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Financial Constraints of EU firms

A Sectoral Analysis

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Abstract

In this paper we provide estimates of financial constraints in all EU sectors. Our empirical strategy consists in using the Orbis firm-level dataset to construct financial constraint measures for each of the firms in our sample, and then aggregate the results either by NACE code, or by business similarity. We use two main – somewhat complementary – financial constraint indices proposed by Ferrando *et al* (2015), and then submit them to a battery of robustness tests, including the alternative financial constraints estimators developed by Kaplan and Zingales (1997), Whited and Wu (2006), and Hadlock and Pierce (2010). We also establish correlations between a sector's degree of financial constraints and other sectoral characteristics, such as firm size, TFP, capital intensity, and innovativeness.

The results show that sectoral financial constraints do not converge for all indicators; yet there are sectors that classify at the bottom or top by two or more financial constraints measures.

Among the 10 *Target Sub-sectors* identified as vulnerable *a priori* to financial constraints, smaller firms in *Marine Fishing* and larger firms in *Urban Regeneration* and *Agricultural SMEs* stand out as financially constrained by one of our measures. Larger firms in *Urban Regeneration* even appear in the top ten financially constrained 2-digit NACE sectors (Divisions).

When ranking the 99 *Target Sectors*, NACE Divisions in mining, sports, transport and media & cultural services stand out as particularly financially constrained. A possible explanation is that activities like mining and sports do not belong to public goods typically supported by public grants – or at least not enough in proportion to the massive investments required. As for media and cultural services, these activities suffer from the “curse of intangibles” – the limited access to finance due to the difficulty of valuing the activities and the underlying assets.

More generally, tighter sectoral financial constraints tend to be associated with a lower firm size, a capital intensity much higher than average, and a total factor productivity lower than average. Another policy-relevant finding is that different factors for financial constraints apply to different industries: services-driven industries are affected by different financially constraining factors than manufacturing or resource extraction related industries. Finally, an unweighted averaging of our measures across countries brings up partially different results than the standard weighted averaging, thus showing that smaller countries may suffer from financial constraints drivers different from larger countries.

Foreword

While sectoral public intervention to support investment is supposed to address market failures in investment financing, no systemic analysis of such market failures – in the form of unduly financial constraints – has been carried out so far at the sectoral level. This paper was conceived as a tool for a systematic analysis of the objectives of EU financing / investment policy. In this sense, it may be viewed as an underpinning of financing policy in the EU. As such, it should be read jointly with other papers trying to lay the foundations of public investment policy, like the 2019 EY report for the Commission on optimal financing,¹ which is another first attempt at systematising the choice of the most appropriate public financing tool – also at sectoral level – once the market failures to be addressed have been properly identified.

However, there is a second level at which this paper can be used, namely as a reference book for sectors and subsectors in financial distress. As such, it could be used by policy DGs focusing on specific sectors, which might be interested in an analytically-based illustration of financial constraints in their sector of intervention.

Finally, a third aspect of interest of this paper is academic. Indeed, it provides one of the few recent empirical analyses of EU financial constraints at sector level, adopting (and combining) state-of-the-art indicators, each providing a different viewpoint. At the same time, this study investigates the association between firms' financial constraints and their predictors (e.g., size) while controlling for the sector (or sub-sector), and hence for all the confounding factors determined by the firms' branch of activity. With rare exceptions,² such partialling out has been long overdue in the empirical corporate finance literature.

⁽¹⁾ EY, 2019. EU financing policies: assessing the optimal use, including blending and combination, of grants and market based financing instruments in possible post 2020 EU investment support instruments. Final report for the European Commission DG-ECFIN.

⁽²⁾ Ferrando and Grieshaber, 2011. Financing obstacles among euro area firms: who suffers the most? European Central Bank Working Paper Series N. 1293.

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Executive summary

One of the guiding principles that inspire the Commission's policy vision for the *Multiannual Financial Framework* that started in 2021 is the enhancement of the budget effectiveness through the set-up of more targeted objectives and fewer higher-quality performance indicators.³ The goal is to calibrate expenditures to address the challenges faced by the EU more adequately.⁴ However, effective policy and budgetary priorities rely on the identification of market failures (as emphasised in the *Next Generation EU* agreement⁵), particularly those generating **financing gaps** among firms, since they lead to under-investment and ultimately to suboptimal growth and employment.⁶ In this paper, we investigate and identify financing gaps by using standard **measures of financial constraints**.

We construct **two firm-level indicators** of financial constraints according to Ferrando et al. (2015). The first indicator, which we call the **Book-Based Indicator (BBI)**, relies on the firms' accounting book values. It determines investment-financing 'scenarios' for each firm and classifies firms into one of three degrees of financial constraint: '*unconstrained*', '*relatively constrained*', and '*strongly constrained*'. The second indicator, which we call the **Regression-Based Indicator (RBI)**, is an innovative indicator – refined in Ferrando et al. (2015) – that estimates the 'probability' that a firm is financially constrained. The indicator is based on managers' answers to the ECB SAFE survey, and uses the firms' financial ratios as predictors. Unlike the BBI, the RBI relies on a probability model estimated by means of regressions. The two indicators thus differ substantially by their approach.

We are interested in the financial constraints of specific **Target Groups** of firms. For this purpose, we first compute the *firm-level* BBI and RBI measures using **Orbis financial data**, then compute the *group level* BBI and RBI measures using two methods: the group-level **simple average** indicator equals the *simple* average of the indicators of the firms in this group; the group-level **asset-weighted average** indicator equals the average of the indicators of the firms in this group, *weighted* by the value of their assets. We thus end up with four group-level indicators, namely the *simple average BBI*, the *weighted average BBI*, the *simple average RBI*, and the *weighted average RBI*.

We identify and name the *Target Groups* of interest according to two approaches: i) in the **bottom-up approach**, **Target Sub-sectors** are single or groups of industries (belonging to any NACE level) empirically chosen on the basis of their public good/externality features; ii) in the **top-down approach**, **Target Sectors** are the 2-digit NACE code Divisions. To perform a basic counterfactual analysis, we compare the *Target Groups*' indicators with other groups of firms for which we also compute the four indicators. For specificity, the *Target Sub-sectors* are groups identified as vulnerable, uncovered or hardly covered by EU policies according to desk research and expert advice.

First, *Target Sub-sectors* are compared with two types of 'neighbouring' *Control Sub-sectors*: the **Narrow Control Sub-sectors**, which are either the immediately upper-level NACE code that comprises the *Target Sub-sector*, or a group of firms at the same NACE level; and the **Broad Control Sub-sectors**, which are either the letter-level NACE category of the *Target Sub-sector* or additionally including multiple letters. We also perform a comparison of *Target Sub-sectors* with all NACE 2-digit sectors, encompassing the entire economy.

We complement the analysis by constructing a 'Mean Quintile Indicator'. For this, we rank *Target Sub-sectors* and *Target Sectors* according to their RBI indicator and each group of firms is assigned the quintile it falls in; we do the same with the BBI. The Mean Quintile Indicator equals the simple average of the BBI and RBI quintiles for each group of firms.

Comparing the results of *simple* and *asset-weighted* indicators has significant implications for the interpretation of our results. Indeed, if, say, a *Target Group* is more financially constrained relatively to its controls on the basis of asset-weighted averages, but not of simple averages, we infer that chiefly larger

⁽³⁾ European Commission (2018).

⁽⁴⁾ European Commission (2021).

⁽⁵⁾ European Council (2020).

⁽⁶⁾ The importance of addressing market failures – particularly for financial instruments, budgetary guarantees and financial assistance – is made explicit in the EU Financial Regulation (<https://op.europa.eu/en/publication-detail/-/publication/e9488da5-d66f-11e8-9424-01aa75ed71a1/language-en/format-PDF/source-86606884>) and in the InvestEU Regulation (<https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=CELEX%3A32021R0523>).

firms of the *Target Group* are financially constrained relatively to their controls; in fact, asset-weighted averages place greater weights on larger firms.⁷

The bottom-up analysis using the Mean-Quintile Indicator shows that, in the *Target Sub-sectors*, smaller firms in *Marine Fishing* and larger firms in *Urban Regeneration* and *Agricultural SMEs* are *globally* financially constrained.⁸ Larger firms in *Urban Regeneration* even appear in the top ten financially constrained sectors according to the RBI – and thus are *globally* financially constrained.⁹ Finally, smaller firms in *Extra-Urban Transport* and larger firms in *Defence Activities* appear *locally* constrained¹⁰ using both the BBI and RBI, measured both at EU-level and at cross-country level. For the rest, the two indicators yield partially different results: the BBI also identifies as highly constrained smaller firms in the *Target Sub-sector* of *Human Health* and larger firms in *Residential Care*, *Employment Agencies* and *Social Work*. Hence, the BBI identifies more *Target sub-sectors* as financially constrained than the RBI. This might be explained by the different perspective taken by the two indicators. The RBI focuses more on a structural perspective and identifies leverage – that is, a high ratio of debts over total assets – as the main determinant of financial constraints, whereas the BBI focuses more on an event perspective, mainly identifying as constrained companies unable to increase their debt (or equity).

Second, we compare the *Target Sectors* with their *Control Sectors*, namely all 2-digit NACE divisions at EU level, using the BBI, RBI, and the mean quintile rankings provided by the BBI and the RBI. We find that the two indicators point to some common sectors: *Mining of metal ores*; *Activities of extraterritorial organisations and bodies*; *Sports activities and amusement and recreation activities* (all firms), *Mining of coal and lignite*; *Air transport*; *Programming and broadcasting activities*; *Gambling and betting activities*; *Libraries, archives, museums and other cultural activities*; *Activities of head offices: Management consultancy activities*; *Motion picture, video and television programme production* (smaller firms), *Publishing activities*; *Warehousing and support activities for transportation*; *Telecommunications*; *Accommodation*; *Manufacture of electrical equipment*; *Printing and reproduction of recorded media*; *Manufacture of wood etc.* (larger firms), *Activities of membership organisations* (smaller firms according to the BBI, larger firms according to the RBI).

However, in the analysis of *Target Sectors*, the two indicators also offer partially different results. On the one hand, the BBI indicator identifies as highly likely to be constrained the sectors: *Food and beverage service activities* (all firms), *Other personal service activities*; *Veterinary activities*; *Retail trade, except of motor vehicles and motorcycles*; *Fishing and aquaculture* (for smaller firms) and *Postal and courier activities*; *Publishing activities*; *Manufacture of basic metals* (for larger firms). On the other hand, the RBI identifies as highly constrained the sectors: *Mining support service activities*; *Construction of buildings* and *Scientific research and development* (all firms), *Extraction of crude petroleum and natural gas*; *Financial service activities, except insurance and pension funding*; *Real estate activities*; *Manufacture of tobacco* (for smaller firms), and *Activities auxiliary to financial services and insurance activities*; *Legal and accounting activities*; *Other professional scientific and technical activities* (for larger firms). Again, the BBI identifies more sectors as highly financially constrained than the RBI. This might again be explained by the different perspective taken by the two indicators (see above).

Overall, when comparing the *Target Sub-sectors* to all 2-digit NACE divisions, only *Urban Regeneration* appears once among the top ten constrained sectors using asset-weighted averages at EU-level. No other *Target Sub-sector* appears among the top 10 financially constrained sectors, under any approach and for any indicator. This suggests that other sectors than the *Target Sub-sectors* are likely to be more financially constrained. Part of the reason for the scarce presence of the 10 identified *Target Sub-sectors* among the most financially constrained firms is probably the public good/externality features of those sub-sectors – which is the reason they had been selected in the first place. In all likelihood, these sub-sectors are already the target of public support – especially through grants – both at the national and European level. Therefore, their inherent financial difficulties have already been at least partially addressed by European public institutions.

When ranking *Target Sectors*, industries in **mining, sports, transports** and **media and cultural services** stand out as particularly financially constrained. This is not surprising in light of our previous observation that

(⁷) Reciprocally, if a Target Group is more financially constrained relatively to its controls on the basis of simple averages but not of asset-weighted averages, we infer that chiefly smaller firms are more financially constrained relatively to their controls.

(⁸) That is, they belong to *Target Sub-sectors* falling in the top quartile of financially constrained sectors.

(⁹) That is, they belong to *Target Sub-sectors* falling in the top decile of financially constrained sectors.

(¹⁰) That is, they belong to *Target Sub-sectors* being more financially constrained than their *Control Sub-sectors*.

activities such as mining and sports do not belong to public goods typically supported by public grants – or at least not enough in proportion to the investments required. As for *Media and cultural services*, these activities suffer from the lack of intangibles: the uncertainty in valuing the projects and intangible collaterals results in a reduced access to external financing.

The different analyses show that firstly, the factors for severe financial constraints differ between smaller and larger firms. This is brought out by the different rankings yielded by using simple or asset-weighted averages for the different methods. But even within the same *Target Sector (or Sub-sector)*, smaller firms are confirmed to be more financially constrained than larger firms, as the corporate finance literature has long been arguing. Secondly, different factors for financial constraints apply to different industries: while the RBI focusses more on capital intensity, the BBI focuses more on difficulties in raising debt, and these differences in perspective result in different financially constrained *Target groups* and show that services-driven industries are affected by different financially constraining factors than manufacturing or resource extraction related industries.¹¹

An additional distinction should be made with reference to the aggregation method – which is the subject of the robustness test carried out in Chapter 5 – when considering a (simple) average across countries rather than an EU-level average.

At the sub-sector level, these cross-sectional results confirm that neither from a frequency perspective do the 10 *Target Sub-sectors* exhibit severe financial constraints when compared with the 2-digit sectors, whether the BBI or the RBI are used. Smaller firms in *Marine Fishing* and larger firms in *Residential Care* are most constrained *Target Sub-sectors* for both the EU aggregate and the cross-country frequency estimations of the BBI; larger firms in *Urban Regeneration* are most constrained *Target Sub-sectors* for both the EU aggregate and the cross-country frequency estimations of the RBI.

At the sector level, the sector ranking emerging from the EU aggregate view of the BBI shows that the top financially constrained *Target Sectors* coincide only in 50% of the cases for smaller firms and in 30% of the cases for larger firms, confirming that the cross-sectional frequency methodology is able to bring out constrained *Target Sectors* in smaller countries that would be overlooked by an EU-aggregate analysis. The results also confirm at the frequency level the different financial situation faced by smaller firms as compared with larger firms.

A further robustness test is performed whose results are reported in Annex 1, where we compare the results for the EU average across 5 different indicators. However, we attach less relevance to the 3 additional indicators, as they are calibrated with US data and for a more distant time period.

Table A: Summary of the methodology and terminologies

Aggregation	Approach	Book-Based Indicator	Regression-Based Indicator	Mean Quintile Indicator
EU-level	Bottom-up	Target Subsectors	Target Subsectors	Target Subsectors
	Top-down	Target Sectors	Target Sectors	Target Sectors
Cross-country	Bottom-up	Target Subsectors	Target Subsectors	Target Subsectors
	Top-down	Target Sectors	Target Sectors	Target Sectors

Source: Own elaborations

⁽¹¹⁾ These different results are strongly affected by the averaging method, that is by firm size.

1 Introduction

Empirical work in industrial organisation and finance has long established that EU markets for products and services (including financial markets) may suffer from inefficiencies due to market failures. In particular, market failures giving rise to financing gaps – and hence under-investment – require specific attention from public authorities in the EU.¹² Such market failures (scarce competitiveness and innovation due to lack of finance, asymmetric information in debt and equity markets, etc.) may occur both at the product and service market level, and at higher levels of aggregation (e.g., in an industry). It is therefore of great importance for the economic policy maker in the EU to identify financing gaps at different levels of sectoral aggregation, so as to intervene through regulation or through budgetary flows (e.g., grants, procurements and risk finance). Since financing gaps – defined as the amount of external finance (partially) denied to financially viable firms and projects – manifest themselves as external financial constraints for the firms, an assessment of their extent can well start from an analysis of a firm's financial constraints, along the lines long traced by the economic and financial literature.¹³

The objective of this study is therefore to investigate financial constraints (henceforth, **FCs**) across productive sectors in Europe, at two levels of aggregation: at the NACE¹⁴ (revision 2) 2-digit level, we focus on all EU **sectors** (labelled *Target Sectors*), while at the finer NACE (revision 2) 3- and 4-digit levels, we focus on appropriately selected single or grouped **sub-sectors** (labelled *Target Sub-sectors*).¹⁵ FCs indicate that firms are unable to access external finance, including equity and debt, at desired levels at current prices, to finance their investment in fixed or working capital.

The FCs of firms have been extensively investigated, both in theoretical and empirical analyses. Structural FCs are typically modelled through principal-agent theoretical frameworks, relating to asymmetric information and the consequent screening and monitoring costs of the financial provider (e.g., Tirole, 2006). However, cyclical FCs may also emerge, due to prolonged or temporary lack of demand from investors (e.g., banks that were forced to rebalance their loan portfolio due to the 2008 financial crisis by cutting off low quality loans for capital allocation reasons).¹⁶ Also, there is a number of studies showing that investment grades and speculative bonds follow market cycles in terms of amounts and pricing: for instance, observers report the so-called “flight to quality” in bad times, and “search for high yields” in a low interest rate environment. FCs may thus be determined also by non-structural factors.

