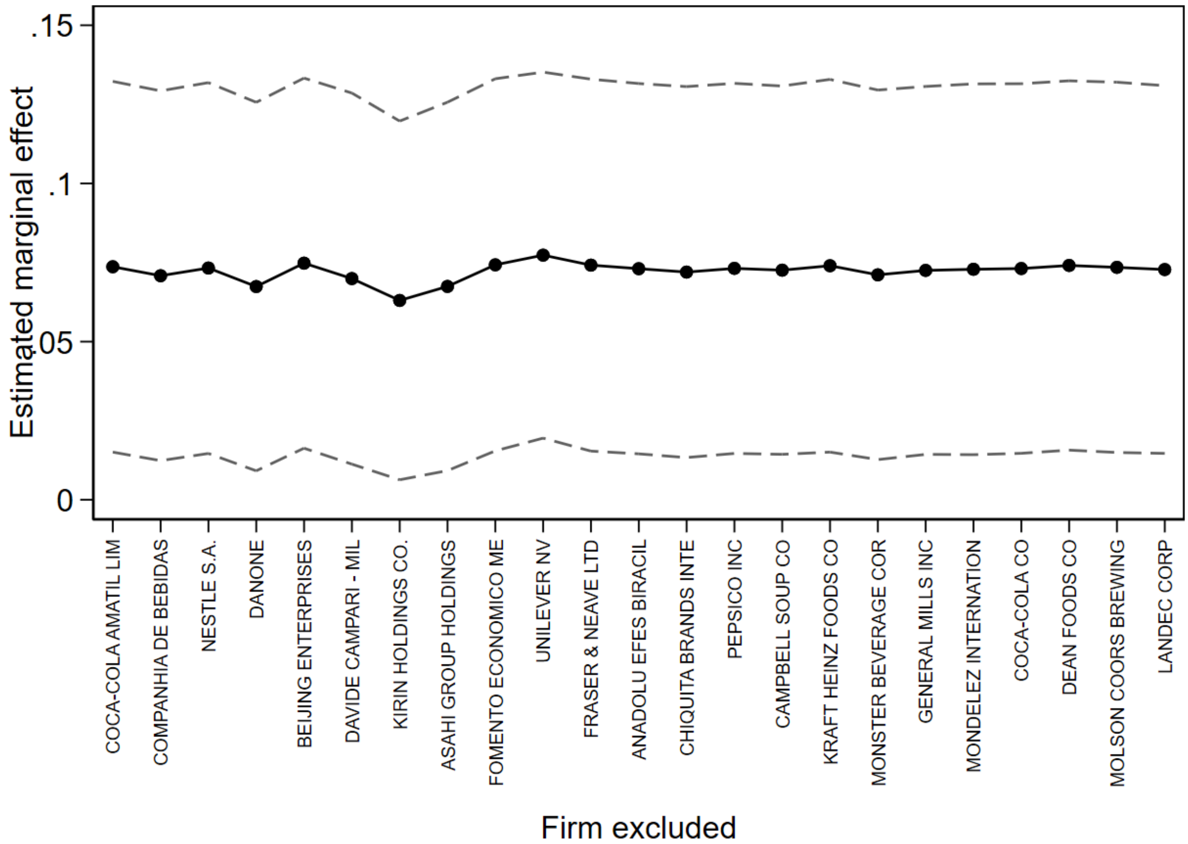


Figure 7.7: Effect of treatment excluding, one at a time, firms jointly owned by BGI and BlackRock



7.6 Robustness checks

In this section, the validity of the previous results is confirmed by a battery of robustness checks, intended to address possible issues related to the research design, which could bias the baseline estimates. First, the traditional event-study analysis on the Lerner Index is carried out. Then, several sensitivity checks are performed on alternative specifications of the sample and on a different definition of the groups of treated and control firms. Finally, some falsification tests are conducted.

7.6.1 Event study analysis

The existence of a common trend is the key identifying assumption for DiD estimates to be unbiased. In the framework of this analysis, the assumption implies that - in the absence of the treatment - firms held by BGI and/or BlackRock in 2007 would have experienced the same trends in their potential Lerner Index as the control firms. While this is not testable, an event-study analysis can shed some light on the validity of the research design. Specifically, following Autor (2003), the interactions of the time dummies and the treatment indicator for pre-treatment periods are added to the baseline specification of Eq. (7.1). If the trends in the Lerner Index in treatment and control groups are the same, then the interactions should be not statistically significant, i.e. the DiD coefficient should not be significantly different between the two groups in the pre-treatment period. An attractive feature of this test is that the interactions of the time dummies after the treatment (up to several years) with the treatment indicator are informative, and can show whether the treatment effect changes over time. In detail, the following specification is estimated:

$$y_{ft} = \alpha + \sum_{\pi=2007}^{2007} \gamma_\pi (treated_f \times year_\pi) + \sum_{\tau=2009}^{2016} \gamma_\tau (treated_f \times year_\tau) + \delta x_{ft} + f_f + f_t + u_{ft} \quad (7.2)$$

where the year 2008 is omitted, coinciding with the period immediately preceding the merger. This specification allows to test for the presence of parallel trends in the pre-treatment period, namely, if the coefficient associated to the lead (γ_π, for 2007) is not statistically different from zero. As already anticipated, this approach is convenient to understand whether the treatment effect fades, increases or stays constant over time, depending on the estimated coefficients of the lags γ_τ , with τ going from 2009 to 2016.

Table 7.7 reports the estimates of Eq. (7.2), with and without control variables. According to the point estimates in col. (1), where controls are not included, there is no difference in the Lerner Index between treated and control units in the pre-treatment period. On the contrary, coefficients associated to lags turn out to be positive and statistically significant from 2 up to 5 years after the merger, indicating that the Lerner Index is growing over time for treated firms if compared to control ones. Results remain qualitatively the same in columns (2) and (3), where controls and controls interacted with *post* are included.

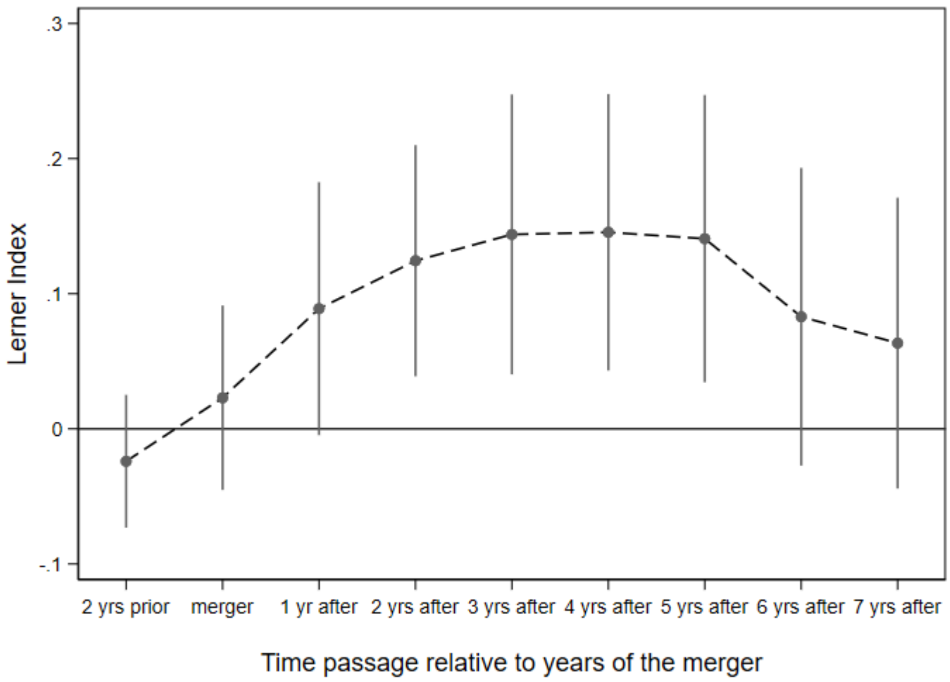
The estimates from column (3) and their 95% confidence intervals are plotted in Figure 7.8. Taken together, these results seem to validate the research design, as there is no evidence against the presence of a common trend between treated and control units.

Table 7.7: Autor test. Reference year 2008, one year before the merger.

Dep. var.: Lerner Index	(1)	(2)	(3)
2 yrs prior	-0.027	-0.027	-0.024
	(0.030)	(0.030)	(0.030)
merger	-0.019	-0.019	0.023
	(0.027)	(0.027)	(0.041)
1 yr after	0.042	0.045	0.089
	(0.038)	(0.039)	(0.057)
2 yrs after	0.080**	0.082**	0.124**
	(0.037)	(0.038)	(0.052)
3 yrs after	0.095**	0.102**	0.144**
	(0.047)	(0.049)	(0.063)
4 yrs after	0.103**	0.104**	0.145**
	(0.047)	(0.048)	(0.062)
5 yrs after	0.097*	0.100*	0.141**
	(0.050)	(0.052)	(0.064)
6 yrs after	0.037	0.043	0.083
	(0.052)	(0.055)	(0.067)
7 yrs after	0.018	0.024	0.063
	(0.053)	(0.056)	(0.065)
(log) Total assets		-0.006	-0.006
		(0.009)	(0.011)
Shareholders’ HHI		0.003	-0.007
		(0.006)	(0.008)
Shares top 4 owners		0.018	0.056
		(0.049)	(0.079)
Firm’s Integration		0.004	-0.005
		(0.034)	(0.044)
Shares owned by Big2		-0.607	0.507
		(0.746)	(1.079)
(log) Total assets*post			0.001
			(0.007)
Shareholders’ HHI*post			0.012**
			(0.005)
Shares top 4 owners*post			-0.041
			(0.076)
Firm’s Integration*post			0.013
			(0.036)
Shares owned by Big2*post			-0.924
			(0.763)
Observations	1,813	1,813	1,813
Treated	483	483	483
Controls	1,330	1,330	1,330
Year fixed effects	yes	yes	yes
Firm fixed effects	yes	yes	yes
R-squared within	0.028	0.032	0.038
R-squared overall	0.619	0.621	0.623

*Robust standard errors, clustered at the firm level, in parentheses; *** p<0.01, ** p<0.05, * p<0.1*

Figure 7.8: Event study



7.6.2 Alternative sample selection

In Table 7.8, other methods for sample selection have been tested. In the first three columns, companies that were not present in the 2007 sample are not considered in the estimation, resulting in a smaller sample size. This means that the control units are constant over time, not introducing any newly created company in the sample. As a result, the sample is composed by 1,513 observations, including all 483 observations from treated firms. The coefficient of interest remains positive and significant at the conventional level.

Yet, another source of concern might derive from the use of an unbalanced sample, which could lead to biased results.[30] Therefore, we replicate our main results by relying on a balanced sample of firms, keeping only those with recorded observations along the entire time-span of the analysis. We have full 10-year information on 105 firms (1,050 observations), of which 36 are treated.[31] Results of this analysis are reported in Table 7.8, col. (4)–(6) and,

[30]The concern about unbalanced panels lies in the possible reason behind missing information. If the data are non-randomly missing, findings are likely to be biased. In our setting, the reasons for the missing data are quite well known, such as firms exiting the market due to their natural life-cycle, or non-reporting of balance sheet information due to lack of legal obligation. Therefore, a good robustness check can come from the comparison of the results obtained with the full unbalanced sample with those obtained using a balanced one. If estimates yield similar results, this suggests that findings are not biased (Baltagi, 2008; Cameron and Trivedi, 2005).

[31]As a reference, note that 82% of the firms of the full sample present data for at least 5 years, which is a quite long time span to capture the effects under study. More in detail, 25% of the companies present between 5 and 8 years of observation, 12% of the firms are observed for 9 years, and 45% have full information for the whole 10 years.

reassuringly, indicate that the coefficient of *treated* × *post* is statistically significant across models and pretty similar to that obtained in the baseline specification.

A final alternative sample definition is used in the last three columns. Here, instead of trimming Lerner Index observations outside the $[-1, 1]$ interval, these are kept in the sample, but their values are set equal to the thresholds of -1 and $+1$. In this case, the sample counts 1,884 observations, of which 489 are related to treated firms. Columns (7)–(9) show the results with this specification, which are consistent with the main model and slightly larger in magnitude.

Table 7.8: Alternative sample definitions

	Existing in 2007			Balanced Sample			Replacing if > 1 or < -1		
Dep. var.: Lerner Index	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treated*post	0.071**	0.073**	0.120**	0.072**	0.080**	0.101***	0.080**	0.085**	0.126**
	(0.034)	(0.035)	(0.048)	(0.033)	(0.034)	(0.038)	(0.037)	(0.038)	(0.056)
(log) Total assets		0.002	0.003		-0.011	-0.014		0.005	0.006
		(0.005)	(0.008)		(0.014)	(0.016)		(0.011)	(0.013)
Shareholders' HHI		0.002	-0.007		0.002	-0.003		-0.021	-0.136
		(0.008)	(0.009)		(0.009)	(0.010)		(0.076)	(0.089)
Shares top 4 owners		-0.017	0.024		0.009	0.047		0.027	0.100
		(0.052)	(0.081)		(0.064)	(0.082)		(0.069)	(0.100)
Firm's Integration		-0.002	-0.007		-0.039	-0.044		0.007	-0.009
		(0.039)	(0.046)		(0.044)	(0.046)		(0.036)	(0.050)
Shares owned by Big2		-0.336	1.157		-0.439	1.426		-0.010	0.001
		(0.567)	(0.944)		(0.835)	(1.206)		(0.007)	(0.011)
(log) Total assets*post			-0.001			0.003			-0.002
			(0.007)			(0.006)			(0.008)
Shareholders' HHI*post			0.012**			0.007			0.139**
			(0.006)			(0.005)			(0.062)
Shares top 4 owners*post			-0.043			-0.046			-0.088
			(0.078)			(0.061)			(0.090)
Firm's Integration*post			0.008			0.004			0.021
			(0.038)			(0.027)			(0.046)
Shares owned by Big2*post			-1.209			-1.515*			-0.010
			(0.758)			(0.814)			(0.008)
Observations	1,513	1,513	1,513	1,050	1,050	1,050	1,884	1,884	1,884
Treated	483	483	483	360	360	360	489	489	489
Controls	1,030	1,030	1,030	690	690	690	1,395	1,395	1,395
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
R-squared within	0.018	0.019	0.026	0.037	0.045	0.051	0.095	0.015	0.014
R-squared overall	0.605	0.605	0.608	0.667	0.670	0.617	0.617	0.626	0.627

*Robust standard errors, clustered a the firm level, are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
In col. (1), (2) and (3) we exclude firms which were not in the sample in 2007
In col. (4), (5) and (6) we keep only firms with 10 years of observation
In col. (7), (8) and (9) values of Lerner Index below -1 or above 1 are replaced with such thresholds.

7.6.3 Different definitions of the treatment and control groups

So far, the definition of the treated group included three types of "exposed" firms, according to the 2007 ownership structure: *i)* firms held only by BlackRock; *ii)* firms held only by BGI and *iii)* firms held by both BlackRock and BGI. The assumption was that all the above three groups of firms were equally exposed to the merger, and could therefore be considered as "treated". However, the interpretation of the role of these three groups might vary, and lead eventually to alternative definitions of the treatment and control groups.

A possible argument could be the following: while the first two groups of firms are fully entitled to be considered treated, the latter may be shifted into the control group. In fact, it might be reasonable to assume that for this set of firms the merger did not produce any effects, given that it is composed by companies already held by both BlackRock and BGI before the merger.

In order to understand potential differences of roles of these three groups of firms, and whether this is reflected in any differential effect on profitability after the merger, an alternative specification of treated and control groups has been experimented. In particular, we split the original group of treated firms into two, separating the 23 companies jointly held by BlackRock and BGI from the rest. A dummy variable, $BGI\&BR$, measured in 2007, is built to account for this issue, equal to one if a firm was held by both BlackRock and BGI, and zero otherwise. Then, this new variable is interacted with the *treated* variable in a model taking the following form:

$$y_{ft} = \alpha + \gamma treated_{f2007} \times post_t + \lambda treated_{f2007} \times post_t \times BGI\&BR_{f2007} + \delta x_{ft} + f_f + f_t + u_{ft} \quad (7.3)$$

where the variable *treated* includes all firms held in 2007 by BlackRock and/or BGI, i.e. all three groups *i)*, *ii)* and *iii)* defined above. It follows that coefficient γ accounts for the effect of the merger for all treated firms, while λ captures the differential effect of the merger for the firms jointly held by BGI and BlackRock in 2007.

If λ in Eq. (7.3) turns out to be statistically significant, then the impact of the merger on firms held by both BlackRock and BGI is different from that on firms held by BlackRock or BGI only. In this case, the treatment variable would need to be redefined, including only firms held either by BlackRock or by BGI. Instead, if λ is not statistically significant, the impact of the merger for firms held by both BlackRock and BGI is not different from the rest of treated firms. Hence, in this case, there would be no need to change the definition of treated and control groups.

According to estimates shown in the first three columns of Table 7.9, the coefficient λ is negative (-0.030) but not statistically significant in the specification that does not include controls (col. 1). Similarly, it is negative and indistinguishable from zero both in the model where controls are included (-0.026; col. 2), and in the last case where we account for the interaction between controls and *post* (-0.003; col. 3). Therefore, in light of these results, there is no evidence against the inclusion of these firms, namely those held in 2007 by both BlackRock and BGI, in the definition of treated firms.

7.6.4 Falsification and other tests

Placebo test

A common way to conduct a placebo tests in the context of DiD analysis is that of focusing on the span prior to the merger, that is to simulate what would have happened to the Lerner Index if a fake year of the merger were used. More in detail, we assume that the merger between BlackRock and BGI occurred in 2008, and the main analysis is replicated on the period 2007-2008. If the coefficient associated to $treated_{f2007} \times (fake)post_{2008}$ turns out positive and significant, it would suggest that before the true year of the merger, treated firms were already experiencing an increase in the Lerner Index compared to control ones, thus casting doubts on the validity of previous results.

Reassuringly, the effect of placebo exercise does not lead to any effect on the Lerner Index as the γ coefficient turns out to be indistinguishable from zero in the specification without controls (Table 7.9, col. 4), and in both the specifications where controls are included (Table 7.9; col. 5), and interacted with $(fake)post$ (Table 7.9; col. 6).

Different definition of the treatment year

The results discussed so far have been based on the indicator of dependence from BlackRock and/or BGI using figures from 2007, a period coinciding with the beginning of the financial crisis. This could raise the concern that BGI and BlackRock could have targeted companies in 2007, which would perform particularly well after the crisis. In other words, it might be the case that BGI and BlackRock – in light of the financial crisis – have decided to invest in "healthier" and more performing firms in 2007, thus questioning the definition of treated and control group, and therefore of the results. In principle, the best solution to tackle this issue would be building our treatment indicator on earlier ownership data, long before the financial crisis. By doing so, we would have a proxy for exposure to BGI and BlackRock which is less subject to possible selection bias. In fact, it would be unrelated to the shareholding strategies of the two financial institutions preparing for the merger and/or the financial crisis. Unfortunately, data on ownership is not available before 2007.

However, there are some ways to mitigate this concern. To begin with, recall that in all estimations we control for year fixed effects that are meant to capture macroeconomic shocks, such as the financial crisis, common to all firms. In this regard, one could claim that treated and control firms could have responded differently to the crisis even in the absence of the merger event. Were it the case, the inclusion of years fixed effect would not be sufficient for obtaining unbiased estimates. Nevertheless, as pointed out by Lewellen and Lowry (2020), it is a major concern only if firms in the control group belong to different sectors than treatment firms, which does not apply in our context as we restricted the analysis to firms operating in the Beverages market.

Second, as discussed in Section 7.2, the possibly non-random allocation of treated and control units can be correlated with other firms' characteristics and/or with the financial crisis, but the introduction of the interaction between controls variables and *post* in the estimates should attenuate the potential bias. In fact, if more performing firms were acquired by BGI and BlackRock in 2007 in light of the crisis, the control variables - which are meant to capture firms' characteristics - interacted with *post* should have picked up this effect, leading to a coefficient of $treated \times post$ indistinguishable from zero. However, as shown in Table 7.6, col. 3, the coefficient of $treated \times post$ is positive and statistically significant at 1%.

Finally, one could argue that the financial crisis produced its effect in Europe starting from 2008.[32] It follows that, in the spirit of a further robustness test, an alternative treatment has been computed according to 2008 ownership data. If the definition of treated and control groups were undermined by the strategic behavior of BGI/BlackRock reacting to the financial crisis, we would observe very different results with respect to those obtained with the treatment indicator based on 2007.

The last three columns of Table 7.9 display the results of this analysis and indicate that the coefficient of interest is positive (0.071) and statistically significant at 5% level when controls are excluded (col. 7), and it is slightly larger, 0.77 and 0.125 respectively, when controls and controls interacted with *post* are included (col. 8 and 9).

The fact that the coefficient of interest remains stable indicates that the two financial institutions did not substantially alter their portfolio in anticipation of the financial and economic turmoil caused by the Great Recession. Taken together, these results are stable across specifications and do not seem to be much affected by the choice of the year used for determining the treated status of firms, thus lessening the concerns that BGI and BlackRock could have targeted only the more performing companies in 2007.

[32] In late 2008 the crisis developed into a number of European bank failures, declines in various stock indexes, large reductions in the market value of equities, a decrease in international trade. The currency crisis spread at the end of October 2008.

Table 7.9: Robustness tests

Dep. var.: Lerner Index	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Treated*post	0.082*	0.075	0.120**						
	(0.050)	(0.048)	(0.056)						
Treated*post*(BGI&BR)	-0.030	-0.026	-0.003						
	(0.060)	(0.058)	(0.069)						
Treated*(fake)post				0.019	0.019	0.011			
				(0.029)	(0.028)	(0.041)			
(2008)Treated*post							0.071**	0.077**	0.125**
							(0.035)	(0.037)	(0.054)
(log) Total assets		-0.005	-0.003		0.025	0.028		-0.009	-0.007
		(0.009)	(0.009)		(0.025)	(0.026)		(0.009)	(0.011)
Shareholders' HHI		0.004	-0.007		-0.012	-0.007		0.009	0.000
		(0.007)	(0.007)		(0.012)	(0.013)		(0.007)	(0.010)
Shares top 4 owners		0.018	0.064		-0.036	-0.035		-0.026	-0.021
		(0.047)	(0.071)		(0.109)	(0.128)		(0.055)	(0.115)
Firm's integration		0.010	-0.003		0.019	0.035		0.032	0.032
		(0.035)	(0.043)		(0.031)	(0.041)		(0.038)	(0.051)
Shares owned by Big2		-0.151	0.919		-4.797***	-4.137***		-0.918	-0.365
		(0.548)	(1.374)		(1.406)	(1.407)		(0.805)	(1.289)
(log) Total assets*post			-0.002						-0.002
			(0.002)						(0.007)
Shareholders' HH*Ipost			0.013**						0.009
			(0.005)						(0.008)
Shares top 4 owners*post			-0.049						0.001
			(0.069)						(0.109)
Firm's Integration*post			0.017						0.001
			(0.035)						(0.040)
Shares owned by Big2*post			-0.916						-0.401
			(1.018)						(0.862)
(log) Total assets*(fake)post						-0.002			
						(0.006)			
Shareholders' HHI*(fake)post						-0.003			
						(0.008)			
Shares top 4 owners*(fake)post						-0.019			
						(0.107)			
Integration*(fake)post						-0.034			
						(0.033)			
Shares owned by Big2*(fake)post						-0.300			
						(0.900)			
Observations	1,813	1,813	1,813	335	335	335	1,646	1,646	1,646
Treated	483	483	483	101	101	101	434	434	434
Controls	1,330	1,330	1,330	234	234	234	1,212	1,212	1,212
Year fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes	yes	yes	yes
R-squared within	0.016	0.014	0.020	0.005	0.041	0.058	0.014	0.024	0.028
R-squared overall	0.614	0.616	0.618	0.613	0.615	0.616	0.629	0.633	0.634

*Robust standard errors, clustered at the firm level, are shown in parentheses. *** p<0.01, ** p<0.05, * p<0.1*

We include, in column (1), (2) and (3), the differential effect of firms that are held by both shareholders; in column (4), (5) and (6), a placebo year of the merger; in column (7), (8) and (9) a different definition of year of treatment.

7.7 Hetereogeneous effects

The baseline results have shown a positive relationship between the Lerner Index after the merger and the exposure to the merger itself. However, these results can be explained in light of two additional aspects not yet considered in the analysis. On the one hand, the merger may take time to materialise its effect on the Lerner Index. On the other hand, the degree of exposure to the merger may influence the actual extent of the effect.

7.7.1 Long-term effects

A significant role could be played by the time elapsed since the merger, as its effects may take some time to materialise. To account for this possibility, a new variable, *duration*, has been included in the model, measuring the time since the merger took place (1 to 8 years). Its quadratic term ($duration^2$) is also included, allowing the effect to be a non-linear function of time. Therefore, the following model is estimated:

$$y_{ft} = \alpha + treated_{f2007} \times post_t \times (\gamma + \lambda\ duration_t + \pi\ duration_t^2) + \delta x_{ft} + f_f + f_t + u_{ft} \quad (7.4)$$

Results of this analysis are reported in Table 7.10. Columns (1)-(3) show the estimates of the linear specification, where the coefficient π in Eq. (7.4) is set equal to zero. Columns (4)-(6), instead, present the estimates of the full quadratic specification. As usual, the three columns for each specification correspond to estimation of models without controls, with controls, and with controls interacted with *post*.

To better understand its dynamics, the aggregate effect has been computed for the years after the merger. The estimated coefficients of Table 7.10 have been used to compute the following combinations: $\gamma + \lambda \times year$ in the case of the linear specification, and $\gamma + \lambda \times year + \pi \times year^2$ for the quadratic specification, for each post-merger year (duration from 1 to 8). The estimated values of the effects are reported in Table 7.11, for the plain model (cols. 1 and 4), and for the models with controls (cols. 2 and 5) and controls interacted with the *post* dummy (cols. 3 and 6). To ease the interpretation of the results, the combinations described above have been plotted against the number of years in Figure 7.9, for the specifications with controls.

Table 7.10: Long-term effects

Dep. var.: Lerner Index	(1)	(2)	(3)	(4)	(5)	(6)
Treated*post	0.050*	0.049*	0.091**	-0.043	-0.046	-0.005
	(0.030)	(0.030)	(0.045)	(0.031)	(0.032)	(0.041)
Treated*duration	0.005	0.006	0.005	0.064***	0.066***	0.066***
	(0.008)	(0.008)	(0.008)	(0.024)	(0.024)	(0.024)
Treated*duration^2				-0.007***	-0.007***	-0.007***
				(0.002)	(0.002)	(0.002)
(log) Total assets		-0.007	-0.008		-0.008	-0.008
		(0.009)	(0.011)		(0.009)	(0.011)
Shareholders' HHI		0.003	-0.007		0.003	-0.007
		(0.006)	(0.008)		(0.006)	(0.008)
Shares top 4 owners		0.009	0.049		0.012	0.051
		(0.049)	(0.079)		(0.049)	(0.079)
Firm's Integration		0.007	-0.003		0.005	-0.004
		(0.035)	(0.044)		(0.034)	(0.044)
Shares owned by Big2		-0.675	0.424		-0.659	0.427
		(0.738)	(1.039)		(0.746)	(1.067)
(log) Total assets*post			0.001			0.001
			(0.007)			(0.007)
Shareholders' HHI*post			0.012**			0.012**
			(0.005)			(0.005)
Shares top 4 owners*post			-0.044			-0.043
			(0.077)			(0.077)
Firm's Integration*post			0.015			0.014
			(0.036)			(0.037)
Shares owned by Big2*post			-0.916			-0.905
			(0.752)			(0.755)
Observations	1,813	1,813	1,813	1,813	1,813	1,813
Treated	483	483	483	483	483	483
Controls	1,330	1,330	1,330	1,330	1,330	1,330
Year fixed effects	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes
R-squared within	0.016	0.021	0.027	0.024	0.028	0.035
R-squared overall	0.614	0.616	0.619	0.617	0.619	0.622

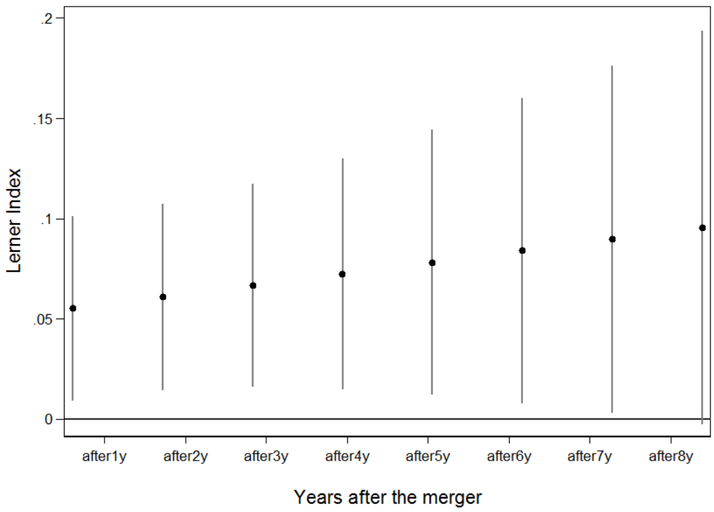
Robust standard errors, clustered at the firm level, are shown in parentheses.

**** p<0.01, ** p<0.05, * p<0.1*

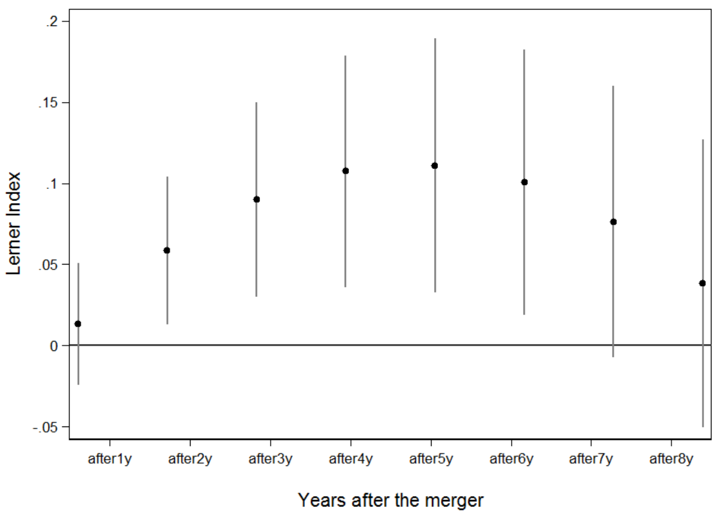
In columns (1)-(3) and (4)-(6) we control for the duration after the merger and its square, respectively.

In the linear specification, the impact of the merger seems to be positively related to time, as the Lerner Index significantly increases with the number of years, and after 6 years the effect vanishes. Looking at the point estimates reported in Table 7.11, col. (1), it emerges that after 2 and 3 years of the merger treated firms show a Lerner Index approximately 0.06 points larger than that of control firms (an estimate statistically significant at 5%), reaching the maximum value of 0.08 difference after 7 years (coefficients are statistically significant at 10%) while disappearing in the 8th year. Results do not change if controls and their interaction with *post* are included, as displayed in col. (2) and (3) of the same table.

Figure 7.9: Long term effects



(a) Linear specification



(b) Quadratic specification

However, a more reliable picture emerges when a quadratic term is introduced, which has a concave effect. In fact, as shown in Figure 7.9b, one additional year after the merger is associated to a larger effect on the Lerner Index. According to estimates of Table 7.11, col. (4), the effect is statistically significant after 2 years and increases up to 5 years from the merger. It slowly decreases and then, after 6 years disappears. Similar results are observed if controls and its interaction with *post* are included (Table 7.11, col. 5 and 6). The main intuition behind these findings is that the merger event prompted a sizable increase of the Lerner Index in treated firms during the first years after which the market self-correction took place.

Table 7.11: Effects in models including linear or quadratic time trends

	Linear			Quadratic		
Years	(1)	(2)	(3)	(4)	(5)	(6)
1 year	0.06**	0.06**	0.010**	0.01	0.01	0.06
	(0.03)	(0.03)	(0.04)	(0.02)	(0.02)	(0.04)
2 years	0.06**	0.06**	0.010**	0.06**	0.06**	0.10**
	(0.03)	(0.03)	(0.04)	(0.03)	(0.03)	(0.04)
3 years	0.06**	0.07**	0.011**	0.09**	0.09**	0.13***
	(0.03)	(0.03)	(0.05)	(0.04)	(0.04)	(0.05)
4 years	0.07**	0.07**	0.011**	0.10**	0.11**	0.15***
	(0.03)	(0.03)	(0.05)	(0.04)	(0.04)	(0.06)
5 years	0.07*	0.08*	0.012**	0.11**	0.11**	0.15**
	(0.04)	(0.04)	(0.05)	(0.05)	(0.05)	(0.06)
6 years	0.08*	0.08*	0.012**	0.09**	0.10**	0.14**
	(0.04)	(0.04)	(0.06)	(0.05)	(0.05)	(0.06)
7 years	0.08*	0.08*	0.013**	0.07	0.07	0.11*
	(0.05)	(0.05)	(0.06)	(0.05)	(0.05)	(0.06)
8 years	0.08	0.09	0.013**	0.03	0.04	0.08
	(0.06)	(0.06)	(0.06)	(0.05)	(0.05)	(0.06)

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Plain model (cols. 1 and 4), with controls (cols. 2 and 5), controls interacted with post (cols. 3 and 6)

7.7.2 Intensity of the exposure

In the main analysis all treated firms receive the same weights. However, it might be that the impact of the merger on profitability depends on the extent of a firm's exposure to BlackRock and/or BGI in 2007. For example, the impact of the merger for a firm held at 1% by BG and/or BlackRock in 2007 could be different from that experienced by a firm held, say, at 3%.

To investigate whether there has been a heterogeneous response according to the intensity of exposure, we build a continuous variable, *shareowned*, corresponding to the value of participation of BGI and/or BlackRock in 2007 (sum of the respective shares). This indicator is interacted with $treated_{f2007} \times post_{2007}$, and a quadratic specification is also considered. The estimated model is a generalised version of Eq. (7.1), taking the following form:

$$y_{ft} = \alpha + treated_{f2007} \times post_t \times (\gamma + \lambda\ shareowned_{f07} + \pi\ shareowned^2_{f07}) + \delta x_{ft} + f_f + f_t + u_{ft} \tag{7.5}$$

Results of estimation for this model are reported in Table 7.12. Columns (1)-(3) show the estimates of the linear specification, where coefficient π in Eq. (7.5) is set equal to zero. Columns (4)-(6) present instead the estimates of the quadratic specification. Like before, each set of three columns corresponds to model without controls, with controls, and with controls interacted with *post*.