The work on FCs – like on other types of market failures – is motivated by their effects on the real economy, e.g., real investment, employment, innovation, growth and survival. For instance, using an exogenous demand shock as a natural experiment, Butler and Cornaggia (2011) found that firms operating in environments with lower FCs were able to invest more and increase production; similar conclusions were reached by García-Posada (2019) for EU firms. Fernandes and Ferreira (2017) and Duygan-Bump et al. (2015) showed the negative effect of FCs on employment. Using innovative FC indicators, Ferrando and Ruggieri (2018) also found that lower FCs benefit labour productivity in a wide range of European countries and sectors, while Savignac (2008) documents the negative effect of FCs on a firm's propensity for innovation.¹⁷ Musso and Schiavo (2008) found that FCs hamper firms' survival. More generally, the literature on the so-called “financial accelerator” rationalises how – in the presence of asymmetric information and FCs – even small shocks (e.g., to asset prices) may amplify business-cycle fluctuations.¹⁸

Of particular concern are the effects of FCs on SMEs, which constitute the backbone of the EU productive fabric. Indeed, both the theoretical and the empirical literature on corporate finance converge in deeming

(¹²) See for example European Commission (2013), Kirschenmann (2016), *fi-compass* (2019, 2020) and related reports, or Bryan and Williams (2021). For a critical review, see Cressy (2002) and related articles.

(¹³) See literature review below.

(¹⁴) NACE stands for *Nomenclature statistique des Activités économique dans la Communauté Européenne*, and is the statistical classification of economic activities used in the European Union. Further details and illustrations are provided in section 3.2.

(¹⁵) In this study, we use the terms “sector” and “sub-sector” – as in *Target Sector* or *Control Sub-sector* – as a reference to the set of companies of interest, not necessarily to a specific NACE classification, such as “division” or “group”.

(¹⁶) Banking regulation requires banks to allocate capital – i.e., book value of equity – to assets in function of risk; riskier loans “consume” more capital than less risky loans. When funding is scarce and costly, raising new capital may become a hazardous endeavour for banks. As a medium-term response, banks tend to replace riskier loans with less risky loans.

(¹⁷) More specifically, Aghion et al. (2012) show that in more credit-constrained firms, R&D investment plummets during recessions but does not increase proportionally during upturns.

(¹⁸) The idea that the asymmetric information-based imperfections in financial markets can influence short-run aggregate economic activity was suggested by Bernanke (1983) and later modelled as a financial accelerator effect in a general equilibrium framework by Bernanke and Gertler (1989).

SMEs relatively more subject to FCs, due to a variety of factors.¹⁹ Likewise, high-growth enterprises seem particularly vulnerable to FCs,²⁰ with similarly pernicious consequences for the real economy.

Although the factors bringing about FCs may be relatively complex and difficult to identify, several authors have attempted to construct measures of firms' FCs. Typically, proposed methods identify to what extent firms are capable of raising external capital, be it in the form of equity or debt, in order to finance projects. Two FCs indicators will be used, representative of the two main methods.

The first method identifies scenarios thanks to the firm's accounting books – especially the balance sheet – that reflect the existence of FCs. The scenarios are inspired by Fazzari, Hubbard, and Petersen (1988), who argue that firms are financially constrained if they rely on *internal* rather than *external* funding for real investment. The rationale lies in the view that firms would prefer external funding unless its price is excessive due to market frictions. For our study of European firms, we construct the indicator proposed by Ferrando *et al.* (2015) and we call it the **Book-based Indicator** (henceforth, BBI).²¹

The second method identifies FCs thanks to managers' statements and develops a predictive model using *regression* estimates; typically, the firm's financial ratios are the predictors. The output is a calibrated model that enables measuring FCs of any firm outside the sample. This method builds on Kaplan and Zingales (1997), Lamont, Polk, and Saá-Requejo (2001), Baker, Stein and Wurgler (2003) and Ferrando *et al.* (2015); all these papers, except Ferrando *et al.* (2015), used samples of US listed firms. The model proposed by Ferrando *et al.* (2015) is more recent and is calibrated using European firms of all sizes, both listed and unlisted, which matches the focus of our analysis. We thus construct the second FCs indicator consistently with Ferrando *et al.* (2015), and call this indicator the **Regression-Based Indicator** (henceforth, RBI).

For each of the *Book-* and *Regression-Based Indicators*, we investigate sector-level FCs following two approaches. In the first, **bottom-up approach**, we compare FCs of specific single or groups of industries that fall under EU financing policy objectives and may *a priori* suffer from market failures. In particular, based on desk research and expert advice, we select business activities characterised by market failures (positive externalities and asymmetric information), and likely to suffer from financing gaps. These groups are labelled the **Target Sub-sectors**. The ten identified *Target Sub-sectors* are: *Agricultural Small & Medium-sized Enterprises (SMEs)*, *Marine Fishing*, *Human Health*, *Residential Care*, *Social Work*, *Vocational/Adult Training*, *Employment Agencies*, *Defence Activities*, *Extra-Urban Transport*, and *Urban Regeneration*.

Under the bottom-up approach we also define neighbouring sub-sectors, which constitute the counterfactual groups and are taken to be both “closer” to (the **Narrow Control Sub-sectors**) and “farther” from (the **Broad Control Sub-sectors**) the *Target Sub-sectors* in terms of business activities. Indicators are then calculated for each of the 10 *Target Sub-sectors* for the whole EU and compared to the *Control Sub-sectors*.

The second approach – the **top-down approach** – consists in comparing FCs in **Target Sectors** with all 2-digit NACE sectors, which are then taken to be the counterfactual group. In this second approach, we look at the indicators at EU level, but also at cross-country level.²² Although they may already be the target of EU policies, *Target sectors* may deserve further attention from policy makers.

A distinctive feature of this study is the rich strategy we adopt to vet the robustness of our methodology and results. In particular:

- Both *Target Sub-sectors* and *Target Sectors* are associated to control groups – the *Control Sub-sectors* and the *Control Sectors* – in order to compare baseline results to appropriate counterfactuals. Specifically, the results for *Target Sub-sectors* are compared with 3 different control groups: *Narrow Control Sub-sectors*, *Broad Control Sub-sectors*, and *Control Sectors*; the results for *Target Sectors* are compared with *Control Sectors*.
- A rich set of indicators is adopted, in order to obtain different – and possibly complementary – perspectives on the phenomenon of FCs. While we select the BBI and the RBI as our preferred indicators,

⁽¹⁹⁾ See for example Canton *et al.* (2013) for the EU, Kuntchev *et al.* (2013) for the developing world and, most recently, Bakhtiari *et al.* (2020).

⁽²⁰⁾ See Ferrando *et al.* (2019).

⁽²¹⁾ Previous versions include Pál and Ferrando (2010) and Ferrando and Ruggieri (2015); Ferrando *et al.* (2015) presents the latest version.

⁽²²⁾ Nevertheless, individual countries may not report enough firm-year observations for each sector, and therefore we limit our *Control Sectors* to sectors with at least twenty observations – whereas we do not impose this limitation to *Target Sectors*.

we also report results from alternative indicators used in the literature. Annex 1 contains this exercise, with comparison tables of all the indicators.

- Results based on EU-wide averages are contrasted with results based on country averages, to detect the degree of heterogeneity of FCs across countries. In particular, we use two methods to gauge country averages (see chapters 4 and 5).

The remaining of the report proceeds as follows. The next chapter peruses the empirical literature on FCs. Chapter 3 defines the methodology. Chapter 4 describes the results at the European level, while Chapter 5 performs a robustness check on the chosen indicators, by carrying out the estimation at cross-country frequency level. The last chapter concludes. Annexes report additional details about sector classification, as well as comparison results across several indicators and results at a finer sectoral disaggregation level.

2 Literature on Financial Constraints Indicators

The modern empirical literature on FCs has initially put forward the cash-flow sensitivity of real investment as an indicator of FCs. Fazzari, Hubbard, and Petersen (1988) constitutes the most cited article pioneering this strategy; other papers include Hoshi, Kashyap and Scharfstein (1991, 1993). Fazzari *et al.* (1988) argued that FCs are due to excessive costs of external funding, and thus financially constrained firms would regard internal funding as relatively less costly than external funding. Assuming that firms with higher costs of external funding exhibit a lower dividend pay-out ratio – i.e., retain a larger fraction of cash-flows – financially constrained firms would thus likely exhibit lower dividend pay-out ratios. The authors then looked at the sensitivity of investment to cash-flows and found that firms with lower dividend pay-out ratios exhibit larger effects of cash-flows on investment decisions.²³ In this approach, preference for internal rather than external funding of real investment is thus the litmus test of FCs.²⁴

The methodology proposed by Fazzari *et al.* (1988) was challenged by Kaplan and Zingales (1997), who introduced “qualitative” indicators of FCs instead of the cash-flow sensitivity of investment. The authors screened management statements in regulatory filings of listed companies and flagged firms as financially constrained whenever the manager expressed her inability to raise external funding, either because she *wished* to raise external funding but *believed* she would not obtain it, or the loan application was effectively *rejected*. The authors then calibrated a general model predicting FCs using the firms’ financial statements. Kaplan and Zingales (1997) concluded that the cash-flow sensitivity of investment could hardly explain the “observed” FCs, and calibrated an innovative “hard” information-based *regression* model as the best predictor of FCs. Lamont, Polk, and Saá-Requejo (2001) constructed the so-called Kaplan-Zingales index of FCs based on regression coefficient estimates in Kaplan and Zingales (1997); finally, Baker *et al.* (2003) proved that the market-to-book value of equity (so-called Tobin’s Q) could be dropped from the model without significant losses. The model was calibrated using listed US firms’ financial information. Ferrando *et al.* (2015) developed the so-called SAFE Score model, which was similar to the method suggested by Baker *et al.* (2003) but was calibrated on a sample of European companies of all sizes, both listed and unlisted. The authors derived firm-level FCs from the ECB’s Survey of Access to Finance of Enterprises (SAFE), which reports answers from firm managers about their access to external finance.²⁵

One difficulty with the survey-based construction of FC indicators is the stability of the parameters both across firms and over time. To avoid this limitation, Whited and Wu (2006) (WW) used a radically different strategy and constructed a measure of FCs by estimating a Euler equation of investment that integrates capital markets frictions.²⁶ The intuition of the model is thus inspired by Fazzari *et al.* (1988), who established that investment is sensitive to access to finance.

Finally, Pál and Ferrando (2010) and Ferrando and Ruggieri (2018) – revised by Ferrando *et al.* (2015) – proposed a method that classifies firms based on investments’ sources of funding. They combined various events including the existence of financing gaps, new debt financing, new equity financing, and classified FCs accordingly. The authors established three categories of FCs that combine events of “investment” with events of “external financing.” This index has the merit of providing a readily applicable indicator of FCs for firms of all sizes.

The traditional indices and methods for measuring FCs were challenged by Hadlock and Pierce (2010) (HP). The authors used a methodology similar to Kaplan and Zingales (1997) (KZ), based on a wider and updated sample of management statements of listed companies. They reviewed the traditional FC indicators and concluded that size and age outperform all indicators and avoid biases due to management statements. More recently, Farre-Mensa and Ljungqvist (2016) showed that firms that are typically classified as financially constrained do not behave as if they were constrained. The authors used changes in tax rates as identification events and observed the impact on leverage – the method is similar to the one used by Heider and Ljungqvist (2015). They concluded that standard measures of FCs rather capture firms in their growing phase, i.e., small, young and fast-growing firms.

⁽²³⁾ In the same vein, Almeida, Campello and Weisbach (2004) look at the cash-flow sensitivity of cash holdings.

⁽²⁴⁾ In the same vein falls the approach by Cleary (1999), who uses discriminant analysis to construct a “Z-score” for the firm’s likelihood of increasing or decreasing dividend payments.

⁽²⁵⁾ In the default risk area, such method was adopted by Altman (1968) using a discriminant analysis, and gave birth to the Altman Z-Score.

⁽²⁶⁾ In their paper, Whited and Wu mention both debt and equity constraints equations. Yet, they claim that they expect factors of financial constraints to be similar for debt and equity, and thus focus on equity constraints only.

Alternatives were also developed to the event approach pioneered by Pál and Ferrando (2010). In particular, Kuntchev et al. (2013) used the World Bank Enterprise Surveys' answers to classify firms into four ordinal categories of credit constraint severity, based on reported qualitative events. Similarly survey-based is the method used by Schauer et al. (2019), who exploit managers' self-assessment of their firm's FC status.

Another strategy is to estimate FCs by compounding different indicators. Fernandes and Ferreira (2017) classify sectors on the basis of a composite indicator of financial vulnerability which uses balance sheet data on external finance dependence, asset tangibility, and the importance of trade credit, as well as the HP size-age index and pre-crisis reliance on short-term debt. Musso and Schiavo (2008) build a composite index based on the most popular determinants of FCs: size, profitability, liquidity, cash flow, solvency, trade credit over total assets and repaying ability.

A most recent strategy – presented in Cherchye et al. (2020) – consists in quantifying financial constraints as the profitability that firms forgo when budget constraints on production inputs bind, impeding them from using the optimal level of inputs and technology.

3 Empirical Strategy and Data

3.1 The firm-level financial constraints indicators

This brief literature review reveals that essentially two methods may be adopted to measure FCs at firm's level. One method consists in looking at financial reports of firms and establishing their FCs – to various degrees. Annalisa Ferrando produced a series of papers using such a method, starting with Pál and Ferrando (2010), with Ferrando and Ruggieri (2018) and Ferrando *et al.* (2015) reporting the latest version. This FC indicator is founded on book-based scenarios of investment and divestment, combined with external financing events. We call this FC index the **Book-based Indicator** (henceforth, **BBI**) of FCs. We prefer the Ferrando *et al.* (2015) book-based version because it is the most refined methodology, using the most recent data (from 2013 to 2015).²⁷

The second method consists in obtaining a measure of FCs through management statements.²⁸ Ferrando *et al.* (2015) followed such a method using the ECB Survey of Access to Finance of Enterprises (SAFE),²⁹ and calibrated a general model of FCs, based on the regression modelling pioneered by Kaplan and Zingales (1997). We will also use their model and call it the **Regression-Based Indicator** (henceforth, **RBI**) of FCs. We prefer the Ferrando *et al.* (2015) regression-based version because it calibrates the relevant parameters using the SAFE sample – that is, a sample of European firms (Euro area), instead of US firms – for the years 2013-2015 – that is, a more recent period.³⁰

3.1.1 Book-based Indicator [BBI]

Consistently with Ferrando *et al.* (2015), we construct the BBI at the firm level as follows. In the first step, we distinguish firms that report positive or nil investment in fixed assets from those that disinvest. In the second step, we control whether a company reports a positive or negative *financing gap*. Positive financing gaps indicate that a firm could not finance its total investments with funds from current operations. In the third step we control whether the firm's net change in debt is positive (new debt) or negative (repayment). Finally, in the last step, we control whether the change in equity is positive (financing) or negative (repurchase).³¹ Based on the combination of these events, we classify firms as “unconstrained” (BBI=0), “relatively constrained (BBI=0.5) or “strongly constrained” (BBI=1), with varying degrees within these categories, as described in Table 1.

Table 1. Book-based Indicator classification system of financially constrained firms.

	Total investment	Financing gap	ΔDebt	ΔEquity
Strongly constrained: BBI=1				
1	≥0	≥0	≤0	≤0
2	<0	≥0		
Relatively constrained: BBI=1/2				
1	≥0	<0	≤0	

⁽²⁷⁾ We also prefer the Ferrando *et al.* (2015) method to similar, survey-based methods à la Kuntchev *et al.* (2013), because it is fully book based.

⁽²⁸⁾ On the reliability of perceived financial constraints in the SAFE survey, see Ferrando and Mulier (2015).

⁽²⁹⁾ Since 2008 the European Central Bank has published a bi-annual Survey on the Access to Finance of Enterprises (SAFE). This survey provides information on micro, small, medium-sized and large firms' financing conditions and their developments over the previous six months in the euro area. See https://www.ecb.europa.eu/stats/ecb_surveys/safe/html/index.en.html.

⁽³⁰⁾ We also excluded indicators based on the results highlighted by Farre-Mensa and Ljungqvist (2016), as they require further evidence and are hardly replicable with our data.

⁽³¹⁾ See the definitions of all variables.

2	≥0	≥0	≤0	>0
3	<0	<0	>0	≤0

Unconstrained: **BBI=0**

1	<0	<0	>0	>0
2	<0	<0	≤0	
3	≥0	<0	>0	
4	≥0	≥0	>0	

Note: This table reports the Book-Based Indicator (BBI) rules to classify firms as *strongly constrained*, *relatively constrained*, or *unconstrained*. *Total investment* is the year-on-year change in tangible fixed assets. *Financing gap* is the share of investment that is not financed by cash flow. *Change in debt* is the year-on-year change in financial debt defined as the sum of long-term debt (in non-current liabilities) and short-term debt (in current liabilities). Change in equity is the year-on-year change in shareholders' funds.

Source: Based on Ferrando *et al.* (2015)

3.1.2 Regression-Based Indicator (RBI)

The second indicator of FCs is representative of the *regression method* and draws from Ferrando *et al.* (2015). We call this indicator the *Regression-Based indicator* [RBI]. In order to identify financially constrained firms, Ferrando *et al.* (2015) used the answers reported in the *Survey of Access to Finance of Enterprises* (SAFE) published every six months by the European Central Bank for the Eurozone, and every year by the European Commission and the European Central Bank for the EU. The authors flagged firms as financially constrained whenever management provided a positive answer to any of the four following questions in SAFE:

1. The loan application of the firm was rejected;
2. The firm was granted only a limited amount of the loan application;
3. The firm rejected the loan conditions offered by the bank because the borrowing costs were too high;
4. The firm would have liked to apply for loans but did not for fear of rejection (discouraged borrowers).

Presumably, positive answers to statements 1 to 3 capture "actual" FCs, whereas question 4 captures "perceived" FCs.

The authors matched the firms participating to the SAFE survey with the Amadeus dataset of European firms' financial accounts (published by Moody's Bureau van Dijk). They then estimated the *probit* model that best predicts the FCs data, where the dependent variable is a dummy that takes the value 1 if the firm is financially constrained and 0 otherwise. The resulting model is named the *SAFE Score* model by the authors.

Under the standard assumption that the coefficients estimated through the *SAFE Score* model can also apply out-of-sample, we construct our *Regression-Based Indicator* (RBI) by incorporating the *SAFE Score* model's coefficients and regressors in our equation:

$$SAFE = -1.88 + 0.71 \times Leverage + 0.28 \times Coverage - 0.51 \times Profit\ Margin - 0.21 \times Collateral - 1.20 \times Cash - 0.05 \times \ln(Assets)$$

For each firm, *Leverage* is the share of financial debts (short-term and long-term debts) to total assets; *Coverage* is the ratio of interest payments to cash-flow (EBITDA); *Profit Margin* is the earnings before interest and tax payments scaled by sales. *Collateral* is the ratio of tangible fixed assets to total assets. *Cash* is the ratio of cash and cash equivalents to total assets. $\ln(Assets)$ is the natural logarithm of total assets.³² For

⁽³²⁾ Note that from the negative coefficient on $\ln(Assets)$, we infer a negative relationship between a measure of firm size and the probability of financial constraints.

each firm, we construct a yearly value of the RBI based on equation [1] in years 2013 to 2015;³³ we then average the RBI's yearly values for each firm over the period 2013 to 2015. In the subsequent empirical analysis, we report the RBI values assuming a normal cumulative distribution with a density mean equal to 0 and variance equal to 1.

3.1.3 BBI and RBI as complementary indicators

It is worth noting that the two indicators – BBI and RBI – provide two distinct perspectives on a company's FCs. On the one hand, the BBI mainly flags as financially constrained those companies unable to increase their debt (or equity). On the other hand, the RBI identifies leverage – that is, a high ratio of debts over total assets – as the main determinant of FCs. This apparent inconsistency about the role of debt is resolved when one considers that the BBI takes a (backward-looking) “event” perspective: having received credit implies that the company has not been financially constrained, in the past. On the contrary, the RBI adopts a (forward-looking) “structural” perspective: if a company has accumulated a high leverage – by obtaining credit that did not generate enough profits to repay its debts (or enough assets to reduce its leverage) – it is less likely to obtain loans, in the future. In simplistic terms, the BBI reflects more the past and current FCs of a company, while the RBI reflects more the financial structure affecting current and future FCs.

The two perspectives should be viewed as two complementary methods, each of which captures different dimensions of FCs, and thus enable identifying the “type” of FC faced by a sector.

In order to offer a summary measure of the BBI and RBI indices, we compute the Mean Quintile indicator: we classify each sector by quintile, and report the quintile of each sector – the lower the value, the less constrained the sector. We then compute the mean value of the quintiles of each sector in each of the FC indicators. The Mean Quintile indicator is also a litmus test of the extent to which the two indicators' results are aligned.

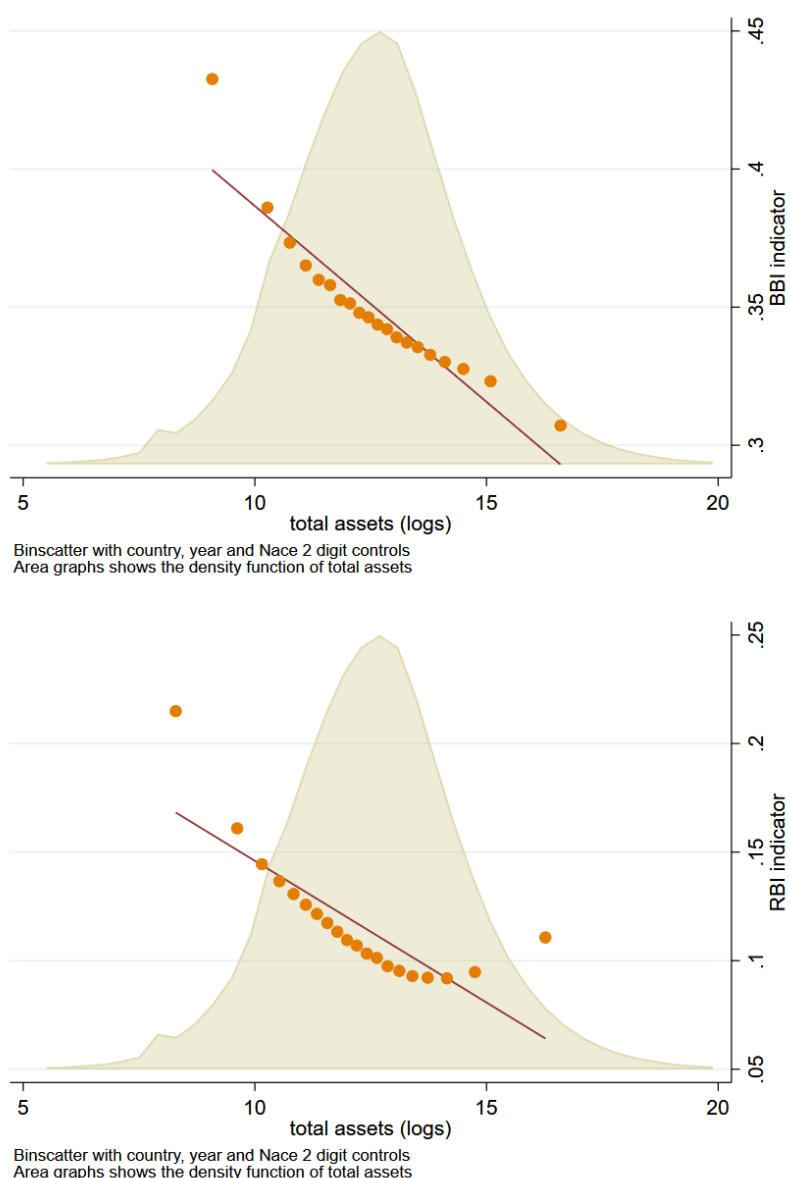
3.2 Data and sector-level measures of financial constraints

Our study is based on the financial statements of a sample of EU firms in the pre-Covid19 period, in order to focus on “normal” times. The data are extracted from Orbis, a firm-level dataset published by Moody's Bureau van Dijk. The period covers a three-year window which allows to calculate an average value over three years and smooth out temporary shocks. We retain all firms regardless of age and size, but the sample is restricted to firms reporting assets for at least two years in a row. Unfortunately, not all countries in Orbis report all the variables needed for the calculation of the FC indicators. As a result, the number of countries covered by our sample is limited to 23, namely: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia and Spain. Finally, the total number of firm-year observations is about 7.2 million, but not all of them could be used for estimating each of the FC indicators: the BBI is constructed using about 3.3 million firm-year observations, and the RBI about 3.9 million.

Figure 1 illustrates the density of firms by log asset size (both panels), depicting a substantially bell-shaped with a median asset value of around 190,000 euros. The top and bottom panels also anticipate one of our findings, namely the inverse statistical relation between firm size and financial constraints.

⁽³³⁾ All variables and Orbis items are defined in the List of Abbreviations and Definitions.

Figure 1. Distribution of firms by logarithmic asset size (thousands), BBI and RBI



Note: This figure reports the distribution of the firms by logarithmic asset size in the sample, BBI and RBI.

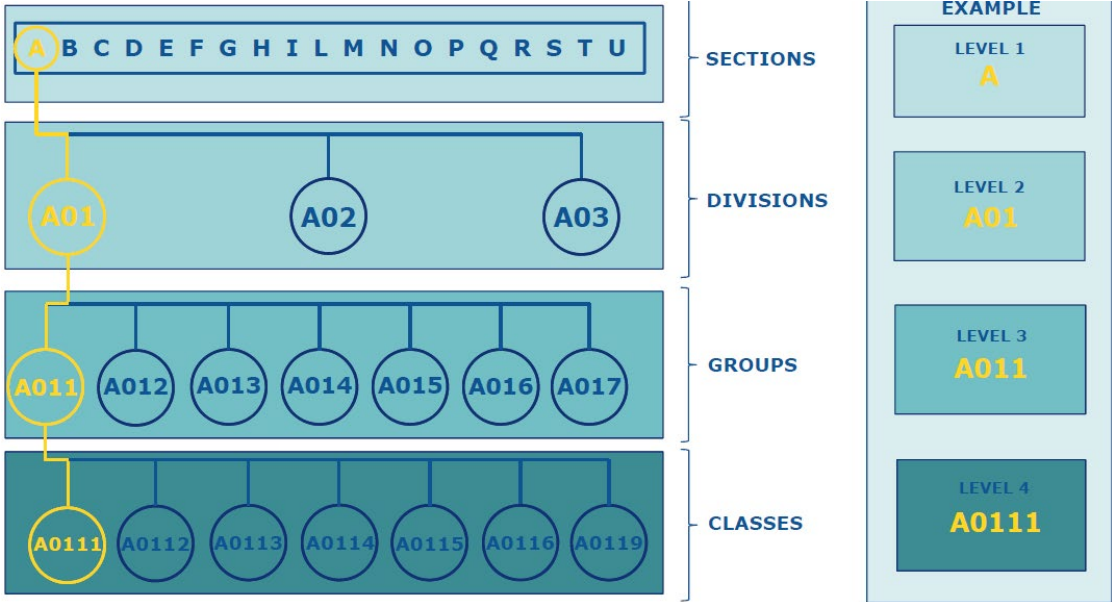
Source: Own elaboration on Orbis data

Our sector classification is based on the *Statistical classification of economic activities in the European Community* (NACE). Since 1970, NACE has identified the statistical classification of productive economic activities in the EU by providing a rigorous framework used for data collection and presentation. In the NACE, an economic activity is characterised by an input of resources, a production process and an output of products (goods or services). NACE consists of a hierarchical structure (as established in the Regulation (EC) No 1893/2006), as follows:

- a first level consisting of headings identified by an alphabetical code (sections),
- a second level consisting of headings identified by a two-digit numerical code (divisions),
- a third level consisting of headings identified by a three-digit numerical code (groups),
- a fourth level consisting of headings identified by a four-digit numerical code (classes).

The divisions are coded consecutively. However, some “gaps” have been provided to allow the introduction of additional divisions without a complete change of the NACE coding. Figure 2 presents a visual illustration of NACE’s hierarchical structure, with an example.³⁴

Figure 2. The Hierarchical Structure of the NACE system – An example



Note: This figure illustrates the NACE classification system and the four levels: Sections, Divisions, Groups, and Classes.

Source: Eurostat’s NACE (rev. 2) structure

3.2.1 Simple-average and weighted-average sector-level measures of financial constraints.

As already mentioned, in this study we use the generic terms “sector” and “sub-sector” instead of specific NACE classifications, such as “division” or “group”. For each FC indicator, we compute two sector-level measures. The first measure equals the average of the FC indicator, either BBI or RBI, of all firms in the sector; we call this measure the **simple-average** sector-level FC indicator. The second sector-level FC equals the average of firm-level indicator values weighted by the total asset value of the firms, to capture the values for larger firms; we call this measure the **weighted-average** sector-level FC indicator.

$$\text{Simple-average sector-level FC} = \text{sum of firm-level FC indicator} / \text{number of firms}$$

$$\text{Weighted-average sector-level FC} = \text{sum of firm-level FC indicator} * \text{firm’s assets} / \text{sector total assets}$$

3.3 Sub-sector Analysis: The Bottom-Up Approach

3.3.1 Target Sub-Sectors

The study first focuses on single or groups of industries³⁵ that, from preliminary explorations, fall under EU financing policy objectives and may suffer from market failures. In particular, we selected activities, based on desk research and expert advice, that are typically characterised by market failures (such as asymmetric

⁽³⁴⁾ The detailed NACE rev. 2 classification (all the way to the 4-digit level) is available in the EUROSTAT website: <http://ec.europa.eu/eurostat/documents/3859598/5902521/KS-RA-07-015-EN.PDF>. See also Eurostat (2008).

⁽³⁵⁾ We call “industry” a generic group of firms belonging to the same category (see definition of terms).

information and/or positive externalities), are therefore likely to experience financing gaps, but are not already a specific target of EU-level financial instruments.³⁶ These groups are labelled the **Target Sub-sectors**. The ten Target Sub-sectors we selected are: Agricultural Small & Medium-sized Enterprises (SMEs), Marine Fishing, Human Health, Residential Care, Social Work, Vocational/Adult Training, Employment Agencies, Defence Activities, Extra-Urban Transport, and Urban Regeneration. The sub-sectors are identified at NACE 2-digit level or by combining one or more NACE 3- and 4-digit industries. Table 2 reports the NACE (Rev. 2) codes of the Target Sub-sectors.

Table 2. Target Sub-sectors

Target Sub-sector	Abbreviation	NACE codes ³⁷
Agricultural SMEs	A	A-01xx, < 250 employees
Defence Activities	D	C-254x, C-304x, O-8422
Employment Agencies	E	N-78xx
Extra-Urban Transport	X	H-491x; H-4939
Human Health	H	Q-86xx
Marine Fishing	F	A-0311; A-0321
Residential Care	R	Q-87xx
Social Work	S	Q-88xx
Urban Regeneration	U	F-4120; N-8130
Vocational / Adult Training	V	P-8532; P-8559

Note: This table reports the sub-sectors of interest for the bottom-up approach – the *Target Sub-sectors*. Abbreviation is the letter abbreviation used in the rest of the paper. NACE codes are the NACE rev. 2 codes corresponding to the *Target Sub-sector*.

Source: Own elaboration

3.3.2 Control Sub-sectors

We identify benchmark groups of firms with which the Target Sub-sectors of interest can be compared and ranked; we label the benchmark groups “**Control Sub-sectors**.” We propose two Control Sub-sectors for each Target Sub-sector. The first Control Sub-sector is either the immediately upper-level NACE code that comprises the Target Sub-sector, or a group of firms at the same NACE level. We call this Control Sub-sector the “**Narrow Control Sub-sector**.” The Narrow Control Sub-sector is chosen to be the “closest” group of

⁽³⁶⁾ See e.g. Anema (2013) for a discussion of market failures in *Marine Fishing and Defence*, European Commission (2013) for *Agricultural SMEs*, and Economics Online (2021) for *Human Health*.

⁽³⁷⁾ A-01xx = Agriculture, forestry and fishing (Division), which consists of the Groups: Growing of non-perennial crops, Growing of perennial crops, Plant propagation, Animal production, Mixed farming, Support activities to agriculture and post-harvest crop activities, Hunting, trapping and related service activities; O-8422 = Defence activities (Class); N-78xx = Employment activities (Division), which consists of the Classes: Activities of employment placement agencies, Temporary employment agency activities and Other human resources provision; H-4910 = Passenger rail transport, interurban (Class); H-4939 = Other passenger land transport n.e.c. (Class); Q-86xx = Human health activities (Division), which consists of the Classes: Hospital activities, General medical practice activities, Specialist medical practice activities, Dental practice activities and Other human health activities; A-0311 = Marine fishing (Class); A-0321 = Marine aquaculture (Class); Q-87xx = Residential care activities (Division), which consists of the Classes: Residential nursing care activities, Residential care activities for mental retardation, mental health and substance abuse, Residential care activities for the elderly and disabled and Other residential care activities; Q-88xx = Social work activities without accommodation (Division), which consists of the Classes: Social work activities without accommodation for the elderly and disabled, Child day-care activities and Other social work activities without accommodation n.e.c.; F-4120 = Construction of residential and non-residential buildings (Class); N-8130 = Landscape service activities (Class); P-8532 = Technical and vocational secondary education (Class); P-8559 = Other education n.e.c. (Class).

firms to the Target Sub-sector; in practice, we select all nearby industries within the same covering upper-level tier, excluding the Target Sub-sector itself.

The second Control Sub-sector encompasses a broader group of firms and is defined by either simply taking the letter-level NACE category of the Target Sub-sector or additionally adding multiple letters (in the Service categories). We call this group the “**Broad Control Sub-sector**.”