The quadratic effect is given by the full combination $\gamma + \lambda \times shareowned_{f2007} + \pi\ shareowned^2_{f07}$, while in the linear specification the impact corresponds to $\gamma + \lambda \times shareowned_{f2007}$; in both cases the effect depends on the specific value of the variable *shareowned*. In practice, it is possible to compute the impact for any value of exposure. For the sake of the example, the linear and quadratic combined effects are computed using the estimated coefficients for some chosen levels of exposure (see Table 7.13). The same results are also plotted in Figure 7.10. Apparently, in the linear specification reported in Figure 7.10a, larger shares owned by BGI and/or BlackRock in 2007 seem to be associated with a reduction on the Lerner Index, however the significance fades for very large values of exposure, rarely observed in practice.

More in detail, the impact of the merger for a firm held at 1% by BGI and/or BlackRock leads to an increase of the Lerner Index of 0.10, an estimation statistically significant at 5%. Such an impact significantly reduces to 0.05 if the held quota increases to 4% (Table 7.13 col. 1). After 5%, there seems to be no significant impact on the Lerner Index.

Regarding the quadratic specification, although in the visual depiction (Figure 7.10b) and in the opposite sign of the polynomial coefficients (see Table 7.12, col. 4 to 6) there seems to be a U-shape pattern, this has no sufficient statistical power.

Further complements to the present exposure analysis are reported in Appendix D.

Table 7.12: Alternative specifications accounting for exposure level

Dep. var.: Lerner Index	(1)	(2)	(3)	(4)	(5)	(6)
Treated*post	0.119**	0.118**	0.144**	0.146*	0.145*	0.172*
	(0.058)	(0.059)	(0.064)	(0.083)	(0.084)	(0.089)
Treated*post*Shareowned	-0.018	-0.017	-0.016	-0.049	-0.048	-0.051
	(0.013)	(0.013)	(0.015)	(0.052)	(0.052)	(0.058)
Treated*post*Shareowned^2				0.004	0.004	0.005
				(0.006)	(0.006)	(0.007)
(log) Total assets		-0.006	-0.006		-0.006	-0.007
		(0.009)	(0.011)		(0.009)	(0.011)
Shareholders' HHI		0.004	-0.006		0.004	-0.007
		(0.007)	(0.008)		(0.007)	(0.008)
Shares top 4 owners		0.005	0.050		0.005	0.058
		(0.050)	(0.079)		(0.050)	(0.079)
Firm's Integration		0.008	-0.002		0.008	-0.002
		(0.035)	(0.044)		(0.035)	(0.044)
Shares owned by Big2		-0.336	-0.141		-0.310	-0.328
		(0.619)	(1.312)		(0.612)	(1.379)
(log) Total assets*post			0.000			0.001
			(0.007)			(0.007)
Shareholders' HHI*post			0.012**			0.013**
			(0.005)			(0.006)
Shares top 4 owners*post			-0.048			-0.059
			(0.076)			(0.076)
Firm's Integration*post			0.015			0.015
			(0.036)			(0.036)
Shares owned by Big2*post			-0.159			0.022
			(0.985)			(1.043)
Observations	1,813	1,813	1,813	1,813	1,813	1,813
Treated	483	483	483	483	483	483
Controls	1,330	1,330	1,330	1,330	1,330	1,330
Year fixed effects	yes	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes	yes
R-squared within	0.019	0.023	0.028	0.020	0.024	0.029
R-squared overall	0.616	0.617	0.619	0.616	0.617	0.619

Robust standard errors, clustered at the firm level, are shown in parentheses.

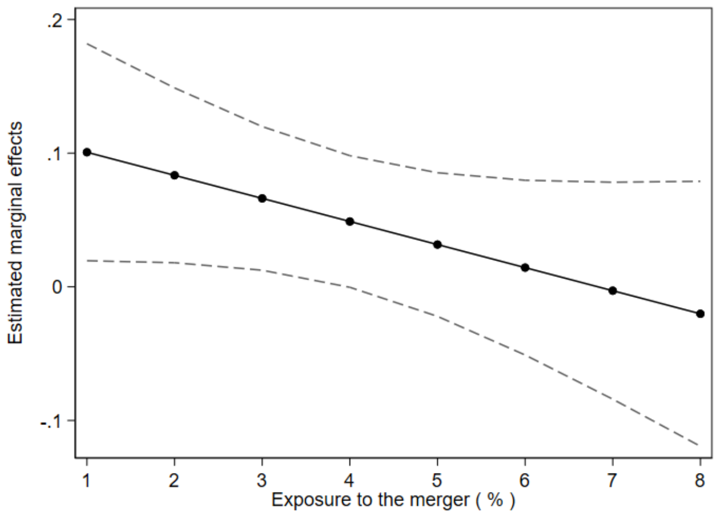
**** p<0.01, ** p<0.05, * p<0.1*

Table 7.13: Heterogeneous effects on the Lerner Index, according to different levels of exposure to BlackRock and/or BGI. The effects are calculated, for the sake of the example, at some chosen levels of exposure (shares owned).

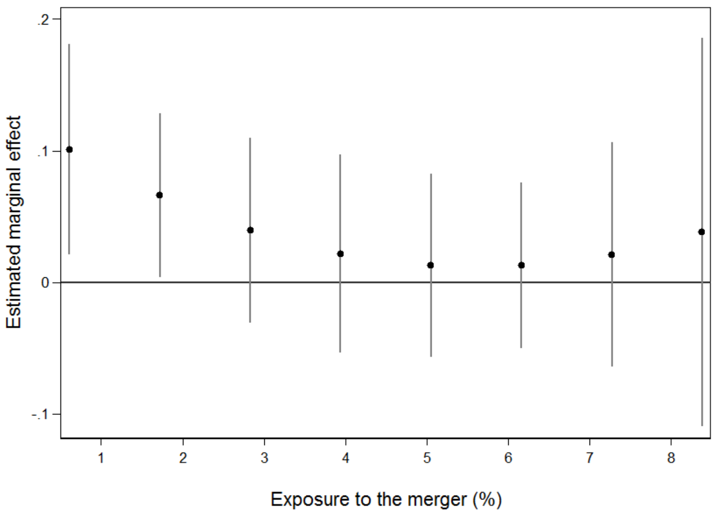
Exposure	Linear			Quadratic		
(Shares owned)	(1)	(2)	(3)	(4)	(5)	(6)
1%	0.10**	0.10**	0.13**	0.10**	0.10**	0.13**
	(0.05)	(0.05)	(0.053)	(0.05)	(0.05)	(0.05)
2%	0.08**	0.08**	0.11**	0.07*	0.07*	0.09*
	(0.04)	(0.04)	(0.05)	(0.04)	(0.04)	(0.05)
3%	0.07**	0.07**	0.10**	0.04	0.04	0.06
	(0.03)	(0.03)	(0.04)	(0.04)	(0.04)	(0.06)
4%	0.05*	0.05*	0.08*	0.02	0.02	0.04
	(0.03)	(0.03)	(0.05)	(0.05)	(0.05)	(0.07)
5%	0.03	0.04	0.07	0.01	0.01	0.04
	(0.03)	(0.02)	(0.05)	(0.04)	(0.04)	(0.07)
6%	0.02	0.02	0.06	0.01	0.01	0.04
	(0.03)	(0.03)	(0.06)	(0.04)	(0.04)	(0.06)
7%	0.02	0.01	0.04	0.01	0.02	0.05
	(0.04)	(0.04)	(0.06)	(0.05)	(0.05)	(0.07)
8%	-0.01	-0.00	0.03	0.03	0.04	0.07
	(0.05)	(0.05)	(0.07)	(0.09)	(0.09)	(0.10)

*Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1*
Plain model (cols. 1 and 4), with controls (cols. 2 and 5), controls interacted with post (cols. 3 and 6)

Figure 7.10: Marginal effects of the exposure to BlackRock and/or BGI. The effects are calculated, for the sake of the example, at some chosen levels of exposure (shares owned).



(a) Linear specification



(b) Quadratic specification

7.8 Final remarks

This analysis presents a first attempt to measure the possible effects of common shareholding on competition in the Beverages industry. The study considers the exogenous shock in ownership given by the BlackRock-BGI merger of 2009. The merger is exploited in a difference-in-differences setting so as to determine a possible causal effect on market competition.

The specific market under investigation is defined by the set of beverages manufacturers active in the EU territory between 2007 and 2016, namely either registered in the EU, or holding participation in at least one firm registered in Europe. The range of manufactured products considered in the study includes soft drinks, mineral waters, juices and beers.

The first evidence collected in this study points to the direction of enhanced market power for the manufacturers that experienced increased common shareholding due to the merger. Moreover, it should be noted that an increase in the Lerner Index - the competitive outcome used in the analysis - appears to be driven more by a marked increase in revenues, rather than a decrease in costs. The effect is larger for those companies which were only marginally participated in by BlackRock or BGI before the merger, having benefitted most from the event. On the other hand, those manufacturers which were more strongly held by either fund pre-merger show a positive but smaller improvement in profitability. The effect is present soon after the merger, but reaches its peak between four and five years after the event, becoming negligible later on. The empirical evidence found in this study is robust to a certain number of checks, including alternative specifications of the outcome and treatment variables. Overall, the findings presented in this chapter seem to confirm similar results obtained by scholars using US data for other industries. This constitutes, to the best of our knowledge, the first investigation using EU data, and the first on the Beverages industry.

These results would appear to suggest a positive association between common shareholding and the market power of firms. However, the findings of this study should be treated with caution; in particular, the following caveats should be considered:

i) The small sample size and the short period of observation are potentially responsible for the limited power of some statistical results, which will require further investigation. In this respect, earlier data on the common shareholding structure of firms would help confirm that BlackRock and BGI in 2007 did not specifically target companies that would have performed well after the crisis. In a similar vein, multiple observations prior to the merger would strengthen the evidence of a common trend between treated and control firms - a key identifying assumption of the difference-in-differences design underlying the analysis.

ii) The study focuses only on the Beverages sector, but while carefully accounting for other industries' specificities as well as possible data shortcomings, the present methodology could be applied to possible future investigations in other markets.

iii) The Lerner Index is used - following the literature - as a proxy of market competition; however, data on prices would help reinforce the evidence on common shareholding and competitive outcomes, as it would facilitate controlling for the heterogeneity of products sold by firms. Moreover, any country/product specific changes in the market could have been factored-in.

A final observation is due, concerning possible unobservable factors that may have affected profitability, other than the merger under consideration. There are a series of possible mechanisms of influence through which asset managers may affect a firm's competitive outcome. Typically, such mechanisms include network effects, general policy consensus between asset managers, or even a specific threshold in ownership that allows for effective leverage, under which a shareholder in practice does not have a strong impact. These factors were not directly observable in the present study and potentially could be further investigated, depending on the availability of additional specific data. In reality, the phenomenon of common shareholding proved to be particularly complex, and disentangling its various effects continues to be challenging. Given that the literature in this area has not yet investigated in depth the channels through which influence is exerted, this certainly constitutes a good candidate for future research.

Box 7.1: Econometrics - Strategy

- We excluded a multi-industry econometric analysis, due to the product and structural heterogeneity of different sectors, and opted instead for a single sector analysis.
- In the definition of the most appropriate econometric strategy, we observed that results from the sectoral analyses did not show a very specific trend. The extent of common shareholding at overall industry level was already high when our observation started in 2007, and remained roughly unchanged until 2016.
- However, looking at a selection of top investors, the sectoral reports revealed that a change in the identity of the main players took place. In particular, we saw the rise of the large investment funds and a contemporaneous drop in the participation of banks and insurance companies.
- In particular, the 2009 merger of BlackRock with BGI, is the largest 'substitution' event between funds and banks. This event was of unprecedented proportions in the history of mergers between asset management funds, and has therefore played a crucial role in shaping the various studies on common shareholding.
- Given that the BlackRock-BGI merger represented a once-in-a-lifetime event, we also investigated the possible existence of other minor changes in ownership at the investors' level, which in turn may have provoked a relevant change in the degree of common shareholding of the firms active in each sector.
- Others have encountered the same finding, that the statistical and economic significance of the effects of these minor mergers is there but "an order of magnitude smaller" than that of the BlackRock-BGI event. We therefore privileged this latter event, in order to analyse possible links between common shareholding and competitive outcomes.

□

Box 7.2: Econometrics - Modelling

- **Challenges.** The econometric modelling has several challenges ahead, principally the lack of an established theory showing how common shareholding affects managers, and from there competitive outcomes. Additional challenges are:
  - Defining market boundaries and proximity. The NACE classification is suited to identify well established sectors, but is unable to capture markets in rapid change where new technologies and products emerge. Instead, we used expert knowledge to define exactly the players in each of the analysed markets.
  - Using a common shareholding measure that overcomes the drawbacks of the MHHI. We develop new measures taken from the literature on sparse matrices and networks.
  - Using a relevant measure of competition. Prices remain the preferred indicator for changes in competitive forces on the market, however obtaining data on prices at the required level of specificity is still a challenge. Instead, we used measures of market power and market concentration. Market power is approximated by the Lerner index, calculated either on the difference between sales and variable costs or on the difference between operating profits and financial costs, to account for fixed costs. Market concentration: the HHI is the typical measure of concentration used in the literature, as it computes the relative size of a firm in an industry in terms of the proportion of total output.
  - A major empirical shortcoming relates to the use of accounting data from consolidated vs unconsolidated accounts. We use unconsolidated accounts whenever available to be more precise in targeting the sector and the geographic area of activity.
- **The sample.** The Beverage sector was chosen for the empirical analysis: the set of beverages manufacturers active in the EU territory between 2007 and 2016, namely either registered in the EU, or holding participations in at least one firm registered in Europe. The range of manufactured products considered in the study includes soft drinks, mineral waters, juices and beers.
- **The model.** The impact of the change in common shareholding - induced by the BlackRock-BGI merger - is estimated using a difference-in-differences approach. The change in markup, before and after the event, for firms exposed to the merger (*"treated"* group) is compared to that of firms that did not have any pre-merger relations with BlackRock and/or BGI (*"control"* group). We refine the estimated model through accounting for several confounding factors, which could distort the measured link between common shareholding and profitability. In particular, we account for the heterogeneity of relevant firm-level characteristics, such as the dimension of the company, the shareholding structure, and the integration of the firm with competitors through common shareholders.

□

Box 7.3: Econometrics - Results

- Estimation indicates that, after the merger, firms that were already held by BlackRock and/or BGI show a Lerner Index on average 0.07 points higher than control firms. This suggests that the merger triggered an increase in profitability of firms already exposed to BlackRock and/or BGI before the event.

- Analogous results are obtained using the alternative competition measure as an outcome, i.e. the Lerner Index adjusted for cost of capital.

- The increase in the Lerner Index seems to be driven more by a marked increase in revenues, than by a decrease in costs.

- We explore the possibility that the effect of the merger on the Lerner Index may take time to materialise. We find that the impact of the merger seems to be positively related to time, as the Lerner Index significantly increases with the number of years; 2 and 3 years on from the merger, treated firms show a Lerner Index approximately 0.06 points larger than that of control firms (an estimate statistically significant at 5%), reaching the maximum value of 0.08 difference after 7 years (although only statistically significant at 10%), while disappearing in the 8th year. The main intuition behind these findings is that the merger event prompted a sizable increase in the Lerner Index in treated firms during the first years, after which the market self-correction took place.

- We explore the possibility that the degree of exposure to the merger may influence the actual extent of the effect. For example, the impact of the merger for a firm held at 1% by BG and/or BlackRock in 2007 could be different from that experienced by a firm held, say, at 3%. We find the effect is larger for those companies which were only marginally part of the BlackRock or BGI portfolios before the merger, having benefitted most from the event. In particular, the impact of the merger for a firm held at 1% by BGI and/or BlackRock leads to an increase in the Lerner Index of 0.10 points, an estimation statistically significant at 5%. Such an impact significantly reduces to 0.05 if the quota held increases to 4%. For firms participated in at 5% or more, there seems to be no significant impact on the Lerner Index. This effect is not driven by efficiency considerations as we find that increased revenues rather than decreased costs drive the result.

□

Box 7.4: Econometrics - Robustness checks

Several sensitivity checks are performed on alternative specifications of the sample, and on a different definition of the groups of treated and control firms (firms directly affected by the merger, and firms whose shareholding structure is not touched by the merger, respectively).

- Is an outlier driving the result? No, the value of the impact does not suffer from notable changes when single firms are dropped from the sample.
- Without the merger, would firms held by BGI and/or BlackRock in 2007 have experienced the same growth in their potential Lerner Index? No, our statistical tests suggest that this would not have happened; i.e. the firms would not have experienced a higher Lerner index, if the merger had not taken place.
- Is the result robust to changes of the sample? Yes, we replicate our main results by relying on a balanced sample of firms, keeping only those with recorded observations along the entire time-span of the analysis. Results are confirmed and the estimated coefficient is even higher.
- In our analysis we had: i) firms held only by BlackRock; ii) firms held only by BGI and iii) firms held by both BlackRock and BGI. The assumption was that all the above three groups of firms were equally exposed to the merger, and could therefore be considered as "treated". However, the interpretation of the role of these three groups might vary, and lead eventually to alternative definitions of the treatment and control groups. Is the result robust to these changes? Yes, estimations are not sensitive to the definition of the treated group.
- We also ran a series of falsification tests to validate our model, all with negative results. In particular, we looked into the possibility that BlackRock/BGI, anticipating the 2008 crisis, could have targeted only the better performing companies in 2007. We find that the two financial institutions did not substantially alter their portfolio in anticipation of the financial and economic turmoil.

□

Box 7.5: Econometrics - Additional comments and limitations of the analysis

- The short period of observation before the merger is probably responsible for the limited power of some statistical results, which will need further investigation. In this respect, earlier data on the common shareholding structure of firms would help confirm that BlackRock and BGI in 2007 did not specifically target companies that would have performed well after the crisis. In a similar vein, multiple observations prior to the merger would strengthen the evidence of a common trend between treated and control firms - a key identifying assumption of the difference-in-differences design underlying the analysis.
- The study focuses only on the Beverages sectors, but while carefully accounting for other industries' specificities, as well as possible data shortcomings, the present methodology could be applied to possible future investigations in other markets.
- The Lerner Index is used - following the literature - as a proxy of market competition; however, data on prices would help reinforce the evidence on common shareholding and competitive outcomes, as it facilitates controlling for the heterogeneity of products sold by firms. Moreover, any country/product specific changes in the market could have been factored-in.
- Additional unobservable factors, other than the merger under consideration, may have affected profitability. There are a series of possible mechanisms of influence through which asset managers may affect a firm's competitive outcome. Typically, such mechanisms include network effects, general policy consensus between asset managers, or even a specific threshold in ownership that allows for effective leverage, under which a shareholder in practice does not have a strong impact. These factors were not directly observable in the present study and potentially could be further investigated, depending on the availability of additional specific data.

The phenomenon of common shareholding proved to be particularly complex, and disentangling its various effects continues to be challenging. Given that the literature in this area has not yet investigated in depth the channels through which influence is exerted, this certainly constitutes a good candidate for future research.

□

Chapter 8

Conclusions

The debate on common shareholding - and its potential antitrust effects - is currently on the agenda of all major think tanks and institutions worldwide. Common shareholders are typically institutional investors - e.g. pension funds and asset managers - holding concomitant shareholdings in a given market. In the last two decades, these investment funds have grown substantially in total size and concentration, both in Europe and worldwide, especially those channeling savings towards investment strategies that replicate the performance of stock market indices, such as the S&P500 or the FTSE100. Despite claiming a so-called passive engagement strategy (not intervening directly in firm's decisions), institutional investors collect, together with the shares, the associated voting rights of their customers. This has led economists (and policy makers) to analyse the effects of this concentration of power, as well as the influence exerted on the management decisions of the firms which common shareholders are mandated to invest in.

This report provides a comprehensive analysis of common shareholding in Europe with a specific focus on five industries/markets, namely Oil&Gas, Electricity, Trading Platforms, Telecommunications and Beverages. Based on firm-level balance sheet and ownership data, a set of new indices of common shareholding is used to describe the investment behavior of shareholders at both industry and investor level. The strength of relationships within the networks of firms and of investors is also studied. Special attention is devoted to the top investors in the EU overall as well as in each industry, and a brief overview of cross-investments within industries is also reported, when relevant. Our baseline analysis is conducted on a historical dataset containing all listed companies active in the EU in the period 2007-2016: this includes all listed firms registered in the EU, plus all listed companies registered elsewhere, but holding shares in at least one firm registered in the EU. The average number of firms observed each year is 26,560 (24,857 in 2017 to 26,942 in 2016) - where on average about 57% are registered in the EU countries, the rest being registered outside the EU.

We find that in 2016, 87.2% of all shareholders of companies in our dataset hold participation in only one company (85.7% in 2007). Common shareholders therefore constitute 12.8% of all shareholders (14.9% in 2007). The number of listed firms that are cross-held by block-holders (common shareholders with at least 5% participation in more than one company) has been increasing, rising from about 15.5 thousand in 2007 to about 17.5 thousand in 2016. Around 67% of the analysed companies are cross-held by block-holders with at least 5% participation. Looking at portfolios, top common shareholders hold shares in as many as 25% of the firms in the market, i.e. more than 6,000 companies overall. They tend to invest equally among the chosen firms, rather than giving priority to certain specific companies by buying higher percentages of shares. The firms included in the largest portfolios represent a significant proportion of the total value of the market, reaching a coverage of above 80% of Total Assets (TOAS) and more than 90% of Market Capitalisation in almost all years. This means that the top investors not only hold shares in a considerable number of firms (around 25%), but also typically choose the largest enterprises, leaving out only minor players - which together do not account for more than 10-20% of the market value. The preference for the largest market players has become stronger over time. When both Total Assets and Market Capitalisation are multiplied by the percentage of shares actually held, we find that in 2016 the top common shareholder holds within its grasp 3.8% of total weighted Market Capitalisation and 6.6% of the weighted TOAS in the EU. These percentages were 2.3 and 3.6 respectively in 2008; an acceleration in the control of Total Assets or MarketCap can be observed as of 2012.

As to specific industries, we find that more than half of investors hold portfolios of very little intensity, with average holdings of less than 1%. The mean portfolio holds shares of about 5-6% on average in the held firms; only Oil&Gas shows lower levels, while Telecoms stands on slightly higher values, given the strong presence of high-participation corporate groups. Top common shareholders are the usual suspects in all sectors (top banks and large asset management funds), except in Telecoms where individuals and large corporate groups dominate via their cross-shareholdings in other companies in the same sector.

In the Oil&Gas sector BlackRock, Vanguard, State Street and Norway hold large amounts of market value in their grasp: their shares in the held companies amount to about 12.88% of the TOAS in 2016. A peculiar case is the Russian Government, which holds almost 6% of the Total Assets of the market in 2016 via its subsidiaries Gazprom and Rosneft, but has little or no participations in other companies.

In the Electricity market top common shareholders hold about 7% of the market's Total Assets through their participation shares, and about 3.5% of Market Capitalisation. France plays a major role in this market, holding very large stakes in three of the top ten EU-based corporations, together with a minor presence in some additional firms. Overall in 2016 France controlled about 6.7% of the Total Assets of this market. China is also a major player, mainly via its subsidiary CHINA HUADIAN CORP, controlling about 3.23% of market TOAS. The usual

US-based funds (BlackRock, State Street and Vanguard) are still present as top investors, but rather for the large number of firms in their portfolios, each held with minority shares. Overall, together they control 5.57% of market TOAS.

The Trading Platforms sector presents some peculiarities. The set of firms operating the trading platforms (stock exchanges, banks, tech companies) is rather heterogeneous, not only in terms of area of activity but also in terms of Total Assets and Market Capitalisation. Banks usually have a value of Total Assets which is incomparably higher than that of a traditional stock exchange, and even more so than a digital platform or technology firm. On the other hand, even companies with few assets can have a large Market Cap (even if the amount of listed firms in the identified set of operators is minor). Many of the companies active in this sector are controlled by large groups, thus presenting a very concentrated ownership structure with large participation shares in the hands of few - or even only one - investors. The picture of top investors in this industry is largely dominated by banks, while funds tend to drop to lower positions in the ranking of common shareholders. In 2016, the big funds appeared to hold very similar portfolios in terms of firms held, but the level of participation varies. For example, BlackRock holds a large share (8.66%) of the London Stock Exchange, while State Street and Vanguard have about 3% each. On the other hand, State Street has a strong presence in the Spanish banks Santander (8.34%) and Banco Bilbao Vizcaya (10.87%), while BlackRock holds about half of that and Vanguard even less (about 1% and 2% respectively). Overall, the size of the portfolios - in terms of the number of firms - does not differ much across investors, with Sweden, Funds, Banks and Insurance companies each fluctuating within the range 15%-20%, while Norway displays a consistently higher value, of above 20%, holding the largest portfolio in 2016 (34 firms).

In 2016, ownership in the Mobile Telecoms industry is concentrated in the hands of select individuals and associated holding groups, alongside large investment management firms such as Blackrock or Vanguard Group. These global shareholders hold significant investments in large pan-European telecom groups such as Vodafone and Orange, as well as national providers. Together, these groups and providers compose almost the entirety of the European mobile telecommunication market. The Telecoms sector exhibits some distinctiveness with respect to the other sectors, notably cross-ownership (the telecoms companies themselves are common shareholders). Another peculiarity of the Telecoms sector is the presence of individuals as common shareholders. Mr. Carlos Slim Helú (Mexico), Mr. Victor Li Tzar Kuoi (Hong Kong/China), and J. Malone (US) control, directly or indirectly, 3.26%, 3.09% and 2.01% of the Total Assets in the market, respectively. Among the funds, BlackRock dominates this industry, with rather large shares in some of the top players (over 8% in Vodafone, almost 7% in BT GROUP PLC and about 6% in KONINKLIJKE KPN NV); overall BlackRock controlled about 3.18% of Total Assets in 2016. Vanguard and Norway lag behind, with relatively small participations, while State Street plays only a minor role. France is also present, with a large participation in the French company Orange, but also with some smaller stakes in other top competitors.

The Beverages market is rather heterogeneous. Relatively small enterprises with local markets and a limited shareholder structure coexist with a set of large firms producing and/or distributing alcoholic products, structured in complex corporate groups with many cross-holdings (as in the Telecoms sector). The top 1% of investors in 2007 held above 14% of the firms in the sector, and in 2016 this declined to 11.2%. These investors hold firms that represent at least between 53% and 60% of the Total Assets of the industry depending on the year (declining trend). The top common shareholder has invested in companies representing up to 82% of the TOAS of the sector in 2016. Such values are in line with expectations, since top investors tend to privilege the largest enterprises. However, when this index is weighted according to the participation share of investors, the trend inverts, demonstrating that the largest investor holds a slightly decreasing share of weighted Total Assets. It would seem that top investors (but this holds for other investors in general) are diluting their investment concentration amongst a larger number of firms.

Likewise, cross-investment also characterises investment behavior in this sector. The first three common shareholders in terms of weighted total assets in the Beverages sector are also part of the market: DIAGEO PLC (UK) with 4.25% of the market TOAS, L'ARCHE GREEN (NL) with 3.40% and ANHEUSER-BUSCH INBEV (BE) with 2.92%. BlackRock is the first common shareholder external to the market, with rather large shares in most of the top players, reaching up to 8.82% in a single firm. Overall, in 2016 BlackRock accounted for 2.33% of the market TOAS. Vanguard and State Street lag behind, with relatively small participations. State Street in particular is a minor player for the observed year.

This report also explores the link between common shareholding and competition, notably the idea that higher markups should be observed in markets with higher common shareholding (Azar et al., 2018). The phenomenon was already present when our observation started in 2007, and remained stable throughout the period of observation, so no specific trend for overall common shareholding could be explored for our econometric strategy. Instead, a change in the identity of the main players is clearly detected, exhibited through the rise of the large investment funds and a contemporaneous drop in the participation of banks and insurance companies. Therefore, the proposed model exploits this feature for the econometric identification. In particular, the 2009 merger of BlackRock with BGI was the largest 'substitution' event between funds and banks. This event was of unprecedented proportions in the history of mergers between asset management funds, and has therefore played a crucial role in shaping the various studies on common shareholding. This is true for all analysed markets, including Beverages, the market eventually used as test case for the econometric analysis.

The econometric modelling posed several challenges, principally (not addressed in this report) the lack of an established theory showing how common shareholding affects managers, and thus competitive outcomes. Additional challenges addressed include (i) the definition of market boundaries and proximity, done in collaboration with experts in the field, (ii) the use of a measure for common shareholding that overcomes the drawbacks of the measure mostly used in the literature (the modified HHI) - for this we developed new measures taken from the literature on sparse matrices and networks; and finally (iii) the use of an appropriate measure of competition. Although prices remain the preferred indicator for changes in competitive forces on the market, obtaining data on prices at the required level of specificity is still a challenge. Instead, we used a measure of market power, approximated by the Lerner index.

The impact of the change in common shareholding induced by the BlackRock-BGI merger is estimated using a difference-in-differences approach, by comparing - before and after the event - the markup of firms exposed to the merger (treated group of treated firms) to that of firms that did not have any pre-merger relations with BlackRock and/or BGI (control group or control firms). The markup is measured through the Lerner Index, calculated either on the difference between sales and variable costs or on the difference between operating profits and financial costs, to account for fixed costs.

The estimations performed indicate that the merger between BlackRock and BGI did in fact have an effect on markups of the firms in their portfolios. After the merger, firms that were already held by BlackRock and/or BGI show a Lerner Index on average 0.07 points higher than control firms, suggesting that the merger triggered an increase in profitability of firms already exposed to BlackRock and/or BGI. Analogous results are obtained using an alternative competition measure as the outcome, the Lerner Index adjusted for cost of capital. We find that the increase in the Lerner Index seems to be driven more by a marked increase in revenues rather than a decrease in costs. We also find that the impact of the merger seems to be positively related to time, as the Lerner Index significantly increases with the number of years; 2 and 3 years on from the merger, treated firms show a Lerner Index approximately 0.06 points larger than that of control firms, reaching the maximum value of a difference of 0.08 points after 7 years, while disappearing in the 8th year. The main intuition behind these findings is that the merger event prompted a sizable increase in the Lerner Index in treated firms during the initial years, after which the market self-correction took place. We also explored the possibility that the degree of exposure to the merger may influence the actual extent of the effect. We find that the effect is larger for those companies which were only marginally part of the BlackRock or BGI portfolios before the merger, having benefitted most from the event. In particular, the impact of the merger for a firm held at 1% by BGI and/or BlackRock leads to an increase of the Lerner Index of 0.10 points on average. Such an impact significantly reduces to 0.05 if the shares held increase to 4%. For firms participated in at 5% or more, there seems to be no significant impact on the Lerner Index.

Our results would appear to suggest a positive association between common shareholding and the market power of firms. However, the findings of this study should be treated with caution; in particular, the following caveats should be considered. First, earlier data on the common shareholding structure of firms would help confirm that BlackRock and BGI in 2007 did not specifically target companies that would have performed well after the crisis. We do not find evidence of this, but our sample is limited. In a similar vein, multiple observations prior to the merger would strengthen the evidence of a common trend between treated and control firms - a key identifying assumption of the difference-in-differences design underlying the analysis. Second, the study focuses only on the Beverages sectors, however, while carefully accounting for other industries' specificities and possible data shortcomings, the present methodology could be applied to possible future investigations in other markets. Third, the Lerner Index is used - following the literature - as a proxy of market competition; however, data on prices would help reinforce the evidence on common shareholding and competitive outcomes, as it would enable controlling for the heterogeneity of products sold by firms. Moreover, any country/product specific changes in the market could be factored-in.

A final observation is due, concerning possible unobservable factors that may have affected profitability, other than the merger under consideration. There are a series of possible mechanisms of influence through which asset managers may affect a firm's competitive outcome. Typically, such mechanisms include network effects, general policy consensus between asset managers, or even a specific threshold in ownership that allows for effective leverage, under which a shareholder in practice does not have a strong impact. These factors were not directly observable in the present study and potentially could be further investigated, depending on the availability of additional specific data. In reality, the phenomenon of common shareholding proved to be particularly complex, and disentangling its various effects continues to be challenging. Given that the literature in this area has not yet investigated in depth the channels through which influence is exerted, this certainly constitutes a good candidate for future research.

Bibliography

[1] Aghion P., Bloom N., Blundell R., Griffith R., Howitt P. (2005) "Competition and Innovation: an Inverted-U Relationship", *The Quarterly Journal of Economics*, vol. 120, pp. 701-28.

[2] Altomonte, C., and Nicolini, M. (2012) "Economic integration and the dynamics of firms' competitive behavior", *Structural Change and Economic Dynamics*, vol. 23, no. 4, pp. 383-402.

[3] Altomonte, C., Ottaviano, G. and Rungi, A. (2018) "Business Groups as Knowledge-based Hierarchies", Working Paper No. 12.

[4] Andrews, D., Criscuolo, C. and Menon, C. (2014) "Do resources flow to patenting firms? Cross-country evidence from firm level data", *OECD Economic Department Working Papers*, n. 1127.

[5] Antón, M., Ederer, F., Giné, M., and Schmalz, M. C. (2017) "Common ownership, competition, and top management incentives", Ross School of Business Paper No. 1328; European Corporate Governance Institute (ECGI) - Finance Working Paper No. 511/2017. Available at SSRN: `https://ssrn.com/abstract=2802332`

[6] Antoniou, I. E., and Tsompa, E. T. (2008) "Statistical analysis of weighted networks", *Discrete dynamics in Nature and Society*, vol. 2008, Article ID 375452, 16 pages, doi:10.1155/2008/375452.

[7] Appel, I. R., Gormley, T. A., and Keim, D. B. (2016) "Passive investors, not passive owners", *Journal of Financial Economics*, vol. 121, no. 1, pp. 111-141.