All Target Sub-sectors and corresponding Narrow and Broad Control Sub-sectors are reported in Table 3. For example, in the case of the Target Sub-sector Extra-Urban Transport [NACE H-4910 & H-4939], the Narrow Control Sub-sector is defined as the NACE industry H-49, excluding the Target Sub-sector itself (NACE H-4910 and H-4939), while the Broad Control Sub-sector is defined as the NACE letter H. In case the Target Sub-sector is already two-digit, then we look at the letter category of the NACE classification. For example, for the Target Sub-sector N-78 – Employment Agencies, the Narrow Control Sub-sector encompasses all other 2-digit industries under letter N – Administrative and Support services, while the Broad Control Sub-sector is composed of all NACE letters in the “human capital services” category.³⁸

In order to calculate sub-sector level FCs indices, we then compute simple averages and asset-weighted averages of firms’ BBIs and RBIs by Target Sub-sectors, and Broad and Narrow Control Sub-sectors.³⁹ The simple average assigns equal weights to all firms; the asset-weighted average weighs BBI and RBI values of firms by their total assets, so as to capture values for larger firms.

Table 3. Target and Control Sub-sector Codes

Target Sub-sector	Target ⁴⁰	Narrow Control ⁴¹	Broad Control ⁴²
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⁽³⁸⁾ Notice that, in practice, firms identify sector classification codes within their respective national sector classification systems, which are however consistent with the European NACE classification.

⁽³⁹⁾ We remind that we use the term “sub-sector” such as in *Target Sub-sector*, as a reference to the set of companies of interest, not necessarily to any specific NACE industry classification.

⁽⁴⁰⁾ A-01xx = Crop and animal production, hunting and related service activities (Division), which consists of the Groups: Growing of non-perennial crops, Growing of perennial crops, Plant propagation, Animal production, Mixed farming, Support activities to agriculture and post-harvest crop activities, Hunting, trapping and related service activities; O-8422 = Defence activities (Class); N-78xx = Employment activities (Division), which consists of the Classes: Activities of employment placement agencies, Temporary employment agency activities and Other human resources provision; H-4910 = Passenger rail transport, interurban (Class); H-4939 = Other passenger land transport n.e.c. (Class); Q-86xx = Human health activities (Division), which consists of the Classes: Hospital activities, General medical practice activities, Specialist medical practice activities, Dental practice activities and Other human health activities; A-0311 = Marine fishing (Class); A-0321 = Marine aquaculture (Class); Q-87xx = Residential care activities (Division), which consists of the Classes: Residential nursing care activities, Residential care activities for mental retardation, mental health and substance abuse, Residential care activities for the elderly and disabled and Other residential care activities; Q-88xx = Social work activities without accommodation (Division), which consists of the Classes: Social work activities without accommodation for the elderly and disabled, Child day-care activities and Other social work activities without accommodation n.e.c.; F-4120 = Construction of residential and non-residential buildings (Class); N-8130 = Landscape service activities (Class); P-8532 = Technical and vocational secondary education (Class); P-8559 = Other education n.e.c. (Class).

⁽⁴¹⁾ A-01xx = Agriculture, forestry and fishing (Division), which consists of the Groups: Growing of non-perennial crops, Growing of perennial crops, Plant propagation, Animal production, Mixed farming, Support activities to agriculture and post-harvest crop activities, Hunting, trapping and related service activities; O-84xx (excl. O-8422) = Public administration and defence; compulsory social security (Division), which consists of the Classes: Regulation of the activities of providing health care, education, cultural services and other social services, excluding social security, Regulation of and contribution to more efficient operation of businesses, Foreign affairs, Justice and judicial activities, Public order and safety activities, Fire service activities and Compulsory social security activities; N-xxxx (excl. N-78xx) = Administrative and Support Service Activities (Section); H-49xx (excl. H-4910, H-4939) = Land transport and transport via pipelines (Division), which consists of the Classes: Freight rail transport, Urban and suburban passenger land transport, Taxi operation, Freight transport by road, Removal services and Transport via pipeline; O-xxxx = Public Administration and Defence; Compulsory Social Security (Section); S-xxxx = Other Service Activities (Section); A-031x (excl. A-0311) = Fishing (Group), which consists of the Freshwater fishing Class; A-032x (excl. A-0312) = Aquaculture (Group), which consists of the Freshwater aquaculture Class; F-41xx (excl. F-4120) = Construction of buildings (Division), which consists of the Development of building projects Classes; N-81xx (excl. N-8130) = Services to buildings and landscape activities (Division), which consists of the Classes: Combined facilities support activities, General cleaning of buildings, Other building and industrial cleaning activities and Other cleaning activities; P-85xx (excl. P-8532, P-8559) = Education (Division), which consists of the Classes: Pre-primary education, Primary education, General secondary education, Post-secondary non-tertiary education, Tertiary education, Sports and recreation education, Cultural education, Driving school activities and Educational support activities.

⁽⁴²⁾ A-xxxx = Agriculture, forestry and fishing (Section); F-xxxx = Construction (Section); H-xxxx = Transportation and Storage (Section); M-xxxx = Professional, Scientific and Technical Activities (Section); N-xxxx = Administrative and Support Service Activities (Section); O-xxxx = Public Administration and Defence; Compulsory Social Security (Section); P-xxxx = Education (Section); Q-xxxx = Human Health and Social Work Activities (Section); R-xxxx = Arts, Entertainment And Recreation (Section); S-xxxx = Other Service Activities (Section).

Agricultural SMEs	A-01xx, <250 employees	A-01xx, >250 employees	A
Defence Activities	O-8422	O-84xx	M, N, O, P, Q, R, S
Employment Agencies	N-78xx	N	M, N, O, P, Q, R, S
Extra-Urban Transport	H-4910, H-4939	H-49xx,	H
Human Health	Q-86xx	N, O, S	M, N, O, P, R, S
Marine Fishing	A-0311, A-0321	A-031x, A-032x	A
Residential Care	Q-87xx	N, O, S	M, N, O, P, R, S
Social Work	Q-88xx	N, O, S	M, N, O, P, R, S
Urban Regeneration	F-4120, N-8130	F-41xx, N-81xx	F, N
Vocational / Adult Training	P-8532, P-8559	P-85xx	M, N, O, P, Q, R, S

Note: This table reports the Target Sub-sectors in the bottom-up approach in the first column, and the corresponding Narrow Control Sub-sectors (column 2) and Broad Control Sub-sectors (column 3). Numbers and letters are NACE (Revision 2) classification codes. Narrow and Broad Control Sub-sectors exclude the corresponding Target Sub-sectors.

Source: Own elaboration based on NACE (rev. 2)

3.4 Sector Analysis: The Top-Down Approach

3.4.1 Target and Control Sectors

Given the potential arbitrariness of the choice of the 10 Target Sub-sectors in the bottom-up approach, we complement our analysis with an exploration of all the EU sectors' FCs. Such investigation can be handled seamlessly at the NACE 2-digit level. Therefore, unlike the bottom-up approach, the top-down approach considers each of the 2-digit sectors as a **Target Sector**, whose financial constraints measures are compared with all the other 2-digit sectors; these are thus the **Control Sectors** for this Target Sector. Table 4 below presents the classification of the 99 2-digit level NACE (Rev. 2) sectors, listed in Eurostat (2008).

Table 4. List of 2-digit NACE rev. 2 Divisions

Code	Parent	Description
01	A	Crop and animal production, hunting and related service activities
02	A	Forestry and logging
03	A	Fishing and aquaculture
05	B	Mining of coal and lignite
06	B	Extraction of crude petroleum and natural gas
07	B	Mining of metal ores
08	B	Other mining and quarrying
09	B	Mining support service activities
10	C	Manufacture of food products

Code	Parent	Description
11	C	Manufacture of beverages
12	C	Manufacture of tobacco products
13	C	Manufacture of textiles
14	C	Manufacture of wearing apparel
15	C	Manufacture of leather and related products
16	C	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
17	C	Manufacture of paper and paper products
18	C	Printing and reproduction of recorded media
19	C	Manufacture of coke and refined petroleum products
20	C	Manufacture of chemicals and chemical products
21	C	Manufacture of basic pharmaceutical products and pharmaceutical preparations
22	C	Manufacture of rubber and plastic products
23	C	Manufacture of other non-metallic mineral products
24	C	Manufacture of basic metals
25	C	Manufacture of fabricated metal products, except machinery and equipment
26	C	Manufacture of computer, electronic and optical products
27	C	Manufacture of electrical equipment
28	C	Manufacture of machinery and equipment n.e.c.
29	C	Manufacture of motor vehicles, trailers and semi-trailers
30	C	Manufacture of other transport equipment
31	C	Manufacture of furniture
32	C	Other manufacturing
33	C	Repair and installation of machinery and equipment
35	D	Electricity, gas, steam and air conditioning supply
36	E	Water collection, treatment and supply
37	E	Sewerage
38	E	Waste collection, treatment and disposal activities; materials recovery

Code	Parent	Description
39	E	Remediation activities and other waste management services
41	F	Construction of buildings
42	F	Civil engineering
43	F	Specialised construction activities
45	G	Wholesale and retail trade and repair of motor vehicles and motorcycles
46	G	Wholesale trade, except of motor vehicles and motorcycles
47	G	Retail trade, except of motor vehicles and motorcycles
49	H	Land transport and transport via pipelines
50	H	Water transport
51	H	Air transport
52	H	Warehousing and support activities for transportation
53	H	Postal and courier activities
55	I	Accommodation
56	I	Food and beverage service activities
58	J	Publishing activities
59	J	Motion picture, video and television programme production, Sound recording and music publishing activities
60	J	Programming and broadcasting activities
61	J	Telecommunications
62	J	Computer programming, consultancy and related activities
63	J	Information service activities
64	K	Financial service activities, except insurance and pension funding
65	K	Insurance, reinsurance and pension funding, except compulsory social security
66	K	Activities auxiliary to financial services and insurance activities
68	L	Real estate activities
69	M	Legal and accounting activities
70	M	Activities of head offices; management consultancy activities
71	M	Architectural and engineering activities; technical testing and analysis

Code	Parent	Description
72	M	Scientific research and development
73	M	Advertising and market research
74	M	Other professional, scientific and technical activities
75	M	Veterinary activities
77	N	Rental and leasing activities
78	N	Employment activities
79	N	Travel agency, tour operator and other reservation service and related activities
80	N	Security and investigation activities
81	N	Services to buildings and landscape activities
82	N	Office administrative, office support and other business support activities
84	O	Public administration and defence; compulsory social security
85	P	Education
86	Q	Human health activities
87	Q	Residential care activities
88	Q	Social work activities without accommodation
90	R	Creative, arts and entertainment activities
91	R	Libraries, archives, museums and other cultural activities
92	R	Gambling and betting activities
93	R	Sports activities and amusement and recreation activities
94	S	Activities of membership organisations
95	S	Repair of computers and personal and household goods
96	S	Other personal service activities
97	T	Activities of households as employers of domestic personnel
98	T	Undifferentiated goods- and services-producing activities of private households for own use
99	U	Activities of extraterritorial organisations and bodies

Note: This table reports the sectors of interest for the top-down approach – the Target Sectors. Columns 1 and 3 report the 2-digit NACE rev. 2 codes and respective descriptions (Divisions). Column 1 reports the corresponding letter classification (Section).

Source: Eurostat's NACE (rev. 2) classification

As mentioned for the sub-sectors, we use the term “sector” such as in *Target Sector*, as a reference to the set of companies of interest, not necessarily to any industry classification in the NACE. In order to calculate sector-level indices of FCs, we compute *simple averages* and *asset-weighted averages* of firms' BBIs and RBIs

by *Target Sectors*. The *simple average* assigns equal weights to all firms; the *asset-weighted average* weighs BBI and RBI values of firms by their total assets, so as to capture values for larger firms.

4 Results (EU level aggregates)

The presentation of our results follows the distinction made in the previous Chapter between a bottom-up **sub-sector** approach and a top-down **sector** approach. Each approach is split into the use of the two FC indicators, namely the BBI and the RBI. Under each approach and indicator we split the outcome in two panels: *simple*- and *weighted*-average sector level indicators. The weighted average is expected to provide an accurate picture of the sector taken as a whole, instead of by individual firms. Moreover, by construction, weighted-averages give larger weights to larger firms and the results will be interpreted accordingly: a *Target Sector* that provides relatively larger weighted-average measures with respect to the *Control sectors* than simple averages would reflect the fact that, within the *Target Sector*, the larger firms are relatively more financially constrained. All the results reported in this chapter are obtained from the analysis carried out at the EU level.

4.1 Financial Constraints by Sub-sector: The Bottom-Up Approach (EU level aggregates)

This section reports the estimates of the FC indicators for the 10 Target Sub-sectors, compared with the Control Sub-sectors. Sub-sectors featuring asset-weighted indicators higher (lower) than simple average indicators are sub-sectors whose larger firms exhibit higher (lower) FCs indicator values relative to smaller firms. For example, in Table 5 below, the *Marine Fishing* Target Sub-sector presents an asset-weighted degree of financial constraints equal to 15.8%, which is lower than the corresponding simple-average (24.4%). We interpret this result as an indication of lower financial constraints for larger firms than for smaller firms.

4.1.1 Book-based indicator – BBI (EU level aggregates)

Table 5 and Figure 3 report the results for the Book-Based Indicator (BBI). In the table, we highlight in yellow the estimates that indicate a degree of FCs for the Target Sub-sectors higher than either one of their Control Sub-sectors; we highlight in red the estimates that indicate a degree of FCs for the *Target Sub-sectors* higher than both their *Control Sub-sectors*. The Target Sub-sector estimates which are not highlighted present instead a degree of FCs lower than both their Control Sub-sectors.

For example, the red-labelled Defence Activities Sub-sector (where firm BBIs are asset-weighted) presents a degree of financial constraints equal to 11.8 %, which is higher than both its Broad and Narrow Control Sub-sectors (11.0 % and 3.7 %, respectively); whereas the yellow-labelled Agricultural SMEs Sub-sector (where firm BBIs are simply averaged) presents a 22.8 % degree of financial constraints, which is higher than its Narrow Control Sub-sector (20.2 %), but lower than its Broad Control Sub-sector (24.1 %).

Table 5. EU level Book-Based Indicators [BBI] for Target and Control Sub-sectors.

	Number of firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Agricultural SMEs	33,598	70,875	171	0.241	0.228	0.202	0.142	0.148	0.169
Defence Activities	1,548,222	336	1,278	0.231	0.200	0.243	0.110	0.118	0.037
Employment Agencies	1,040,653	9,594	180,451	0.237	0.201	0.219	0.087	0.091	0.080
Extra-Urban Transport	165,882	9,805	117,231	0.224	0.237	0.230	0.157	0.123	0.150
Human Health	100,501	3,972	1,106	0.232	0.245	0.322	0.146	0.157	0.114
Marine Fishing	906,526	117,916	285,607	0.237	0.244	0.238	0.084	0.158	0.078
Residential Care	906,526	11,650	285,607	0.237	0.220	0.238	0.084	0.163	0.078
Social Work	906,526	14,155	285,607	0.237	0.212	0.238	0.084	0.093	0.078

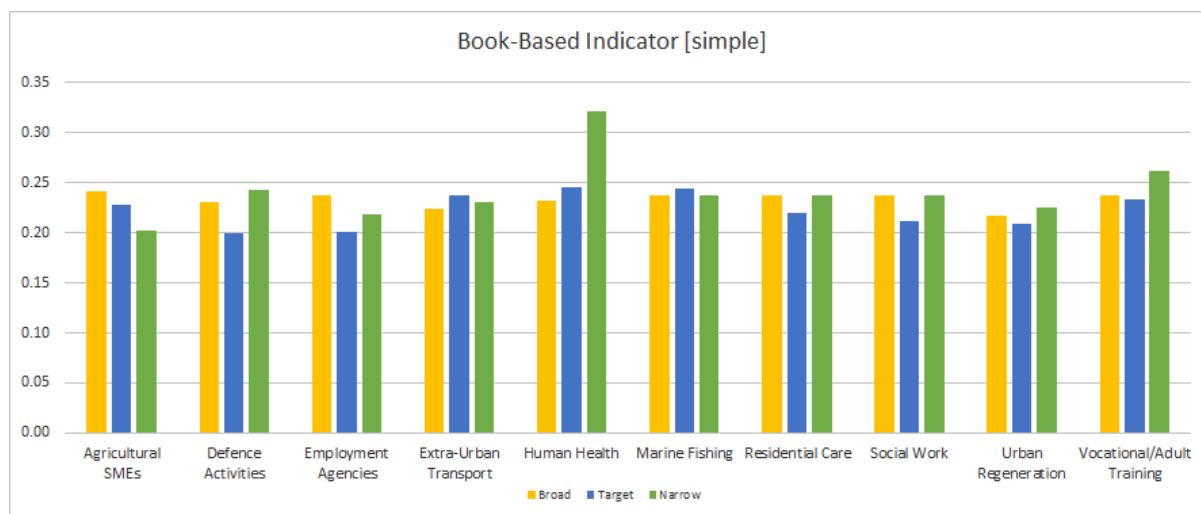
Urban Regeneration	574,245	187,441	97,351	0.217	0.209	0.225	0.101	0.127	0.136
Vocational/Adult Training	1,020,941	29,306	22,381	0.237	0.233	0.262	0.087	0.131	0.171

Note: This table reports the Book-Based Indicator (BBI) values of FCs for Target and Control Sub-sectors. Yellow-coloured cells indicate the Target Sub-sectors whose BBI is larger than either their Narrow Control Sub-sectors or their Broad Control Sub-sectors. Red-coloured cells indicate the Target Sub-sectors whose BBI is larger than both their Narrow and Broad Control Sub-sectors.

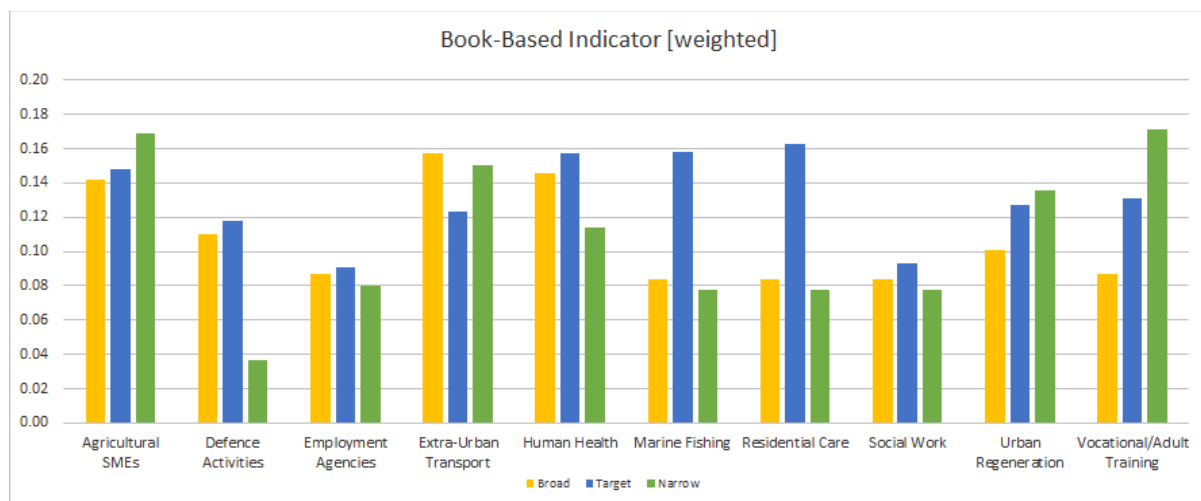
Source: Own elaboration

Figure 3. EU level Book-Based Indicators [BBI] for Target and Control Sub-sectors

Panel A: Simple average



Panel B: Weighted average



Note: Average Book-Based Indicator (BBI) values of *Target* and *Control Sub-sectors*. *Narrow Control Sub-sectors* are represented by the right-hand green bars; *Broad Control Sub-sectors* are represented by the left-hand yellow bars; *Target Sub-sectors* are the middle blue bars. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaboration

From Table 5 and Figure 3, based on the BBI method, only one *Target Sub-sector* – *Marine Fishing* – exhibits a degree of FCs higher than its *Control Sub-sectors* both in simple and asset-weighted average. Smaller firms in *Extra-Urban Transport* and larger firms in *Defence Activities*, *Employment Agencies*, *Human Health*, *Social Work*, and above all *Residential Care*, also exhibit relatively high FCs.

According to the BBI method, the highest degree of FCs in absolute terms accrues to the smaller firms in the *Narrow Control Sub-sector of Human Health*, composed of *Administrative and support service activities, Public administration and defence, Compulsory social security and Other service activities*.

4.1.2 Regression-Based Indicator – RBI (EU level aggregates)

Table 6 and Figure 4 report the results for the Regression-Based Indicator (RBI). Again, we highlight in yellow the estimates that indicate a degree of FCs for the *Target Sub-sectors* higher than either one of their *Control Sub-sectors*; we highlight in red the estimates that indicate a degree (probability) of FCs for the *Target Sub-sectors* higher than both their *Control Sub-sectors*. The *Target Sub-sector* estimates which are not highlighted present instead a degree of FCs lower than both their *Control Sub-sectors*.

Table 6. EU level Regression-Based Indicators [RBI] for Target and Control Sub-sectors

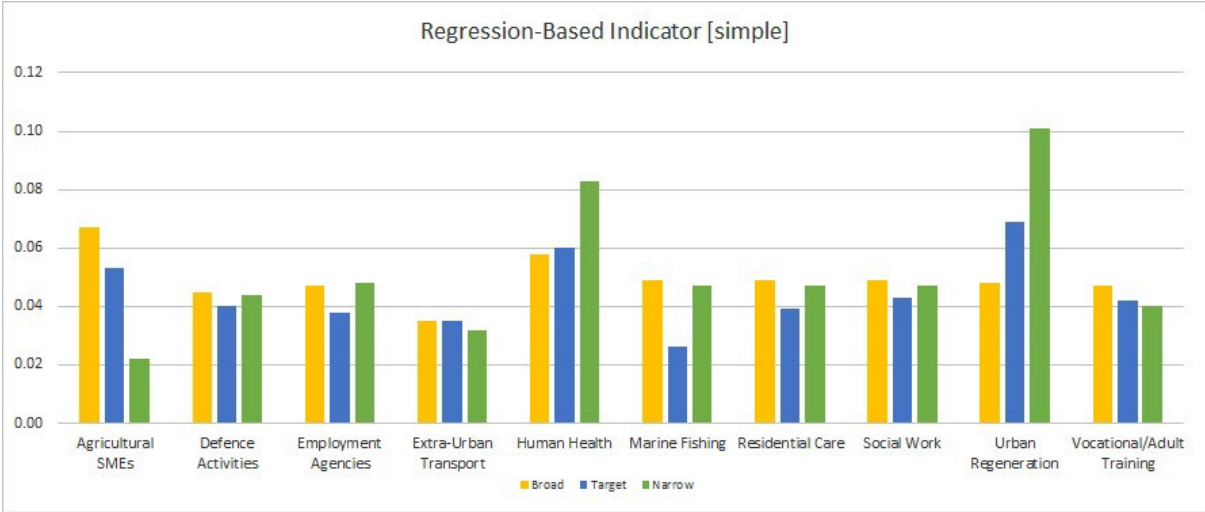
	Number of firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Agricultural SMEs	41,549	84,966	197	0.067	0.053	0.022	0.055	0.041	0.012
Defence Activities	1,802,518	352	1,508	0.045	0.040	0.044	0.048	0.061	0.038
Employment Agencies	1,222,553	13,140	218,340	0.047	0.038	0.048	0.063	0.013	0.029
Extra-Urban Transport	209,278	12,085	151,082	0.035	0.035	0.032	0.043	0.008	0.017
Human Health	122,349	4,166	1,619	0.058	0.060	0.083	0.046	0.028	0.042
Marine Fishing	1,094,536	113,613	352,869	0.049	0.026	0.047	0.065	0.029	0.035
Residential Care	1,094,536	11,591	352,869	0.049	0.039	0.047	0.065	0.020	0.035
Social Work	1,094,536	15,953	352,869	0.049	0.043	0.047	0.065	0.007	0.035
Urban Regeneration	648,662	234,286	101,880	0.048	0.069	0.101	0.048	0.078	0.111
Vocational/Adult Training	1,197,824	37,869	27,194	0.047	0.042	0.040	0.063	0.018	0.030

Note: This table reports the Regression-Based Indicator (RBI) values of FCs for Target and Control Sub-sectors. Yellow-coloured cells indicate the Target Sub-sectors whose RBI is larger than either their Narrow Control Sub-sectors or their Broad Control Sub-sectors. Red-coloured cells indicate the Target Sub-sectors whose RBI is larger than both their Narrow Control Sub-sectors and their Broad Control Sub-sectors.

Source: Own elaboration

Figure 4. EU level Regression-Based Indicators [RBI] for Target and Control Sub-sectors

Panel A: Simple average



Panel B: Weighted average



Note: Average Regression-Based Indicator (RBI) values of *Target* and *Control Sub-sectors*. *Narrow Control Sub-sectors* are represented by the right-hand green bars; *Broad Control Sub-sectors* are represented by the left-hand yellow bars; *Target Sub-sectors* are the middle blue bars. Panel A reports simple averages; Panel B reports the asset-weighted averages.

Source: Own elaboration

Based on the RBI method (Table 6 and Figure 4), mainly larger firms in *Defence Activities* – and, barely, smaller firms in *Extra-Urban Transport* – exhibit higher degrees of FCs than their controls. It is worth noting instead that the *Narrow Control Sub-sector* of *Urban Regeneration* – composed of *Construction of buildings* and *Services to buildings and landscape activities* – exhibits a very high degree of FCs in absolute terms.

4.2 Financial Constraints by Sector: The Top-Down Approach (EU level aggregates)

In this section, we report the results of the top-down approach, which estimates the FCs measures of the two indicators for all 2-digit NACE codes (which we labelled **Target Sectors**), at the EU level. We also retain the specific 10 *Target Sub-sectors* of interest analysed in Section 4.1, for comparison purposes. Figures 5 to 7 label the 99 Sectors using the codes listed in Table 4 (list of 2-digit NACE rev. 2), and the Sub-sectors using the abbreviations listed in Table 2 (Target Sub-sectors). Indeed, vulnerable *Target sectors*, although potentially already the targets of EU policies, may deserve further attention from policy makers.

For each indicator of FCs – RBI and BBI – Figures 4-5 illustrate the *simple average* across all firms in a sector (panels A), as well as the *asset weighted average* (panels B). Sectors featuring asset-weighted indicator values higher than simple averages are sectors whose larger firms exhibit higher FC values relative to smaller firms.

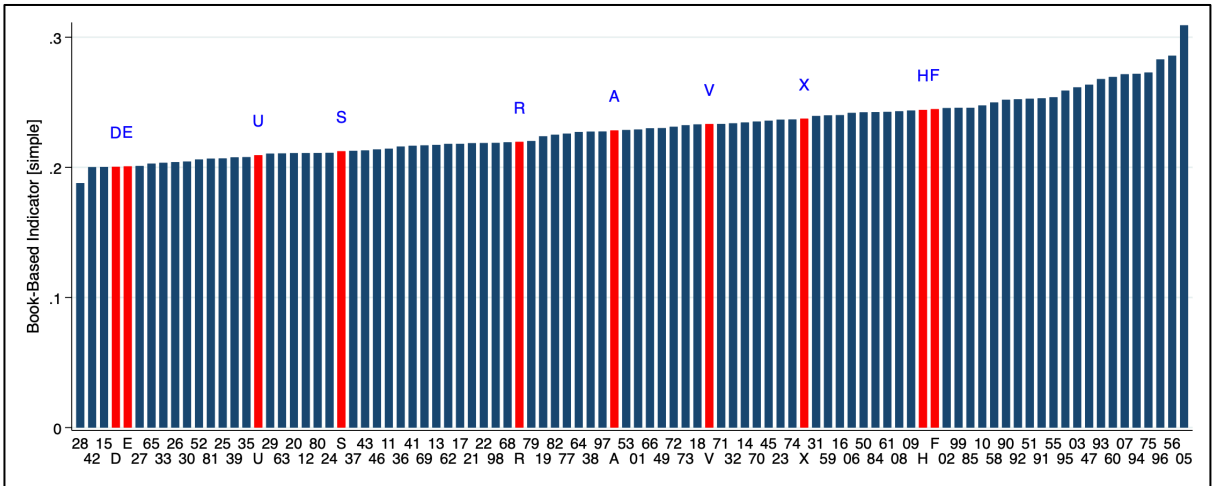
In Figure 7, we present a measure of FCs that combines the RBI and the BBI. For each of the indicators – RBI and BBI – sectors are ranked by quintiles, where the lowest (highest) quintile 1 (5) represents the sectors with least (most) FC issues. For each sector we then calculate the average quintile it belongs to. For instance, a sector that is ranked into the third quintile according to the RBI and in the second quintile according to the BBI, would receive the value 2.5. This simple approach has the advantage of allowing a comparison – and an average – between two relative distributions of indicators otherwise incommensurable.

4.2.1 Book-Based Indicator – BBI (EU level aggregates)

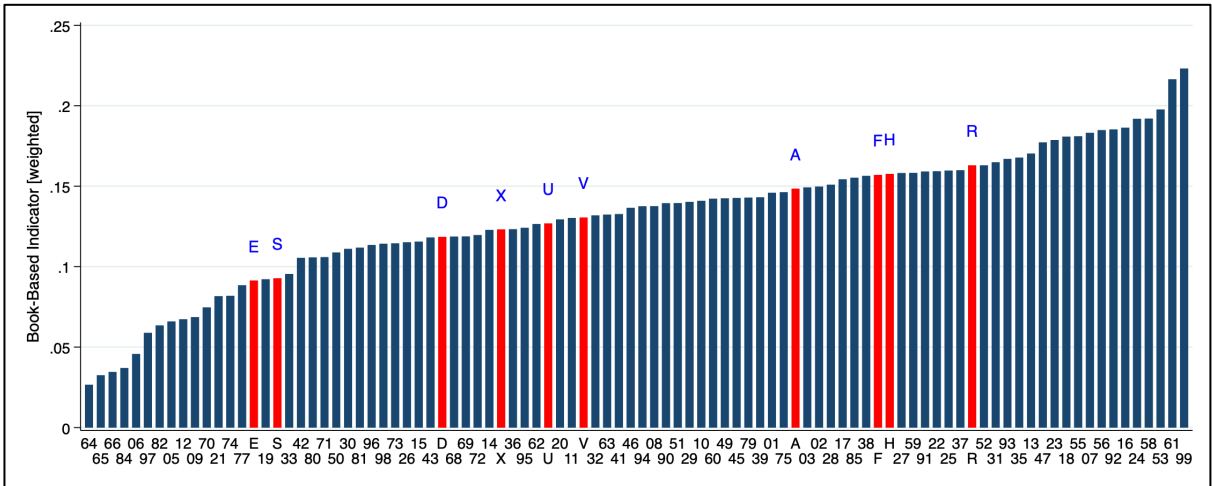
Figure 5 reports the sector-level Book-Based Indicator values using the top-down approach. It also shows the *Target Sub-sectors* (red bars) analysed in Section 4.1.

Figure 5. Book-Based Indicator – Target and 2-Digit NACE Sectors.

Panel A: Simple average



Panel B: Weighted average



Note: This figure reports the average Book-Based Indicator (BBI) measures (left scale) of Target Sub-sectors (red) and 2-digit NACE Target Sectors (blue) – see abbreviations and definitions in Table 2 and Table 4, respectively. Firm-level BBI equals either 0=unconstrained, ½=relatively constrained, or 1=strongly constrained. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaboration

The results depicted in Figure 5 show that, based on the BBI index, the 10 most financially constrained Sectors in the EU do not include any of the 10 *Target Sub-sectors* analysed in section 4.1. However, we find that *Human Health* (H) and especially *Marine Fishing* (F) are among the most financially constrained *Target Sub-Sectors* for all firm sizes, and for larger firms the FCs of the *Residential Care* (R) sector stand out.

The *top-down approach* results then reveal that those *Target Sub-Sectors*, while more constrained than their neighbours, are only moderately constrained when viewed in the broader perspective of the entire economy. Instead, in the top 10 we find different *Target Sectors*, listed in Table 7. In the case of smaller firms, illustrated in Figure 5A and listed in Table 7, we find the following *Target Sectors* (in decreasing order): *Mining of coal and lignite* (05); *Food and beverage service activities* (56); *Other personal service activities* (96); *Veterinary activities* (75); *Activities of membership organisations* (94); *Mining of metal ores* (07); *Programming and broadcasting activities* (60); *Sports activities and amusement and recreation activities* (93); *Retail trade, except of motor vehicles and motorcycles* (47); *Fishing and aquaculture* (03).

Table 7. Top ten financially constrained *Target Sectors* according to BBI (in decreasing order)

Simple average	Weighted average
Mining of coal and lignite (05)	Activities of extraterritorial organisations and bodies (99)
Food and beverage service activities (56)	Telecommunications (61)
Other personal service activities (96)	Postal and courier activities (53)
Veterinary activities (75)	Publishing activities (58)
Activities of membership organisations (94)	Manufacture of basic metals (24)
Mining of metal ores (07)	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (16)
Programming and broadcasting activities (60)	Gambling and betting activities (92)
Sports activities and amusement and recreation activities (93)	Food and beverage service activities (56)
Retail trade, except of motor vehicles and motorcycles (47)	Mining of metal ores (07)
Fishing and aquaculture (03)	Accommodation (55)

Source: Own elaboration

Regarding larger firms, as depicted in Figure 5B and listed in Table 7, we find the following *Target Sectors*: *Activities of extraterritorial organisations and bodies* (99); *Telecommunications* (61); *Postal and courier activities* (53); *Publishing activities* (58); *Manufacture of basic metals* (24); *Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials* (16); *Gambling and betting activities* (92); *Food and beverage service activities* (56); *Mining of metal ores* (07); *Accommodation* (55).