[8] Asdrubali, P., and Signore, S. (2015) "The Economic Impact of EU Guarantees on Credit to SMEs Evidence from CESEE Countries", No. 002/2015, Directorate General Economic and Financial Affairs (DG ECFIN), European Commission.

[9] Autor, D.H. (2003) "Outsourcing at Will: The Contribution of Unjust Dismissal Doctrine to the Growth of Employment Outsourcing", *Journal of Labor Economics*, vol. 21, no. 1, pp. 1-42.

[10] Azar, J. (2012) "A new look at oligopoly: Implicit collusion through portfolio diversification.", *PhD Dissertation*, Princeton University.

[11] Azar, J., Raina, S., and Schmalz, M. C. (2019) "Ultimate ownership and bank competition", *Manuscript*. Available at SSRN: `https://ssrn.com/abstract=2710252`

[12] Azar J., Schmalz M.C. (2017) "Common ownership of competitors raises antitrust concerns", *Journal of European Competition Law and Practice*, vol. 8, pp. 329-332.

[13] Azar, J., Schmalz, M. C., and Tecu, I. (2017) "Why Common Ownership Creates Antitrust Risks", *CPI Antitrust Chronicle*, June 2017.

[14] Azar, J., Schmalz, M. C., and Tecu, I. (2018) "Anti-Competitive Effects of Common Ownership", *Journal of Finance*, vol. 73, no. 4, pp. 1513-1565.

[15] B2B Platform (2011) "Vertical relationships in the Food Supply Chain: Principles of Good Practice", November 29, 2011. Available at `https://www.supplychaininitiative.eu/sites/default/files/b2b_principles_of_good_practice_in_the_food_supply_chain.pdf`

[16] B2B Platform (2013) “Framework for the implementation and enforcement of the principles of good practice in vertical relations in the food supply chain”, January 25, 2013. Available at `https://www.supplychaininitiative.eu/sites/default/files/b2b_voluntary_initiative_-framework.pdf`

[17] Backus, M., Conlon, C., and Sinkinson, M. (2018) "Common ownership and competition in the ready-to-eat cereal industry", *New York University Stern Working Paper*, Available for download from `http://www.law.northwestern.edu/research-faculty/clbe/events/antitrust/documents/sinkinson_cereal.pdf`.

[18] Baltagi, B. (2008) *Econometric analysis of panel data*, John Wiley & Sons.

[19] Baqaee, D. and E. Farhi (2020) "Productivity and Misallocation in General Equilibrium", *The Quarterly Journal of Economics*, vol. 135, no. 1, pp. 105-163.

[20] Bebchuk, L. A., Brav, A., and Jiang, W. (2015) "The Long-Term Effects of Hedge Fund Activism", *Columbia Law Review*, pp. 1085-1155.

[21] Bernard, H. R. (2012) *Social research methods: Qualitative and quantitative approaches*, Sage.

[22] BlackRock (2017) "Index investing and common ownership theories", *BlackRock Viewpoint*.

[23] Blonigen, B. and J. Pierce (2016) "Evidence for the Effects of Mergers on Market Power and Efficiency", *Working Papers 16-43, Center for Economic Studies*, U.S. Census Bureau.

[24] Bonaccorsi, A., and Giuri, P. (2001) "Network structure and industrial dynamics. The long-term evolution of the aircraft-engine industry", *Structural Change and Economic Dynamics*, vol. 12, no. 2, pp. 201-233.

[25] Bonacich, P. (1991) "Simultaneous group and individual centralities", *Social networks*, vol. 13, no. 2, pp. 155-168.

[26] Bonacich, P., and Lloyd, P. (2015) "Eigenvector centrality and structural zeroes and ones: When is a neighbor not a neighbor?", *Social Networks*, vol. 43, pp. 86-90.

[27] Borgatti, S. P. (2012) "Social network analysis, two-mode concepts in", In *Computational complexity*, pp. 2912-2924, Springer New York.

[28] Borgatti, S. P., Mehra, A., Brass, D. J., and Labianca, G. (2009) "Network analysis in the social sciences", *Science*, vol. 323, pp. 892-895.

[29] Borgatti, S. P., and Everett, M. G. (1997) "Network analysis of 2-mode data", *Social networks*, vol. 19, no. 3, pp. 243-269.

[30] Borgatti, S. P., Everett, M. G., and Johnson, J. C. (2018) *Analyzing social networks*, Sage.

[31] Borgatti, S. P., and Halgin, D. S. (2011) "Analyzing affiliation networks", In *The Sage handbook of social network analysis*, vol. 1, pp. 417-433.

[32] Boyd, S. and Vandenberghe, L. (2018) *Introduction to Applied Linear Algebra - Vectors, Matrices, and Least Squares*. Cambridge University Press.

[33] Brav, A., Jiang, W., Partnoy, F., and Thomas, R. (2008) "Hedge fund activism, corporate governance, and firm performance", *The Journal of Finance*, vol. 63, no. 4, pp. 1729-1775.

[34] Bravo-Biosca, A., Criscuolo, C., and Menon, C. (2016) "What drives the dynamics of business growth?", *Economic Policy*, vol. 31, no. 88, pp. 703-742.

[35] Bresnahan, T. F., and Salop, S. C. (1986) "Quantifying the competitive effects of production joint ventures", *International Journal of Industrial Organization*, vol. 4, no. 2, pp. 155-175.

[36] Bureau van Dijk (2018a), "Orbis Brochure", *Bureau van Dijk - A Moody's Analytics Company*. Available for download from `https://www.bvdinfo.com/en-gb/our-products/data/international/orbis`

[37] Bureau van Dijk (2018b), "Bureau van Dijk historical ownership databases - User Guide - 2017 Q4", *Bureau van Dijk - A Moody's Analytics Company*. Available with the purchase of the Orbis Ownership database.

[38] Cameron, A. C., and Trivedi, P. K. (2005) *Microeconometrics: methods and applications*, Cambridge university press.

[39] Cassels, J. and Whiddingtion, C. (2012) "EU: food sector antitrust task force" *Field Fisher Waterhouse Publications*, 11 January 2012, available from `https://www.fieldfisher.com/publications/2012/01/eu-food-sector-antitrust-task-force`

[40] Chauve, P., Parera, A., and Renckens, A. (2014) "Agriculture, Food and Competition Law: Moving the Borders", *Journal of European Competition Law & Practice*, vol. 5, no. 5, pp. 304-313.

[41] Chauve, P., and Renckens, A. (2015) "The European Food Sector: Are Large Retailers a Competition Problem?", *Journal of European Competition Law & Practice*, vol. 6, no. 7, pp. 513-529.

[42] Collinson, A. and Woodward-Carlton, J. (2012) "Action by DG Competition's food sector 'task force' still pending" *Lexology*, 30 March 2012, available from `https://www.lexology.com/library/detail.aspx?g=a6cb8be2-f928-4dce-bb05-a94335d7672f`

[43] Costa, L. D. F., Rodrigues, F. A., Travieso, G., and Villas Boas, P. R. (2007) "Characterization of complex networks: A survey of measurements". *Advances in physics*, vol. 56, no. 1, pp. 167-242.

[44] Dalton, H. (1920) "The measurement of the inequality of incomes", *The Economic Journal*, vol. 30, no. 119, pp. 348-361.

[45] De Loecker J., J. Eeckhout, and G. Unger (2020) "The Rise of Market Power and the Macroeconomic Implications", *NBER* Working Paper n. 23687. The Quarterly Journal of Economics, vol. 135, no. 2, pp. 561-644.

[46] De Loecker J., and Warzynski, F. (2012) "Markups and Firm-Level Export Status", *American Economic Review*, vol. 102, no. 6, pp. 2437-2471.

[47] Demsetz, H., and Villalonga, B. (2001) "Ownership structure and corporate performance", *Journal of Corporate Finance*, vol. 7, no. 3, pp. 209-233.

[48] Dennis, P., Gerardi, K., and Schenone, C. (2019) "Common Ownership Does Not Have Anti-Competitive Effects in the Airline Industry", *Manuscript*, Available at SSRN: `https://ssrn.com/abstract=3063465` or `http://dx.doi.org/10.2139/ssrn.3063465`

[49] Diez, M. F. J., Fan, J., and C. Villegas-Sánchez (2019) "Global Declining Competition", *IMF Working Paper* No. 19/82.

[50] Egghe, L., and Rousseau, R. (2003) " A measure for the cohesion of weighted networks". *Journal of the Association for Information Science and Technology*, vol. 54, no. 3, pp. 193-202.

[51] Elzinga K., David E. M. (2011) "The Lerner index of monopoly power: origins and uses", *The American Economic Review*, vol. 101, pp. 558-64.

[52] European Commission (2008) Commission Communication on "Tackling the challenge of rising food prices - Directions for EU action", COM (2008) 321, May 20, 2008.

[53] European Commission (2008) Commission Communication on "Food Prices in Europe", COM (2008) 821, December 9, 2008.

[54] European Commission (2009) Commission Communication "A better functioning food supply chain in Europe", COM(2009) 591, October 28, 2009.

[55] European Commission (2009) Commission Staff Working Document, "Competition in the food supply chain", accompanying document to the Communication "A better functioning food supply chain in Europe", SEC(2009) 1449, October 28, 2009.

[56] European Commission (2014) Report "The economic impact of modern retail on choice and innovation in the EU food sector". Available at `https://ec.europa.eu/competition/sectors/agriculture/retail_study_report_en.pdf`

[57] European Commission (2018) Commission Report "The application of the Union competition rules to the agricultural sector", COM(2018) 706, October 26, 2018.

[58] European Commission (2018) Commission Staff Working Document, accompanying document to the Communication "The application of the Union competition rules to the agricultural sector", SWD(2018) 450, October 26, 2018.

[59] European Commission (2018) "Competition/Agriculture: Commission publishes report on application of competition rules in the agricultural sector", *Press release*, 26 October 2018, available from `http://europa.eu/rapid/press-release_IP-18-6182_en.htm`

[60] European Parliament (2020) See Frazzani et al. (2020)

[61] European Competition Network (2012) "Report on competition law enforcement and market monitoring activities by European competition authorities in the food sector". Available at `https://ec.europa.eu/competition/ecn/food_report_en.pdf`

[62] Eurostat (2008) "NACE Rev. 2. Statistical Classification of Economic Activities in the European Community", Eurostat Methodologies and Working papers, *Office for Official Publications of the European Communities, Luxembourg.*

[63] Everett, M. G., and Borgatti, S. P. (2013) "The dual-projection approach for two-mode networks", *Social Networks*, vol. 35, no. 2, pp. 204-210.

[64] Ferdman, R. A. (2014) "The American energy drink craze in two highly caffeinated charts", *Quartz*, 26 March 2014, available from `https://qz.com/192038/`

the-american-energy-drink-craze-in-two-highly-caffeinated-charts/#/h/56821,2/

[65] Fichtner, J., Heemskerk, E. M., and Garcia-Bernardo, J. (2017) "Hidden power of the Big Three? Passive index funds, re-concentration of corporate ownership, and new financial risk", *Business and Politics*, vol. 19, no. 2, pp. 298-326.

[66] Fink, L. D. (2018) "A sense of purpose", *Annual letter to CEOs*.

[67] Frazzani, S., Noti, K., Schinkel, M. P., Seldeslachts, J., Banal-Estañol, A., Boot, N., Angelici, C., (2020) “Barriers to Competition through Common Ownership by Institutional Investors”, Study for the Committee on Economic and Monetary Affairs, Policy Department for Economic, Scientific and Quality of Life Policies, European Parliament, Luxembourg, 2020, Available at https://www.europarl.europa.eu/RegData/etudes/STUD/2020/652708/IPOL_STU(2020)652708_EN.pdf

[68] Gal, P. N. (2013) "Measuring total factor productivity at the firm level using OECD-ORBIS", *OECD Economic Department Working Papers*, n. 1049.

[69] Gilje, E., Gormley, T. A. and Levit, D. (2018) "Who’s Paying Attention? Measuring Common Ownership and Its Impact on Managerial Incentives", *Journal of Financial Economics*, Forthcoming.

[70] Grullon G., Yelena L., Michaely R. (2019) "Are US industries becoming more concentrated?", *Review of Finance*, vol. 23, no. 4, pp. 697–743.

[71] Gutiérrez, G. and T. Philippon (2017) "Investmentless Growth: An Empirical Investigation", *Brookings Papers on Economic Activity*, 89-169.

[72] Gutiérrez, G. and T. Philippon (2018) "How EU Markets Became More Competitive Than US Markets: A Study of Institutional Drift", *NBER Working Papers* 24700, National Bureau of Economic Research, Inc.

[73] Hall, R. (1988) "The Relation between Price and Marginal Cost in the U.S. Industry", *Journal of Political Economy*, vol. 96, no. 5, pp. 921-947.

[74] Hallak I., Rosati N. (2018) "Market Concentration in Europe", *JRC Technical Report*.

[75] Harasztosi, P. (2018) "Representativeness of ORBIS database", *JRC Technical Report*.

[76] He, J., and Huang, J. (2017) "Product Market Competition in a World of Cross-Ownership: Evidence from Institutional Blockholdings". *The Review of Financial Studies*, vol. 30, no. 8, pp. 2674-2718.

[77] Hurley, N., and Rickard, S. (2009) "Comparing measures of sparsity", *IEEE Transactions on Information Theory*, vol. 55, no. 10, pp. 4723-4741.

[78] ICGN (2018) "Common ownership: do institutional investors really promote anti-competitive behaviour?", ICGN Viewpoint, October 2018, *International Corporate Governance Network.*

[79] International Monetary Fund (2019) "The rise of corporate market power and its macroeconomic effects", *IMF - World Economic Outlook, Chapter 2*. Available at `https://www.imf.org/~/media/Files/Publications/WEO/2019/April/English/Ch2Annex.ashx?la=en`

[80] Kalemli-Ozcan, S., Sorensen, B., Villegas-Sanchez, C., Volosovych, V., and Yesiltas, S. (2015) "How to construct nationally representative firm level data from the ORBIS global database", *National Bureau of Economic Research Working Paper*, No. w21558, Available at `http://www.nber.org/papers/w21558`

[81] Kang, J. K., Luo, J., and Na, H. S. (2018) "Are institutional investors with multiple blockholdings effective monitors?", *Journal of Financial Economics*, vol. 128, no. 3, pp. 576-602.

[82] Karvanen, J., and Cichocki, A. (2003) "Measuring sparseness of noisy signals", *4th International Symposium on Independent Component Analysis and Blind Signal Separation*, pp. 125-130.

[83] Kennedy, P., O'Brien, D. P., Song, M. and Waehrer, K. (2017) "The Competitive Effects of Common Ownership: Economic Foundations and Empirical Evidence", July 24 (2017) Available at SSRN: `https://ssrn.com/abstract=3008331`

[84] König M. D. and Battiston, S. (2009) "From graph theory to models of economic networks. A tutorial", In *Networks, Topology and Dynamics*, pp. 23-63, Springer, Berlin, Heidelberg.

[85] Konigs J., and Vandenbussche H. (2005) "Antidumping Protection and Markups of Domestic Firms", *Journal of International Economics*, vol. 65, pp. 151-165.

[86] Kwoka, J. (2013) "Does merger control work? A retrospective on U.S. enforcement actions and merger outcomes", *Antitrust Law Journal*, vol. 78, no. 3, pp. 619-650.

[87] Latapy, M., Magnien, C., and Del Vecchio, N. (2008) "Basic notions for the analysis of large two-mode networks", *Social networks*, vol. 30, no. 1, pp. 31-48.

[88] Lechner, M. (2011) "The estimation of causal effects by difference-in-difference methods", *Foundations and Trends in Econometrics*, vol. 4, no. 3, pp. 165-224.

[89] Lerner Abba P. (1934) "Economic Theory and socialist economy", *Review of Economic Studies*, vol. 2, pp.51-61.

[90] Lewellen, K. and Lowry, M. B. (2020) “Does Common Ownership Really Increase Firm Coordination?”, Tuck School of Business Working Paper No. 3336343. Available at SSRN: https://ssrn.com/abstract=3336343

[91] Lopez A.L., Vives X. (2017) "Cross-ownership, R&D spillovers and antitrust policy", CESifo Working Paper Series No. 5935. Available at SSRN: https://ssrn.com/abstract=2805398

[92] Massa, M., Schumacher, D. and Wang, Y. (2018) “Who Is Afraid of BlackRock?”, INSEAD Working Paper No. 2015/60/FIN. Available at SSRN: https://ssrn.com/abstract=2641078

[93] Monopolies Commission (2018) “Common ownership”, Excerpt from Chapter II of the XXII Biennial Report of the Monopolies Commission (“Competition 2018”) in accordance with Section 44 Paragraph 1 Sentence 1 of the German Act against Restraints of Competition. Available at https://www.monopolkommission.de/images/HG22/Main_Report_XXII_Common_Ownership.pdf

[94] Newham, M., Seldeslachts, J. and Banal-Estañol, A. (2018) "Common Ownership and Market Entry: Evidence from the Pharmaceutical Industry", *DIW Berlin Discussion Paper*, No. 1738. Available at SSRN: https://ssrn.com/abstract=3194394

[95] Newman, M. E. (2003) "The structure and function of complex networks". *SIAM review*, vol. 45, no. 2, pp. 167-256.

[96] O’Brien, D. P., and Salop, S. C. (2000) "Competitive effects of partial ownership: Financial interest and corporate control", *Antitrust Law Journal*, vol. 67, pp. 559-614.

[97] O’Brien, D. P., and Waehrer, K. (2017) "The Competitive Effects of Common Ownership: We Know Less Than We Think", *Manuscript*. Available at SSRN: https://ssrn.com/abstract=2922677

[98] OECD (1993) “Glossary of Industrial Organisation Economics and Competition Law”, compiled by R.S. Khemani, and D.M. Shapiro, available at http://www.oecd.org/regreform/sectors/2376087.pdf.

[99] OECD (2012) Proceedings of the 2012 Policy Roundtable on Market Definition, available at http://www.oecd.org/daf/competition/Marketdefinition2012.pdf

[100] OECD (2018) "Market Concetration". *Issue paper*, 6-8 June 2018, http://www.oecd.org/daf/competition/market-concentration.htm

[101] Opler, T., Pinkowitz, L., Stulz, R., and Williamson, R. (1999) "The determinants and implications of corporate cash holdings", *Journal of financial economics*, vol. 52, no. 1, pp. 3-46.

[102] Opsahl, T., Agneessens, F., and Skvoretz, J. (2010) "Node centrality in weighted networks: Generalizing degree and shortest paths", *Social networks*, vol. 32, no. 3, pp. 245-251.

[103] Ormosi, P., Havell, R. and Mariuzzo, F. (2015) “A review of merger decisions in the EU: What can we learn from ex-post evaluations?” European Commission. ISBN 978-92-79-51935-2, doi: 10.2763/84342

[104] Pagliari, R., and Graham, A. (2019) "An exploratory analysis of the effects of ownership change on airport competition", *Transport Policy*, vol. 78, pp. 76-85.

[105] Pastor, G., Mora-Jiménez, I., Jäntti, R., and Caamano, A. J. (2013) "Sparsity-Based criteria for entropy measures", *Wireless Communication Systems (ISWCS 2013), Proceedings of the Tenth International Symposium*, pp. 1-5.

[106] Pastor, G., Mora-Jiménez, I., Jäntti, R., and Caamano, A. J. (2015) "Mathematics of sparsity and entropy: Axioms core functions and sparse recovery", Manuscript available at *arXiv preprint arXiv:1501.05126*.

[107] Quéré, R., and Frélicot, C. (2012) "A new index based on sparsity measures for comparing fuzzy partitions". In *Joint IAPR International Workshops on Statistical Techniques in Pattern Recognition (SPR) and Structural and Syntactic Pattern Recognition (SSPR)*, pp. 291-300. Springer, Berlin, Heidelberg.

[108] Ragoussis, A., and E. Gonnard (2012) "The OECD-ORBIS database treatment and benchmarking procedures", *document interne*, Éditions OCDE, Paris.

[109] Rajan, R. G., and Zingales, L. (1995) "What do we know about capital structure? Some evidence from international data", *The journal of Finance*, vol. 50, no. 5, pp. 1421-1460.

[110] Ribeiro, S. P., Menghinello, S., and De Backer, K. (2010) "The OECD ORBIS database: Responding to the need for firm-level micro-data in the OECD", *OECD Statistics Working Papers*, 2010(1), 1.

[111] Rickard, S., and Fallon, M. (2004) "The Gini index of speech", *Proceedings of the 38th Conference on Information Science and Systems (CISS’04)*.

[112] Robins, G., and Alexander, M. (2004) "Small worlds among interlocking directors: Network structure and distance in bipartite graphs", *Computational & Mathematical Organization Theory*, vol. 10, no. 1, pp. 69-94.

[113] Roeger W. (1995) "Can Imperfect Competition Explain the Difference between the Primal and Dual Productivity Measures? Estimates for U.S. Manufacturing", *Journal of Political Economy*, vol. 103, no. 2, pp. 316-330.

[114] Santos A., Cincera M., Neto P., Serrano M.M. (2018) "Competition effect on innovation and productivity, the Portuguese case", *Public Policy Portuguese Journal*, vol. 3, no. 2, pp. 52-84.

[115] Shelegia S., and Spiegel Y. (2017) "Bertrand competition when firms hold passive ownership stakes in one another", *Economic letters*, vol. 114, pp. 136-138.

[116] Schild, C. J. (2016) "Linking ‘Orbis’ Company Data with Establishment Data from the German Federal Employment Agency", *German Record Linkage Center Working Paper*, No. WP-GRLC-2016-02.

[117] Schmalz M.C. (2017) "Common ownership and competition: facts, misconceptions and what to do about it", *Manuscript*. Background paper for the 128th meeting of the OECD Competition committee.

[118] Schmalz, M. C. (2018) "Common Ownership, Concentration and Corporate Conduct", *Annual Review of Financial Economics*, vol. 10, pp. 413-448.

[119] Schmidt, J. P. (2013) "Antitrust developments in the food sector in the EU", *European Competition Law Review*, vol. 34, no. 5, pp. 274-279.

[120] Scott, J. (2017) *Social network analysis*, Sage.

[121] Seldeslachts, J., Newham, M., and Banal-Estañol, A. (2017) "Changes in common ownership of German companies", *DIW Economic Bulletin*, vol. 7, no. 30, pp. 303-311.

[122] Tybout, J. (2003) "Plant- and firm-level evidence on ’New’ trade theories". In: Choi, K., Harrigan, J. (Eds.), *Handbook of International Trade*, Basil Blackwell, UK, Oxford and US, MA.

[123] Weche, J.P., and A. Wambach (2018) "The fall and rise of market power in Europe", *ZEW Discussion Papers* 18-003, ZEW - Leibniz Centre for European Economic Research.

[124] Zhang, X. D (2017) *Matrix analysis and applications*, Cambridge University Press.

[125] Zonoobi, D., Kassim, A. A., and Venkatesh, Y. V. (2011) "Gini index as sparsity measure for signal reconstruction from compressive samples", *IEEE Journal of Selected Topics in Signal Processing*, vol. 5, no. 5, pp. 927-932.

List of Abbreviations and Definitions

AEGS Antón, Ederer, Giné and Schmalz

AMF Asset Management Funds

ARS Azar, Raina and Schmalz

AST Azar, Schmalz and Tecu

AUM Assets Under Management

BGI Barclays Global Investors

Big2 State Street and Vanguard

Big Three BlackRock, State Street and Vanguard

BR BlackRock

BvD Bureau van Dijk

CEO Chief Executive Officer

CHF Cross-Held Firm

DUO Domestic Ultimate Owner

EBITDA Earnings Before Interest, Taxes, Depreciation and Amortization

EEA European Economic Area

EMM European Media Monitor

ECGI European Corporate Governance Institute

EP European Parliament

ESMA European Securities Market Authorities

EU European Union

FTC Federal Trade Commission

GUO Global Ultimate Owner

HHI Herfindahl-Hirschman Index

ICGN International Corporate Governance Network

ISO International Organization for Standardization

MHHI Modified Herfindahl-Hirschman Index

MKT CAP Market Capitalisation

MNO Mobile Network Operator

MO Majority Owner

MVNO Mobile Virtual Network Operator

NACE European Classification of Economic Activities (Nomenclature générale des Activités économiques dans les Communautés Européennes)

OECD Organisation for Economic Co-operation and Development

NAICS North American Industry Classification System

ROA Return on Assets

ROE Return on Equity

SH Shareholder

SIC Standard Industrial Classification

TFEU Treaty on the Functioning of the European Union

TOAS Total Assets

TSO Transmission System Operator

List of Boxes

List of Figures

List of Tables

Annexes

Appendix A

The Database of EU Ownership

A dataset comprising the ownership information of companies is a rich resource that can be used to investigate several research questions about the structure of corporate groups. Such a dataset also allows to obtain relevant empirical evidence, which can help make informed decisions based on deeper knowledge of market structures.

Despite the availability of large commercial databases of firm-level micro data, the extraction and cleaning of the relevant information is in itself a hard task, given the huge size of the data involved, the complexity of the ownership information, and the need to match it with several additional firm's characteristics. The challenge is not new in applied research, as reported, for instance, in Ribeiro et al. (2010), or Kalemli-Ozcan et al. (2015). However, given the specific focus of each empirical study, different purposely-built sets of data may be needed, rather than a comprehensive all-inclusive database.

The present Appendix describes the procedure followed in the construction of an *ad hoc* dataset with ownership information on a specific target group, i.e. the *listed companies active in the EU between 2007 and 2016*. All firm-level data are extracted from Bureau van Dijk's Orbis database, which will be presented in detail later.

The set of firms selected for the current study includes not only listed firms registered in one of the EU countries, but also listed firms registered elsewhere, but holding stakes in EU firms. Overall, a set of 31,864 different firms are observed, with an average of 26,560 per year; of these, roughly four in ten are registered outside the EU. The shareholding structures of these firms comprise more than 100,000 distinct reported owners per year, with over 6 million shareholder-firm links registered over the period of observation.

The Appendix highlights the challenges encountered in the development of the *ad hoc* ownership dataset, and discusses the choices made along the way. The final dataset is constructed with the immediate purpose of specific applications, such as drawing the picture of common shareholding in the EU, or measuring the possible effect of common shareholding on the market. However, the dataset is rather general and is suitable for several other empirical studies on firms and their ownership structure.

The procedure used for the construction of the dataset is also quite general, following some overall principles that are justified and detailed in this Appendix. Such procedure can easily be adapted - with minor modifications - to the extraction of similar information for different target groups of companies, or different geographical regions.

The Appendix is organised as follows: Section A.1 presents the structure of the Orbis database. Section A.2 describes the method of identification and selection of the companies of interest, i.e. the listed companies which were active in the EU between 2007 and 2016. The same section also discusses the procedure of firms' selection used to identify different sectors of economic activity. Section A.3 describes the Orbis variables that were extracted to be enclosed in the database, ranging from general company information, to financial variables and finally to ownership information. Section A.4 describes the organisation and cleaning of the different parts of the database, which contain, respectively, the legal and the ownership information, the industry classification and the financial variables. A short version of the ownership data is also constructed, containing summarised ownership information suitable to be merged with the financial and industry data. Some new variables defined for the current purpose, which were constructed based on the Orbis variables, are also presented. Section A.5 contains some descriptive statistics of the various parts of the database, while Section A.6 compares them to evidence from official statistics.

A.1 Structure of the Orbis database

BvD provides online access to the Orbis information, with the possibility of downloading a certain amount of selected data. However, the download process has several shortcomings, as reported for instance in Kalemli-Oezcan et al. (2015). For example, the presence of a *download cap* makes the online consultation more appropriate for a search on a specific (limited) set of companies rather than for a massive download of a whole country or industry. Moreover, the occasional reclassification of companies' identifiers (so-called BvD IDs) makes sometimes difficult to match companies' information downloaded at different points in time, since their identifier might have changed. Although BvD provides a"correspondence table" of BvD IDs, the task does not always have an easy solution. Finally, some online ownership information only presents the current situation (such as the current Global Ultimate Owner), but does not allow to reconstruct the previous historical information.

As an alternative, BvD provides the Orbis data twice a year through the release of flat files, which mirror the online information at a specific point in time. The flat files information has the advantage of being consistent in terms of companies' identifiers, and also provides the full historical ownership information. Although the large size of the files calls for the need to split them into smaller sets of data, there is no imposed cap on the amount of data that can be processed, being dependent only on the computer's capacity. A reasonable machine allows to process much more information at a time than the download. For these (and other) reasons the present database is constructed starting from the flat files.

BvD provides the data not in a single dataset, but via a number of files, each containing different parts of the Orbis database. This is due to the very large dimension of the data provided, which would make a single database unmanageable.[1] BvD provides also an accompanying document with the list of variables included in each one of the files, together with a brief explanation on their definition. Hence, the initial key task is to locate and extract from the various files the information that is needed.

The present database is based on the last release at the time of the study, available since February 2018, which refers to information updated to December 2017. However, companies' financial statements for the year 2017 were still not available on that date, as well as many other variables which need more time to be processed.[2] Therefore the present database will contain only information relative to the period 2007-2016.

Table A.1 provides an overview of the different flat files that compose the Orbis database, and reports the main variables they contain. The first batch of files provides descriptive information of the companies. The second batch provides the accounting data (Global Format and Ratios). Further files provide information on the directorates of a company, its advisors and the stock market where a company is listed, respectively. Lastly, additional files contain the historical information on ownership and (current) names and types of all entities.

A.2 Extraction of companies

In order to compose the relevant database for the analysis, the extraction of information from Orbis should undergo two selection procedures, one relative to the units to be included in the sample (firms), the other relative to the choice of economic variables to be retained. This section discusses the selection procedure for firms, while relevant variables retention is described in Section A.3.

Since the present project refers to the population of listed companies that are active in the EU, we should first define how this characteristic is identified. Subsequently, we shall discuss how to identify the industries of interest for the sectoral studies.

[1] For example, the file with the financial information alone reaches a size of about 100 Gigabytes, while the ownership information (2007-2016) occupies about 330 Gigabytes. Any empirical analysis needs the availability of a very capable server, with a considerable amount of RAM memory, in order to be able to store, read in and analyse the data.

[2] Notice that the release of microdata suffers generally a two-year delay in most common databases.

Table A.1: Structure of the Orbis database *(for acronyms, see p. 227)*

Files	**Main Variables**
Contact Info/All Addresses	Address, Telephone/Additional Addresses of the Firm
Identifiers/BvD9	Identification numbers/BvD-Identification number, BvD9
Legal Information	Listing Status, Delisting Date, Main Exchange
Additional Company Information	Changes in the Company Name
Industry Classification	NACE Code, US SIC, NAICS
Trade Description	Peer Group Specification
Overviews	Business lines, Brand names, Production site
Key Financial Indicators	Total Assets, Cash Flows, Turnover
Global Format & Financial Ratios	Fixed Assets, Current Assets, EBITDA, ROA, ROE
Directorates Current/Previous	Name, Educational Degree, Salary
Bankers Current/Previous	Name, Appointment Date
Advisors/Other Advisors Current	Name, Appointment Date, Resignation Date
Stock data	Stock exchange and Stock Index
Ownership Structure	Shareholder Information, Ownership Shares, Ultimate Owner
Entities	BvD-Identification number, Name, ISO Code, Entity Type

A.2.1 Identification of listed companies active in the EU

First, the current listing status of all global companies is obtained from the Legal Information file. Only companies that are currently classified as “Listed” or “Delisted” are retained, whereas all those that are classified as “Unlisted” are discarded.[3]

Subsequently, the population of “listed companies active in the EU” is extracted from the previous selection, comprising in the present study two sets of listed/delisted companies:

1. listed/delisted companies registered in one of the EU countries;
2. listed/delisted companies registered outside the EU, but holding shares in at least one firm registered in the EU in the period 2007-2016.

[3] “Delisted” status denotes a company that is currently not listed in any exchange, but was listed at some point in the past; “Unlisted” indicates a company that has never been listed in any exchange.

In order to identify the companies in group 2., the list of all quoted companies registered outside the EU is compared with the yearly ownership files. If any of the quoted companies in this list appears as shareholder of one or more EU firm between 2007 and 2016, then it is considered “active” in the EU.

The country of registration of listed/delisted companies and of the firms they participate in is obtained again from the Legal Information file, through the company identifier. In this context the term EU comprises the 28 countries of the EU as of 2017, excluding candidate countries and countries which are simply associates of the European Economic Area (EEA).

A.2.2 Identification of sectors of economic activity

There are several international systems of classification of the economic activity of firms, among which the US-SIC (US Standard Industrial Classification), the I-SIC (International Standard Industrial Classification), the NAICS (North American Industry Classification System), and finally the NACE (Nomenclature générale des Activités économiques dans les Communautés Européennes).

The Orbis database reports, in the Industry Classification file, the NACE, the US-SIC and the NAICS codes for each company, describing the set of industries where the firm is active at the time of release of the database, i.e. as of December 2017. Previous industry classifications or changes in the current classification are not recorded, although for most companies the economic activities are rather stable over time.

The NACE industry classification is the European statistical classification for economic activities, and therefore will be the chosen classification system in the present project. The NACE classification has evolved over time, since previous versions were based on existing national classification and lacked international compatibility. The present analysis refers to the most updated version (NACE Revision 2), which has been introduced in the year 2007. This revised version accounts for the rise of new activities in recent years and guarantees an international compatibility, due to its alignment with the ISIC codes, the international classification of economic activity.

We summarise in the following the main features of this industrial classification, as well as any further aspects considered relevant for the current project. A detailed description and discussion of the NACE Rev. 2 codes can be found in Eurostat (2008).

The NACE Codes are composed by four digits, reflecting a hierarchical structure of Sections, Divisions, Groups and Classes, as detailed below:

- **Level 1 - Section:** Sections are defined by an alphabetical code, given by letters A-U. The NACE Rev. 2 classification contains 21 sections, such as Agriculture, Forestry and Fishing (A), Manufacturing (C), Construction (F), and so on.

- **Level 2 - Division:** The divisions are identified by the first two digits of the NACE code, ranging from 01 to 99. The divisions separate different broad areas of activity within each Section. For example, within Section A (Agriculture, Forestry and Fishing), division 01 corresponds to “Crop and animal production, hunting and related service activities”, division 02 to “Forestry and logging”, while division 03 to “Fishing and aquaculture”. There are 88 Divisions in total.

- **Level 3 - Group:** Groups are identified by the first three digits of the NACE code, separating further the activities within each Division. There are 272 Groups in the current revision.

- **Level 4 - Class:** Classes are identified by the full four-digit NACE Code, and represent the most detailed definition of economic activity (615 classes in total).

The NACE Code does not include the alphabetical identifier of the Section. Table A.2 reproduces an excerpt from Section A, providing an example of the hierarchical structure of the NACE Code. The full list of the 21 sections and corresponding divisions is reported in Table A.3. The ISIC and NACE codes contain the same classification at higher levels of the hierarchy, however the NACE is more detailed in the subgroups.

A single company can present several NACE codes, if involved in more than one economic activity. The NACE codes reported in Orbis can be of three types: the so-called *core* code, which uniquely identifies the main activity of the company according to certain criteria;[4] up to four *primary* codes, denoting other sectors of activity with a high weight in the total activity of the firm; and a series of *secondary* codes identifying further activities of smaller size. Although in general most companies do not present more than four secondary codes, some companies can present dozens of them.

Regarding the present analysis, the possible identification of sectors of interest through suitable NACE codes has been assessed as follows. First, the NACE classification has been inspected, identifying possible codes defining each market at a two-digit level. Divisions 35 (Electricity, gas, steam and air conditioning supply) and 61 (Telecommunications) seem a natural choice for the first two industries. However, in the case of stock markets no specific Division seems to correspond to the industry. Subsequently, some key players of each of the three sectors have been identified in the EU, and the respective four-digit core NACE codes extracted from Orbis. The following core NACE codes have been observed:

- *Energy Generation:* codes
  - **0610** - Extraction of crude petroleum
  - **3511** - Production of electricity
  - **3523** - Trade of gas through mains

[4] For more details about the identification of the core industry of activity, see Chapter 3 in Eurostat (2008).

Table A.2: NACE Codes

Section	Division	Group	Class	Description	NACE Code
A	**Agriculture, Forestry and Fishing**				
	01			Crop and animal production, hunting and related service activities	0100
				...	
	02			Forestry and logging	0200
				...	
	03			Fishing and aquaculture	0300
		03.1		Fishing	0310
			03.11 03.12	Marine fishing Freshwater fishing	0311 0312
		03.2		Aquaculture	0320
			03.21 03.22	Marine Aquaculture Freshwater aquaculture	0321 0322

- *Stock Markets:* codes
  - **6492** - Other credit granting
  - **6499** - Other financial service activities, except insurance and pension funding n.e.c.
  - **6611** - Administration of financial markets
  - **6612** - Security and commodity contracts brokerage
- *Telecommunications:* code **6190** - Other telecommunications activities

The previously highlighted Divisions for the energy and the telecommunication markets seem to be confirmed (35 and 61), although in the energy market an additional division appears, 06 - Extraction of crude petroleum and natural gas. On the other hand, in the case of stock markets Divisions 64 (Financial service activities, except insurance and pension funding) and 66 (Activities auxiliary to financial services and insurance activities) are very general and comprise a wide range of financial services beyond stock markets. For this industry we might wish to consider the three-digit level, i.e. the Group; for example, Group 66.1 (Activities auxiliary

Table A.3: Sections and Divisions of NACE Rev. 2

Section	Title	Divisions
A	Agriculture, forestry and fishing	01 – 03
B	Mining and quarrying	05 – 09
C	Manufacturing	10 – 33
D	Electricity, gas, steam and air conditioning supply	35
E	Water supply; sewerage, waste management and remediation activities	36 – 39
F	Construction	41 – 43
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	45 – 47
H	Transportation and storage	49 – 53
I	Accommodation and food service activities	55 – 56
J	Information and communication	58 – 63
K	Financial and insurance activities	64 – 66
L	Real estate activities	68
M	Professional, scientific and technical activities	69 – 75
N	Administrative and support service activities	77 – 82
O	Public administration and defence; compulsory social security	84
P	Education	85
Q	Human health and social work activities	86 – 88
R	Arts, entertainment and recreation	90 – 93
S	Other service activities	94 – 96
T	Activities of households as employers; undifferentiated goods- and services-producing activities of households for own use	97 – 98
U	Activities of extraterritorial organisations and bodies	99

to financial services, except insurance and pension funding) includes both Classes 6611 and 6612 listed above, which seem to better identify the given industry. A similar reasoning applies to Group 64.9 (Other financial service activities, except insurance and pension funding). Analogous reasoning was followed in the identification of beverages manufacturers. Details of all sectors' definitions are reported in Appendix C.

For the identification of a specific market, all companies presenting the chosen NACE code as core, primary or secondary can be considered as active in that specific industry. However, this very comprehensive criterion can be restricted - for example - only to core, primary and first *n* secondary codes. In this case, a company that declares the chosen activity as being its secondary activity of order > n would not be considered as having an important role in the industry, and therefore would be excluded. The value of n can be decided according to the purposes of the study.

A.3 Selection of relevant company information

The company information relevant for this project is extracted from five different datasets within the Orbis database. Starting from the files listed in Table A.1, some general company information is retrieved from the Legal Information and Entities files, the NACE codes are obtained from the Industry Classification file, the Global format & Financial Ratios file provides the financial variables, and the shareholders' structure comes from the Ownership file.

Some variables from the Legal Information and Industry Classification files have already been described earlier, in Section A.2, given that they were used for the selection of the relevant companies to be included in the database. The remaining variables are presented in the remainder of this section.

A.3.1 General company information

Company ID and definition of country of reference

All files contain the so-called BvD identification number (BvDID), which identifies uniquely each firm in Orbis, and allows to merge information from different files. The first two digits of the BvDID mirror the ISO code of the country where the entity is incorporated. Therefore in the present analysis whenever a firm or a market is identified by country, it should be interpreted always as the country of registration. Notice that this does not necessarily coincide with the trading market of the company.

The rest of the BvDID is constituted by the company's fiscal identification number, if known. Otherwise the internal identification number of the provider, which has provided the information regarding this particular entity, is employed. In the case of shareholders, some may be individuals rather than firms, in which case the personal fiscal identification number is used.

If the information is retrieved by BvD itself, the latter compose an identification number with the ISO country code, an asterisk, followed by numerical digits. Whenever BvD cannot identify the ISO code, the latter is replaced with YY for companies and WW for individuals.

Listed/Delisted/Unlisted variable

The Legal Information file provides a variable classifying each company in one of the following three categories, as mentioned earlier: "Listed", "Delisted" or "Unlisted". This classification refers to the latest available information, updated to December 2017, and indicates - respectively - whether the company is currently publicly listed, whether it was listed in the past but is currently delisted, or finally whether it has never been listed.

Given that the focus of the current database has been restricted only to listed companies active in the EU between 2007 and 2016, all companies in our sample are classified either as “Listed” or as “Delisted”.

Incorporation, IPO and delisting dates

Information on different dates describing the life-cycle of the companies is obtained from the Legal Information file. These variables comprise the incorporation date of the company, the initial public offering (IPO) date (the day of the first public selling of shares of the respective company), and the delisting date in case it has been delisted, as well as a comment on the reason for delisting.

In order to confirm whether the currently delisted companies were actually active (and when) in the period 2007-2016, the IPO and delisting dates have been inspected, allowing us to define yearly dummies identifying for each year the listing status of a firm. This helps also identify, in the case of currently listed companies, the actual starting year of the “Listed” status. The construction of the yearly dummies is described in section A.4.5.

Main exchange

The Legal Information file provides also the identification of the primary stock exchange on which a company is listed. The stocks might be traded in other stock markets likewise (called secondary listings), however in smaller volumes.

Type of entity of company

The Entities file contains the basic information regarding each entity, i.e. the Name and the type of entity (for example Industrial Company, Bank, Fund, Public Authority, Individuals, etc.). This information is retrieved not only for the companies under study, but also for all the shareholders and the Global Ultimate Owners of the companies in the database. This allows not only to identify more quickly who is who via the name rather than an alphanumerical code, but also to characterise the shareholders’ structure in terms of types.

To each firm and shareholder Orbis assigns a classification (entity type), depending on their legal status or business field. Table A.4 lists the entity types contained in the database.

Table A.4: Entity Types

Entity Type	Description
A	Insurance Company
B	Bank
C	Industrial Company
D	Unnamed private shareholders, aggregated
E	Mutual & Pension Fund/ Nominee/ Trust/ Trustee
F	Financial Company
H	Self Ownership
I	One or more known individuals or families
J	Foundation/ Research Institute
L	Unnamed shareholders (companies or a mixture of companies and private owners)
M	Employees/ Managers/ Directors
P	Private Equity Firms
Q	Branch
S	Public authorities, States, Governments
V	Venture Capital
W	Marine Vessels
Y	Hedge Fund
Z	Public

Notice that "Public" (Z) comprises atomistic shareholders of publicly listed companies. In contrast, "Unnamed Private Shareholders" (D) and "Unnamed Shareholder (Companies and Private Owners)" (L) represent atomistic shareholders of non-publicly listed companies. Given the present company selection only Z is relevant. Since atomistic shareholder cannot individually exert control over a company, they are aggregated.

A.3.2 Ownership information

The historical Ownership file defines the relationships (links) between a “subsidiary” and its shareholders for a given year. **The term “subsidiary” here denotes *any firm in portfolio*, independent of the quantity held.** The information includes

- the BvD ID of both subsidiary and shareholder
- the percentage the shareholder holds (direct and total ownership shares),
- the source from which BvD has received the information,
- the date of the validity of the information,
- a classification of the subsidiary-shareholder relationship (the “type of relation”)
- the ultimate owners according to several definitions

A link with a shareholder is present for a given year whenever the shareholder information has been confirmed in that year, or when it has been confirmed for the previous and the subsequent years. Older shareholder information, which has not been updated in the current year is considered as still being valid and kept in the database. However, any previous shareholder that no longer holds shares in the present year is dismissed.

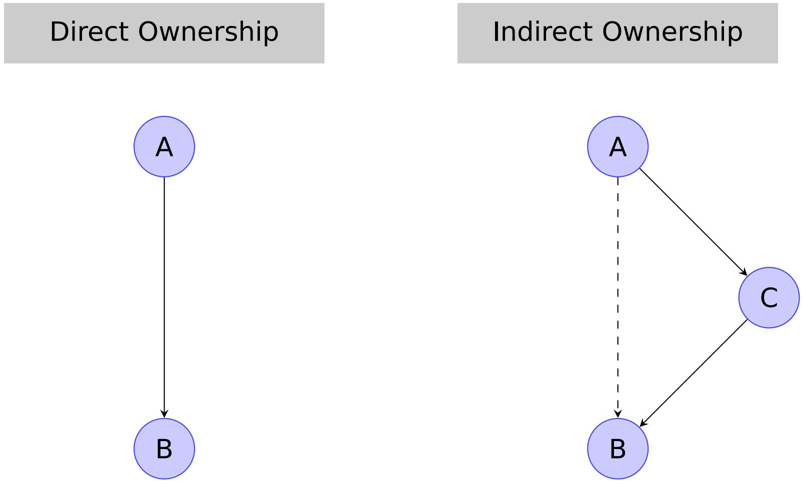
The historical files are updated twice a year, the number of recorded links having increased after each update. The files contain ownership links from the year 2007 onwards.

Direct and Total ownership shares

Orbis differentiates between direct and total ownership shares. A direct ownership documents a direct participation of the shareholder in the subsidiary, as it is shown in Figure A.1 a). In other words, the shareholder owns shares of the subsidiary directly and not via its participation in a third, intermediate company as depicted in Figure A.1 b) (total ownership).

Whenever the shareholder distinguishes between voting and non voting shares, Orbis reports the former. Sometimes the direct and total ownership shares are reported using non-numerical values (*direct and total %*). The variable *“direct % & total % only figures”* transforms these qualitative ownership indications into numeric values according to the conversion in Table A.5.

Figure A.1: Ownership of Investor A on Firm B. Left: direct, right: indirect through Firm C.



Type of relation

The variable *type of relation* defines the characteristic of each subsidiary-shareholder link. It comprises four general types of relationship between the subsidiary and the shareholder (reported in Table A.6), and various categories describing different types of ultimate owners.

The ultimate owner (UO) is the first independent shareholder in the hierarchy above the subsidiary that holds a minimum percentage of ownership shares (direct or total), according to a specific value of interest (for example 25%). An entity is defined to be independent when none of its shareholders holds more than the chosen percentage of its shares. Additionally, all shareholders belonging to one of the following three entity types are also considered independent: Individuals and Families, Public authorities/State, or Employees/Managers/Directors.

BvD distinguishes UOs based on their country of registration, defining the Domestic Ultimate Owner (DUO) as one located in the same country as the respective subsidiary, while the Global Ultimate Owner (GUO) can be located worldwide. A further distinction is given by limiting the choice of the UO among only some types of entities, namely banks and financial/insurance/industrial companies. In such cases the respective UOs are indicated with an additional “c”, i.e. as GUOc/DUOc.

As for the possible choices of percentages, Orbis presents the options of UOs based on a minimum of 25% or 50% of ownership. Any shareholder that is located in the hierarchy in-between the subsidiary and the UO must in turn likewise hold either minimum 25% or 50% of the shares of its subsidiary, i.e. the chosen percentage defines the minimum ownership of all companies appearing in the path to the UO.

Table A.5: Construction of the Direct % and Total % - Only Figures

Non-Numeric Value Direct% and Total %	**Corresponds to:**	**Direct% and Total % only figures**
WO - wholly owned	>=98.1-%	98%
MO - majority owned	>=50.01%	50.01%
JO - jointly owned	=50.00%	50.00%
NG - negligible	<=0.01%	-
CQ+1	50.00% + 1 share	50.01%
GP - General Partner		-
BR - Branch		100.00%
F - Foreign Company		100.00%
T - Sole Trader		100.00%
n.a./ -		-
'>X		X+0.01%
'<X		X-0.01%
+/- X		X

All-together, the choice of the percentage of interest, the location of the UO, and its entity type give rise to eight possible different definitions, that are reported in Table A.7. In some cases the UOs are not reported simply because they do not exist according to the chosen definitions. For example, if a firm does not have any shareholder holding more that 25% of its shares, then none of the above eight types of UOs will exist. On the other hand, if some of its shareholders hold more than 25% but none more than 50%, then the GUOs/DUOs based on a 25% definition might exist, while those based on a 50% threshold are not defined.

Table A.6: Shareholder types

Type	Definition
SHH	Any kind of shareholder, which has been reported to BvD. The direct and total ownership shares might be known or not. It can hold any amount of ownership shares.
ISH	A shareholder who directly owns the subsidiary and is in turn directly or indirectly owned by the ultimate owner of that particular subsidiary.
HQ	Is the single shareholder of the subsidiary (headquarter), implying that the subsidiary is a branch or foreign company of the shareholder.
CTP	A shareholder with both direct and indirect participation, whose total ownership shares have been obtained by the Calculated Total Percentage method.

Table A.7: Ultimate Owners Types

Type	Definition
DUO25	Domestic Ultimate Owner characterised by a minimum of 25% ownership shares in the path from the subsidiary to the ultimate owner
GUO25	Global Ultimate Owner characterised by a minimum of 25% ownership shares in the path from the subsidiary to the ultimate owner
DUO50	Same as DUO25, but using a minimum 50% definition
GUO50	Same as GUO25, but using a minimum 50% definition
DUO25C	Same as DUO25, but UO only bank or financial/insurance/industrial company
GUO25C	Same as GUO25, but UO only bank or financial/insurance/industrial company
DUO50C	Same as DUO50, but UO only bank or financial/insurance/industrial company
GUO50C	Same as GUO50, but UO only bank or financial/insurance/industrial company

A.3.3 Financial information

To estimate the plausible causal effect of common shareholding in the analysis, we take into account firms' characteristics and their economic and financial performances based on financial and non-financial measures. The main objective of profit seeking entities is the maximization of shareholders' wealth since shareholders are the legal owners of a company and their interests should be prioritised. Generally, the shareholders' wealth maximization is achieved thought different objectives such as (i) to make profits, since shareholders are interested in current and future earnings, and (ii) to maintain firm's growth and development. Both objectives are driven by the financial performance of the firm and can be identified in a number of ways both financial and non-financial. The most common financial indicators used in the financial empirical literature refer to profitability, revenues, return on investment, cash flow, whereas the most used non-financial measures relate to the total sales, number of employees and market shares.

A first important measure capturing firm's size is represented by *Total Assets (TA)*. TA refers to the total amount of assets owned by the firm at its market value. TA includes cash, marketable securities, inventory, fixed assets, intangibles and goodwill. According to the time taken to be converted - more or less quickly - into cash, they are classified either current assets or long-term assets. The balance sheet composition of total assets is very relevant for potential acquirors, in particular if the value stated in the balance sheet corresponds to its current value. In case the firm's asset has a higher current value compared to that reported in the balance sheet, possible acquirors may have greater incentive to invest in the firm. As a result, we expect larger firms with higher current and future values to be targeted by large investors, whereby their investments are distributed across larger companies in the market in the same proportions as the stock index.

A relevant financial variable, generally considered in empirical financial literature, is *Leverage*. Leverage represents how a firm uses debt to finance its activities and asset purchases, and it is computed as the sum of long-term debt and debt in current liabilities divided by total assets. Generally, firms with higher leverage are considered riskier and may not be able to increase the share of debt in their liabilities. However, the optimal capital structure differs across firms and industries. Empirical evidences predict a positive relationship between firm's size and leverage (Rajan and Zingales, 1995) and the main explanation is that large companies suffer less of asymmetry information problems so that they have an easier access to the market of debt financing.

A financial variable measuring firm's performance is the Cash Flow. Cash flow is the net amount of cash and cash-equivalents flowing in - from customers who buy firm's products or services - and out of a firm - for all the payments in the accounting year. We define *Cash Flow* as the ratio of earnings after interest and taxes plus depreciation minus common dividends to Total Assets. Following the pecking order theory, investments should preferably be financed with the internal funds, then with debt and finally with equity. As a result, more cash should be accumulated in companies with the positive cash flow.

Efficiency measures

An alternative variable considered in literature as a substitute for liquid assets (Opler et al., 1999) is *Net Working Capital (NWC)*. NWC measures firm's efficiency and indicates if a firm has enough short term assets to cover its short term debt. NWC is defined as the ratio of the current assets minus current liabilities and minus savings to assets net of savings. A ratio below one indicates a negative NWC whereas a ratio higher than two could mean that the firm is not investing its excess of cash.

As an additional measure of company's efficiency use of capital is *Operational Efficiency (OE)*, which shows the ability of firm's management to generate profit if revenues decrease. OE is defined as the ratio between operating expense to net sales. This measure is commonly used to identify the trend of operational efficiency or inefficiency in a firm over a period of time. When in a trend the ratio goes up it means that the operating environment is working inefficiently and might need to implement cost controls for margin improvement. Conversely, a decrease in the ratio indicates an efficient operating environment in which operating expenses represent an increasingly smaller percentage of sales.

Profitability measures

As a measure of firm's profitability we consider (i) the *Net Income (NI)*, (ii) the *Return on Equity (ROE)*, (iii) earnings before interest, taxes, depreciation and amortization *(EBITDA)* and (iv) *Return on Assets (ROA)*.

The net income (NI) is an indicator that measures how profitable is a firm over a certain period of time. NI is computed subtracting from total revenues all the business expenses and operating costs other than taxes that firm a incurred in doing business. The net income is relevant because it can be used to compute the earnings for share and consequently the earnings of each shareholder on the basis of the shares they own.

The variable Return on Equity (ROE) shows how many profits a firm has generated with investments in capital made by shareholders. ROE represents the amount of profits returned as a percentage of shareholders' equity. The ROE is useful for comparing the profitability of a company to that of other firms operating in the same industry. It illustrates how effective the company is at turning the cash put into the business into greater gains and growth for the company and investors. The higher the ROE, the more efficient the company's operations are making use of those funds.

As additional metric of profitably we consider the earnings before interest, taxes, depreciation and amortization (EBITDA). EBIDTA is computed by adding to operating profits (i.e. earnings before interest and tax) the firms' depreciation and amortization expenses. This measure has the benefit of removing the distorting effects of taxes on profits, interest income and expenses but also remove the effect of investments in capital in the company. This measure also provides a picture of a firm's short-term operational efficiency showing that the firm is generating enough earnings for payment back of its debt. EBIDTA is also widely used by investors to analyse capital-intensive and high leveraged companies and compare them in sectors of activities where depreciation rates and interest payments on debt are larger with respect to other sectors, such as utilities or telecommunications companies, and in the case of acquisition targets.

The last profitability measures we consider in the analysis is ROA. Such a metric is informative about how many earnings the firm generated with the invested capital (assets) or, saying differently, how effective the company has been in converting its investments into net income. ROA is computed as net income (NI) over total assets. Due to high variation of its value across firms and sectors, ROA is more suitable for a comparison of publicly-traded companies with similar characteristics that operate in the same industry.

Growth measures

To proxy for a firm's growth opportunities in their business, we consider several measures. A first measure refers to *"Research and Development expenses" (R&D)* and represents the operating expenses that a firm incurs into to develop new products or services in a year. In some industries - i.e., technological, industrial, pharmaceutical - R&D expenses are usually higher compared to those of other sectors. The main reason is that firms have to reinvest a significant portion of their profits in R&D activities to continuously grow, allowing them to maintain their market positions or find new areas of opportunistic growth that diversify their business activities. Firms with higher R&D expenditures are expected to have greater growth opportunities.

A second measure for growth opportunities is the variable *Book-to-Market Ratio*. The Book-to-Market Ratio of listed companies reflects the management's ability to effectively use firms' assets to grow, and it is computed as the ratio between common shareholders' equity at the book value and the market capitalization determined in the stock market where the firm is publicly listed. Book-to-Market Ratio is also used to determine whether the market value of a publicly traded company reflects its real value or just an investor speculation.

The last measure of firm's growth we consider is the variable *Employment*. Employment represents the total number of full time employees of a company in a certain year. An increase in the job creation means that the firm is growing in its business activities.

Definition of main financial variables from the Orbis dataset

Tables A.8 and A.9 report the specific definitions of some main financial variables collected in the Orbis dataset, from the balance sheet and the profit&loss account.

Table A.8: List and definition of Balance Sheet variables collected by Orbis

Acronym	Label/Formula	Definition
FIAS	Fixed Assets IFAS+TFAS+OFAS	Total amount (after depreciation) of non current assets (Intangible assets + Tangible assets + Other fixed assets)
IFAS	Intangible Fixed Assets	All intangible assets such as formation expenses, research expenses, goodwill, development expenses and all other expenses with a long term effect
TFAS	Tangible Fixed Assets	All tangible assets such as buildings, machinery, etc.
OFAS	Other Fixed Assets	All other fixed assets such as long term investments, shares and participations, pension funds etc.
CUAS	Current Assets STOK+DEBT+OCAS	Total amount of current assets (Stocks + Debtors + Other current assets)
STOK	Stocks	Total inventories (raw materials + in progress + finished goods)
DEBT	Debtors	Trade receivables (from clients and customers only)
OCAS	Other Current Assets	All other current assets such as receivables from other sources (taxes, group Companies), short term investment of money and Cash at bank and in hand.
TOAS	Total Assets FIAS+CUAS	Total assets (Fixed assets + Current assets)

Table A.9: List and definition of Profit & Loss Account variables collected by Orbis

Acronym	**Label/Formula**	**Definition**
OPRE	Operating revenue (Turnover)	Total operating revenues. The figures do not include VAT. (Net sales + Other operating revenues+ Stock variations)
TURN	Sales	Net sales
COST	Cost of Goods Sold	Cost of sold goods, production, services. Costs directly related to the production of the goods sold + depreciation of those costs
GROS	Gross Profit OPRE-COST	Operating revenue - Cost of goods sold
MATE	Material Costs	Detail of the purchases of goods (raw materials + finished goods). No services.
STAF	Cost of Employees	Detail of all the employees costs of the Company (including pension costs)
EBIT	Operating P/L	All operating revenues - all operating expenses (Gross profit-Other operating expenses)
DEPR	Depreciation & Amortization	Total amount of depreciation and amortization of the assets
AV	Added Value	Profit for period + Depreciation + Taxation + Interests paid + Cost of employees
EBTA	EBITDA EBIT+DEPR	Operating profit + Depreciation

A.4 Organisation and cleaning of data

The selection of firms and of variables according to the procedures described in the previous sections allowed us to extract from Orbis a large amount of data used in the empirical analyses of the project. This section describes the structures used to organise the data, together with the cleaning procedures used to treat the raw data.

Due to the heterogeneous format of the various parts of the data, the final firm-level data for the analysis is organised in four separate datasets containing, respectively, the legal information, the industry classification, the ownership links and the financial variables. The legal and industry information refer to the firms' situation in December 2017, while the financial and ownership data are available yearly for the period 2007-2016.

The contents of the four datasets, as well as the choices made in their construction, are reported in the following. Some descriptive statistics of the data are presented in Section A.5 An assessment of the coverage of the data is presented in Section A.6, where figures from the present datasets are compared to official statistics.

Unless stated otherwise, all variables contained in the four datasets have been earlier described in detail in Section A.3 All datasets can be linked using the BvD ID, the unique firm's identifier, according to the specific needs.

A.4.1 The legal information

The first set of data contains for each firm the following information: the firm's identifier, the name (trimmed to first 20 characters due to space constraints), the date of incorporation, the country of registration, a dummy for the EU area, the type of entity, plus a series of variables about the listing information (listing status as of December 2017, IPO date, main exchange, delisted date and delisted comment - for delisted companies only).

The firms included in this dataset constitute the population of all listed companies recorded in Orbis that are or were active in the EU during the period 2007-2016. The selection of this group of companies from the general Orbis database has been described in Section A.2.

The list of firms' identifiers can be used as the basis of companies' selection or searches in order to extract information of interest from any of the files constituting the Orbis database. As mentioned earlier, the present project extracted information only from five of those files, but many more are available for possible use.

A.4.2 The industry classification

The second set of data reports all NACE codes classifying the sector of economic activity of each firm in December 2017. Together with the NACE Section (A-U), the core NACE code is reported, as well as the four primary codes and all twenty available secondary codes. For a detailed description of the NACE industry classification system, see Section A.2.

The information contained in this dataset can be used to create lists of selected companies exerting activity in different sectors or industries.

A.4.3 The ownership links

The third set of data is the largest and constitutes the core of the database for the project. For each year between 2007 and 2016, all available ownership information about the population of quoted firms active in the EU is retained, independent of their listing status in that specific year. The decision of whether to use only the firms listed in a specific year can be taken later, given that firms can be selected easily using the purpose-built dummy variable on the "current listing status" (see description in Section A.4.5).

Not all firms in our population have ownership information available in all years. This can be due to several reasons:

(i) the firm did not exist in the specific year - if needed, this can be confirmed through the date of incorporation in the legal information dataset;

(ii) the firm was independent in the given year, i.e. did not have any shareholders;

(iii) the firm had some shareholders in the given year, but no provider supplied ownership information to BvD, and BvD itself did not manage to obtain any information.

Case (iii) may occur only if a firm has not yet entered the Orbis database; in fact, if the firm has some previous ownership information, and no update is available for the year of interest, BvD still provides ownership for the given year, namely maintains the last available information. This situation can be identified through the variable "date of information", when the date refers to older years.

In each year, a firm can present information on dozens of shareholders, but some firms even present hundreds of them. Each shareholder can have several roles in its relationship with a subsidiary, for example it can be the GUO25 and also the DUO25. All different roles are recorded in the variable "type of relation" presented earlier, implying that for each subsidiary-shareholder pair several links can be present in Orbis, one for each role.

Table A.10 reports an excerpt of raw ownership data for a given company in 2008, where the actual firm's and shareholders' identifiers have been replaced by fictitious values. The example shows the case of multiple links between the subsidiary and some of its shareholders (second and third blocks), which in this case fulfill several definitions of Ultimate Owner each, therefore appearing in different UO roles. Notice also that not all dates of information are updated to the end of 2008, showing that for some shareholders the information was not provided in the given year, and previous information has been maintained.

Table A.10: Example of raw ownership information. SH=shareholder.

Firm	SH	Direct	Total	Date of information	Type of relation	GUO 25	GUO 50	GUO 25C	GUO 50C
IT00	CH11	.	46.1	13mar2008	SHH	CH33	CH33	CH33	CH33
IT00	IT22	65.73	.	31dec2008	SHH	CH33	CH33	CH33	CH33
IT00	IT22	65.73	.	31dec2008	ISH	CH33	CH33	CH33	CH33
IT00	IT22	65.73	.	31dec2008	DUO 25	CH33	CH33	CH33	CH33
IT00	IT22	65.73	.	31dec2008	DUO 50	CH33	CH33	CH33	CH33
IT00	IT22	65.73	.	31dec2008	DUO 25C	CH33	CH33	CH33	CH33
IT00	IT22	65.73	.	31dec2008	DUO 50C	CH33	CH33	CH33	CH33
IT00	CH33	.	65.73	31dec2008	GUO 25	CH33	CH33	CH33	CH33
IT00	CH33	.	65.73	31dec2008	GUO 50	CH33	CH33	CH33	CH33
IT00	CH33	.	65.73	31dec2008	GUO 25C	CH33	CH33	CH33	CH33
IT00	CH33	.	65.73	31dec2008	GUO 50C	CH33	CH33	CH33	CH33
IT00	IT44	.	4.99	06dec2006	SHH	CH33	CH33	CH33	CH33
IT00	LU55	4.66	.	19sep2008	SHH	CH33	CH33	CH33	CH33
IT00	FR66	.	.	11may2005	SHH	CH33	CH33	CH33	CH33
IT00	DE77	.	1.99	14oct2008	SHH	CH33	CH33	CH33	CH33

In order to eliminate redundant or duplicate information from the raw data, all cases where a subsidiary-shareholder link is appearing multiple times undergo the following cleaning process: only one record is kept with the subsidiary and shareholder identifiers, the total and direct ownership share information and the date of information, while all roles recorded in the variable "type of relation" are registered in additional variables named after the several UO definitions, where the corresponding shareholder's identifier will appear. The variable "type of relation" is then dropped. Table A.11 reports the result of previous example after the cleaning procedure, where only one link per shareholder appears.

The "current listing status" variable mentioned in Section A.4.5 is then added, together with the name, entity type and country of registration of each of the shareholders and ultimate

Table A.11: Example of cleaned ownership information. SH=shareholder.

Firm	SH	Direct	Total	Date of information	GUO 25	GUO 50	GUO 25C	GUO 50C	DUO 25	DUO 50	DUO 25C	DUO 50C
IT00	CH11	.	46.1	13mar2008	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22
IT00	IT22	65.73	.	31dec2008	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22
IT00	CH33	.	65.73	31dec2008	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22
IT00	IT44	.	4.99	06dec2006	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22
IT00	LU55	4.66	.	19sep2008	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22
IT00	FR66	.	.	11may2005	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22
IT00	DE77	.	1.99	14oct2008	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22

owners. A dummy is also created to identify "independent" firms, i.e. those for which the ultimate owners' are not defined or coincide with the firm itself.

In a second stage, the ownership structure of a subsidiary is summarised into one link per subsidiary with all essential information, in order to be able to merge it with other parts of the dataset. For each year of observation, the essential ownership information is summarised through the minimum and maximum values of direct and total ownership shares owned by the shareholders, and through the identification number of all ultimate owners. The result is shown in Table A.12.

The minimum and maximum of "direct" and "total" variables can be used to perform checks in cases where ultimate owners are not defined - in such cases the maximum of the ownership shares held should always be less than 25% or 50%. Additional summary information can be added, such as the total number of shareholders for the given year, or the identification of the largest shareholder, and so on.

This summarised ownership information of each firm is very useful if we wish to merge it with the corresponding listing, financial or industry classification data, without having to carry around the full list of shareholders and their shares, which can be consulted separately.

Table A.12: Firm's summarised ownership information.

Firm	Dir Min	Dir Max	Tot Min	Tot Max	GUO 25	GUO 50	GUO 25C	GUO 50C	DUO 25	DUO 50	DUO 25C	DUO 50C
IT00	4.66	65.73	1.99	65.73	CH33	CH33	CH33	CH33	IT22	IT22	IT22	IT22

A.4.4 The financial information

The last set of data contains about a hundred financial variables coming from the yearly balance sheets of the firms. The main ones have been described earlier, but many more are available for selection. For each year, a firm can present more than one account, therefore it is necessary to set some criteria to select only one account per firm per year.

Accounts may differ according to the type of consolidation, the closing date, the number of months of reference and the accounting practice. Moreover, not all accounts are equally populated, so further checks are needed in order to include accounts where the main variables of interested are not missing. The accounts with closing date in the first quarter of a certain year are considered to be referring to the financial activity of the previous year.

The criteria used for the selection of the appropriate account for the current project are as follows (in order of importance):

A) Consolidation type: Orbis presents six possible classifications of the consolidation type of an account:

- C1 = Consolidated account of a company-headquarter of a group, aggregating all companies belonging to the group (affiliates, subsidiaries, etc.), where the company-headquarter has no unconsolidated account
- C2 = Consolidated account as above, but where the company-headquarter also presents an unconsolidated account
- U1 = Unconsolidated account of a company with no consolidated account
- U2 = Unconsolidated account of a company with a consolidated account
- LF = Limited number of financial items
- NF = No financial items at all

In the construction of the financial database, priority is given to accounts in the order C1, C2, U1, U2, LF, NF.

B) Number of months: When different accounts for the same year refer to periods of different length, the account covering the highest number of months is chosen.

C) Missing variables: Priority is given to accounts with minimum missing values on the following ten variables: total assets, shareholders funds, number of employees, sales, operating revenue (turnover), net income, EBITDA, Research & Development expenses, ROE and ROA.

D) Accounting practice: Accounts are reported either by IFRS (International Financial Reporting Standards) or GAAP (US Generally Accepted Accounting Principles) standards. Priority is given to IFRS practice.

A.4.5 Definition of new variables

Annual dummies for current listing status

In each year of the sample, say *t*, it is important to identify whether a firm is listed or not; in fact, the listing status of the firms for a specific year is not directly available, since the Listed/Delisted variable described above gives the last available status (in our case referring to December 2017).