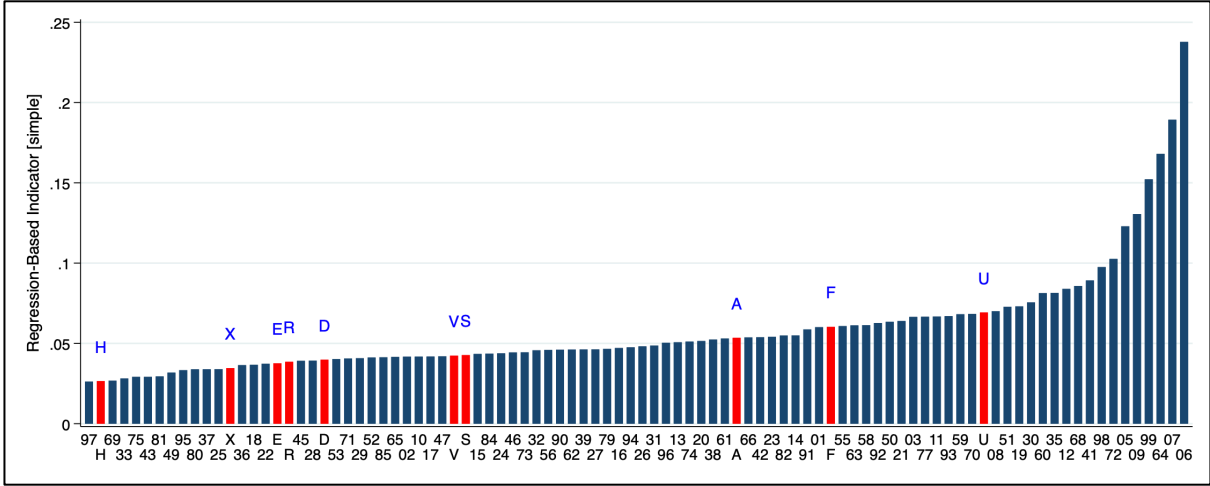
An interesting feature of Table 7 is that only two sectors exhibit FCs for both smaller and larger firms – namely, *Food and beverage service activities* and *Mining of metal ores* – with probably relatively more acute FCs amongst smaller firms. For the rest, the 8 most financially constrained sectors are different between smaller and larger firms, suggesting that – at least based on the BBI – at the sector level the factors determining severe FCs are largely different depending on a firm's size.

4.2.2 Regression-Based Indicator – RBI (EU level aggregates)

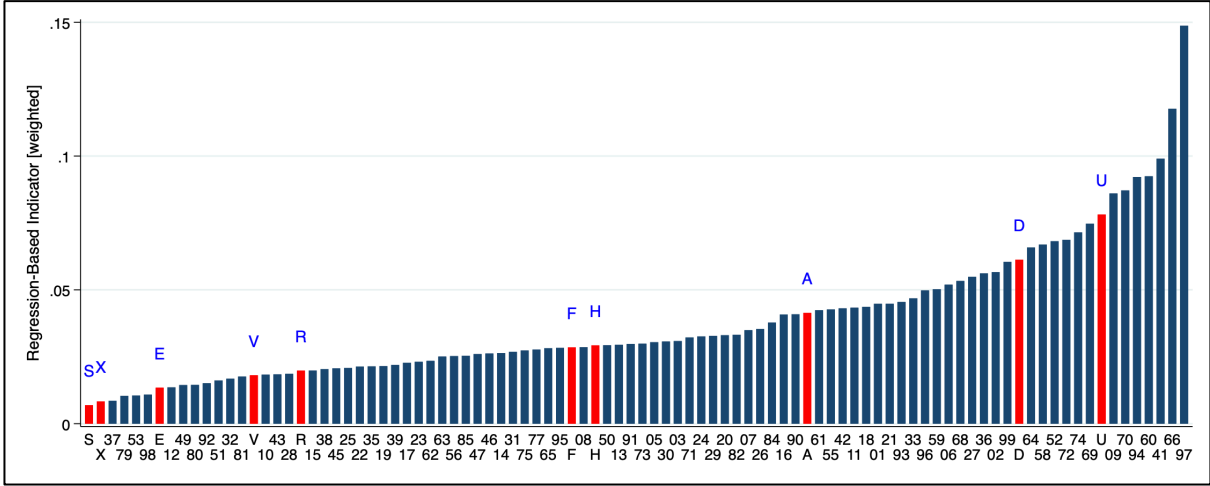
Figure 6 shows the results of the Regression-Based Indicator using the top-down approach. It also shows the *Target Sub-sectors* (red bars) analysed in Section 4.1.

Figure 6. Regression-Based Indicator – Target 2-digit NACE Sectors.

Panel A: Simple average



Panel B: Weighted average



Note: This figure reports the average Regression-Based Indicator (RBI) measures (left scale) of *Target Sub-sectors* (red) and 2-Digit NACE *Target Sectors* (blue) – see abbreviations and definitions in Table 2 and Table 4, respectively. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaboration

The results depicted in Figure 6 show that, based on the RBI index, the 10 most financially constrained sectors in the EU include only one of the 10 *Target Sub-Sectors*, namely *Urban Regeneration* (U) – other sub-sectors with high indexes are smaller firms in *Marine Fishing* (F) and larger firms in *Defence Activities* (D).

Note that *Urban Regeneration* (U) has also been identified through the RBI in the bottom-up approach (see section 4.1.). Its presence in the top quintile in Figure 6B indicates that this *Target Sub-sector* is not only more financially constrained with respect to its neighbours, but also in comparison with the entire economy’s sectors. Smaller firms in *Marine Fishing* (F) and larger firms in *Agricultural SMEs* (A) – also identified via the bottom-up approach – are instead only moderately constrained, in a wider perspective.

In the top 10 of Figure 6A we find the following smaller firms’ *Target Sectors*, listed in Table 8 (in decreasing order): *Extraction of crude petroleum and natural gas* (06); *Mining of metal ores* (07); *Financial service activities, except insurance and pension funding* (64); *Activities of extraterritorial organisations and bodies* (99); *Mining support service activities* (09); *Mining of coal and lignite* (05); *Scientific research and development* (72); *Undifferentiated goods and services producing activities of private households for own use* (98); *Construction of buildings* (41); *Real estate activities* (68).

As shown in Figure 6B and Table 8, the 10 most financially constrained sectors for larger firms according to the RBI index are (in decreasing order): *Activities of households as employers of domestic personnel* (97);

Activities auxiliary to financial services and insurance activities (66); Construction of buildings (41); Programming and broadcasting activities (60); Activities of membership organisations (94); Activities of head offices: Management consultancy activities (70); Mining support service activities (09); Legal and accounting activities (69); Other professional, scientific and technical activities (74); Scientific research and development (72).

Table 8. Top ten financially constrained *Target Sectors* according to RBI (in decreasing order)

Simple average	Weighted average
Extraction of crude petroleum and natural gas (06)	Activities of households as employers of domestic personnel (97)
Mining of metal ores (07)	Activities auxiliary to financial services and insurance activities (66)
Financial service activities, except insurance and pension funding (64)	Construction of buildings (41)
Activities of extraterritorial organisations and bodies (99)	Programming and broadcasting activities (60)
Mining support service activities (09)	Activities of membership organisations (94)
Mining of coal and lignite (05)	Activities of head offices: Management consultancy activities (70)
Scientific research and development (72)	Mining support service activities (09)
Undifferentiated goods- and services-producing activities of private households for own use (98)	Legal and accounting activities (69)
Construction of buildings (41)	Other professional scientific and technical activities (74)
Real estate activities (68)	Scientific research and development (72)

Source: Own elaboration

Like the BBI indicator, also the RBI only identifies three sectors which are severely financially constrained for both smaller and larger firms – namely *Mining support service activities*, *Scientific research and development*, and *Construction of buildings*. Hence, also the RBI results confirm that the factors determining severe FCs for smaller firms are substantially different from those related to larger firms.

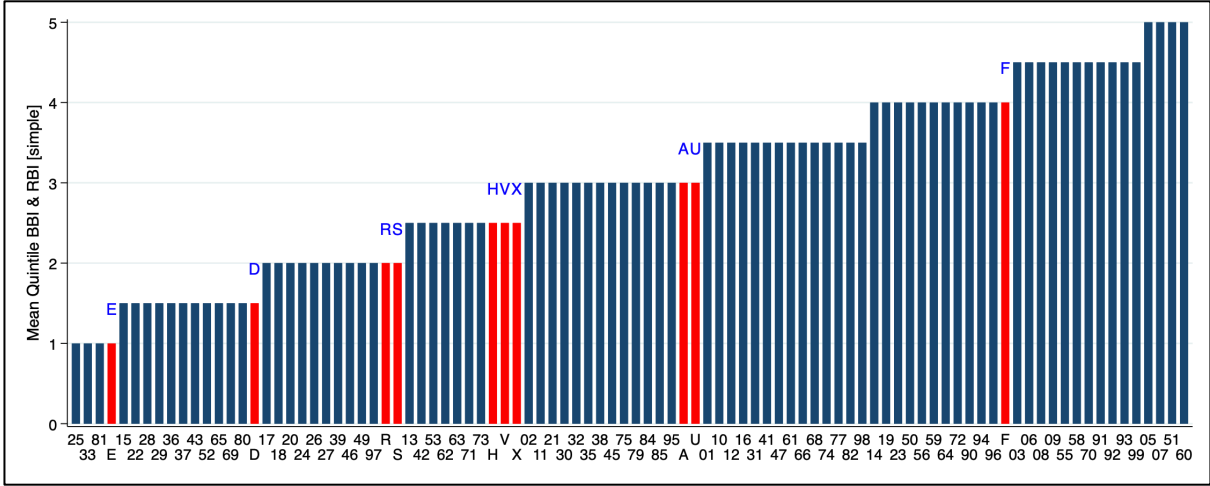
Comparing BBI and RBI measures, according to their simple averages, both list smaller firms in *Mining of coal and lignite (05)* and *Mining of metal ores (07)* among the top ten financially constrained *Target Sectors*. The next sub-section provides a more systematic comparison of the two approaches.

4.2.3 Mean quintile indicator and discussion

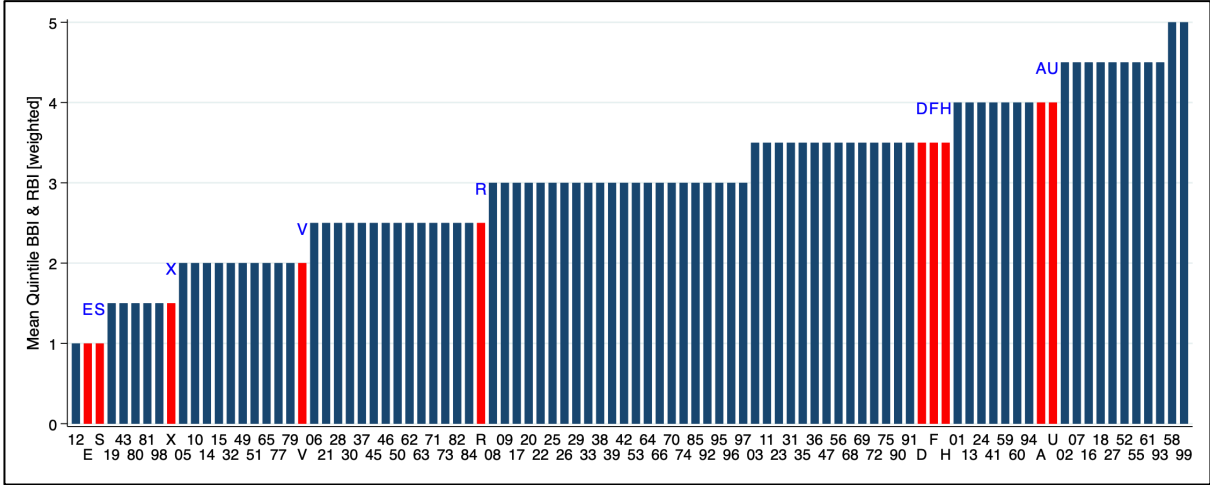
In order to provide a summary indicator for the top-down approach, which combines the two classes of indicators, Figure 7 shows the mean quintiles of the Book- and Regression-Based Indicators (see sub-section 3.1.3).

Figure 7. Mean Quintiles of the Book-and Regression-Based Indicators

Panel A: Simple average



Panel B: Weighted average



Note: This figure reports the average quintile of the *Target Sub-sectors* (red) and 2-Digit NACE *Target Sectors* (blue) across all sectors – see abbreviations and definitions in Table 2 and Table 4, respectively – as an average between BBI and RBI measures; higher numbers indicate higher degrees of FCs. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaboration

Figure 7 helps identify the results that are common to the two indicators. At the Sub-sector level, *Employment Agencies* (E) is the least financially constrained *Target Sub-sector*, using either weighted or non-weighted indexes. The most financially constrained *Target Sub-sector* is *Marine Fishing* (F) according to both asset-weighted and (especially) simple average measures. *Agriculture SMEs* (A), *Urban Regeneration* (U) and *Human Health* (H) are among the most financially constrained for larger firms. Finally, *Residential Care* (R) is “mildly” financially constrained among the larger firms.

In addition, the mean quintile indicator identifies as likely to be financially constrained small firms belonging to the following *Target Sectors* (see Table 10, left column): [Mean quintile = 5.00] *Mining of coal and lignite* (05), *Mining of metal ores* (07), *Air transport* (51), *Programming and broadcasting activities* (60); [Mean quintile = 4.50] *Fishing and aquaculture* (03), *Extraction of crude petroleum and natural gas* (06), *Other mining and quarrying* (08), *Mining support service activities* (09), *Accommodation* (55), *Publishing activities* (58), *Activities of head offices, management consultancy activities* (70), *Libraries, archives, museums and other cultural activities* (91), *Gambling and betting activities* (92), *Sports activities and amusement and recreation activities* (93), *Activities of extraterritorial organisations and bodies* (99). In addition, firms of larger size are more likely to be constrained in the following *Target Sectors* (see Table 9, right column): [Mean quintile=5.00] *Publishing activities* (58), *Activities of extraterritorial organisations and bodies* (99); [Mean quintile=4.50] *Forestry and logging* (02), *Mining of metal ores* (07), *Manufacture of wood and of products of*

wood and cork, except furniture; manufacture of articles of straw and plaiting materials (16), Printing and reproduction of recorded media (18), Manufacture of electrical equipment (27), Warehousing and support activities for transportation (52), Accommodation (55), Telecommunications (61), Sports activities and amusement and recreation activities (93). As foreseeable, most of the sectors identified as constrained by the mean quintile indicator have also been classified as such by at least one of the other indicators.

Table 9. Top ten financially constrained *Target Sectors* according to the Mean Quintile Indicator.

Simple average	Weighted average
Mean quintile = 5.00	
Mining of coal and lignite (05)	Publishing activities (58)
Mining of metal ores (07)	Activities of extraterr. organisations and bodies (99)
Air transport (51)	
Programming and broadcasting activities (60)	
Mean quintile = 4.50	
Fishing and aquaculture (03)	Forestry and logging (02)
Extraction of crude petroleum and natural gas (06)	Mining of metal ores (07)
Other mining and quarrying (08)	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (16)
Mining support service activities (09)	Printing and reproduction of recorded media (18)
Accommodation (55)	Manufacture of electrical equipment (27)
Publishing activities (58)	Warehousing and support activities for transportation (52)
Activities of head offices, management consultancy activities (70)	Accommodation (55)
Libraries, archives, museums and other cultural activities (91)	Telecommunications (61)
Gambling and betting activities (92)	Sports activities and amusement and recreation activities (93)
Sports activities and amusement and recreation activities (93)	
Activities of extraterr. organisations and bodies (99)	

Source: Own elaboration

In order to place these results in the broader context of sectors' profiles, it is of interest to characterise the main features of financially-constrained sectors, by presenting their capital intensity, their degree of innovativeness and their total factor productivity. Together with information on their size –already presented in the previous sections via the distinction between simple and asset-weighted averages – Table 10 therefore provides further details about the sectors under analysis.