For this purpose, a indicator variable has been defined for each year, named “current listing status”. It refers to the year *t* in which the ownership link is reported, and is derived from the listing/delisting information of the firm. The full IPO and listing dates are available, but only the corresponding year is retained for the construction of the yearly listing status. The assignment rules for different values of the yearly dummies are summarised in Table A.13.

The first case occurs when the IPO year of the firm lies in the past, or at most coincides with year *t* itself; if the delisting year lies in the future, the value 1 is assigned to the company, indicating that it is currently active in the stock market. The assigned value is 0 if both the IPO and the delisting year are in the past. We assume that a missing indication of the delisting year is due to the fact that the company has not yet been delisted, therefore in this case the status variables takes value 1 too.

A second possibility is that the link is recorded before the IPO year, in which case the current listing status is equal to 0, independent of the delisting year. In other words the company is not listed in the year of observation.

Whenever the IPO Date is missing, while the delisting year is given, the company is assumed to having been listed a long time ago, before year *t*. Therefore the listing status in determined according to the same criteria as in the first case above.

If both the IPO and the listing dates are missing, but the firm is still listed in 2017, we assume again that the company was listed a long time ago, and therefore that is listed throughout the period of observation. On the other hand, if both dates are missing and the firm is delisted in 2017, then the current status variable is not defined, i.e. is recorded as missing. Specific assumptions can be considered in order to assign an actual 0/1 value.

In only two cases the delisting date was prior to the IPO date, probably denoting companies that re-entered the market at a later stage. In such cases they were considered as still listed in 2017, hence listed in all years after the IPO date (as if the delisting date was missing).

Table A.13: Construction of the "current listing status" variable for year t.

IPO year	Delisting year	Listing Status in 2017	Current Listing Status in year t
$\leq t$	$\geq t$	any	1
	n.a.	any	1
	$< t$	any	0
$> t$	any	any	0
n.a	$\geq t$	any	1
	$< t$	any	0
n.a	n.a	Listed	1
n.a	n.a	Delisted	–

DUOs and ISH Variables

The Ownership database contains the variables GUO50, GUO50C, GUO25, GUO25C, which report for every subsidiary-shareholder link the respective global ultimate owner of the subsidiary in that particular year, according to the definitions in Table A.7, in case they exist.

In order to enhance the analysis, we construct similar variables reporting the DUO50, DUO50C, DUO25, DUO25C and ISH of the subsidiary for the given year (when present), derived from the variable "type of relation" presented earlier.

Minimum and maximum total and direct ownership percentage

Four new variables are created, reporting for each subsidiary the amount of direct or total ownership shares held by its biggest and smallest shareholder in that particular year. The variables are invariant for all links of a respective subsidiary in a given year. Such variables are useful in analysing the shareholders' structure of a company, and can also be used to test the correctness of the ultimate owner information presented in the database. For example, whenever the largest shareholder holds less than 50%/25% of the shares, the subsidiary cannot have an ultimate owner at the 25% or 50% level, or vice-versa.

A.4.6 Note on cleaning procedures

Since there is a non-negligible fraction of recorded shareholder-subsidiary links that do not specify the actual amount of participation, an imputation strategy has been adopted in order to fill in the missing information, where possible.

The imputation criteria adopted for the ownership information are as follows: if there is a non-reporting for one or two consecutive periods, but the amount of shares is available before or after, then the missing share is replaced by the value recorded in the previous or following year. This is a rather conservative operation, given that in general the value of the shares held is rather stable. In case of a gap of more than two years, no action is taken, considering that the closest reported amount of shares is too far in time to be considered reliable.

After this first round of imputation, the values that are still missing are filled according to extra information available from Orbis. If the shareholder is declared to be the GUO (Global Ultimate Owner) or DUO (Domestic Ultimate Owner) according to a definition of minimum 50% or 25% of shares, then the missing share is replaced by 50.01% or 25.01%, respectively. If the shareholder is not the GUO or DUO, then all its portfolio is analysed, and the average share held in the portfolio is considered to be representative of the shareholder's investing behaviour, and is therefore imputed in the missing cases, but these are very few.

After all this procedure, there are still some links with no available share (about 3%). They correspond to the cases where the shareholder is not the GUO or DUO of the subsidiaries, where for all the years of observation the shareholder-subsidiary link has been recorded with no share available, and where no average share for the shareholder's portfolio is available, since for all subsidiaries of that shareholder no share information is available. This is usually the case of single shareholders with small participation (<25%), being linked to only one subsidiary in the market, but with no share information, so in general they are not very important players. For these cases, the information about the existence of a shareholder-firm link can still be used, but the indicators requiring the quantification of the shares held cannot be calculated.

As for financial variables, there are no major issues of missing data on the main variables (Total Assets and Market Capitalisation). The Total Assets are basically almost available. Nevertheless, in case of non-reporting in some years, values are imputed from previous or following years, giving a final coverage of 99% of firm-year. As for Market Capitalisation, it is not always available, due to the fact that the listing status of firms can change throughout the period of observation. Therefore, the missing values are mainly related to years where the companies were still unlisted or have been delisted, hence no imputation is performed on this variable.

A.5 Dataset descriptive statistics

Following the selection procedure outlined in Section A.2, a historical dataset containing all listed companies active in the EU in the period 2007-2016 is obtained. The average number of firms observed each year is 26,560 - as displayed in Table A.14 - where on average about 57% are registered in the EU countries, the rest being registered outside the EU. The proportion of EU versus Non-EU registered companies remains roughly constant over time. The total number of observed firms increases slightly over the years, except for the last, where due to the reporting lag the number of covered firms is slightly smaller than in the previous year. Overall, a set of 31,864 different firms are observed.

Table A.14: Sample composition by country of registration and year.

Country	2007	2008	2009	2010	2011	2012	2013	2014	2015	2016
EU	14,434	14,849	15,000	15,122	15,171	15,125	15,479	15,564	15,336	15,086
Non-EU	10,423	10,819	11,169	11,398	11,581	11,710	11,756	11,846	11,877	11,856
Total	24,857	25,668	26,169	26,520	26,752	26,835	27,235	27,410	27,213	26,942

The largest groups of EU companies are registered in the UK and Spain (around 20% in each country), followed by Romania (9%), Germany (8,5%), France (7,5%), Poland (5,5%) and Sweden (5%). Again, the distribution stays roughly constant over time. Most of the companies registered outside the EU are in the US (30%), followed by Japanese companies (9.7%), Canadian (6.78%) and Australian companies (6.6%), while 4,83% of the companies are from India.

Table A.15 reports - for the total sample of 31,864 firms - the coverage of the ownership information, the NACE industry classification and the financial indicators in the sample. The number of firms for which none of the information is available is negligible. As an additional note, 77.78% of such firms have been delisted from the stock markets by the year 2017. On the other hand, 97.3% of companies present ownership data, and complete ownership, NACE and financial information is available for 28,931 firms - 91% of the sample.

Although not all companies are observed all years, due to the natural birth and death processes of firms, generally the sample is rather stable. About 68% of the companies have complete records, i.e. they are present throughout the whole 10 years of the period under analysis, and 80% are observed during at least 7 years; a small percentage of firms (15%) were recorded maximum during half of the period, i.e. at most for 5 years.

Table A.16 reports the listing status of companies in each year of observation. On average, every year around 83% of the companies are listed. In about 3.5% of the cases it was not possible to determine the listing status of the firms by year, given that both the IPO date and delisting dates were missing, and the firms were classified as "Delisted" in 2017. Over time

Table A.15: Structure of the Database

	No Financials			Financials		
	No Nace	**Nace**	**Total**	**No Nace**	**Nace**	**Total**
No Ownership	63	523	586	4	272	276
Ownership	218	1649	1867	204	28931	29135
Total	231	2172	2453	208	29203	29411

the proportion of quoted companies in a given year decreases slightly. While initially 89% of the companies were listed, the share drops to 78% in 2016. Among the currently delisted firms, the large majority (89%) have been listed before or in 2007. i.e. before the beginning of the period of observation. Only very few companies are listed and delisted within the sample period. A large proportion of firms (68%) are always listed in all years when they are observed.

Table A.16: Current listing status of firms, by year. If both IPO date and delisting dates are missing, the listing status is not available (NA).

Year	Delisted	Listed	NA	Total
2007	1,602	22,218	1,037	24,857
2008	2,254	22,377	1,037	25,668
2009	3,055	22,070	1,044	26,169
2010	3,477	22,023	1,020	26,520
2011	3,827	22,008	917	26,752
2012	4,122	21,826	887	26,835
2013	4,438	21,938	859	27,235
2014	4,524	22,038	848	27,410
2015	4,515	21,883	815	27,213
2016	5,236	20,914	792	26,942

The bulk of firms are concentrated in few industries. In Table A.17 the proportion of firms active in the main NACE Sections are reported, with “Manufacturing” (Section C) and “Financial and insurance activities” (Section K) comprising the largest number of firms. Each one of the remaining Sections represented less than 2.5% of the total sample.

Table A.18 pictures the number of companies which are classified as being active in any of

Table A.17: Proportion of firms active in the main NACE Sections

Section	Description	No Firms	%
C	Manufacturing	10,242	32.69
K	Financial and insurance activities	7,713	24.62
J	Information and communication	3,002	9.58
G	Wholesale and retail trade	1,889	6.03
M	Professional, scientific and technical activities	1,486	4.74
L	Real estate activities	1,151	3.67
B	Mining and quarrying	1,119	3.57

the sectors of interest identified by the eight Nace Codes discussed in Section A.2. The Core Nace Codes were inspected, as well as all four Primary Nace Codes (Prim) and the first four Secondary Nace Codes (Second), respectively. None of the companies presented any of the eight codes as their third or fourth Primary Codes, therefore they are omitted.

The first Primary Nace Code coincides with the Core Nace Code of the company. The bulk of firms is classified in these categories by their Core Nace Code or first Secondary Nace Code. The number of firms who are active in these categories as a second, third or fourth activity is small. An exception are the classifications “Other financial service activities, except insurance and pension funding” (Nace Code 6499) and “Security & Commodity Contracts Brokerage” (Nace Code 6612), where a lot of companies are active as a side activity.

Overall, most of the companies that present some of the eight core Nace Codes are active in “Other Credit Granting” (Nace Code 6492). This might be due to the fact that this categorization is very broad, and therefore not very selective.

The dataset contains 6,070,111 ownership links. On average, each company has about 22 shareholders per year. However, 50% of the companies have at most 7 shareholders in a given year, while 9,5% of the companies even have only one shareholder. The number of total links per year rises slightly from 604,385 in 2007 to 617,353 in 2016.

Every year, on average over 87% of the companies report an ultimate owner of some type. The percentage rises slightly over the sample period from 83.24% in 2007 to 88.49% in 2016. About 60% of companies have a domestic GUO50, with non-EU companies showing a larger share (70%) compared to EU (56%).

Overall, 64% of the subsidiary-shareholder links are recorded between entities registered in the same country (domestic shareholders), the remaining cases denoting a shareholder located abroad. The proportion is rather similar in the case of EU or non-EU based companies.

Table A.18: NACE Codes

Code	Core	1 Prim	2 Prim	1 Second	2 Second	3 Second	4 Second
0610	237	237		38	1		
3511	273	273		57	5		8
3523			14	1	2		
6190	593	593		132	43	23	9
6492	3,029	3,029	33	1,179	50	36	13
6499	236	236	22	501	239	59	648
6611	45	45		32	20	5	3
6612	310	310		327	305	706	5

In terms of financial information, only 1% of the reported accounts presents limited financial information. Most of the accounts (70%) are consolidated, either of type C1 or C2, while all remaining are unconsolidated. For what concerns the time and variable coverage, 75% of accounts refer to a time period of 12 months, and 95% present at least six of the main financial indicators. The most frequent accounting standard is the GAAP (62%), while the IFRS practice is used in the remaining cases.

A.6 Comparison with official statistics

The World Bank provides information on the number of listed companies in individual countries, as well as regions (e.g Europe & Asia/ Arabian World). The data is obtained from the World Federation of Exchange.

The data include either companies that are either incorporated in the same country as their exchange, or foreign companies which are exclusively registered in that particular stock market. Hence, in comparison to the present dataset, foreign companies which holds shares in a firm in the EU but are quoted outside the EU are not reported. Nevertheless, we consider it a good base for comparison.

Table A.19 reports the ratio of the numbers of firms present in our dataset per country and year compared to the data provided by the World Bank. The ratios are displayed in percentage points, and only European countries are considered. The latter is the case, as we consider the number of firms which are foreign but have their exclusive exchange in Europe to be small. Hence, with this approach companies which are registered and active in Europe are set in comparison. Unfortunately, the World bank does not provide listing information for 5 EU countries (Denmark, Estonia, Finland, Latvia, Lithuania, Sweden). Overall, the present dataset contains a higher number of companies in comparison to the data provided by the World Bank.

Table A.19: Coverage of our dataset in comparison to World Bank (ratio in %)

	2007	**2008**	**2009**	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
Austria	128	134	136	147	147	150	154	150	152	166
Belgium	122	131	138	139	146	150	188	195	184	184
Bulgaria	130	122	128	132	132	135	135			
Croatia	96	98	130	153	157	171	188	182	188	216
Cyprus	125	138	151	156	161	171	179	179	205	214
Czech Republic	346	289	338	313	340	306	373	400	367	373
Denmark	Not Contained in the World Bank Data									
Estonia	Not Contained in the World Bank Data									
Finland	Not Contained in the World Bank Data									
France	168	178	183	192	199	201	226	223	221	220
Germany	163	172	184	188	194	196	202	220	229	237
Greece	114	113	112	114	110	108	116	110	111	123
Hungary	115	115	107	106	100	100	100	104	113	119
Ireland	202	212	222	246	260	312	329	319	330	343
Italy	123	127	143	146	135	135	144	141	141	139
Latvia	Not Contained in the World Bank Data									
Lithuania	Not Contained in the World Bank Data									
Luxembourg	221	255	307	324	400	436	483	492	448	414
Malta	94	89	95	110	138	141	130	133	148	148
Netherlands	124	135	172	185	193	204	290	288	277	264
Poland	147	137	153	142	122	114	112	111	112	113
Portugal	167	164	169	177	178	184	200	196	191	198
Romania	2617	2265	1943	1900	1800	1784	1675	1649	1629	1562
Slovak Republic	26	48	97	150	93	200	206			
Slovenia	93	101	125	133	147	159	176	186	198	237
Spain	84	84	85	87	86	87	98	96	87	87
Sweden	Not Contained in the World Bank Data									
United Kingdom	120	134	148	151	160	169	168	168	166	164

Appendix B

Common Shareholding Indices

Chapter 2 overviewed the main tools used in the academic literature to assess the effects of common shareholding, highlighting pros and cons. It also set up a framework for the analysis of ownership data, introducing a simplified market example and discussing several measurement issues. Finally, it translated sparsity and network indicators into the common shareholding context, proposing feasible measures to be computed in the empirical analysis, according to our data restrictions. In the present technical annex, the above statistical methodologies are analysed, setting the theoretical background for the identification of new indices of the extent of common shareholding. The proposed methods explore several new aspects of investors' behaviour and of portfolios' composition, which can help us draw a more precise picture of the phenomenon. The same applies to the analysis of the firms' shareholding structures, which can reveal interesting patterns of overlap in a given market.

Although several methodologies were considered, many present limited applicability to the common shareholding study. Hence, the focus of subsequent developments has been restricted to techniques based on two main groups of methods, coming from the Sparsity and Network literature respectively. Their applicability to the measurement of common shareholding is discussed in detail, and the implementation of the proposed measures is illustrated through a simple example of a fictitious market. Measures that allow comparison with benchmark scenarios are also considered. Further insight will be available later from the real-data applications for listed firms and for the five industries under study.

The concept of sparsity is generally found in the literature on inequality or diversity, and studies the distribution of a certain phenomenon in a given population, e.g. of income, in particular in the aspects related to its concentration in the hands of a small number of players. The higher the concentration of the variable in the population, the higher the inequality of the distribution. By contrast, a low concentration denotes higher diversity of the phenomenon in the population. This framework extends easily to the common shareholding analysis, applying the relevant concepts to the distribution of the investments of shareholders across firms in a given market. Here, a low concentration signals diversification of investments across the market and therefore goes in the direction of common shareholding.

The second approach comes from the literature on the analysis of networks. This field studies the empirical structure of the relationships that exist between elements of a population. Such relationships induce flows of information within the population according to its level of connectedness, and additionally allow to identify the most important or central players. Considering the population of the firms and owners of a market, the corporate ownership structure can naturally be represented through a network, where the network relations are given by the ownership links between firms and their shareholders.

Section B.1 presents the concept of sparsity and related indices, coming from the inequality literature, and applies them to the common shareholding analysis. Section B.2 approaches the market structure as a network of owner-firms relations, adapting network measures to the current research objective. The real data applications will be of value in determining the best measure to be used.

B.1 Sparsity

The concept of sparsity is often linked to definitions of inequality or diversity, giving rise to different interpretations and measures.[1] However, a common agreement is that a distribution with all its information concentrated in one coefficient, and all other zero, is the most sparse. On the other hand, there is agreement that the least sparse distribution is found when the information is evenly spread over all coefficients. In the following, this will be the reference definition of sparsity.

In the inequality literature, maximum and minimum sparsity would correspond to the most unequal case and to perfect equality, respectively. In the case of corporate ownership, a sparse investment behaviour would correspond generically to a high concentration of ownership in few hands (or few firms), while low sparsity would be observed in case of more widespread investments across the market. A more detailed analysis of the application of sparsity concepts to corporate ownership will be discussed in Section B.1.2 below.

B.1.1 Measuring sparsity

There is a large set of sparsity measures in the literature, coming mainly from the fields of signal processing and information theory. The most common are the Kurtosis, the Gini Index, the Hoyer measure, the *pq*-means, the ℓ_p norms and their combinations. These and other

[1] A comprehensive review of these and other fields of application can be found in Hurley and Rickard (2009).

measures are discussed, for instance, in Karvanen and Cichocki (2003), Rickard and Fallon (2004), Hurley and Rickard (2009), Zonoobi et al. (2011), Pastor et al. (2013), and Pastor et al. (2015).

Before presenting the details of each measure, it is important to focus on desirable properties of a generic sparsity function, in order to be able to choose between alternatives. Desirable criteria that a sparsity measure should fulfill are, among others, the so-called “Robin Hood” property, the scaling or homogeneity, the “rising tide” property, and the “cloning” property. These four criteria were initially proposed by Dalton (1920) in the financial setting of inequality measurement of wealth distribution, but are nowadays generally recognised to be minimum criteria a “good” measure of sparsity should satisfy, being referred to as “Dalton’s Laws”. More recently, Rickard and Fallon (2004) added two extra properties, named “Bill Gates” and “Babies”, respectively, which will be defined below, together with Dalton’s Laws. Additional axioms and attributes, whose analysis goes beyond the scope of this report, can be found in Pastor et al. (2013, 2015).

Properties of sparsity measures

- **Robin Hood:** *A “fair” readjustment of coefficients decreases sparsity*. Taking some amount from the larger coefficients and “redistributing” towards smaller coefficients yields a less concentrated i.e. more equal distribution.

- **Scaling:** *A change in scale of the coefficients does not change sparsity*. Multiplying wealth of all units by an equal factor does not change the level of (in)equality of the distribution.

- **Rising Tide:** *An identical increase in all coefficients decreases sparsity*. Adding a fixed amount to each coefficient reduces the relative difference between large and small values, i.e. yields a more equal distribution.

- **Cloning:** *Doubling the number of coefficients by cloning the same values does not change sparsity*. If a second population is cloned, reproducing the same values as the first one, then the level of (in)equality of the merged populations equals that of the initial population.

- **Bill Gates:** *A significant increase in one coefficient increases sparsity*. When one coefficient becomes very large, the level of inequality increases.

- **Babies:** *The addition of extra zero coefficients increases sparsity*. Adding individuals with zero wealth to a population increases inequality, by concentrating the (positive) total wealth in the hands of a smaller share of individuals.

More details about the above properties can be found in Hurley and Rickard (2009); the paper also presents sixteen sparsity measures and prove which of them satisfy which properties. The main result is that only two measures satisfy all six properties, namely the Gini Index and the *pq*-means (see below), while all remaining measures satisfy some, but not all of them.

Some common sparsity measures

Table B.1 below presents some among the most common sparsity measures, and reports their properties. For easier reference in the following, the measures will be sometimes referred to according to the numbering presented in the table, rather than their full names. The coefficients of the distribution under analysis are denoted by c_k, $k = 1 \ldots, N$, while their ordered set is indicated by $c_{(k)}$ (in increasing order). Measures 1-4 and 6-7 are presented in their normalised version, which accounts for the length N of the vector representing the distribution. The normalised versions in general satisfy more properties than the original measures. Properties only satisfied in the normalised version of the measures, and not in the original ones, are indicated in brackets.

The measures in Table B.1 do not present a unified notation in the literature; we follow here the suggestions of Hurley and Rickard (2009), where some measures have been modified - either with a minus sign or by changing the direction of some inequality - in order to obtain an homogeneous interpretation in the sense that an increase in sparsity yields a positive increase in the corresponding measure. In particular, notice that measure 1 is usually defined in the literature as the count of non-zero values, but this would go in the opposite direction, increasing when sparsity decreases. For this reason here the definition is reversed, counting the number of zeros instead. For all these measures, the less sparse the distribution, the smaller the value of the index, the value increasing with sparsity.

As we can see from Table B.1, most measures fulfill many of the presented properties, if not all. Karvanen and Cichocki (2003) compare measures 1-4 and 6-7. Quéré and Frélicot (2012) compare 7 and 8 through a set of simulations on binary (0-1) distributions, testing their performance in the context of fuzzy partitions. Measure 10 is considered, among others, in Rickard and Fallon (2004) and Zonoobi et al. (2011). Hurley and Rickard (2009) and Pastor et al. (2015) propose more comprehensive accounts of original and normalised measures, other additional measures and properties not discussed here, as well as proofs of the fulfillment of the respective properties.

Measures 1 and 2 simply compute the proportion of zero or negligible elements of the distribution; the higher the proportion, the more concentrated the distribution, i.e. the higher the sparsity. In measure 6, any zero coefficient gives a zero log value in the summation, contributing towards a smaller total; the minus sign reverts the direction of this effect, so that the more the null coefficients in the sum, the higher the sparsity measure. Measure 7 is based on

Table B.1: Some common sparsity measures and their properties. Measures 1-4 and 6-7 presented in version normalised wrt N; c_k, $k = 1 \ldots, N$ are the distribution's coefficients; $c_{(k)}$ denote the ordered coefficients (increasing). Properties as presented earlier: RH = Robin Hood; Sc = Scaling; RT = Rising Tide; Cl = Cloning; BG = Bill Gates; Ba = Babies. Properties in brackets are only valid for the normalised version of the measures.

No.	Measure	Definition	RH	Sc	RT	Cl	BG	Ba
1.	ℓ^0/N	$\#\{k : c_k = 0\}/N$		✓		(✓)		✓
2.	ℓ^0_ϵ/N	$\#\{k : c_k \leq \epsilon\}/N$				(✓)		✓
3.	$-\ell^1/N$	$-\frac{1}{N}\sum_k c_k$			✓	(✓)		(✓)
4.	$-\ell^p/N$	$-\frac{1}{N}\left(\sum_k c_k^p\right)^{1/p}, \quad 0 < p < 1$	✓		✓			(✓)
5.	ℓ^2/ℓ^1	$\sqrt{\sum_k c_k^2}/\left(\sum_k c_k\right)$	✓	✓			✓	
6.	$-\log/N$	$-\frac{1}{N}\sum_k \log(1 + c_k^2)$			✓	(✓)		(✓)
7.	$N\kappa_4$	$N\sum_k c_k^4/\left(\sum_k c_k^2\right)^2$		✓	✓	(✓)	✓	(✓)
8.	Hoyer	$\frac{1}{\sqrt{N}-1}\left(\sqrt{N} - \frac{\sum_k c_k}{\sqrt{\sum_k c_k^2}}\right)$	✓	✓	✓		✓	✓
9.	pq-mean $p < q$	$-\left(\frac{1}{N}\sum_k c_k^p\right)^{1/p}/\left(\frac{1}{N}\sum_k c_k^q\right)^{1/q}$	$p \leq 1, q > 1$	✓	✓	✓	✓	✓
10.	Gini	$1 - \frac{2}{N\sum c_k}\sum_{k=1}^N (N - k + \frac{1}{2})\ c_{(k)}$	✓	✓	✓	✓	✓	✓

the Kurtosis coefficient κ_4 - named by analogy to the measure of peakedness of a probability distribution - while measure 10 is the well-known Gini Coefficient of inequality.

Measures 3-5 and 8-9 are based on ℓ^p-type norms, which are sums of the coefficients each raised to a certain power p, sum that in turn is raised to the power $1/p$ in order to go back to the original scale of the coefficients. The ℓ^p-type norms do not have in general an intuitive interpretation, except for the ℓ^1 norm which is simply the average. However, a special note should be devoted to two measures, namely ℓ^0 and ℓ^2, from which several other measures in the table are derived.

The ℓ^0 index is the base for the popular *density* measure, i.e. the proportion of non-zero elements of a vector. The density concept is complementary to sparseness, and has several applications both to matrices and to networks, which will be discussed later. Measure 2 restricts the attention to relevant coefficients only, thus ignoring all those of a negligible size. A corrected density index can be proposed according to this more restrictive exclusion criterion, only considering values above a certain threshold.

The ℓ^2 norm is also known as *Euclidean norm*, and for vector $C = (c_1, ..., c_N)$ of coefficients is given by:

$$\ell^2(C) = \sqrt{\sum_{k=1}^{N} c_k^2}$$

This is one of the most popular norms in several fields of application; it is commonly used to compute the "length" of vectors of size N, since it corresponds to the distance from the origin (the null vector) to the point C in an N-dimensional space. The vectors presenting larger coefficients will have a larger ℓ^2 norm, showing that they are further away from the origin. Based on this norm, several distance measures have been developed, especially in error minimisation contexts, such as the *least squares* criterion (which minimises the square of the ℓ^2 norm), or the *mean square error* measurement (divides by N the square of the ℓ^2 norm).

Notice that the ℓ^2 norm gives higher weight to larger coefficients, by squaring their values, contrary to the simple average ℓ^1. For this reason, the derived measure number 5, given by the ratio of ℓ^2 to ℓ^1, can be seen as assessing the relative weight of larger coefficients over the coefficients' total, hence showing larger values for more concentrated distributions, i.e. for higher sparsity. For example, considering three distributions with same total value and increasing concentration - say (2, 2, 2), (4, 1, 1) and (5, 1, 0) - measure ℓ^2/ℓ^1 takes values 0.58, 0.71 and 0.85 respectively. In the sparsest case, i.e. (6, 0, 0), we get $\ell^2/\ell^1 = 1$.

B.1.2 Application to the common shareholding framework

In order to apply the sparsity concept to the common shareholding problem, and in particular to the two matrices defined in Chapter 2 - Ownership Matrix (OM) and Relation Matrix (RM) - it is necessary to identify the most and least sparse scenarios and their meaning. The main issue to be considered is the applicability of the sparsity concept to a matrix, since the concept itself, as well as the measures, were initially developed in relation to a vector of coefficients - representing the distribution of wealth.

The extension of a vector measurement to a matrix can be done in three different ways, which in turn give rise to different benchmark scenarios, as discussed below. Let index $i = 1, ..., I$ denote the owners, and $j = 1, ..., J$ the firms. The sparsity of a given ownership structure can be studied looking at the following dimensions in the OM and RM:

(1) <u>column dimension</u>: *sparsity of the shareholders' distribution for a given firm*.

In the analysis of a column, the maximum sparsity is achieved when a given firm j presents only one owner who holds 100% of the shares, the least sparse distribution corresponding instead to having n_j shareholders, each with a proportion of $1/n_j$ of the shares. For the RM, these cases correspond, respectively, to a vector with one unit element and all the rest zero, or to a vector of all ones.

(2) row dimension: *sparsity of the investment distribution of a given owner into the firms constituting the market*.

If we look at a row, the sparsest case occurs when an owner only holds shares of one firm in the market (whatever the percentage), the minimum sparsity being achieved when the owner owns shares in all firms in the market, at a constant percentage (does not show preference for any firm in particular).

(3) overall dimension: *global sparsity of the market*.

In the overall analysis of the matrices we can define maximum sparsity either of all the rows (one firm only per each owner, for all owners; one firm can have more owners, $I \geq J$), or of all the columns (one owner only per each firm, for all firms; the owner can be common to other firms, $I \leq J$), or of both at the same time (square diagonal matrix, one owner only per each firm and one firm only per each owner, $I = J$).
Defining maximum sparsity of a matrix looking at the column dimension would consider only the shareholders' structure of a given firm, and not the inter-linking between firms caused by common shareholders, so does not correspond to the primary objective of our study. However, this approach can be used to assess other market characteristics in a later stage. The last approach (joint maximum sparsity of both rows and columns) again imposes the column maximum sparsity, which is not of central interest at this stage, so it will be left for later analyses.
It follows that the row-wise approach for the definition of overall maximum sparsity of a matrix seems more appropriate for our case, as being directly connected to the study of common shareholding. In fact, in this approach the most sparse matrix corresponds to the absence of common shareholders, i.e. each row only presents one non-zero element, while the opposite happens when each row is completely filled with positive and equal values, that is each owner being linked to all firms in the economy with equal shares (least sparse scenario). Notice that this last case, being repeated for all owners, implies that the shareholder structure of all firms is identical. The relative weight of each shareholder in a firm is not constrained to a specific value, however it will depend on its financial capacity.

Following these considerations, the most and least sparse versions of the OM and RM of the initial example are computed in Table B.2, according to the overall dimension (3) above, with row-wise maximum sparsity definition. These will be the benchmark matrices for the present study, even though other reference scenarios can be considered according to the different approaches presented above, if the research objective changes.

Looking at Table B.2, in the least sparse scenario of the OM the shares are not specified

Table B.2: Ownership (OM) and relation (RM) matrices of the market example from Table 2.1. Maximum (left) and minimum (right) sparsity. Row-wise approach for the definition of overall sparsity: maximum sparsity corresponds to absence of common shareholders; minimum sparsity implies equal shareholder structure for all firms.

OM, maximum sparsity

	F1	F2	F3	F4
O1	p_1			
O2	p_2			
O3	p_3			
O4		p_4		
O5			p_5	
O6			p_6	
O7				p_7
O8				p_8

OM, minimum sparsity

	F1	F2	F3	F4
O1	p_1	p_1	p_1	p_1
O2	p_2	p_2	p_2	p_2
O3	p_3	p_3	p_3	p_3
O4	p_4	p_4	p_4	p_4
O5	p_5	p_5	p_5	p_5
O6	p_6	p_6	p_6	p_6
O7	p_7	p_7	p_7	p_7
O8	p_8	p_8	p_8	p_8

RM, maximum sparsity

	F1	F2	F3	F4
O1	1	0	0	0
O2	1	0	0	0
O3	1	0	0	0
O4	0	1	0	0
O5	0	0	1	0
O6	0	0	1	0
O7	0	0	0	1
O8	0	0	0	1

RM, minimum sparsity

	F1	F2	F3	F4
O1	1	1	1	1
O2	1	1	1	1
O3	1	1	1	1
O4	1	1	1	1
O5	1	1	1	1
O6	1	1	1	1
O7	1	1	1	1
O8	1	1	1	1

numerically, given the arbitrariness of their value, but they are simply indicated as p_i for owner $i = 1, \ldots, 8$, with $\sum_{i=1}^{8} p_i \leq 100\%$. On the other hand, the representation of the RM is unique in both scenarios, so that the actual values of the coefficients are reported.

Properties of sparsity measures revisited

Given that the properties of sparsity measures were initially considered in a welfare inequality context, they need to be critically reassessed in the common shareholding framework, specifically in the sense discussed above, i.e. looking at row-wise sparsity (increase in sparsity = decrease of the extent of common shareholding; decrease in sparsity = stronger presence of common shareholding). Each property will be analysed initially looking at a change in behaviour of one single owner, subsequently extending the same behaviour to all owners in the market (if meaningful) in order to assess the overall effect on the OM and RM. This exercise will also help exclude sparsity measures that are inappropriate for our purpose.

Robin Hood: in case an owner holding a large share in a firm decides to divest, redirecting the investment towards other firms where it holds smaller (or zero) shares, the measure captures the change as a decrease in sparsity, i.e. a movement from absence or low level of common shareholding towards a higher level of common shareholding. The same applies if all owners change their behaviour in an analogous way: the measure would detect a reduction in sparsity. This is a desirable property as it goes in the direction of the effect we would like to measure. Therefore sparsity measures that fulfill the Robin Hood property are appropriate in our context.

Scaling: If an owner, say, doubles the ownership shares held in all the firms participated in, the measure does not detect a change in sparsity, i.e. the extent of common shareholding is considered unchanged. For a single row, this change in investment does not alter the presence of common shareholding, since the number of existing links is unchanged. However, given that the strength of the links increased, and that the column sum of the shares is constrained to be $\leq 100\%$, this implies a decrease of the strength of the links other owners have with the same firms. Such decrease in the limit could even lead to a zero share, therefore eliminating an existing link, and altering the sparsity. It follows that this property is somewhat controversial, especially in the case of the OM, which might suffer an (undetected) readjustment of all rows when one owner changes its investments. The property seems more acceptable for the RM, which in general will be unchanged under this scenario, although in an extreme case the actual number of links might be affected, as mentioned earlier. Therefore, a measure fulfilling this property raises some concerns, and should be tested further. The situation where all owners would double their shares is an impossible event given the above constraint on the column totals, therefore is not analysed.

Rising Tide: If an owner increases its ownership shares by $k > 0$ points in all firms in the market (even in those where it had previously no shares), then the sparsity decreases. In the limit, an owner that only owned shares in one firm, becomes common shareholder of all companies in the economy, so there is a change toward an increased level of common shareholding. This property is in line with the dynamics of common shareholding, therefore is acceptable for our study. If all owners made a similar change in investments, the RM would immediately become the sparsest one proposed earlier, therefore going again in the direction of this property; however, in the case of the OM we cannot add indefinitely extra shares to all elements, due to the column total constraint, so this case will not be contemplated.

Cloning: If the number of firms in the market doubles, and an owner invests in the new firms exactly the same amounts of shares held in the original set of firms, sparsity does not change. Duplicating ("cloning") the initial vector of investments does not change their relative concentration, since the proportion of firms held by the owner is unchanged. However, the absolute number of firms linked by the owner doubled, introducing more inter-connections between firms. In the most extreme case, an owner who had invested only in one firm (and therefore who was not a common shareholder) will introduce a connection between two firms, and become a common shareholder. Therefore, measures with this property are acceptable if we seek to measure the relative extent of common shareholding, but are less suitable for absolute measurements.

Bill Gates: If one owner increases largely its investment in one firm, sparsity increases. The owner will have to divest with respect to other firms held, in order to move funds massively to that specific firm. Therefore all remaining existing links of that owner will decrease in strength, some even reaching a zero value, i.e. some links may disappear. The same will happen at column level, as a larger share held by the owner under consideration makes all other shares of that specific firm decrease largely, again possibly causing some links of that firm with other owners to vanish. In both cases this implies an increase in sparsity, therefore the property is in line with the market dynamics and is acceptable for our analysis.

Babies: Adding an extra firm in the market whose owners are not common to any other firm increases sparsity. This amounts to adding a new column with the shareholders' structure of the added firm, and some new lines corresponding to the new added owners, which were not present before in the market, since they are not common to any other firms. Therefore, the column will be filled with zeros, except for the last few elements containing the shares held by the new owners. This implies that each line corresponding to an existing owner will have an extra zero, hence increasing the sparsity of that line. On the other hand, since the new owners are not common to other firms, the degree of common shareholding decreases. It follows that the market dynamics in this scenario goes in the direction predicted by the property, which therefore is admissible in the common shareholding framework.

Summarising, all six properties of sparseness measures are overall still meaningful in the context of common shareholding, although the scaling and cloning properties show some limitations when applied to the OM, being less problematic in the RM case.

Extension of sparsity measures to ownership and relation matrices

Consider now the application of the sparsity measures to either the OM or RM matrix, say X, whose elements shall be denoted by x_{ij}; as before, index $i = 1\ldots, I$ spans the rows i.e. the owners, and index $j = 1\ldots, J$ the firms in the columns. Recall that the elements represent, respectively, either the ownership share or the presence/absence of a owner-firm link.

Given the row-wise maximum sparsity definition discussed above, any of the sparsity measures of Table B.1 can be applied to each row i of X, and then aggregated across rows according to some criterion. Denoting generically by $S(x_i)$ a sparsity measure applied to row i (i.e. to elements x_{ij}, with fixed i), an overall measure of row-wise sparsity for matrix X is given by $S(X)$ defined as follows:

$$S(X) = \sum_{i=1}^{I} S(x_i)$$

This type of aggregation is mentioned in Rickard and Fallon (2004) as a common measure of matrix sparsity, however other ways of summarising rows information can be considered.

Table B.3 proposes some alternative aggregation methods of row sparsity indices $S(x_i)$, discussing the interpretation of the resulting matrix measures. Besides the sum of row indices, the average across rows is considered, as well as the median and other relevant percentiles; as alternatives, the maximum or minimum row sparsity are also of interest, representing, respectively, the value of sparsity corresponding to the owner with most concentrated investments (in the limit *not* a common shareholder), and to the most "democratic" owner, investing more equally across firms in the market (in principle a common shareholder). In general, low values of $S(X)$ raise concerns in the common shareholding context, showing more evenly spread investments of owners across firms in the market, going in the direction of common shareholding.

Table B.3: Matrix sparsity measures $S(X)$ constructed applying different row aggregation criteria. $S(x_i)$ denotes a generic sparsity measure for the investment behaviour of owner i.

No.	Criterion	$S(X)$	Interpretation
1.	Sum	$\sum_{i=1}^{I} S(x_i)$	Total owners' sparsity. A high value denotes high concentration in the investment behaviour, i.e. owners tend to hold shares of few firms. A low value denotes tendency of owners to distribute investments across firms.
2.	Average	$\frac{1}{I}\sum_{i=1}^{I} S(x_i)$	Average owners' sparsity. Same as above, but normalised by I, the number of owners in the market.
3.	Median	Med $S(x_i)$	Median sparsity. 50% of owners have an investment behaviour with sparsity lower than $S(X)$. If $S(X)$ is high, then owners do not diversify much investments; if low, there is stronger tendency for common shareholding.
4.	p^{th} percentile	$Q_p\ S(x_i)$	Same as above, with now p% of owners having investments with sparsity lower than $S(X)$. Threshold that determines the degree of sparsity of the p% most "democratic" owners.
5.	Minimum	$\min_i S(x_i)$	Sparsity of most "democratic" market owner, holding a very similar proportion of shares in all market firms.
6.	Maximum	$\max_i S(x_i)$	Sparsity of most "unequal" market owner, holding very different proportion of shares across market firms, in the limit having invested only in one firm.

Among the possible row-sparsity measures that can be used to construct the matrix indices, measure 5 from Table B.1 will be used to illustrate the application to the OM and RM matrices, the remaining measures presenting in general analogous interpretations. The special case of measure 1, given its links with other fields in the literature, will be discussed separately below.

Measure 5 is the ℓ^2/ℓ^1 sparsity index; the expression applied to one row of the OM or RM is given by:

$$S(x_i) = \frac{\ell^2(x_i)}{\ell^1(x_i)} = \frac{\sqrt{\sum_{j=1}^{J} x_{ij}^2}}{\sum_{j=1}^{J} x_{ij}}$$

The general meaning of this measure was discussed in Section B.1.1; in the common shareholding application, the ℓ^2 measure considers one owner i at a time, sums the squares of the shares the owner holds in each firm j in the market - giving more weight to larger shares - and finally takes the square root of the total. This measures the (Euclidean) "distance" of the owner's investment behaviour from the "null" owner, i.e. an owner that holds zero (or negligible) shares in all firms in the market. The ratio of ℓ^2 to the ℓ^1 measure (simple sum of the shares held by the owner in all the firms in portfolio), re-scales such distance according to the owner's total investment, giving a relative measure of how concentrated is the owner's investment behaviour across the market. Such individual behaviour can then aggregated according to any method proposed in Table B.3.

The row-wise calculation of the ℓ^2/ℓ^1 sparsity index for the OM and RM of our example is given in Table B.4, together with the overall matrix measures obtained according to the various aggregation criteria discussed earlier.[2] Looking at the row indices, we notice that all owners that hold shares of only one firm have maximum sparsity score of one in both the RM and OM. On the other hand, the common shareholders can be ranked according to the scores, where the RM only accounts for the number of investments among the market firms, while OM adds the information about the intensity of the investments and their relative distribution. Common shareholders O1 and O2 are equivalent in terms of number of investments (from matrix RM both score 0.707), but the values obtained in the OM reveal that O1 has a more concentrated investment behaviour, having a higher sparsity index (0.898 vs 0.710). Owner O3 scores the lowest among the common shareholders in both matrices, given not only that it invests in more firms, but also that the level of investment is rather even across firms; this is the most "democratic" owner in the market, and its scores will correspond to the minimum criterion for the matrix measures. Notice that in the case of O3, the actual shares held in firm F2 are not available, so that the OM score has been computed based only on the three firms where shares were known.

Among the remaining matrix measures, the sum aggregation criterion is not very meaningful for this specific sparsity index, while its standardised version given by the average has a more intuitive interpretation. The average values indicate for both matrices that the investment behaviour is rather concentrated, while the median shows that at least 50% of the owners are single owners (have maximum sparsity index). The maximum criterion being equal to one is

[2]Except percentiles, which were not computed due to the very small number of observations.

not very informative, simply indicating that the owner with the most concentrated investment behaviour is actually owner of a single firm.

Table B.4: Matrix sparsity measures for OM and RM of Tables 2.2-B.7, based on ℓ^2/ℓ^1 row-sparsity index. Row index $i = 1, \ldots, 8$.

Row measures

i	RM			OM		
	ℓ^2	ℓ^1	ℓ^2/ℓ^1	ℓ^2	ℓ^1	ℓ^2/ℓ^1
1	$\sqrt{2}$	2	0.707	13.197	14.7	0.898
2	$\sqrt{2}$	2	0.707	13.495	19	0.710
3	$\sqrt{4}$	4	0.5	9.81	16.8	0.584
4	1	1	1	1	1	1
5	1	1	1	1	1	1
6	1	1	1	1	1	1
7	1	1	1	1	1	1
8	1	1	1	1	1	1

Matrix measures based on ℓ^2/ℓ^1

	RM	OM
Sum	6.9140	7.1922
Average	0.8643	0.8990
Median	1	1
Min	0.5	0.5842
Max	1	1

A little more attention should be devoted to measure 1, whose link to the vector density measure was discussed in Section B.1.1. If we choose $S(x_i) = \ell^0/J$ i.e. the proportion of null elements of row i, then the average aggregation criterion would give:

$$S(X) = \frac{1}{I}\sum_{i=1}^{I} S(x_i) = \frac{1}{I}\sum_{i=1}^{I} \frac{\#\{j : x_{ij} = 0\}}{J} = \frac{\#\{(i,j) : x_{ij} = 0\}}{IJ}$$

This is the overall proportion of null elements of the X matrix, the complement of the well-known *matrix density* index - an index very widely used in matrix analysis and also in the networks literature - i.e. the proportion of non-zero elements of the matrix:

$$\text{density}(C) = \frac{\#\{(i,j) : x_{ij} \neq 0\}}{IJ}$$

A thorough discussion of this index in the analysis of networks will follow in Section B.2.3.

In the ownership application, however, Assumption A6 above implies that all lines of the OM or RM must have at least one non-zero element, i.e. each owner is included in the matrix if and only if it owns at least one firm in the market. Therefore, the sparsity index for each row should compute the proportion of null row elements excluding those that are structurally non-zero, i.e. should take the expression $S(x_i) = \ell^0/(J-1)$, otherwise the row index would never reach the maximum of one in the case of maximum sparsity (absence of common shareholding). This yields the following common shareholding-corrected matrix sparsity measure:

$$S_{CS}(X) = \frac{\#\{(i,j) : x_{ij} = 0\}}{I(J-1)}$$

For the same reason, a common shareholding variation of the matrix density index should also be considered as follows:

$$\text{density}_{CS}(X) = \frac{\#\{(i,j) : x_{ij} \neq 0\} - I}{I(J-1)}$$

which computes the proportion of non-zero elements only among the entries in the matrix which can actually be zero, thus excluding the cases that are bound to be non-zero. This modified density index will reach the minimum value of zero in case of absence of common shareholders, hence allowing to have a zero-density benchmark for a market with only single owners.

In both cases, matrices RM and OM in Tables 2.2-B.7 present 19 null elements, therefore $S_{CS}(X) = 19/(8 \times 3) = 0.7917$, showing a high level of sparsity, in line with the results based on the ℓ^2/ℓ^1 metric. The corrected density, eliminating all "structural" links, accounts only for $(13-8) = 5$ non-zero entries, out of $I(J-1)$, i.e. $\text{density}_{CS}(X) = 5/24 = 0.2083 = 1 - S_{CS}(X)$.

Similarity measures for comparison to benchmark scenarios

A possible alternative approach to the measurement of the extent of common shareholding, as mentioned earlier, is the comparison of the observed market structure with an hypothetical benchmark scenario of interest. As long as it is possible to express the desired benchmark through a specific matrix - as was illustrated in Table B.2 for our example - then the comparison with the benchmark can be performed through the computation of a similarity measure between the benchmark matrix and the matrix representing the actual market.

Matrix similarity measures are intended to assess the "distance" $d(A,B)$ between two matrices A and B, with identical number of rows and columns, not necessarily square. Similarity measures are usually calculated entry-wise, that is the elements of the two matrices in the same position are compared (usually calculating differences), and these values are then aggregated through a matrix *norm*, a matrix measure similar to the vector measures considered earlier.

In order to compute a matrix norm, the matrix is basically treated as a long vector, where the columns (or rows) have been stacked together; the norms treat a $I \times J$ matrix as a vector of size IJ, and apply any vector measure to it. Among the most popular, we have the ℓ^p-type norms, the Frobenius norm and the more general family of $L_{p,q}$-norms, whose formulas are given in Table B.5. The structure of these norms is very similar to the sparsity measures presented earlier, the main differences being that summation is now performed over the two row and column indices, i and j respectively, to span all elements of the matrix.

Both the $L_{2,1}$ and the Frobenius norm are particular cases of the family of $L_{p,q}$ norms, since the Frobenius is actually an $L_{2,2}$ norm. The $L_{2,1}$ norm is a popular error function used in robust data analysis and in sparse coding, given that the error for each data point (the matrix row in this case) is not raised to any power, but simply summed over all points (rows).

The Frobenius norm is also rather popular, being the Euclidean norm on the $I \times J$ space of matrix elements. It is invariant under rotations of rows and/or columns, i.e. the order in which the firms and the owners are arranged into the matrix is irrelevant. For a full account of matrix theory and applications, see for instance Zhang (2017), or Boyd and Vandenberghe (2018).

For the calculation of the distance between matrices, the chosen norm is not applied to the original matrices, but to the transformed matrix (of differences). In the right column of Table B.5, the norms presented above are used for the measurement of matrices similarity, based on the matrix of differences $A-B$.

Table B.5: Some common matrix norms, applied either to a single matrix C (left), or to a pair of matrices A and B (right) in order to determine their distance $d(A,B)$. The elements of the reference matrix are denoted by p_{ij}, $i=1\dots,I$, $j=1\dots,J$, were $p=a,b$ or c, according to the case.

No.	Norm	Definition	$d(A,B)$
1.	ℓ^p-type	$\left(\sum_i \sum_j \lvert c_{ij}\rvert^p\right)^{1/p}$	$\left(\sum_i \sum_j \lvert a_{ij}-b_{ij}\rvert^p\right)^{1/p}$
2.	$L_{2,1}$	$\sum_i \sqrt{\sum_j \lvert c_{ij}\rvert^2}$	$\sum_i \sqrt{\sum_j \lvert a_{ij}-b_{ij}\rvert^2}$
3.	Frobenius	$\sqrt{\sum_i \sum_j \lvert c_{ij}\rvert^2}$	$\sqrt{\sum_i \sum_j \lvert a_{ij}-b_{ij}\rvert^2}$
4.	$L_{p,q}$	$\left(\sum_i \left(\sum_j \lvert c_{ij}\rvert^p\right)^{q/p}\right)^{1/q}$	$\left(\sum_i \left(\sum_j \lvert a_{ij}-b_{ij}\rvert^p\right)^{q/p}\right)^{1/q}$

For the sake of the example, we shall compute the similarity measures no. 2 and 3 from Table B.5 between the usual incidence matrix X of Table B.7 and the two benchmark scenarios seen before. Denote the maximum and minimum sparsity relation matrices RM by MAR and MIR, as presented earlier in Table B.2, bottom left and bottom right respectively. The matrix differences $X-MAR$ and $X-MIR$ are displayed in Table B.6, together with the quantities necessary for the calculation of the $L_{2,1}$ and the Frobenius norms. The $L_{2,1}$ norm gives the following values: $d(X, MAR) = 3.7320$ and $d(X, MIR) = 11.4887$, while the Frobenius norms yields $d(X, MAR) = 2.236$ and $d(X, MIR) = 4.359$. The distance of the incidence matrix from the maximum sparsity scenario is smaller under both measures, if compared to the distance from the opposite benchmark, showing that the market considered in the example is closer to the case of absence of common shareholding than to the case of completely connected market. This result is in line with the findings obtained through the matrix sparsity indices analysed earlier, i.e. the market does not show a strong presence of common shareholding.

Table B.6: Differences between incidence matrix X and benchmark matrices MAR and MIR representing relation matrices under maximum and minimum sparsity respectively. Elements of the difference matrices are denoted generically by d_{ij}. Similarity indices computed according to $L_{2,1}$ and Frobenius norms.

$$X - MAR = \begin{array}{c} \\ \begin{bmatrix} 0 & 0 & 0 & 1 \\ 0 & 0 & 1 & 0 \\ 0 & 1 & 1 & 1 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \\ 0 & 0 & 0 & 0 \end{bmatrix} \end{array} \begin{array}{c} \sum_j |d_{ij}|^2 \\ 1 \\ 1 \\ 3 \\ 0 \\ 0 \\ 0 \\ 0 \\ 0 \end{array} \qquad X - MIR = \begin{array}{c} \\ \begin{bmatrix} 0 & -1 & -1 & 0 \\ 0 & -1 & 0 & -1 \\ 0 & 0 & 0 & 0 \\ -1 & 0 & -1 & -1 \\ -1 & -1 & 0 & -1 \\ -1 & -1 & 0 & -1 \\ -1 & -1 & -1 & 0 \\ -1 & -1 & -1 & 0 \end{bmatrix} \end{array} \begin{array}{c} \sum_j |d_{ij}|^2 \\ 2 \\ 2 \\ 0 \\ 3 \\ 3 \\ 3 \\ 3 \\ 3 \end{array}$$

$L_{2,1} = 3.7320$ | $L_{2,1} = 11.4887$

Frobenius = 2.236 | Frobenius = 4.359

If we wish to use the *density* index (or its variation presented earlier) in the case of comparison of matrices, we can either compute the densities of the two matrices and then compare them, or compute directly the density of the matrix of differences. Since the density is not a linear operator, in general $\text{Density}(A) - \text{Density}(B) \neq \text{Density}(A - B)$ (unless $A = B$, in which case they are both null). In the first computation on the left-hand side, we assess the difference in sparsity between A and B; if the difference is positive, then matrix A is more dense i.e. has more non-zero elements than B, the reverse applying in case of a negative value. On the other hand, the density of $A - B$ will always be a positive value, computing the proportion of non-zero values of the difference matrix, i.e. the proportion of cases for which the elements of A and B are not equal. A small value indicates that the two matrices coincide in most entries, while a value close to one means that most of the elements of the two matrices are different, hence producing non-zero entries in the difference matrix.

B.2 Network methods

Social network analysis studies the empirical structure of social relations and associations that may be expressed in network form. It can therefore be applied to the analysis of the corporate ownership structure of a market, which can be easily represented through a network of relationships between owners and firms.

A light introduction to social networks can be found in Borgatti et al. (2009), while König and Battiston (2009) present the main features of models of economic networks. For a comprehensive account of social networks analysis see, for instance, Scott (2017) or Borgatti et al. (2018).

A social network is constituted by a set of *nodes* (also denoted vertices or actors), and a set of *ties* (also edges or links) that connect pairs of nodes. There are several measures that can help characterise features of a given network, based on concepts such as *centrality*, the study of the importance of a node based on its position, or *cohesion*, the extent of connectedness of the network. Extensive surveys of network measurements can be found, for example, in Newman (2003) and in Costa et al. (2007).

The nodes can be all of the same type, for example when studying relationships between individuals, giving rise to a so-called *one-mode network*. However, in many cases the interest is in studying the links between actors of different nature, such as individuals and organisations *(affiliation networks)*, or individuals and events. These kinds of data present several facets of interactions, considering that - for example - belonging to the same organisation or club creates links between individuals, but on the other hand common members can also create mutual influence among organisations. This kind of data can be represented through a *two-mode network*, also known as *bipartite network*. Two interesting applications of bipartite network methods are developed in the empirical studies by Bonaccorsi and Giuri (2001) and by Robins and Alexander (2004), where network indices are utilised for the characterisation of industry dynamics and corporate interlocking, respectively.

The network nodes and ties can be represented through a matrix, where rows and columns can represent the same set of entities (one-mode matrix), or two distinct groups of actors, such as individuals and organisations (two-mode matrices), in this case the nodes from one group being arranged on the rows and those from the other group on the columns. The entries of the matrices represent the presence (or absence) of a tie or link between the nodes; in the case of a two-mode network, a tie exists only between one entity of one set and one entity of the other set, but not between entities belonging to the same set. For example, in the case of affiliation networks, links are defined only between individuals and organisations, but not between individuals or between organizations. Links between nodes *within* each group can then be derived from the initial links recorded *across* groups.

B.2.1 Network representation of the common shareholding framework

In the study of common shareholding, the structure of the market presented in Section 2.2.1, and in particular assumptions A2-A3 and A7 therein, yielded a natural division of the actors into the two groups of firms and owners, whose links have been represented through matrices OM and RM there defined. This structure corresponds precisely to the concept of two-mode data referred above, and to a two-mode matrix representation; therefore in the following our attention will focus on two-mode network methods.

Although a common representation of networks is given by graphs, the matrix representation is preferred in the present approach, given the framework and example introduced in Sections 2.2.1-2.2.2, and the connection to the matrix methods presented in Section B.1, which will be made explicit later. For the sake of simplicity, the initial presentation of the methods will be generally based on presence/absence of ties, i.e. on the RM, and not on the complete OM. The actual value (weight) of the tie will be considered later, with reference to the weighted networks literature.

The network analysis of two-mode data can be performed according to two different approaches. The first is a *unimodal* or separate approach, which projects the data into one-mode and then looks at relationships within one group of actors at a time; the second approach is *bimodal* or joint, where the two groups of actors are analysed together. The two approaches are referred to, respectively, as "conversion" and "direct" approach in Borgatti and Halgin (2011).

The direct approach has been preferred in the recent years, on the basis that the conversion or projection procedure to one-mode would lead to loss of structural information. A discussion of both approaches is presented in Everett and Borgatti (2013), where the conversion method is actually revalued and considered equally valid when compared to the direct approach, as long as both projections to one-mode dimensions are used jointly in the analysis. Moreover, the authors highlight that the conversion approach can provide different insights compared to the direct analysis. For these reasons, both approaches will be presented, and subsequently illustrated with reference to our initial example. For a more comprehensive review of two-mode network analysis, see for instance Borgatti and Everett (1997) and Borgatti (2012).

Unimodal approach

With reference to the market example introduced in Section 2.2.2, and in particular to the relation matrix (RM) presented in Table 2.3, let us compute the projection of the ties in the RM onto each of the groups of agents, namely the owners and the firms.

For easier reference, the Table is reproduced below:

Table B.7: (Reproduction of Table 2.3) Relation matrix (RM) of the market example from Table 2.1.

	F1	F2	F3	F4	Total
O1	1	0	0	1	2
O2	1	0	1	0	2
O3	1	1	1	1	4
O4	0	1	0	0	1
O5	0	0	1	0	1
O6	0	0	1	0	1
O7	0	0	0	1	1
O8	0	0	0	1	1
Total	3	2	4	4	13

Table B.8 presents the two projections into one-mode matrices, with the owners represented in the left panel, and the firms in the right one. Intuitively, the projection matrices allow us to capture similarities between owners in terms of their participation into firms, and similarities between firms due to the shared owners. If the RM matrix is denoted as usual by X (also referred to as *incidence* matrix), then the two one-mode projections matrices can be obtained, respectively, as the products XX' and $X'X$, where X' is the transpose of matrix X.

The one-mode matrices are symmetric, and represent the overlaps between actors belonging to the same groups, that is, respectively, the number of firms common to each pair of owners (left), and the number of owners common to each pair of firms (right). The values on the diagonal represent the number of firms owned by each owner, and the number of owners of each firm, respectively, i.e. they correspond to row and column totals in Table B.7.

The pairwise overlaps between two distinct actors correspond also to the number of 2-step paths between them, as pointed out in Borgatti (2012); for example, the fact that F1 and F3 have two owners in common means that we can reach F3 from F1 through two different 2-step paths, one going through O2 (F1 → O2 → F3) and the other through O3 (F1 → O3 → F3). Of course the same applies the other way around, that is considering paths from F3 to F1.

Let us consider first the projection into the owners' group, recalling that owners O1-O3 were common across more than one firm, while O4-O8 only owned one firm. It follows that the expected number of ties in the left panel for the non-common shareholders O4-O8 cannot exceed one, since they can only share one firm with another owner. For example, O5 shares one firm with O2, one with O3 and one with O6, which incidentally is the same firm F3, the only one it holds. On the other hand, the common shareholders O1-O3 might share more than one firm with other owners, therefore the recorded number of ties can be larger than one. This is highlighted in the left panel, where values relative to the common shareholders are shown in italics. For example, O1 shares ownership of one firm with O2 (that is F1), and one with O7 and O8 (that is firm F4), while has two firms in common with O3 (both F1 and F4).

Table B.8: Projection matrices of the relation matrix X from Table B.7. Values in the matrices represent the number of overlapping ties for any pair of actors in each group. Left: projection into the owners' group (XX'); on the diagonal number of firms owned by each owner, off-diagonal number of firms shared by each pair of owners. Right: projection into the firms' group ($X'X$); on the diagonal number of recorded owners per firm, off-diagonal number of owners common to each pair of firms.

	O1	O2	O3	O4	O5	O6	O7	O8
O1	*2*	*1*	*2*	0	0	0	1	1
O2	*1*	*2*	*2*	0	1	1	0	0
O3	*2*	*2*	*4*	1	1	1	1	1
O4	0	0	1	1	0	0	0	0
O5	0	1	1	0	1	1	0	0
O6	0	1	1	0	1	1	0	0
O7	1	0	1	0	0	0	1	1
O8	1	0	1	0	0	0	1	1

	F1	F2	F3	F4
F1	3	1	2	2
F2	1	2	1	1
F3	2	1	4	1
F4	2	1	1	4

Notice that the maximum possible number of ties corresponds to the total number of firms in the market, in this example being four. Since we observe that one of the ties actually reaches the maximum value, in the case of O3 with itself, this fact highlights that O3 owns shares in *all* firms in the market, therefore creating a strong interconnection between the firms. A comparison of the maximum observed tie with the maximum possible value can therefore be an informative index of the degree of interconnection present in the market.

In the firms' projection in the right panel, the values off the main diagonal represent the strength of the ties between firms induced by the presence of common shareholders. In this simple example, all firms are connected, as all values are non-zero, either through one common shareholder - like for instance in the case of F1 and F2, which share O3 - or through more than one common shareholder, as in the case of F1 and F4, which share both O1 and O3.

In case a firm does not share any holder with the rest of the firms in the market, the corresponding line and column would present all zero elements (except on the diagonal). This would represent a "stand alone" firm, i.e. disconnected from the rest of the actors in the group.

Other patterns can arise from the analysis of this second projection, when for instance distinct clusters of firms can be identified, having strong internal interconnections induced by common shareholders, but not sharing any owners with other clusters. This situation would give rise to blocks filled with null entries in the firms' matrix, after appropriate rearrangement of the firms' order in the rows/columns.

In this cursory overview, the two projection matrices provide a useful summary of the ownership information, suggesting that an appropriate analysis of the sparseness of these matrices can lead to a quantification of the extent of common shareholding, and more in general of the strengths of interconnections existing in the market. The analysis can be applied to the whole matrices, or also to specific blocks of the matrices with a relevant meaning - such as the top-left block in the owners' matrix, which was highlighted in italics in Table B.8 - or any other which could be of interest.

Besides sparsity indices, other measures can be applied to the unimodal analysis, namely indices coming from the network literature, linked to the concept of centrality or cohesion mentioned earlier. Since such measures can be used also in the bimodal approach, they will be discussed later, after presenting the bimodal framework.

Bimodal approach

In this approach both modes are analysed jointly, via the construction of a so-called bipartite adjacency matrix, say B, where both groups (owners and firms) appear on the rows *and* on the columns. Matrix B is symmetrical and is composed of four blocks, one of them being the original incidence matrix X displayed in Table B.7, and another its transpose X', all remaining elements of the B matrix being zero. The bipartite adjacency matrix for our example is shown in Table B.9, where X appears in the top-right block, and X' in the bottom-left. The remaining blocks are null, since no ties are recorded between actors belonging to the same mode.

Table B.9: Bipartite adjacency matrix B constructed from the relation matrix X of Table B.7.

	O1	O2	O3	O4	O5	O6	O7	O8	F1	F2	F3	F4
O1	0	0	0	0	0	0	0	0	1	0	0	1
O2	0	0	0	0	0	0	0	0	1	0	1	0
O3	0	0	0	0	0	0	0	0	1	1	1	1
O4	0	0	0	0	0	0	0	0	0	1	0	0
O5	0	0	0	0	0	0	0	0	0	0	1	0
O6	0	0	0	0	0	0	0	0	0	0	1	0
O7	0	0	0	0	0	0	0	0	0	0	0	1
O8	0	0	0	0	0	0	0	0	0	0	0	1
F1	1	1	1	0	0	0	0	0	0	0	0	0
F2	0	0	1	1	0	0	0	0	0	0	0	0
F3	0	1	1	0	1	1	0	0	0	0	0	0
F4	1	0	1	0	0	0	1	1	0	0	0	0

The pairwise overlaps displayed in the projection matrices of the unimodal approach can be easily obtained through multiplication of the B matrix by itself. The resulting matrix is still square and symmetric, say BB, and is divided into four blocks, two of them null, and two of them corresponding to the two projection matrices. The BB matrix for our example is displayed in Table B.10.

Contrary to the projection matrices of the unimodal approach, the BB matrix presents several "structural" zeros, since there are no 2-step paths that can link actors of different modes (remember that, as noted earlier, pairwise overlaps correspond to 2-step paths). Therefore any analysis of such matrix should take this into account. For example, in the calculation of a sparsity measure or other connectedness metric, the structural zeros should be distinguished from the actual zeros denoting absence of a tie between actors of different groups. Unfortunately,

Table B.10: Matrix *BB* of pairwise overlaps, giving the number of 2-step paths between nodes.

	O1	O2	O3	O4	O5	O6	O7	O8	F1	F2	F3	F4
O1	2	1	2	0	0	0	1	1	0	0	0	0
O2	1	2	2	0	1	1	0	0	0	0	0	0
O3	2	2	4	1	1	1	1	1	0	0	0	0
O4	0	0	1	1	0	0	0	0	0	0	0	0
O5	0	1	1	0	1	1	0	0	0	0	0	0
O6	0	1	1	0	1	1	0	0	0	0	0	0
O7	1	0	1	0	0	0	1	1	0	0	0	0
O8	1	0	1	0	0	0	1	1	0	0	0	0
F1	0	0	0	0	0	0	0	0	3	1	2	2
F2	0	0	0	0	0	0	0	0	1	2	1	1
F3	0	0	0	0	0	0	0	0	2	1	4	1
F4	0	0	0	0	0	0	0	0	2	1	1	4

few techniques have been developed specifically for this purpose, and most analyses apply standard network techniques to the bipartite matrices of two-mode data.

An exception is the measurement of centrality, where some specific two-mode measures have been proposed (see for instance Bonacich, 1991). Besides the problem of occurrence of structural zeros, Bonacich and Lloyd (2015) underline another feature to be taken into account in the case of centrality measures of a bipartite network: if the two groups are of different size, actors of the smaller group have more possible ties available (given by the size of the larger group) and consequently may appear to be more central. The authors also warn about the possible existence of exogenous ties ("structural ones") within a certain group of actors, such as in the case of siblings in a same classroom, or the case of scientific collaboration between PhD student and advisor. In the common shareholding problem this could arise when, for instance, two firms belong to the same corporate group, or two owners are linked by some structural relationship. In all such cases, appropriate corrections may be introduced; some possible proposals for centrality measures are given by Bonacich and Lloyd (2015), where the original error minimisation criteria are adjusted excluding structural zeros and ones.

As an alternative, the results from standard techniques can be corrected *a posteriori*, for example normalising by dividing metrics by bipartite maxima, as discussed in Borgatti (2012).

B.2.2 Alternative representations for one-mode matrices

Borgatti (2012) presents some alternative representations of the one-mode projections, leading to matrices similar to those in Table B.8, where elements are computed according to different methods that re-scale the mere counts presented there.

Two of such alternatives are discussed below, and can be considered in the analysis of common shareholding. For the sake of the example, the alternative methods will be presented here with reference to the projection matrix of the owners' group, i.e. the left panel of Table B.8, analogous reasoning holding for the firms' projection matrix. Besides the suggestions in Borgatti (2012), some further alternatives for binary matrices are also considered below.

Following the notation in Borgatti (2012), let X be the original relation matrix (RM), and let $A = XX'$ be the projection matrix into the rows' space (owners); denote by a_{ij} the corresponding elements of A, counting the number of ties between owners i and j. The maximum number of ties between two owners is J, i.e. the total number of firms in the market.

(1) A first alternative to the projection in A is given by the matrix of Pearson correlations among the rows of X, say R, whose entries r_{ij} are related to the a_{ij} as follows:

$$r_{ij} = \frac{a_{ij}/J - u_i u_j}{s_i s_j}$$

Here a_{ij}/J represents the proportion of common ties between two owners, relative to the maximum possible number of ties, while the u and s elements are used to standardise the previous measure, and represent, respectively, the mean and standard deviation of the corresponding row of X. The row means u can be interpreted as the proportion of links each owner has with the firms in the market, with respect to the total number of firms. For example, in our case O2 would have $u = 0.5$, since it owns shares in two out of four firms.

The Pearson correlation coefficient r_{ij} varies between -1 and 1, where the two values indicate, respectively, maximum negative and maximum positive association between the ownership choices of the two owners. A value of zero denotes absence of association between the two behaviours. Notice that in case of zero ties existing between two owners (i.e. $a_{ij} = 0$), the value of r_{ij} will always be negative, indicating that the two owners go in opposite directions in their choices, given that they do own some firms, but never the same ones. The analysis of this matrix, and of the signs of its elements, can reveal further features of the interaction of owners in the market.

(2) The second alternative to projection matrix A proposed by Borgatti (2012) is a matrix, say C, whose elements are given by the Jaccard coefficients c_{ij} defined below. Such coefficients are obtained starting from a cross-tabulation of row i and j of the original relation matrix X (shown below right), which shows the number of firms owned by both owners (a), the number not owned by any of them (d), and the number owned by one but not the other owner (b and c respectively):

$$c_{ij} = \frac{a}{a+b+c}$$

$$\begin{array}{ccc} & & \text{Row } j \\ & & \begin{array}{cc} 1 & 0 \end{array} \\ \text{Row } i & \begin{array}{c} 1 \\ 0 \end{array} & \boxed{\begin{array}{cc} a & b \\ c & d \end{array}} \end{array}$$

The Jaccard coefficient c_{ij} measures the degree of association between the choices of the two owners, since is computes the proportion of firms owned by both owners over the total number of firms owned by any of the two.