Table 10. Capital intensity, Productivity, Innovativeness and Financial constraint of EU sectors

(1)	(2)	(3)	(4)	(5)	(6)
NACE 2- digit	Sector Name	Financial constraint (quintile)	Capital intensity (EU average 100)	Productivity (log) (EU average 100)	Innovativeness (EU average 100)
01	Agriculture	3.5	34	109	N/A
02	Forestry	3	34	109	N/A
03	Fishing	4.5	34	109	N/A
05	Mining	5	139	92	N/A
06	Nat. Gas	4.5	139	92	N/A
07	Mine Metal	5	139	92	N/A
08	Mine Other	4.5	139	92	N/A
09	Mine Service	4.5	139	92	N/A
10	Man. Food	3.5	49	101	52
11	Man. Beverages	3	49	101	52
12	Man. Tobacco	3.5	49	101	52
13	Man. Textile	2.5	25	95	52
14	Man. Apparel	4	25	95	52
15	Man. Leather	1.5	25	95	52
16	Man. Wood	3.5	53	97	52
17	Man. Paper	2	53	97	52
18	Man. Media	2	53	97	52
19	Man. Coke	4	538	80	104
20	Man. Chem.	2	153	93	157
21	Man. Pharma	3	230	88	209
22	Man. Rubber	1.5	56	98	104
23	Man. Mineral	4	56	98	104
24	Man. Metal	2	45	101	104
25	Man. Fabricated	1	45	101	104
26	Man. Computer	2	120	92	209

(1)	(2)	(3)	(4)	(5)	(6)
NACE 2- digit	Sector Name	Financial constraint (quintile)	Capital intensity (EU average 100)	Productivity (log) (EU average 100)	Innovativeness (EU average 100)
27	Man. Electr.	2	48	94	157
28	Man. Machinery	1.5	48	99	157
29	Man. Motor	1.5	99	99	157
30	Man. Transport	3	99	99	157
31	Man. Furniture	3.5	27	99	52
32	Man. Other	3	27	99	52
33	Repair	1	27	99	104
35	Electricity	3	492	97	N/A
36	Water Treatment	1.5	212	98	N/A
37	Sewerage	1.5	212	98	N/A
38	Waste	3	212	98	N/A
39	Remediation	2	212	98	N/A
41	Construction	3.5	23	111	N/A
42	Civil Eng.	2.5	23	111	N/A
43	Spec. Constr.	1.5	23	111	N/A
45	Wholesale-Retail	3	22	87	62
46	Wholesale	2	28	95	62
47	Retail	3.5	16	97	62
49	Transport	2	57	92	62
50	Transport Water	4	221	81	125
51	Transport Air	5	161	72	125
52	Warehousing	1.5	237	87	62
53	Postal	2.5	19	80	62
55	Accommodation	4.5	20	107	62
56	Food service	4	20	107	62

(1)	(2)	(3)	(4)	(5)	(6)
NACE 2- digit	Sector Name	Financial constraint (quintile)	Capital intensity (EU average 100)	Productivity (log) (EU average 100)	Innovativeness (EU average 100)
58	Publish.	4.5	63	94	125
59	Video, TV.	4	63	94	125
60	Broadcasting	5	63	94	125
61	Telecom.	3.5	307	92	125
62	Computer Prog.	2.5	27	99	125
63	Information	2.5	27	99	125
64	Financial services	4	62	104	125
65	Insurance	1.5	62	104	125
66	Aux. fin. services	3.5	62	104	125
68	Real Estate	3.5	5098	103	62
69	Legal	1.5	27	108	125
70	Head offices	4.5	27	108	125
71	Architecture	2.5	27	108	125
72	Research	4	27	108	125
73	Advertising	2.5	27	108	125
74	Oth. Professional	3.5	27	108	125
75	Veterinary	3	27	108	125
77	Rental	3.5	32	108	62
78	Employment	1	32	111	125
79	Travel	3	32	118	62
80	Security	1.5	32	108	125
81	Landscaping	1	32	111	62
82	Administrative	3.5	32	106	62
84	Public admin.	3	149	111	125
85	Education	3	43	108	125

(1)	(2)	(3)	(4)	(5)	(6)
NACE 2- digit	Sector Name	Financial constraint (quintile)	Capital intensity (EU average 100)	Productivity (log) (EU average 100)	Innovativeness (EU average 100)
86	Human health	2.5	40	111	125
87	Residential care	2	27	111	125
88	Social work	2	27	111	125
90	Creative, Art.	4	84	101	125
91	Libraries	4.5	84	101	125
92	Gambling	4.5	84	101	125
93	Sports	4.5	84	101	125
94	Membership	4	17	103	62
95	Repair	3	17	103	62
96	Pers. Service.	4	17	103	62
97	Househ. employers	2	N/A	N/A	62
98	Undiff. Goods	3.5	N/A	N/A	62
99	Extraterritorial	4.5	N/A	N/A	62

Note: This Table reports the financial constraint quintile of 2-Digit NACE *Target Sectors* and the corresponding sectoral capital intensity, productivity and innovativeness. Data for stock of capital, hours of labour and gross value added are taken from the EU KLEMS database ([EUKLEMS & INTANProd - Luiss Lab of European Economics](#)). Capital (K_GFCF) is measured in millions of units of national currency. The same is true for gross value added (VA_CP). For those countries which do not have euro as national currency, the exchange rate was taken from Eurostat. Labour is measured as total hours worked by persons engaged (including owners and family members) (H_EMP). Capital intensity is computed through a simple ratio of capital stock over hours worked. Productivity refers to the Total Factor Productivity (Solow residual), obtained through a simple regression of value added on both hours worked and stocks of capital. Innovativeness is reported following Eurostat's definition ([eurostat_classificazione_industry-service \(2\).pdf \(ceceu.int\)](#)). For manufacturing activities, we assigned a numerical ranking from 1 to 4 to, respectively, "Low technology", "Medium-low technology", "Medium-high technology" and "High-technology". For services, we assigned values 1 and 2, respectively, to "Less knowledge intensive services" and "Knowledge intensive services"

Source: EU KLEMS database; Eurostat

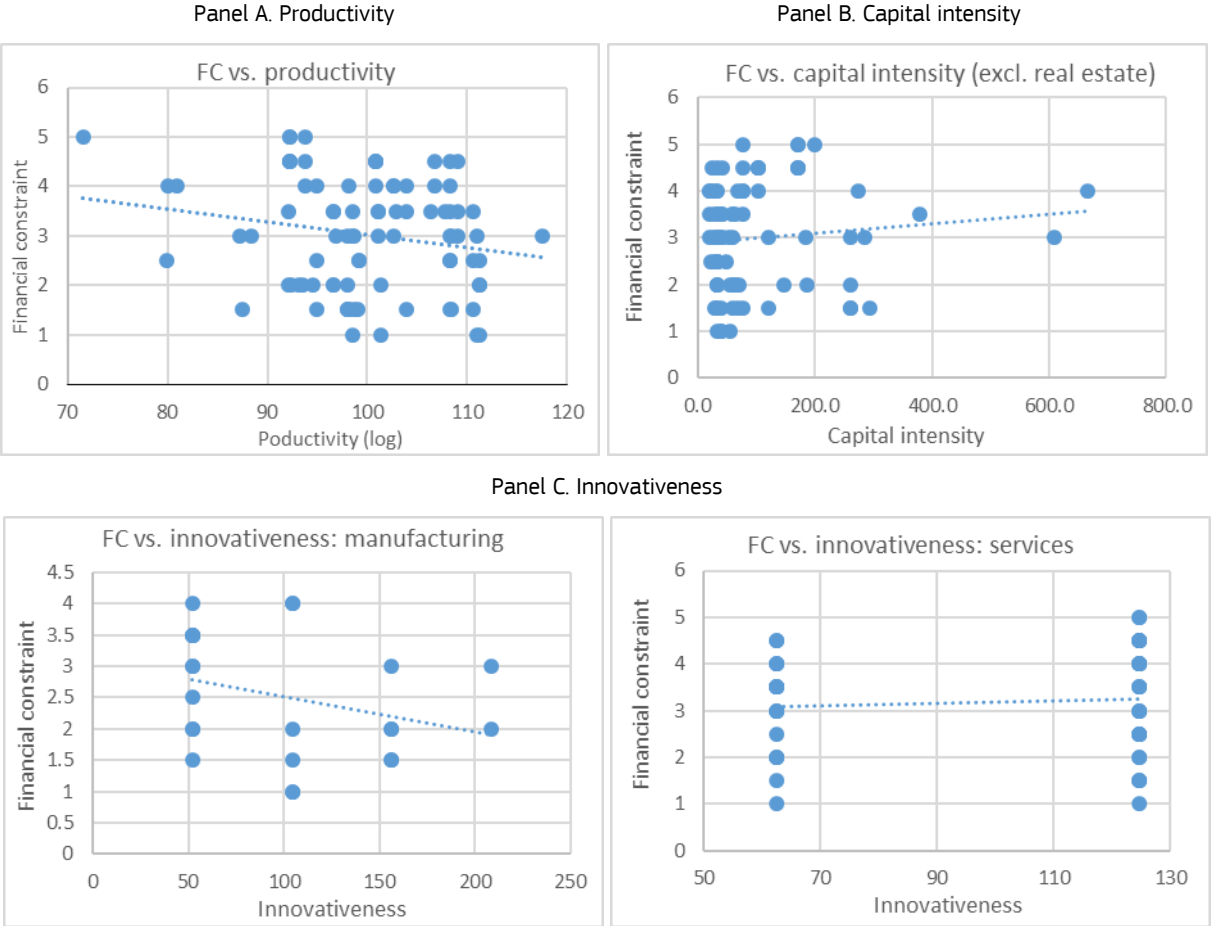
For each 2-digit NACE sector (columns 1 and 2), Table 10 presents the corresponding mean quintile indicator of financial constraints (column 3), its level of productivity compared to the EU average (column 4), its capital intensity compared to the EU average (column 5), and its innovativeness index compared to the EU average (column 6). A general observation is that the most financially-constrained sectors tend to have a capital intensity much higher than both the least financially constrained and the average, in line with our observation above. The most financially-constrained sectors also tend to exhibit a total factor productivity lower than both the least financially constrained and the average. Instead, no clear difference emerges between the top, average and bottom quintiles in terms of innovativeness.

To extract more structured information from Table 10, we plotted the financial constraints indicator against the other 3 indexes, in turn. The resulting scatterplots in Figure 8 confirm for the entire sample the negative correlation between financial constraints and total factor productivity (panel A), as well as the positive correlation between financial constraints and capital intensity (panel B). As for the (apparent) absence of

correlation between financial constraints and innovativeness, panel C shows that it only holds for services, whereas manufacturing sectors exhibit a negative correlation.

While the results on the relation between financial constraints and productivity or innovativeness can be easily rationalised, the less obvious association between financial constraints and capital intensity may be due to the financial burden implied by large upfront investments in capital.

Figure 8. Financial constraint of sectors plotted against sectors' characteristics



Note: This figure reports the mean quintile financial constraint value (y-axis) and the sector level characteristics (x-axis). Sector level characteristics are obtained from EU KLEMS database (Eurostat). Panel A: productivity; Panel B: capital intensity (excluding real estate); Panel C: Innovativeness manufacturing and services.

Source: EU KLEMS database; Eurostat

4.3 Summary of results (EU level aggregates)

This section first presented the analysis of FCs using the “bottom-up approach” whereby we compared the FC indicators’ values of *Target Sub-sectors* with those of “neighbouring” *Control Sub-sectors*, namely the *Narrow Control Sub-sectors*⁴³ and the *Broad Control Sub-sectors*.⁴⁴ We then used the “top-down approach” whereby we compared the *Target Groups* – i.e., *Target Sub-sectors* and *Target Sectors* – with all NACE 2-digit sectors (*Control Sectors*), hence encompassing the entire economy. Based on the results we computed the quintile which a *Target Sector* belongs to according to the BBI and RBI, respectively, and computed the *Mean Quintile Indicator* as the average of the two quintiles. Table 11 presents a synoptic view of the results.

⁽⁴³⁾ *Narrow Control Sub-sectors* are either the immediately upper-level NACE code that comprises the *Target Sub-sector*, or a group of firms at the same NACE level.
⁽⁴⁴⁾ *Broad Control Sub-sectors* are either the same letter-level NACE category of the *Target Sub-sector* or additionally including multiple letters.

According to the bottom-up approach, the BBI classifies as locally (financially) constrained⁴⁵ the smaller firms in *Extra-Urban Transport* and *Marine Fishing*, as well as the larger firms in *Defence Activities*, *Employment Agencies*, *Human Health*, *Marine Fishing*, *Residential Care* and *Social Work*; the RBI classifies as locally (financially) constrained the smaller firms in *Extra-Urban Transport* and larger firms in *Defence Activities*. Therefore, smaller firms in *Extra-Urban Transport* and larger firms in *Defence Activities* are found locally (financially) constrained according to both the BBI and the RBI; and both smaller and larger firms in *Marine Fishing* are found locally (financially) constrained according to the BBI.

According to the top-down approach to the analysis of *Target Sub-sectors*, the BBI classifies as globally (financially) constrained⁴⁶ the smaller firms in *Human Health* and *Marine Fishing*, as well as the larger firms in *Residential Care*; the RBI classifies as globally (financially) constrained the smaller and larger firms in *Urban Regeneration* and the larger firms in *Defence Activities*. Therefore, the two sets of globally (financially) constrained *Target Sub-sectors* identified by the BBI and RBI, respectively, do not overlap. The Mean Quintile Indicator reports smaller firms in *Marine Fishing* and larger firms in *Agricultural SMEs* and *Urban Regeneration* as globally (financially) constrained.

According to the top-down approach to the analysis of *Target Sectors*, the BBI classifies as globally (financially) constrained⁴⁷ smaller firms in *Activities of membership organisations*, *Fishing and aquaculture*, *Food and beverage service activities*, *Mining of coal and lignite*, *Mining of metal ores*, *Other personal service activities*, *Programming and broadcasting activities*, *Retail trade, except of motor vehicles and motorcycles*, *Sports activities and amusement and recreation activities*, and *Veterinary activities*; and larger firms in *Accommodation*, *Activities of extraterritorial organisations and bodies*, *Food and beverage service activities*, *Gambling and betting activities*, *Manufacture of basic metals*, *Manufacture of wood and of products of wood and cork, except furniture*, *Mining of metal ores*, *Postal and courier activities*, *Publishing activities*, and *Telecommunications*.

The RBI classifies as globally (financially) constrained smaller firms in *Activities of extraterritorial organisations and bodies*, *Construction of buildings*, *Extraction of crude petroleum and natural gas*, *Financial service activities, except insurance and pension funding*, *Mining of coal and lignite*, *Mining of metal ores*, *Mining support service activities*, *Real estate activities*, *Scientific research and development*, *Undifferentiated goods and services producing activities of private households for own use*; and larger firms in *Activities of extraterritorial organisations and bodies*, *Construction of buildings*, *Extraction of crude petroleum and natural gas*, *Financial service activities, except insurance and pension funding*, *Mining of coal and lignite*, *Mining of metal ores*, *Mining support service activities*, *Real estate activities*, *Scientific research and development*, and *Undifferentiated goods and services producing activities of private households for own use*.

Therefore, both the BBI and RBI indicate as globally (financially) constrained smaller firms in *Mining of coal and lignite* and *Mining of metal ores*. The BBI identifies all firms (smaller and larger) in *Food and beverage service activities* and *Mining of metal ores* as globally (financially) constrained; the RBI identifies all firms in *Construction of buildings*, *Mining support service activities*, and *Scientific research and development* as globally (financially) constrained.

As discussed in Section 3, the different results implied by the BBI and RBI based analyses might be explained by the different (and complementary) perspectives taken by the two indicators. Indeed, while the RBI further focuses on a *structural* perspective and identifies leverage⁴⁸ as the main determinant of FCs, the BBI further focuses on an *event* perspective, mainly identifying as financially constrained those companies unable to raise debt (or equity). Thus, for instance, if firms in *Marine Fishing* have more limited capacity to finance their activity, the BBI will record this as a sign of FCs, whereas the RBI's low leverage ratio will drive the measure in the opposite direction. Similarly, the resource extraction sectors tend to be capital intensive and highly leveraged, a feature that has a strong effect on the probability of being financially constrained according to the RBI.⁴⁹ On the contrary, service activities tend to have more difficulty in raising debt and equity finance, a feature that has a strong bearing on the degree of FC according to the BBI. Instead, larger firms display longer records and enhanced transparency so that access to finance is less of a problem and the divergence fades out.

⁽⁴⁵⁾ The *Target Sub-sector* is more financially constrained than its neighbouring *Control Sub-sectors*; see definition of terms.

⁽⁴⁶⁾ That is, they belong to the top quartile of the distribution of the FC indicator; see definition of terms.

⁽⁴⁷⁾ That is, they belong to the top decile of the distribution of the FC indicator; see definition of terms.

⁽⁴⁸⁾ Defined as the ratio of financial debts to assets; see definition of variables.

⁽⁴⁹⁾ This interpretation is supported by the results on the correlation between financial constraints and capital intensity, illustrated in section 4.2.

It is worth noting that whether under the bottom-up or the top-down approach, the BBI and the RBI report higher simple average – statistically speaking – than the corresponding weighted average. Therefore, both FC indicators identify smaller firms as more financially constrained than larger firms,⁵⁰ which is consistent with a widely recognised tenet of corporate finance: so much so that several authors use a measure of firm size as a proxy for the level of FCs.

Table 11. Financially constrained *Target Sub-sectors* and *Target Sectors* – EU-level aggregates

	Book Based Indicator BBI	Regression Based Indicator RBI	Mean Quintile indicator
Target Sub-sectors			
Simple average	Extra-Urban Transport [†] Human Health ^{**} Marine Fishing ^{†/ **}	Extra-Urban Transport [†] Urban Regeneration ^{***}	Marine Fishing ^{**}
Weighted average	Defence Activities [†] Employment Agencies [†] Human Health [†] Marine Fishing [†] Residential Care ^{†/ **} Social Work [†]	Defence Activities ^{†/ **} Urban Regeneration ^{**}	Agricultural SMEs ^{**} Urban Regeneration ^{**}
Target Sectors			
Simple average	Activities of membership organisations ^{***} Fishing and aquaculture ^{***} Food and beverage service activities ^{***} Mining of coal and lignite ^{***} Mining of metal ores ^{***} Other personal service activities ^{***} Programming and broadcasting activities ^{***} Retail trade, except of motor vehicles and motorcycles ^{***} Sports activities and amusement and recreation activities ^{***}	Activities of extraterritorial organisations and bodies ^{***} Construction of buildings ^{***} Extraction of crude petroleum and natural gas ^{***} Financial service activities, except insurance and pension funding ^{***} Mining of coal and lignite ^{***} Mining of metal ores ^{***} Mining support service activities ^{***} Real estate activities ^{***} Scientific research and development ^{***} Undifferentiated goods and services producing activities of private households for own	Accommodation ^{***} Activities of extraterritorial organisations and bodies ^{***} Activities of head offices, management consultancy activities ^{***} Air transport ^{***} Extraction of crude petroleum and natural gas ^{***} Fishing and aquaculture ^{***} Gambling and betting activities ^{***} Libraries, archives, museums and other cultural activities ^{***} Mining of coal and lignite ^{***} Mining of metal ores ^{***} Mining support service activities ^{***}

⁽⁵⁰⁾ While this result may be built in the specification of the RBI – which includes a negative coefficient on $\ln(\text{Assets})$ – it is an original outcome of the BBI. Also note that this result does not necessarily hold for the Mean Quintile Indicator, because of its ordinal nature.