The coefficient varies between a minimum of zero (there is no firm in the market that is owned by both owners, i.e. $a = 0$), and a maximum of one (all firms owned by owner i are also held by owner j and vice-versa ($b = c = 0$). Contrary to the case of matrix R, the elements of C cannot take up negative values, although the qualitative picture of the association of owners' behaviour is similar. Incidentally, notice that element a of the contingency table for owners i and j displayed above corresponds to the previously defined entry a_{ij} of matrix A, so the c_{ij} coefficients are again a normalisation of the values of A.

Besides the coefficients presented in Borgatti (2012), many other measures of similarity or association between pairs of rows/columns are available in the case of a binary matrix, like the RM analysed above. In general, they are based on the contingency table representation introduced above, like for instance the Goodman and Kruskal's gamma, or its special case called Yule's Q association coefficient, defined as:

$$Q = \frac{ad - bc}{ad + bc}$$

where elements $a, \ldots, d$ are those from the contingency table.

For this binary case, the Pearson correlation coefficient introduced earlier has itself a simplified expression, called Pearson's Φ coefficient:

$$\phi = \frac{ad - bc}{\sqrt{(a+c)(b+d)(a+b)(c+d)}}$$

again based on elements $a, \ldots, d$ as above. For more association measures for 2×2 contingency table, see for instance Bernard (2012).

In principle, it should be possible to apply these suggestions in the bimodal approach too. In fact, bipartite matrices can be constructed starting from the adjacency matrix B, following the alternatives given above for the unimodal problem, i.e. the one-mode blocks appearing in the BB pairwise overlaps matrix of Table B.10 can be replaced by alternative one-mode matrices representing, for instance, the Jaccard coefficients or the Pearson correlations discussed earlier. The calculation of appropriate indices starting from these alternative matrices - and their interpretation in the unimodal and bimodal approaches - will be discussed in Section B.2.3.

B.2.3 Network measures

The previous sections proposed an overview of various matrix representations that can originate from the initial relation matrix of a network, both in the unimodal and bimodal approaches to bipartite networks. From any of the matrices presented above, different measures can be calculated in order to capture certain network characteristics. Their meaning and interpretation will vary according to the underlying chosen matrix, and to the selected approach, as discussed in the following. For the sake of simplicity, the measures will be presented and interpreted here with reference to either incidence matrices or projections matrices based on counts of links between nodes.

Applications to alternative representations of projection matrices - such as the matrices based on Pearson coefficients or other nodes' association measures presented in B.2.2 - are also possible, but will not be discussed thoroughly in the present note. The application to such alternative matrices will be analogous to that of the counts matrices, but might require the modification of the indices accordingly, or the adoption of different indices. A first simple example is given in Section B.2.5 below, where a new network index is proposed for the Pearson coefficients' matrix, drawing from the measures presented earlier in the sparsity context. Further cases can be considered according to the need. Notice that care should also be taken in the interpretation of the resulting indices, given that the underlying matrices have a different informational content.

In this section, two sets of measures taken from the network literature will be presented - respectively *cohesion* and *centrality* measures. For a thorough account of network measures, see for instance the aforementioned reference works of Scott (2017) or Borgatti et al. (2018). A specific discussion of network measures for large two-mode networks can be found in Latapy et al. (2008).

The general purpose of centrality and cohesion measures was introduced earlier, namely on the one hand studying the importance of a node based on its position, and on the other hand assessing the extent of connectedness of the network, respectively. In the common shareholding measurement, the focus is more on a global evaluation of the strength of the ties in the whole network induced by common shareholding, rather than the analysis of the importance of single actors, or their individual contribution to the cohesiveness of the network. For this reason, cohesion measures arise as a natural candidate in this context, and their possible application to the common shareholding problem is straightforward. However, some centrality measures can also be applied to the common shareholding study, as long as they are interpreted as a global characteristic of the network, and not used to assess individual performance of actors. Below the two most common measures of cohesion and centrality are presented, *density* and *degree*, respectively. Their interpretation in the common shareholding context is discussed, and illustrated based on our fictitious market example. The connection of each measure to the previous matrix methods is also highlighted and commented upon.

Network cohesion

The most popular network cohesion measure is the so-called *density*, defined as the proportion of actual links known in the network over the theoretical number of possible relationships. This measure evaluates the degree of connectedness between the nodes of a network, and consequently the extent to which different paths facilitate circulation of information among network's participants.

The minimum value of the density is zero, corresponding to a totally disconnected network, while the maximum of one represents a network where all possible links are actually present. A low value corresponds to a sparse network, where information flows are weaker, since nodes are less cohesive. As the number of nodes increases, the density tends to decrease, given that in a larger network the number of possible links increases fast.

The calculation of the density measure varies according to the type of network. For example, in a simple one-group network a "connection" of a node to itself does not count, since the relevant ties in such network are only those that link two different nodes; if the network is constituted by n nodes, then the maximum number of ties is $n(n-1)$. On the other hand, in a two-mode network only links across two different groups are possible, therefore the maximum number of possible ties exclude all within-group connections; if n_1 and n_2 represent the number of nodes of each group, then the maximum possible number of connections is $n_1 n_2$. The ratio of the actual number of connections to these maxima will measure the density of the network. The minimum number of connections in the two cases is usually considered to be zero, i.e. a set of "stand alone" actors in the case of one group, and two separate sets of actors with no interconnections in the case of a bipartite network.

When a matrix representation of the network is adopted, as in our approach, the density can be computed with respect to different matrices, obtaining different insights and interpretations of a network's properties. For example, in the case of a bipartite network the density index can be calculated with respect either to the original incidence matrix X, taking into account the direct (one-step) links between the two groups, or also be applied to the one-mode projection matrices, evaluating the density of the (two-step) links induced within each group by the connections in X. Notice that, even if the X matrix is rather sparse (and hence presents low density), it is sufficient to have one element of a group having links to all members of the second group to obtain a totally (two-step) connected second group. This is exactly the case of owner O3 in our example, which "links" all four firms in the market, giving rise to a totally connected one-mode firms matrix, as shown in Table B.8 (right), whose density is one.

The calculation of the density index of a network matrix will differ in the case of one-mode and of two-mode matrices, as discussed in the following.

In a *one-mode matrix* - say A - like those in Table B.8, all self-links should be ignored, i.e. all elements on the diagonal are excluded. It follows that the density for a one-mode matrix with n nodes is given by a corrected version of the expression introduced in Section B.1.2, namely:

$$d_{1M} = \frac{\#\{(i,j),\ i \neq j : a_{ij} \neq 0\}}{n(n-1)}$$

As pointed out earlier, in the common shareholding framework the additional specificity of the matrices deriving from Assumption A6 should be taken into account, i.e. that all actors of one group must have at least one link to one actor of the other group. For the one-mode density, the only effect is on the interpretation of the index, not on the formula above (which is still valid): the measure applied to the two projection matrices will then refer to the density of links between all owners in the market, but will represent the density of connections only between the non-independent firms of the market, i.e. only between firms that have at least one recorded owner, therefore should not be interpreted as density of the whole market firms.

The two projection matrices of our example (Table B.8) present 28 and 12 non-zero off-diagonal elements, in the owners' and firms' case respectively; given that the size of the two matrices is 8 for the owners and 4 for the firms, it follows that one-mode densities are computed according to the above formula as $d_{1M}^{owners} = 28/(8 \times 7) = 0.5$ and $d_{1M}^{firms} = 12/(4 \times 3) = 1$, as expected. In our bipartite network, these values refer to two-step links within the groups, induced by the direct links observed across groups; therefore the computed densities reveal that the cross-groups connections induce only 50% of all possible links between owners in the market, while activate all possible interconnections between (non-independent) firms, in line with what observed earlier.

In terms of a *two-mode* matrix of a general network, all recorded links are of interest, therefore the density can be calculated with the usual matrix density expression of Section B.1.2. For a two-mode incidence matrix in the common shareholding context, the modified density index proposed in Section B.1.2 should be adopted, again due to Assumption A6. Assuming without loss of generality that $I \geq J$, i.e. that there are more owners than firms, then the minimum possible number of ties in the incidence matrix X equals I - the number of owners. Hence we subtract from the recorded number of ties the number of owners, in order to attain the desired minimum value of zero in case of absence of common shareholding. Therefore, the density of X is given by:

$$d_{2M} = \frac{\#\{(i,j) : x_{ij} \neq 0\} - I}{I(J-1)}$$

As for the density of the two-mode incidence matrix X, we have 13 non-zero entries (Table B.7), with $I = 8$ and $J = 4$, giving a density of $d_{2M}^{X} = (13-8)/(8 \times 3) = 0.21$, i.e. the market presents only 21% of the possible "extra" links of owners beyond the first firm they own, denoting a low overall level of common shareholding. This result seems to be in contrast with the higher densities obtained within groups, but we should keep in mind that index d_{2M}^{X}

measures the density of the direct connections between the two sets of entities, while the previous indices assesses the intra-group induced cohesion for each set of actors separately, therefore measuring a different dimension of the market structure.

It is easy to confirm that in the two benchmark scenarios of minimum and maximum sparsity of Table B.2, the above formula gives the expected values of zero density for absence of common shareholders (RM, maximum sparsity), and unit density for the totally connected minimum sparsity case.

In case the bimodal approach is adopted, the structural zeros present in the bipartite adjacency matrix B or in the BB matrix of pairwise overlaps should be accounted for, modifying formulas accordingly.

Node centrality

An alternative common network characteristic is the *degree* of a node - which is a centrality measure - given by the number of connections or ties that a node has to other nodes. The degree can be normalised dividing by the maximum number of possible ties; this normalisation is even more relevant in a bipartite network, since the maximum number of ties of a node depends on the group the node belongs to. In fact, as mentioned earlier, nodes in the smaller group would look more central without normalisation, given the larger number of possible ties (equal to the size of the larger group).

Notice that the row and column totals of the incidence matrix X of a bipartite network correspond exactly to the number of connections of the nodes in the two groups, i.e. to the degree of each node. The same values can also be read on the diagonal of the two projection matrices into the one-mode spaces, as mentioned earlier.

If we denote by d_i and d_j the degree of owner i or firm j of X, respectively, then the normalised degree of the nodes in the bipartite network is given by:

$$d_i^* = \frac{d_i}{J} \quad \text{and} \quad d_j^* = \frac{d_j}{I}$$

For example, in our simplified market the maximum possible ties of an owner i are $J = 4$ (one for each firm), while a firm j can present at most $I = 8$ ties (one for each owner). The maximum degree in our example is observed for owner O3, which is linked to all four firm (100% degree), while the firms with highest degree are F3 and F4, each presenting links to four of the eight owners (50% degree). The actor (firm or owner) presenting highest degree is considered to be the *most central actor*.

Although the degree in itself is usually computed as a measure of the centrality of one node, in order to identify the most important actors, this measure can be useful also in identifying general patterns in the network. This can be achieved by analysing the distribution of the degree over the whole network, called the *degree distribution*, giving for each integer k the proportion p_k of nodes with degree equal to k. Many aspects of this distribution can be studied, such as the average or its maximum value, which represents the maximum number of connections stemming from a single actor. The distribution is generally very asymmetric, with a long right tail, due to the heterogeneity of real-world networks, where the majority of nodes have a low degree, but still some nodes can present a very high degree.

In a bipartite network, the degree distribution of each group of actors should be analysed separately, giving rise to two different degree distributions, for example one for the firms and one for the owners. A high degree in one distribution does not necessarily correspond to a high value in the other; for example, a market can present complete absence of common shareholding, so that all owners have degree one, but each firm can have a large number of owners, therefore showing large values for the firms' degree distribution. The average degree for each group of actors can be a useful indicator of the level of connectedness of the network.

In our example, the degrees for the four firms in the market are $(3, 2, 4, 4)$ respectively, with a quite even distribution around the middle of the possible values (range between 1 and 8). The average is 3.25 out of 8, showing a medium level of centrality of firms. For the case of owners, the degrees are $(2, 2, 4, 1, 1, 1, 1, 1)$, a much more asymmetric distribution, with the majority of the owners having minimum degree of one, but one firm achieving the maximum degree of four. The average degree for the owners is 1.625 connections out of 4. The average values tend to hide the difference in symmetry between the two distributions, so different measures such as the range, minimum or maximum can be more useful in characterising the distributions. In particular, the *maximum degree* is a popular network measure, which in general will depend on the network size, as noticed earlier (see for instance Newman, 2003, and Costa et al., 2007).

A full characterisation of the degree distribution of a network can also be achieved, based on certain probability distributions. The study of the parameters governing such distributions can be of help in identifying the behaviour of the network through the degree. Several scholars model the degree distribution $p_k, k = 0, 1, \ldots$ by fitting a power law, where $p_k \sim k^{-\alpha}$; the value of the exponent α summarises in one coefficient the behaviour of the network connectedness. The power law is widely recognised as being an appropriate representation of the degree distribution for large real-world networks; Latapy et al. (2008) report that empirically the exponent α takes values between 2 and 3.5, reflecting an heterogeneous degree behaviour with a typical long right tail.

Further details about the degree distribution and power laws, as well as other degree measures such as average or maximum degree, can be found, for example, in Newman (2003).

B.2.4 Modified indices for weighted networks

Some of the previous indices have been modified in the context of *weighted networks*, i.e. when the ties between nodes are characterised by a weight representing the strength of the tie, rather than a simple binary indicator of presence/absence. Such weighted representation of the network resembles the representation of corporate ownership through the full ownership information of matrix OM, hence some additional indices of the market structure can be derived from this literature. The popular *node strength* index, extension of the node degree presented above, will be discussed here. For further indices see for instance Egghe and Rousseau (2003), Antoniou and Tsompa (2008) or Opsahl et al. (2010).

The node strength is defined as the sum of the weights of all ties stemming from one node, i.e. the total strength of all relationships of that node. In the simple (unweighted) network all ties have weight one, therefore the node strength simply counts the number of ties per node, i.e. corresponds to the node degree as defined earlier. If w_{ij} represent the strength of the relationship between node i and node j, the node strength is obtained, respectively, as:

$$s_i = \sum_{j=1}^{J} w_{ij} \quad \text{and} \quad s_j = \sum_{i=1}^{I} w_{ij}$$

corresponding to the row and column total of the weighted network matrix representation. The definition is valid both for a one-mode and a two-mode network.

Given that the information about the total strength of the ties is complementary to the number of ties, both should be accounted for in the analysis of a node's centrality. Opsahl et al. (2010) propose a degree centrality measure that combines both aspects, given by:

$$C_i^{\alpha} = d_i \left(\frac{s_i}{d_i} \right)^{\alpha}$$

where d_i is the degree of node i and s_i the node strength. The exponent α is a positive tuning parameter, whose value is chosen according to the research objectives. If $0 < \alpha < 1$, a high degree is taken as favourable, while the opposite occurs if $\alpha > 1$. Further details about this measure can be found in Opsahl et al. (2010).

In our application, the rows and columns refer to the owners and firms, respectively, so that the row and column totals of matrix OM correspond exactly to the nodes' strength. In Table 2.2 column totals were displayed, since they had the direct meaning of the proportion of shares held by recorded shareholders of a firm. The firm with highest strength is firm F3 with a total weight of 100%. The row totals were not displayed, as not having a specific economic interpretation, but nevertheless gain this new meaning in the network context. In this case, the owner with highest strength is O5, with a total weight of 66.3%. Notice that the row totals can exceed 100%, since they sum ownership shares on different firms, while the total (direct) shares owned by the different owners of a firm are bounded above by 100%.

B.2.5 Other matrix summary indices

Additional indices coming from the matrix literature presented in Section B.1 can be considered in the study of networks. The main advantage of such indices is that they can be applied to any kind of matrix, i.e. not only to the relation matrix recording presence or absence of owner-firm links, or its derived matrices.

For example, if we consider the alternative matrix representations for one-mode groups - such as the case of the matrix R of Pearson correlation coefficients between actors r_{ij} - interest could lie only on non-zero correlations that pass a specific threshold, rather than considering all non-zero elements.

In this case, an alternative definition of density based on the sparsity measure ℓ^0_ϵ (see measure 2 in Table B.1) could be considered, giving rise to the following one-mode index:

$$d'_{1M} = \frac{\#\{(i,j),\ i \neq j : r_{ij} \geq \epsilon\}}{n(n-1)}$$

This index evaluates the proportion of actors in the group presenting a “high” correlation in their investment behaviour (or in their ownership structure), where threshold ϵ will determine the relevant correlation strength.

Additionally, notice that matrix or sparsity indices can also be applied to the full ownership matrix, taking into account the actual shares involved in each ownership link. For example, the above modified density could be applied to a matrix with Pearson correlations based on the full ownership information in OM, or to a matrix whose elements are given by the Euclidean distance between the rows (or columns) of the OM.

Appendix C

Identification of Sectors

C.1 Selection of companies and definition of sectors

Any meaningful analysis of common shareholding crucially depends on the correct identification of the firms operating in each of the analysed sectors. At first, for each sector and EU country, the identification of companies has been done using the official NACE-four digit code of economic activity associated to each of the listed firms, active in Europe (core, primary and secondary NACE codes[1]). The rationale behind the choice of using also Secondary Codes was that of minimising the probability of losing important market players by having the largest possible set of firms.

In a successive step, we then trimmed this list excluding possibly irrelevant companies. In fact, the broad definition of some NACE categories led to the selection of some companies that - despite being related to the field of interest - did not match precisely the actual definition sought in terms of economic activity. For example, in the Energy market transmission system operators had to be excluded, given that transmission is a highly regulated activity. In many cases, this refinement involved manual checks of companies to verify their precise trade description.

To the original set of listed firms active in the EU, we also added a variable number of unlisted companies to be sure to include the main market players. The final list of companies for each sector has been constructed in agreement and collaboration with our colleagues at DG COMP, taking advantage of their detailed field knowledge.

As possible complement to the above selection, we also explored the possibility to link company identification to its dimension (measured with assets or turnover), thereby trimming all firms with a low asset value. In order to check the impact of this selection procedure on the

[1] Each firm can have, besides one Core NACE code, many Primary and Secondary codes depending on the value added coming from its different productive activities.

reliability of common shareholding indicators, we computed the common shareholding indices based on matrix methods both on the original set of firms and on the reduced set (after excluding firms with low or absent turnover). We performed the check for both the Electricity and the Oil&Gas markets. In both sets, the indices gave an analogous picture; in fact, for the indices based on financial values, the firms with no record are automatically dropped, and those with small assets have a very low impact, so that they do not alter the general results. For indices based on headcount (e.g. share of firms in a common shareholder's portfolio, etc.), the inclusion of small firms changed the scale but not the time trends; relative values remained unaffected.

These results confirm that the crucial issue remains the inclusion of relevant players and not the exclusion of irrelevant ones. For the first, we finally discarded a refinement simply based on assets, preferring that based on NACE codes, expert judgments and on manual verification of firms' identity and importance. This also acknowledges the fluid nature of some of these markets. We present below the peculiarities of firms' selection for each sector.

C.2 Energy sector, split into Oil&Gas and Electricity

All companies that presented at least one NACE code starting with "35" (Electricity, gas, steam and air conditioning supply) among Core, Primary or Secondary have been initially selected as potential candidates for the Energy sector. We noticed the importance to consider also the Secondary codes especially in the Oil&Gas sector to capture relevant companies having their Core and Primary codes in Mining (610, 620) or Manufacturing (1920). Firms were then classified into the "Electricity" or "Oil&Gas" sectors according to the following criteria:

1. Electricity: codes 3511, 3512, 3513, 3514 among Core or first three Primary codes
    - production of electricity (NACE: 3511)
    - transmission of electricity (NACE: 3512)
    - distribution of electricity (NACE: 3513)
    - trade of electricity (NACE: 3514)
2. Oil&Gas: codes 0610, 0620, 1920, 3521, 3522, 3523 among Core or first three Primary codes, corresponding to:
    - extraction of crude petroleum (NACE: 0610)
    - extraction of natural gas (NACE: 0620)
    - manufacture of refined petroleum products (NACE: 1920)
    - manufacture of gas (NACE: 3521)

- distribution of gaseous fuels through mains (NACE: 3522)
- trade of gas through mains (NACE: 3523)

According to the selection outlined above, we obtained 360 firms active in the EU for the Electricity sector. As for the Oil&Gas, this procedure selected 112 firms. Of these, 19 firms actually met both criteria 1) and 2) above, i.e. were active both in the Electricity and in the Oil&Gas sectors, so they were included in both datasets. As suggested by our colleagues in DG COMP, we removed transmission system operators (TSOs) from the list, given that transmission is a highly regulated activity. This implied the removal of six companies from the Electricity dataset and one from the Oil&Gas.

Additional 42 unlisted firms for Electricity and 42 for Oil&Gas were added to complement the dataset, based on expert opinion. For unlisted firms we proceeded to the extraction of all available financial and ownership information, which was not included in the original database of only listed firms. The final dataset used for the analysis has 396 companies for the Electricity sector and 153 companies for the Oil&Gas sector.

C.3 Trading Platforms for Financial Instruments

The initial attempt of capturing through NACE codes the industry of Trading Platforms for Financial Instruments failed to identify the relevant companies. Given that a specific NACE code for Trading Platforms does not actually exist, possible codes have been selected based on what reported by the main players of this sector. Unfortunately, such categories were either too broad ("6492: Other credit granting"; "6499: Other financial service activities, except insurance and pension funding n.e.c.") or too narrow ("6611: Administration of financial markets"; "6612: Security and commodity contracts brokerage"), therefore were of no help for the identification of the other players of the industry.

As a consequence, the list of Trading Venues and Systematic Internalisers operating in the EU has been constructed manually, using the list of markets maintained by the European Securities Market Authorities (ESMA). First, four separate lists for different categories of Trading Venues were compiled: Regulated Markets, Multilateral Trading Facilities, Organised Trading Facilities, and Systematic Internalisers. Then, together with colleagues in DG COMP, we identified a single list of 176 companies operating such platforms in the EU. The Trading Platforms operators reflect the actual players active in this industry, and are hence considered the relevant companies for this sector.

This list entailed the manual check of each company name and the match with its BvD identifier. Of the identified operators, only 48 were listed companies, and therefore present in the original database; for the remaining 128 unlisted operators, all financial and ownership information had to be extracted anew.

C.4 Telecommunications - Mobile networks

The NACE codes "60: programming and broadcasting activities" and "61: telecommunications" have been used as base to select, in each EU country, the initial list of Mobile Network Operators (MNOs). This list was updated and complemented by our colleagues in DG COMP by trimming unrelated companies and adding additional MNOs and 153 Mobile Virtual Network Operators (MVNOs).

For all 255 companies finally selected we had to manually match firm's name and BvD identifier. Only in a limited number of cases, in fact, the MNOs or the MVNOs corresponded to the initial list provided by DG COMP, as we privileged mobile telecom operators rather than mother companies when the operator was an active commercial firm. For example, the second MNO in Austria is T-Mobile Austria, part of the Deutsche Telekom group. This company is actually present on Orbis as T-MOBILE AUSTRIA GMBH, so we included this company in the list and discarded Deutsche Telekom for Austria.

Most of the MVNOs were not actually identifiable companies but rather commercial initiatives. In that case, we included preferably the mother companies at the country level - when classified as telecoms - or the international conglomerate when a national reference company operating in the telecom sector was not available. We never included public bodies (government and its departments) as mother companies. In some cases, domestic operators were subsidiaries of large international conglomerates operating in very different fields (e.g. large retails such as MediaMarkt, COOP or SPAR holding). In that case, we retained the largest controlling company operating in the telecom sector if available.

In a few cases, we had to select the company among a list of very similar names (e.g. Telnet, Telnet holding, Telnet group, all located in Belgium, the first classified as telecom, the second as financial holding, the third as post and telecoms). In that case, again, we selected the last controlling domestic company classified as telecoms. Finally, four companies currently dissolved but with financial data for the period 2007-2016 were also included.

Of the 255 operators included in the country-level list, some are repeated due to one (or both) of the following reasons: (i) they are active in more than one country (for example, A1 TELEKOM AUSTRIA is active both in Austria and in Bulgaria as an MNO); (ii) they are active in a same country both as an MNO and as an MVNO (taking again the example of A1 TELEKOM AUSTRIA, which is a MNO in Austria, but also operates in the same country the MVNO "Ge org!"). After removing the repeated operators, we obtain a final list of 231 firms.

This list is a first attempt to define this industry. It may benefit from further refinements, for example dropping minor companies (especially MNVOs). Since the MVNOs are smaller entities, sometimes representing only a specific mobile package and not an actual identifiable company, for the sake of robustness we also adopt an alternative definition of the sector which does not include them. All-together, we are left with 105 MNOs active in the EU. The set of

MNOs is then complemented with the corresponding controlling parents in the period 2007-2016, so as to include all relevant companies that exert influence in the industry, even though they are not directly mobile operators.

The choice of including the controlling parents has several facets. Indeed, it is usually the case that big investors and potential common shareholders choose to hold shares in the parent company, through which they manage to influence all subject companies, rather than investing directly in the smaller subsidiaries. It is also often the case that the parent company is listed, while the other firms in the corporate group are unlisted, hence the investor's preference can also be linked to the listing status. Moreover, several parent companies exert influence in the industry even though they are not directly mobile operators. For example, DEUTSCHE TELEKOM AG is not an MNO, but controls several mobile operators, such as T-MOBILE AUSTRIA GMB, T-MOBILE NETHERLANDS and TELEKOM DEUTSCHLAND. Some other parent companies may even not be active directly in the telecoms, being holding or financial companies; nevertheless, being controlling parents of MNOs they still influence the market. It follows that, in order to study the extent of common shareholding in the mobile market, the inclusion of such mother companies and the analysis of their ownership structure is crucial.

The choice of the relevant parent company has been based on the definition of Global Ultimate Owner (GUO), according to a minimum participation of 50% (GUO50). The GUO50 is provided directly in the Orbis database, and is not reconstructed manually from the ownership information. Nevertheless, several quality checks have been performed on this variable, having found it consistently defined and reliable.

Orbis defines the GUO50 as being the Global Ultimate Owner characterised by a minimum of 50% ownership shares in the path from the subsidiary to the ultimate owner. If the GUO holds direct participation in the subsidiary, then it owns more than 50% of shares. If there are any intermediate ownership steps between the company and the GUO, all of them present more than 50% of ownership.

The types of GUOs considered for this analysis are only banks or financial/insurance/industrial companies, i.e. only entities of types A, B, C and F according to Orbis definition (see Table A.4 in Appendix A). This definition implies that entities such as individuals, states or public administrations are not considered as controlling parents, given that these last entities would not present any ownership structure themselves.

In general the GUO50 is rather constant over the ten years of observation, but there are occasional changes when there is a change in ownership due to either a merger or acquisition, or simply an increase/decrease in participation.

All-together, in 2007-2016 we identified 107 controlling parents for the 105 MNOs. Some of the parents are themselves MNOs (35 companies), so they are already included in the initial list. The remaining 72 parents are partly companies active in the telecoms industry, partly holding or financial companies. Adding these parents to the initial list of MNOs, we obtain a final list of 177 companies that represent all firms active in or influencing mobile telecommunications in the EU over 2007-2016.

In this report, we will discuss our metrics according to the second industry definition. Results including the smaller entities (MVNOs) are qualitatively the same (available upon request).

C.5 Beverages manufacturers

The set of firms active in the Beverages sector in the EU has been obtained in two steps, following the criteria explained below.

First, a selection has been made starting from the database of listed firms, based on the following NACE codes for beverages manufacturing: code 1105 (Manufacture of beer); code 1107 (Manufacture of soft drinks; production of mineral waters and other bottled waters); and code 1032 (Manufacture of fruit and vegetable juice). All listed firms active in the EU which present at least one of the above codes as primary or secondary activity[2] are included in the sample.

Following this initial selection, a number of unlisted relevant players has been added based on the expert opinion of colleagues from DG COMP, representing unlisted companies with significant market share or presence in European countries. In some cases the added firms are part of larger corporate groups, partially owned by one or more firms from the initial group of listed enterprises. In general, the added unlisted companies presented at least one of the above NACE codes as primary or secondary activity.

After this selection, a manual check was performed on firms classified as manufacturers of beverages only as *secondary* activity, to ensure that they are actually active in the market. Following this investigation, five cases were excluded from the sample, due to the following situations: some companies had a beverages business in the past, but had sold it before 2007, and are currently concentrating on other activities as their core business; in a couple of cases we were unable to trace any link to beverages manufacturing - these were dropped supposing that the industry classification in one of the NACE codes above might be a strategy to "hoard" codes for possible future needs, and does not reflect an actual current activity in the market.

All-together, we obtain a list of 290 firms, of which 214 are listed (or delisted) manufacturers of Soft Drinks, Beer or Juices. The remaining 76 firms are the relevant unlisted players.

The main features of the five markets are summarised in Table C.1.

[2] Up to 20 secondary activities.

Table C.1: Definition of the five markets under analysis. Total number of distinct firms active over 2007-2016. Total number of distinct shareholders investing in market over 2007-2016. Criteria for inclusion of firms in each market.

Market	No. firms	No. SH	Inclusion criteria
Oil&Gas	153	4882	All listed firms active in the EU[1] classified with the following NACE codes among Core or first three Primary codes of industrial activity: extraction of crude petroleum (0610); extraction of natural gas (0620); manufacture of refined petroleum products (1920); manufacture of gas (3521); distribution of gaseous fuels through mains (3522); trade of gas through mains (3523). Removed transmission system operators (TSOs). Few extra unlisted firms added based on expert opinion.
Electricity	396	9115	All listed firms active in the EU[1] classified with the following NACE codes among Core or first three Primary codes of industrial activity: production of electricity (3511); transmission of electricity (3512); distribution of electricity (3513); trade of electricity (3514). Removed transmission system operators (TSOs). Few extra unlisted firms added based on expert opinion.
Trading Platforms	176	4165	All companies (listed and unlisted) operating trading venues in the EU. The list of Trading Platforms was supplied by the European Securities Market Authorities (ESMA), and includes regulated markets, multilateral trading facilities, organised trading facilities, and systematic internalisers. The list of companies operating each platform was supplied by DG COMP.
Telecoms	177	3199	All Mobile Network Operators (MNOs) active in the EU, together with their respective controlling parents throughout 2007-2016. The controlling parent is identified with the GUO50[2]. The list of MNOs was supplied by DG COMP, while the identification of the controlling parent was obtained from Orbis data.
Beverages	290	5498	All listed firms active in the EU[1] classified with the following NACE codes of industrial activity (among Core, or first four Primary codes, or first twenty Secondary codes): manufacture of beer (1105); manufacture of soft drinks, production of mineral waters and other bottled waters (1107); manufacture of fruit and vegetable juice (1032). Few dozens of extra unlisted firms added based on expert opinion.

1 *Definition of firm active in the EU: either registered in the EU, or registered outside the EU but holding shares in at least one firm registered in the EU.*
2 *Orbis defines the GUO50 as being the Global Ultimate Owner characterised by a minimum of 50% ownership shares in the path from the subsidiary to the ultimate owner.*

Appendix D

Complements to the Econometric Analysis

D.1 Ownership changes between investors

Given that the BlackRock-BGI merger represented a once-in-a-lifetime event, we investigated the possible existence of other minor changes in ownership at the investors' level, which in turn might have caused a relevant change in the degree of common shareholding of the firms active in each sector. In each of the five markets, besides the usual set of top global investors,[1] a second group of relevant shareholders holding slightly smaller portfolios has been identified; this second group of investors represents a possible target of M&A from the largest investors, therefore being likely candidates of changes in ownership events.

The selection procedure for these "secondary top investors" (or alternatively, sector specific top investors) occurred based on two criteria: a threshold for minimum investments of at least x% in at least y% of firms over the entire period. This selection procedure has been applied to the set of shareholders of each sector, after eliminating the global main investors. As a robustness check, the selection procedure has also been applied to the whole set of shareholders, and all primary investors resulted in the list of extracted shareholders, indicating that the selection criteria is robust.

The global main investors are the usual 20 top shareholders used in previous ownership-based analysis, with the addition of four new global main investors for the purpose of this exercise. These additional four were funds that resulted comparable in size to the other 20, and were not included in the original list only for the cutoff imposed at 20. When looking at ownership jumps between investors, they behave similarly to the top global 20.

[1] Also denoted as "primary investors". See previous dedicated sections in Chapter 4.

Table D.1 reports the list of primary investors (common to all five markets) and a compilation of the main secondary investors, i.e. those appearing in most of the markets. The group of secondary players includes several funds or financial intermediaries that, despite having several holdings across industries, globally were too small to be considered at the same level of the main global investors. Most of the investors listed in the table had already been identified in the initial analyses as top-ranking shareholders based on the five density-based common shareholding indices, therefore confirming again the robustness of the selection procedure.

Some sector-specific investors have not been included in the list for the sake of brevity. Cross-investors have been excluded from the set of secondary shareholders, given that they belong to the list of firms active in each market, and here the objective was to identify movements at the higher level of shareholding.

Table D.1: Primary and secondary investors.

PRIMARY INVESTORS	ALLIANZ SE; AXA SA; BANK OF AMERICA CORP; BANK OF NEW YORK MELLON; BARCLAYS PLC; BLACKROCK INC; BNP PARIBAS; CREDIT SUISSE GROUP; DEUTSCHE BANK AG; DIMENSIONAL FUND ADV; EATON VANCE CORP; FMR LLC; GOLDMAN SACHS GROUP; ING GROEP NV; INVESCO LTD; JPMORGAN CHASE & CO; MORGAN STANLEY; NORTHERN TRUST CORP; NORWAY; STATE STREET CORP; STICHTING PENSIOENFO; TEACHERS INSURANCE; UBS AG; VANGUARD GROUP INC
SECONDARY INVESTORS	ABERDEEN ASSET MANAGENT; AFFILIATED MANAGERS; AGEAS SA-NV; AMERICAN INTERNATIONAL; AMERIPRISE FINANCIAL; ASGARD INVESTMENT CO; ASSICURAZIONI GENERALI; AVIVA PLC; BANCO SANTANDER SA; BANK OF MONTREAL; BANQUE PICTET & CIE BPCE SA; CANADIAN IMPERIAL BANK; CAPITAL GROUP CO INC; CITIGROUP INC; CRÉDIT AGRICOLE S.A; FIDELITY INTERNATIONAL; FIRST EAGLE INVESTMENT; FRANKLIN RESOURCES; HSBC HOLDINGS PLC; INTESA SANPAOLO; JANUS CAPITAL GROUP; JANUS HENDERSON GROUP; JUPITER FUND MANAGEMENT; KBC GROEP NV/ KBC GR; LAZARD LIMITED; LEGAL & GENERAL GROUP; LEGG MASON INC; LEHMAN BROTHERS HOLDING; LLOYDS BANKING GROUP; LORD ABBETT & CO; MACQUARIE GROUP LTD; MASSACHUSETTS MUTUAL; MERRILL LYNCH & CO.; OLD MUTUAL PLC; PRUDENTIAL PLC; ROYAL BANK OF CANADA; SCHRODERS PLC; SOCIÉTÉ GÉNÉRALE; STANDARD LIFE ABERDEEN; SUN LIFE FINANCIAL; SWEDBANK AB; T ROWE PRICE GROUP; TORONTO DOMINION BANK; UBS GROUP AG; UNICREDIT SPA; WELLINGTON MANAGEMENT; WELLS FARGO & CO; WINDY CITY INVESTMENT

The purpose of the first selection (minimum investment level) is to eliminate those shareholder-firm links that are too minor to be considered of interest. Similarly, the second criteria only considers those investors that over the entirety of the period had these 'significant' investments in at least a certain percent of firms in the sample. This second criteria is quite lax in general, but experimenting with different values (5 or 10 percent for example) the resulting investors extracted are often the same ones identified in earlier phases of the study.

This analysis required then the extraction of the ownership information for each secondary investor selected. With this information, we were able to check all the jumps in ownership that the global main investors made into our secondary sector specific investors per year, separating by positive and negative investment jumps. Figures D.1-D.3 below plot this, where the selection of the secondary investors has been based on thresholds of minimum 5% investment in at least 10% of the firms active in the decade of observation. The only exception was the MNOs and Parents sector, where 1% and 5% cut-offs were used; the different thresholds were necessary due to the strongest presence of corporate groups, as noted earlier. Further fine-tuning of the selection thresholds can be applied.

The ownership jumps were weighted by a proxy of the size of the secondary investor, based on an index of TOAS density of its respective portfolio. This information for TOAS density was previously calculated from ORBIS financial data for all shareholders, as one of the density-based common shareholding indices (see definition in previous sectoral analyses). For those investors where ORBIS did not provide information on portfolio Total Assets, as can happen for some of these smaller financial firms, an average of the yearly TOAS density of shareholders of the same entity type was calculated, and used as a substitute where the weight was missing.

The patterns in the graphs are similar to those already seen in the discussion specific to the 'Big Three' and the BlackRock-BGI merger in Chapters 5 and 6. In almost every sector there is a sharp increase in ownership jumps of BlackRock in the sector, driven by its acquisition of BGI, and in turn a sharp sell-off on behalf of Barclays as they sell their division. By far these ownership jumps are the most significant in each sector.

Figure D.1: Ownership changes between primary and secondary investors - Oil&Gas sector.

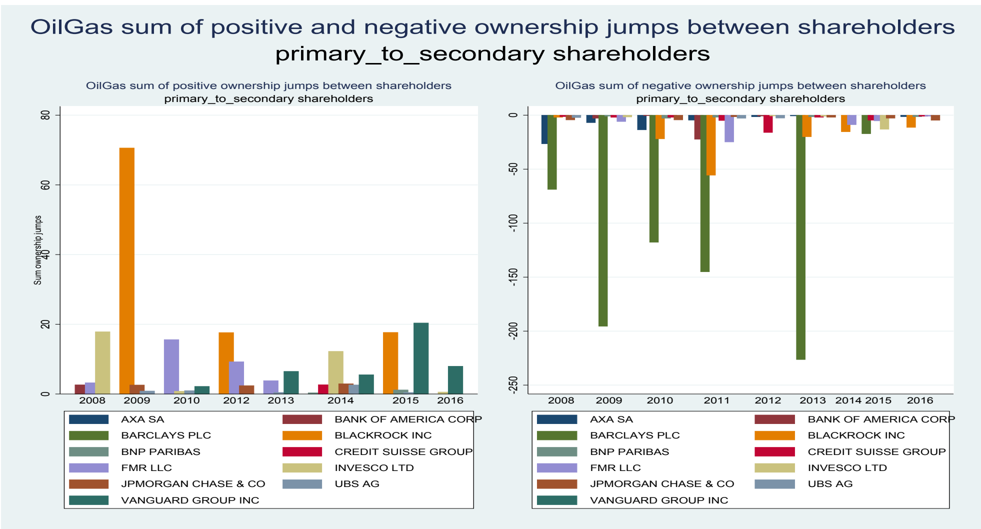
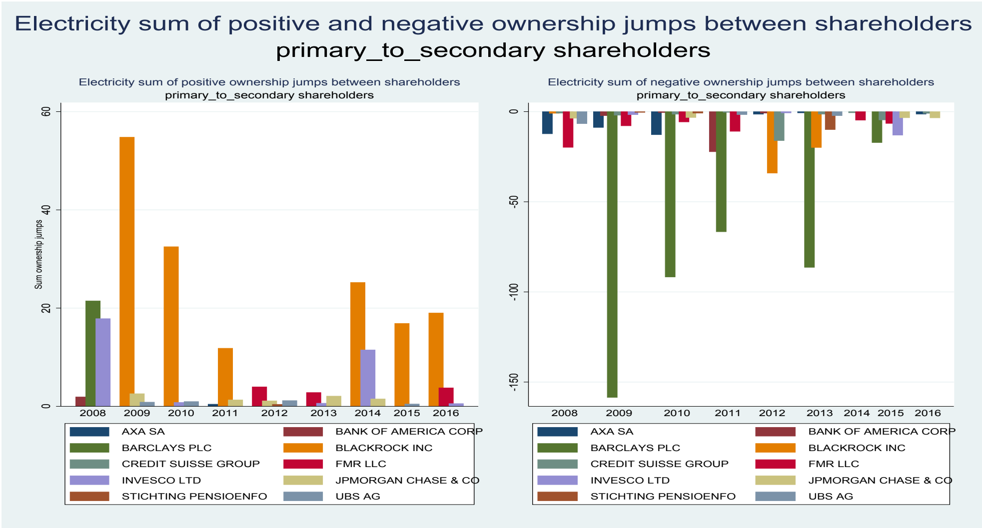


Figure D.2: Ownership changes between primary and secondary investors - Electricity and Trading Platforms sectors.



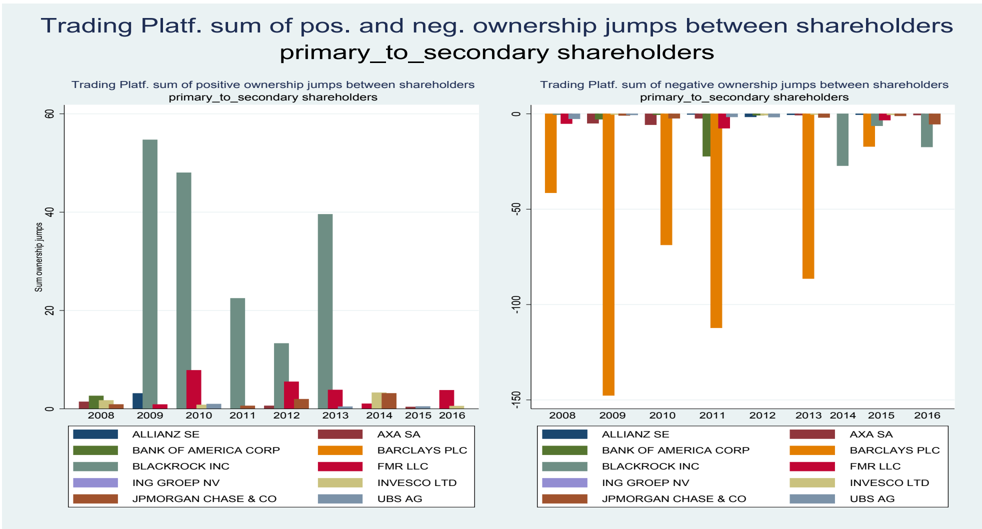
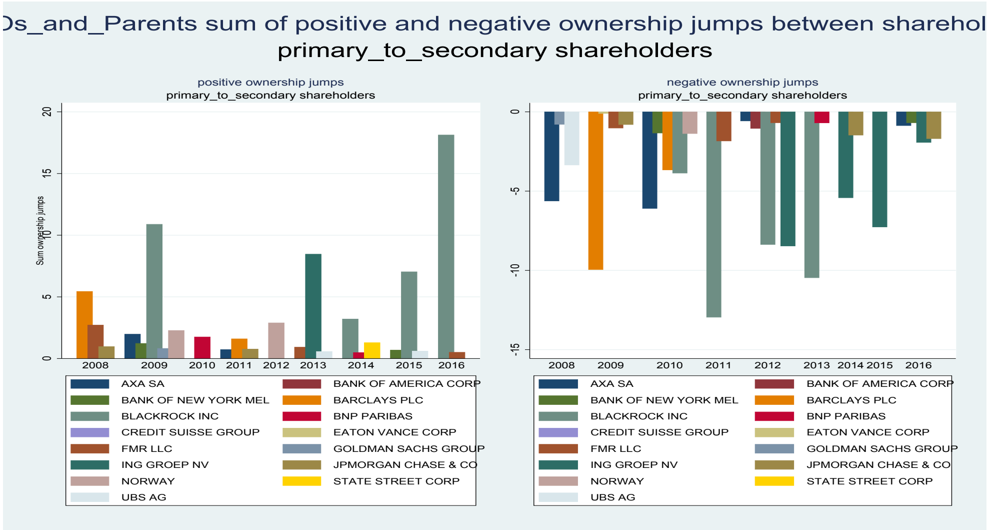
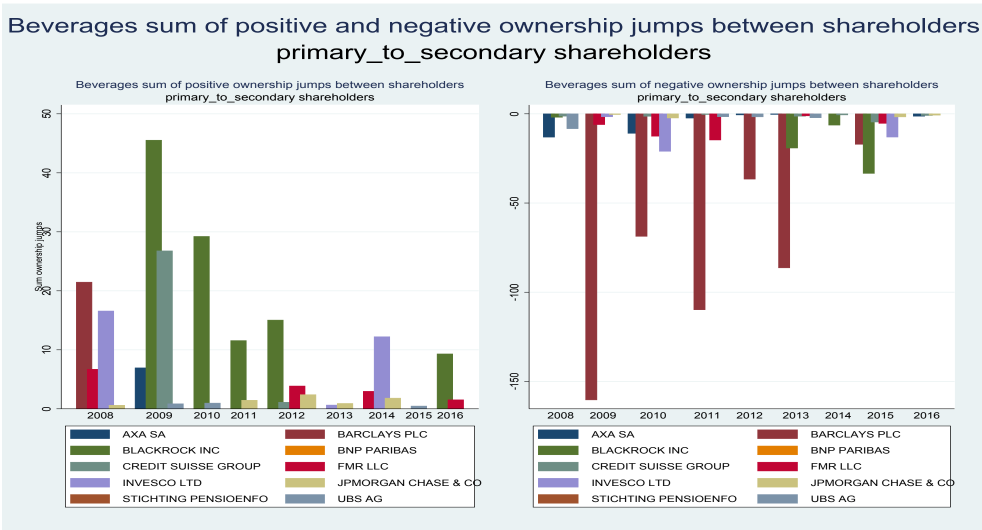


Figure D.3: Ownership changes between primary and secondary investors - Telecoms and Beverages sector.





D.2 Sample exclusion due to missing values

Table 7.1 reported the number of observations which were dropped each year from the analysis, due to unavailable data on either the response variable or the controls. Few extra values were dropped once the outcome variable was limited to the interval $[-1, 1]$, following IMF (2019).

In order to understand possible implications on the empirical results, the excluded observations were studied so as to identify possible concerns. Table D.2 below reports some descriptive statistics about the observations excluded from the sample.

The first column reports the number of years (out of ten) a firm was excluded from the analysis due to missing or trimmed values. In the large majority of cases, firms are excluded only for a limited number of years. An exception is given by a set of firms which are systematically excluded from the sample for the whole period of observation. For this group we observe that almost all firms were delisted or unlisted in 2017, and registered in Germany. This suggests that exclusion from the sample may be due to total absence of financial data, given the less stringent reporting obligations of this type of firms and legal framework. Even for those firms missing for a smaller number of years, it is still predominant the unlisted/delisted status, as well as registration in Germany.

Table D.2: Number of firms with missing values, by listing status and country of registration

No years missing	No. firms	Listing status in 2017		Country	
		Listed	Delist./Unlist.	DE	Other
1	37	19	18	11	26
2	23	8	15	2	21
3	17	8	9	5	12
4	14	4	10	4	10
5	8	3	5	0	8
6	7	2	5	0	7
7	3	0	3	0	3
8	7	1	6	2	5
9	9	0	9	1	8
10	31	3	28	26	5
Total	156	48	108	51	105

D.3 Evolution of ownership over time

In Figures D.4-D.5, we provide descriptive statistics of the evolution of ownership among some of the largest firms active in the EU, registered both in and out of the EU.

The graphs display the trajectories of ownership by BlackRock and BGI individually, the total shares held by the "Big2" (State Street and Vanguard), and firms size measured in logarithms of total assets. As regards other dimensions that might be of interest, trends in industry classification are not analysed, given that it is constant over time. Finally, it is important to keep in mind that the treatment variable is defined using ownership figures from 2007.

In many cases, a steep increase in BlackRock participation is evident after the merger, together with a large drop in BGI's shares. The ownership by the Big2 has been overall increasing in the decade of observation.

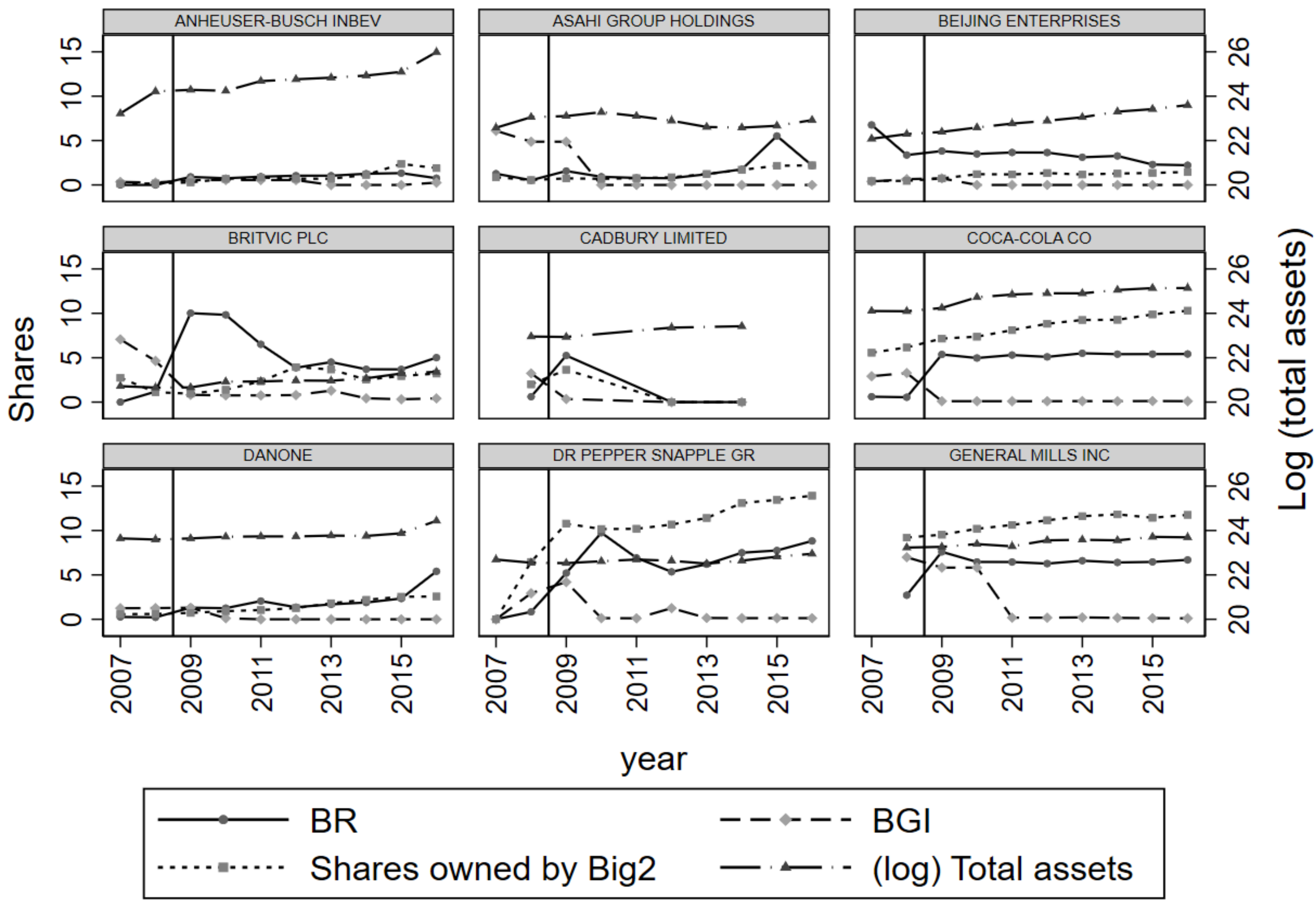


Figure D.4: Evolution of ownership among some largest firms active in the EU

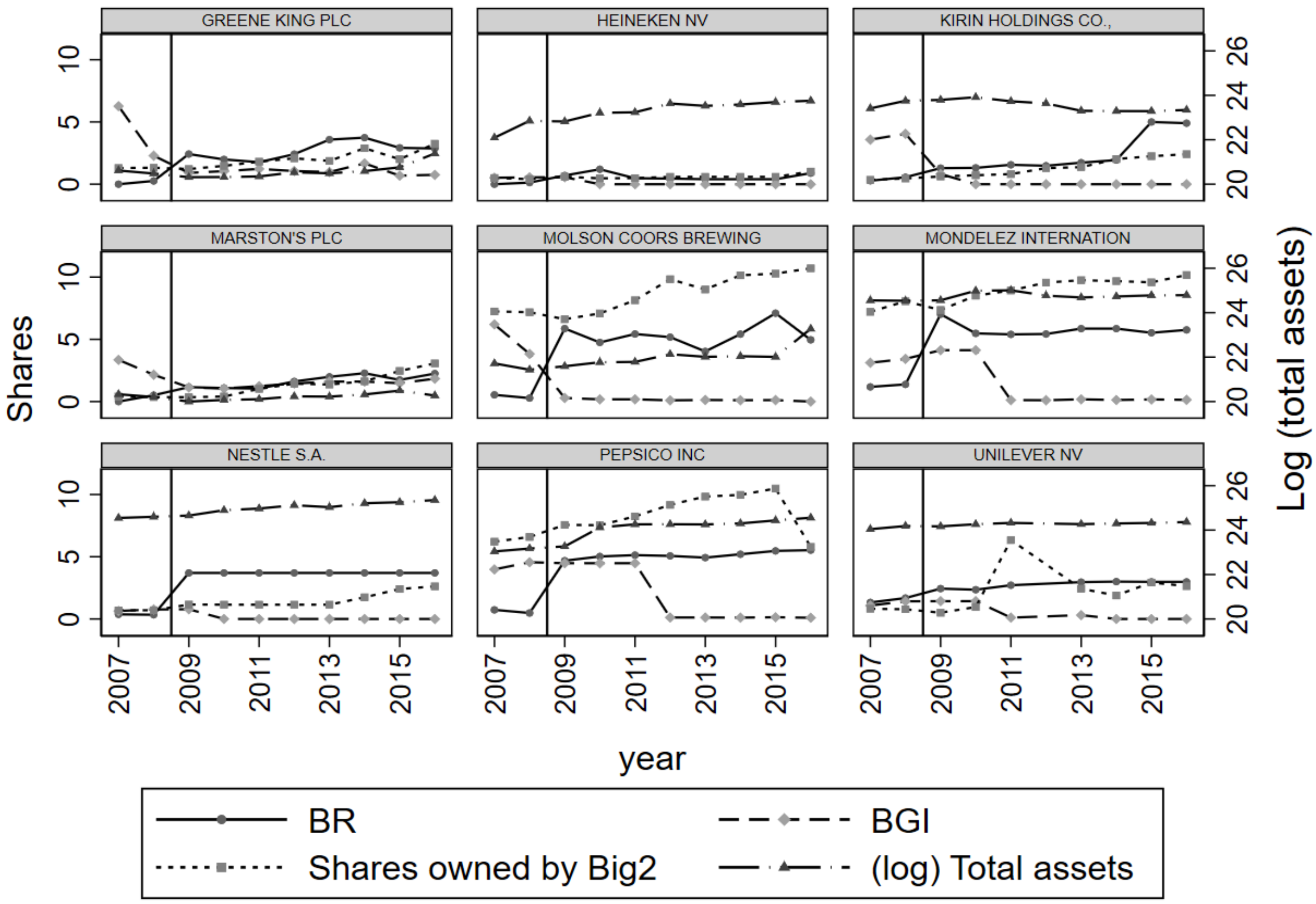


Figure D.5: Evolution of ownership among some largest firms active in the EU (cont.)

D.4 Alternative competition measure

Table D.3: Adjusted Lerner Index as dependent variable

Dep. var.: Lerner Index Adjusted	(1)	(2)	(3)
Treated*post	0.091**	0.093**	0.147***
	(0.036)	(0.037)	(0.049)
(log) Total assets		0.000	-0.001
		(0.006)	(0.009)
Shareholders' HHI		-0.001	-0.007
		(0.006)	(0.008)
Shares top 4 owners		0.001	-0.007
		(0.043)	(0.080)
Firm's Integration		-0.009	0.016
		(0.030)	(0.046)
Shares owned by Big2		-0.318	1.524
		(0.552)	(0.992)
(log) Total assets*post			0.001
			(0.008)
Shareholders' HHI*post			0.008
			(0.006)
Shares top 4 owners*post			0.017
			(0.078)
Firm's Integration*post			-0.031
			(0.040)
Shares owned by Big2*post			-1.452*
			(0.798)
Observations	1,730	1,730	1,730
Year fixed effects	yes	yes	yes
Firm fixed effects	yes	yes	yes
R-squared within	0.031	0.032	0.042
R-squared overall	0.917	0.917	0.917
Number of firms	225	225	225

Robust standard errors, clustered at the firm levels, are shown in parentheses

**** p<0.01, ** p<0.05, * p<0.1*

D.5 Heterogeneity of exposure

Ownership of companies exposed to the merger

We further inspect the relative size of ownership between BGI and BlackRock. The composition of the overall exposure to the merger is examined in particular for firms that are held by both BGI and BlackRock, and few other relevant players with high participations by one of them.

The cross-section distribution of the treated firms in 2007 is reported in Table D.4, where the number of treated firms is grouped into classes according to the relative size of the ownership of BGI and BlackRock. This joint distribution is also instrumental to interpret the relevance of the shock in the sample under analysis and the (in)ability to measure its effect with sufficient precision.

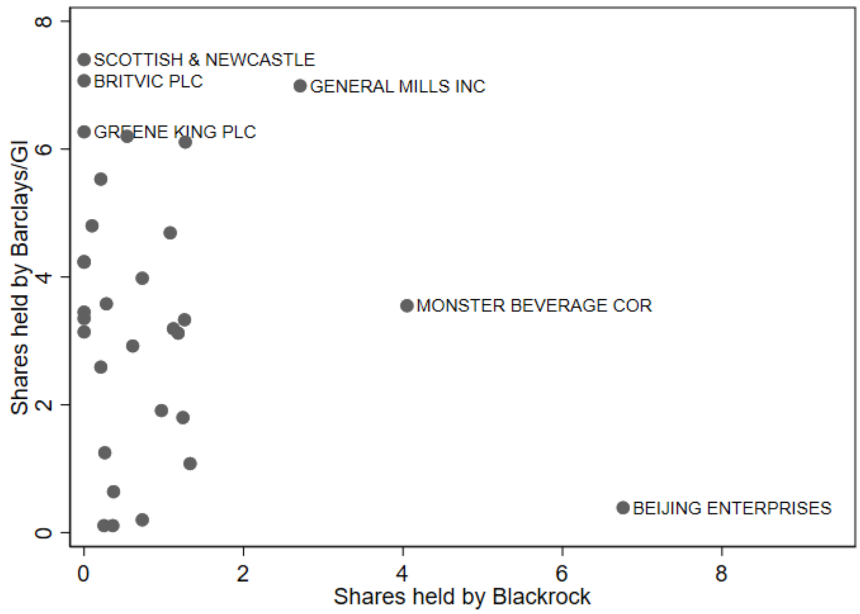
Table D.4: Number of firms by relevant shareholder composition in 2007

		Shares held by BlackRock								
		0%	**0-1%**	**1- 2%**	**2-3%**	**3-5%**	**5-7%**	**7-10%**	**>10%**	**Total**
Shares held by BGI	**0%**	118	3	0	0	0	0	0	0	121
	0-1%	12	5	0	0	0	1	0	0	18
	1-2%	6	2	2	0	0	0	0	0	10
	2-3%	0	1	0	0	0	0	0	0	1
	3-5%	5	2	4	0	1	0	0	0	12
	5-7 %	1	3	1	0	0	0	0	0	5
	7-10%	2	1	0	1	0	0	0	0	4
	>10%	0	0	0	0	0	0	0	0	0
	Total	144	17	7	1	1	1	0	0	171

The same pattern emerges in the Figure D.6, with BGI having a more sizeable ownership in most cases. This is not surprising because the portfolio of BlackRock in the late 2000s was not as large as that of Barclays/BGI. Companies with a more sizeable participation of BGI and/or BlackRock among their shareholders are identified explicitly in the graph.

Table D.5 reports some summary statistics of classes of exposure, where classes are defined according to the sum of the shares held by BlackRock and BGI in 2007. We display the number of firms and the number of observations belonging to the specific exposure class over the entire period of observation. Please note that the panel structure of the available data is not perfectly balanced and hence the number of observations can be smaller than 10 times the number of unique firms.

Figure D.6: Treated firms by shares owned by merging investors



Among the descriptive statistics for each class, Table D.5 reports the average size of firms (as measured by the log of Total Assets), and the number of firms in the class that are breweries (core NACE code = 1105) or manufacturers of soft drinks/mineral waters (core NACE code = 1107). A detailed description of the firms belonging to each exposure class, including among others size and industry is provided in Table D.6.

Table D.5: Summary statistics of exposure classes

Exposure	Nr. of obs.	Nr. of firms	(log) assets	Breweries	Sodas/waters
0-1%	162	19	20.99	10	2
1-2%	81	9	22.16	2	2
2-3%	26	3	22.91	1	0
3-4%	60	6	22.26	2	4
4-5%	64	7	21.53	1	2
5-12%	98	13	22.12	6	5

Firm	Nace	% BR	% BGI	Assets	Global Ultimate Owner
Exposure class [0% ; 1%)					
ANADOLU EFES BIRACIL	1105	0.25	0.11	21.54	ANADOLU EFES BIRACIL
ANHEUSER-BUSCH INBEV	1105	0	0.34	23.22	ANHEUSER-BUSCH INBEV
ARCA CONTINENTAL SAB	1107	0.34	0	20.80	ARCA CONTINENTAL SAB
BARRY CALLEBAUT AG	1082	0.22	0	21.38	JACOBS HOLDING AG
CHINA HUIYUAN JUICE	1031	0.55	0	20.28	CHINA HUIYUAN JUICE
CHRIST WATER TECHNOL	3600	0.31	0.23	18.56	CHRIST WATER TECHNOL
COMPANHIA DE BEBIDAS	1105	0.73	0.2	23.33	ANHEUSER-BUSCH INBEV
DATACOLOR AG	1105	0	0.16	18.89	DATACOLOR AG
DAVIDE CAMPARI - MIL	1101	0.36	0.11	21.04	DAVIDE CAMPARI - MIL
GRUPO MODELO, S.A.B.	1105	0	0.72	22.55	GRUPO MODELO, S.A.B.
HEINEKEN NV	1105	0	0.52	23.20	L'ARCHE GREEN N.V.
HITE JINRO HOLDINGS	1105	0	0.52	21.42	HITE JINRO HOLDINGS
IHLAS HOLDING A.S.	8690	0	0.13	20.04	IHLAS HOLDING A.S.
JERONIMO MARTINS SGP	4711	0	0.11	20.88	SOCIEDADE FRANCISCO
SAPPORO HOLDINGS LIM	1105	0	0.99	21.93	SAPPORO HOLDINGS LIM
SUMOL+COMPAL, S.A.	1107	0	0.33	18.56	REFRIGOR, S.A.
TAKARA HOLDINGS INC	1102	0	0.67	21.00	TAKARA HOLDINGS INC
TSINGTAO BREWERY COM	1105	0	0.3	20.38	TSINGTAO BREWERY COM
YOUNG & CO'S BREWERY	1105	0	0.51	19.73	YOUNG & CO'S BREWERY
Exposure class [1% ; 2%)					
ABI SAB GROUP HOLDIN	1105	0	1.89	23.84	ABI SAB GROUP HOLDIN
C&C GROUP PLC	1102	0	1.27	20.54	C&C GROUP PLC
COCA-COLA FEMSA SAB	1107	0	1.2	22.37	FOMENTO ECONOMICO
DANONE	1051	0.26	1.25	23.64	DANONE
FOSTER'S GROUP PTY L	1105	0	1.15	22.51	FOSTER'S GROUP PTY L
NESTLE S.A.	1089	0.37	0.64	24.96	NESTLE S.A.
NICHOLS PLC	1107	0	1.17	17.76	NICHOLS PLC
SWIRE PACIFIC LIMITE	6831	0	1.1	23.53	JOHN SWIRE & SONS LI
WIMM-BILL-DANN FOODS	1051	0	1.46	20.26	WIMM-BILL-DANN FOODS
Exposure class [2% ; 3%)					
CAMPBELL SOUP CO	1089	0.45	2.08	22.15	CAMPBELL SOUP CO
FRASER & NEAVE LTD	1105	0.97	1.91	22.53	FRASER & NEAVE LTD
UNILEVER NV	1089	1.33	1.08	24.04	UNILEVER NV

Firm	Nace	% BR	% BGI	Assets	Global Ultimate Owner
Exposure class [3% ; 4%)					
COCA COLA BOTTLING C	1107	0	3.14	20.59	COCA COLA BOTTLING C
COCA-COLA CO	1107	0.61	2.92	24.10	COCA-COLA CO
COTT CORP	1107	0	3.45	20.47	COTT CORP
FOMENTO ECONOMICO	1107	1.24	1.8	23.06	FOMENTO ECONOMICO
KIRIN HOLDINGS CO.,	1105	0.28	3.58	23.41	KIRIN HOLDINGS CO.,
MARSTON'S PLC	1105	0	3.35	21.94	MARSTON'S PLC
Exposure class [4% ; 5%)					
A.G. BARR P.L.C.	1107	0	4.24	18.93	A.G. BARR P.L.C.
DEAN FOODS CO	1052	1.12	3.19	22.29	DEAN FOODS CO
FULLER SMITH & TURNE	1105	0	4.23	19.98	FULLER SMITH & TURNE
KRAFT HEINZ FOODS CO	1039	1.26	3.33	22.72	KRAFT HEINZ FOODS CO
LANDEC CORP	2016	0.17	3.97	18.39	LANDEC CORP
MONDELEZ INTERNATION	1051	1.18	3.12	24.56	ALTRIA GROUP INC
PEPSICO INC	1107	0.73	3.98	23.88	PEPSICO INC
Exposure class [5% ; 12%)					
ANHEUSER-BUSCH CO	1105	0.49	5.67	23.18	ANHEUSER-BUSCH CO
ASAHI GROUP HOLDINGS	1105	1.27	6.11	22.58	ASAHI GROUP HOLDINGS
BEIJING ENTERPRISES	1105	6.76	0.39	22.08	BEIJING ENTERPRISES
BRITVIC PLC	1107	0	7.07	20.72	BRITVIC PLC
CHIQUITA BRANDS INTE	1031	1.08	4.69	21.32	CHIQUITA BRANDS INTE
COCA-COLA AMATIL LIM	1107	0.21	5.53	21.75	COCA-COLA AMATIL LIM
GENERAL MILLS INC	1089	2.28	5.4	23.23	GENERAL MILLS INC
GREENE KING PLC	1105	0	6.27	22.15	GREENE KING PLC
MOLSON COORS BREW	1105	0.54	6.2	22.94	MOLSON COORS BREW
MONSTER BEVERAGE	1107	4.05	3.55	19.73	MONSTER BEVERAGE
PEPSI BOTTLING GROUP	1107	2.36	9.47	22.91	PEPSI BOTTLING GROUP
PEPSIAMERICAS INC	1107	0.97	8.88	22.01	PEPSIAMERICAS INC
SCOTTISH & NEWCASTLE	1105	0	7.4	22.98	SCOTTISH & NEWCASTLE

Table D.6: Summary of firm's characteristics by exposure classes. Nace core classification. Values of shares held by BlackRock (BR) and BGI, (log) Assets and GUO refer to the year 2007.

GETTING IN TOUCH WITH THE EU

In person

All over the European Union there are hundreds of Europe Direct information centres. You can find the address of the centre nearest you at: https://europa.eu/european-union/contact_en

On the phone or by email

Europe Direct is a service that answers your questions about the European Union. You can contact this service:

- by freephone: 00 800 6 7 8 9 10 11 (certain operators may charge for these calls),

- at the following standard number: +32 22999696, or

- by electronic mail via: https://europa.eu/european-union/contact_en

FINDING INFORMATION ABOUT THE EU

Online

Information about the European Union in all the official languages of the EU is available on the Europa website at: https://europa.eu/european-union/index_en

EU publications

You can download or order free and priced EU publications from EU Bookshop at: https://publications.europa.eu/en/publications. Multiple copies of free publications may be obtained by contacting Europe Direct or your local information centre (see https://europa.eu/european-union/contact_en).

KJ-NA-30312-EN-N

The European Commission's science and knowledge service

Joint Research Centre

JRC Mission

As the science and knowledge service of the European Commission, the Joint Research Centre's mission is to support EU policies with independent evidence throughout the whole policy cycle.

EU Science Hub
ec.europa.eu/jrc

@EU_ScienceHub

EU Science Hub - Joint Research Centre

EU Science, Research and Innovation

EU Science Hub

Publications Office of the European Union

doi:10.2760/734264

ISBN 978-92-76-20876-1