	Book Based Indicator BBI	Regression Based Indicator RBI	Mean Quintile indicator
Weighted average	Veterinary activities***	use***	Other mining and quarrying*** Programming and broadcasting activities*** Publishing activities*** Sports activities and amusement and recreation activities***
	Accommodation***	Activities auxiliary to financial services and insurance activities***	Accommodation***
	Activities of extraterritorial organisations and bodies***	Activities of head offices: Management consultancy activities***	Activities of extraterritorial organisations and bodies***
	Food and beverage service activities***	Activities of households as employers of domestic personnel***	Forestry and logging***
	Gambling and betting activities***	Activities of membership organisations***	Manufacture of electrical equipment***
	Manufacture of basic metals***	Construction of buildings***	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials***
	Manufacture of wood and of products of wood and cork, except furniture***	Legal and accounting activities***	Mining of metal ores***
	Mining of metal ores***	Mining support service activities***	Printing and reproduction of recorded media***
	Postal and courier activities***	Other professional scientific and technical activities***	Publishing activities***
	Publishing activities***	Programming and broadcasting activities***	Sports activities and amusement and recreation activities***
Telecommunications***	Scientific Research and Development***	Telecommunications***	
			Warehousing and support activities for transportation***

Note: * Locally (financially) constrained *Target Sub-sectors*; ** Glocally (financially) constrained; *** Globally (financially) constrained. See definition of terms.

Source: Own elaboration

5 Further cross-country analysis

Results at EU level could be driven by few large Member States, thereby capturing the status of a small number of countries rather than general features across Europe. To explore this issue, we repeated the analyses carried out in chapter 4 using a cross-country approach.

5.1 Financial Constraints by Sub-sector: The Bottom-Up Approach (Cross-country averages)

The following tables and figures report the Bottom-Up Approach using cross-country averages: each indicator is computed at the country level and then (simply) averaged across countries.⁵¹

5.1.1 Book-based indicator – BBI (Cross-country averages)

The cross-country measures of BBI, Table 12 and Figure 9, suggest that three *Target Sub-sectors* – namely, *Human Health*, *Social Work* and *Urban Regeneration* – exhibit a degree of FCs higher than their respective *Control Sub-sectors* (both in simple and asset-weighted average). Larger firms in *Extra-Urban Transport*, *Marine Fishing*, *Residential Care*, and above all *Defence Activities*, also exhibit relatively high FCs.

According to the BBI method, the highest degree of FCs in absolute terms accrues to the *Target Sub-sector* of *Extra-Urban Transport* (larger firms).

Table 12. Cross-Country Averages of Book-Based Indicator [BBI] – *Target* and *Control Sub-sectors*

	Number of firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Agricultural SMEs	33,598	70,875	171	0.270	0.265	0.222	0.141	0.154	0.201
Defence Activities	1,548,222	336	1,278	0.271	0.214	0.272	0.125	0.193	0.146
Employment Agencies	1,040,653	9,594	180,451	0.267	0.226	0.249	0.112	0.098	0.109
Extra-Urban Transport	165,882	9,805	117,231	0.245	0.229	0.242	0.149	0.208	0.154
Human Health	100,501	3,972	1,106	0.267	0.292	0.258	0.153	0.189	0.129
Marine Fishing	906,526	117,916	285,607	0.266	0.264	0.263	0.109	0.160	0.116
Residential Care	906,526	11,650	285,607	0.266	0.246	0.263	0.109	0.171	0.116
Social Work	906,526	14,155	285,607	0.266	0.268	0.263	0.109	0.123	0.116
Urban Regeneration	574,245	187,441	97,351	0.247	0.248	0.247	0.113	0.127	0.115
Vocational/Adult Training	1,020,941	29,306	22,381	0.266	0.279	0.310	0.112	0.144	0.146

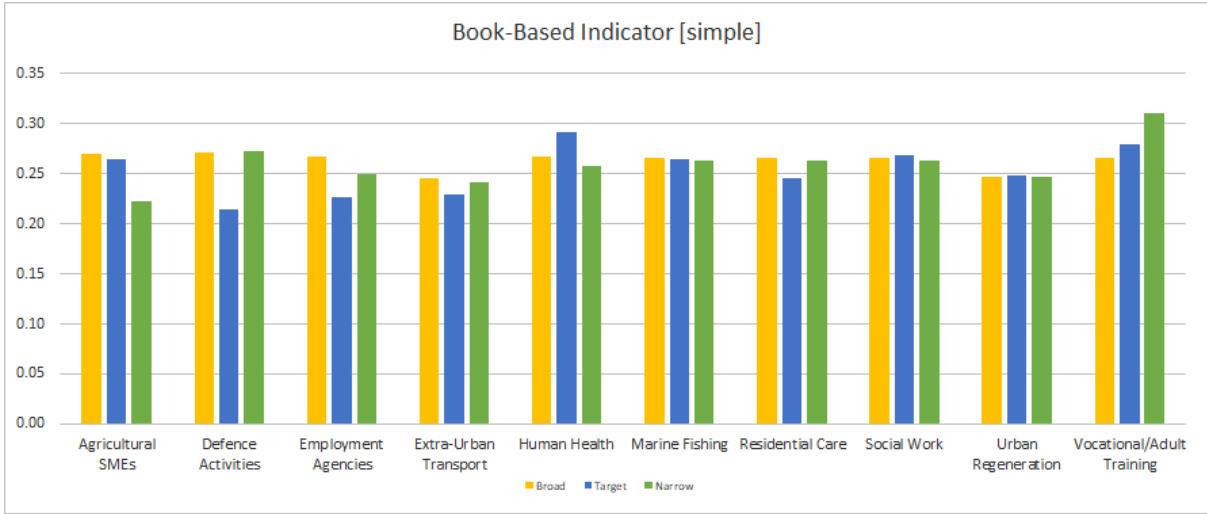
Note: This table reports the Book-Based Indicator values of FCs for *Target* and *Control Sub-sectors*. Yellow-coloured cells indicate the *Target Sub-sectors* whose BBI is larger than either their *Narrow Control Sub-sectors* or their *Broad Control Sub-sectors*. Red-coloured cells indicate the *Target Sub-sectors* whose BBI is larger than both their *Narrow* and *Broad Control Sub-sectors*.

Source: Own elaborations

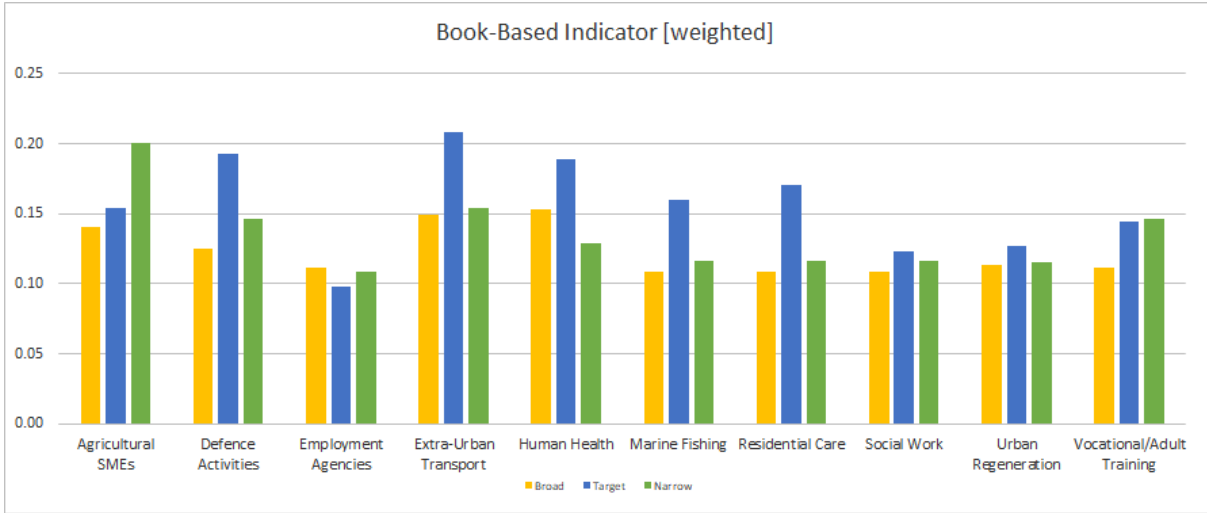
⁽⁵¹⁾ The number of countries covered by our sample is limited to 23, namely: Austria, Belgium, Bulgaria, Croatia, Czech Republic, Denmark, Estonia, Finland, France, Germany, Greece, Hungary, Ireland, Italy, Lithuania, Latvia, Netherlands, Poland, Portugal, Romania, Slovakia, Slovenia and Spain

Figure 9. Cross-Country Averages of Book-Based Indicators [BBI] – Target and Control Sub-sectors

Panel A: Simple average



Panel B: Weighted average



Note: Average Book-Based Indicator values of *Target* and *Control Sub-sectors*. *Narrow Control Sub-sectors* are represented by the right-hand green bars; *Broad Control Sub-sectors* are represented by the left yellow bars; *Target Sub-sectors* are the middle blue bars. Panel A reports simple averages; Panel B reports asset-weighted averages.

Source: Own elaborations

These results are not strikingly different from those at EU aggregate level, reported in Table 5 and Figure 3. However, some differences emerge: a few *Target Sub-sectors* are more financially constrained using cross-country averages, hence in smaller countries (*Urban Regeneration*, smaller firms in *Social Work*, *Human Health*, *Vocational/Adult Training*, and larger firms in *Extra-urban transport*), whereas other *Target Sub-sectors* are more financially constrained using EU-level averages, hence in larger countries (larger firms in *Employment Agencies*, smaller firms in *Extra-urban transport* and *Marine Fishing*).

5.1.2 Regression-Based Indicator – RBI (Cross-country averages)

Table 13 and Figure 10 report the results for the RBI using cross-country averages. As in the corresponding EU aggregate results presented in Table 6 and Figure 4, smaller firms in the *Extra-Urban Transport Target Sub-sector* are locally (financially) constrained.

Table 13. Cross-Country Averages of Regression-Based Indicator [RBI] – *Target* and *Control Sub-sectors*

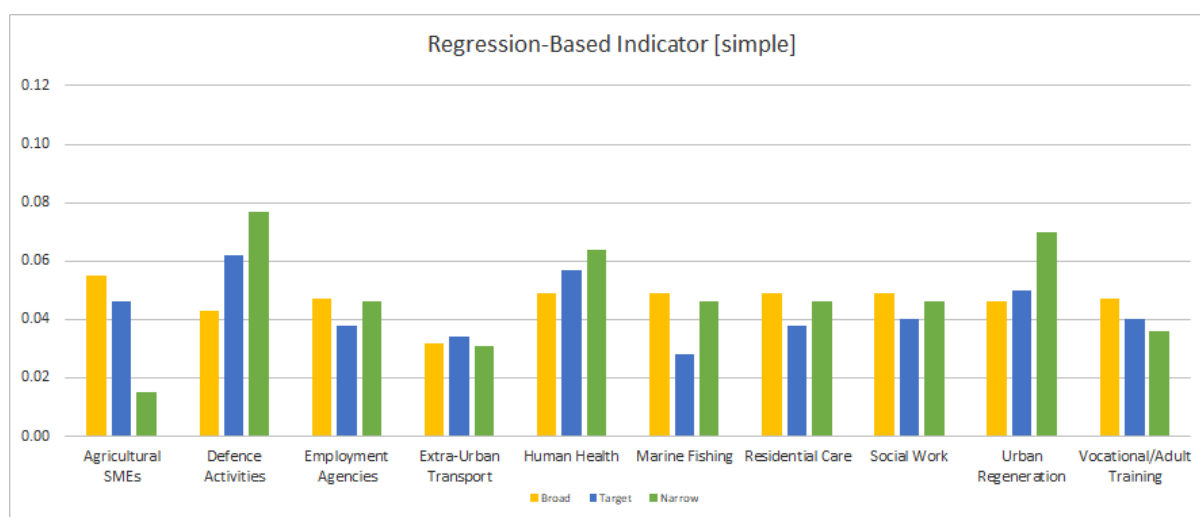
	Number of firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Agricultural SMEs	41,549	84,966	197	0.055	0.046	0.015	0.038	0.031	0.012
Defence Activities	1,802,518	352	1,508	0.043	0.062	0.077	0.046	0.043	0.070
Employment Agencies	1,222,553	13,140	218,340	0.047	0.038	0.046	0.069	0.017	0.043
Extra-Urban Transport	209,278	12,085	151,082	0.032	0.034	0.031	0.038	0.012	0.017
Human Health	122,349	4,166	1,619	0.049	0.057	0.064	0.036	0.042	0.081
Marine Fishing	1,094,536	113,613	352,869	0.049	0.028	0.046	0.072	0.021	0.048
Residential Care	1,094,536	11,591	352,869	0.049	0.038	0.046	0.072	0.052	0.048
Social Work	1,094,536	15,953	352,869	0.049	0.040	0.046	0.072	0.023	0.048
Urban Regeneration	648,662	234,286	101,880	0.046	0.050	0.070	0.051	0.062	0.116
Vocational/Adult Training	1,197,824	37,869	27,194	0.047	0.040	0.036	0.069	0.026	0.028

Note: This table reports the Regression-Based Indicator values of FCs for *Target* and *Control Sub-sectors*. Yellow-coloured cells indicate the *Target Sub-sectors* whose RBI is larger than either their *Narrow Control Sub-sectors* or their *Broad Control Sub-sectors*. Red-coloured cells indicate the *Target Sub-sectors* whose RBI is larger than both their *Narrow Control Sub-sectors* and their *Broad Control Sub-sectors*.

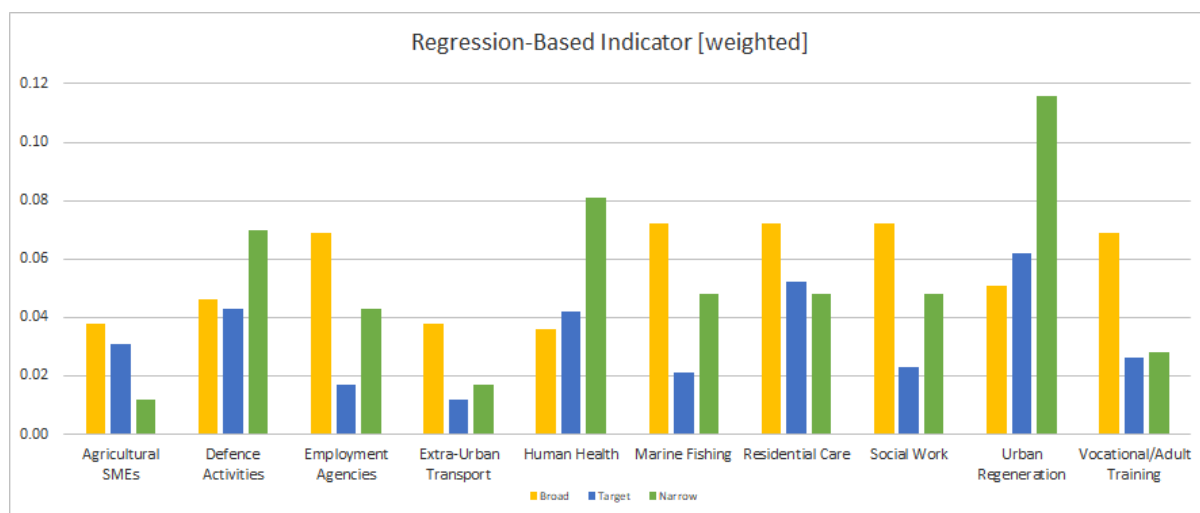
Source: Own elaborations

Figure 10. Cross-Country Averages of Regression-Based Indicator [RBI] – *Target* and *Control Sub-sectors*

Panel A: Simple average



Panel B: Weighted average



Note: Average Regression-Based Indicator values of *Target* and *Control Sub-sectors*. *Narrow Control Sub-sectors* are represented by the right-hand green bars; *Broad Control Sub-sectors* are represented by the left yellow bars; *Target Sub-sectors* are the middle blue bars. Panel A reports simple averages; Panel B reports asset-weighted averages.

Source: Own elaborations

Overall, the cross-country results in this section lend robustness to the EU-level results in the previous section on the *Target Sub-sectors* suffering from relatively more serious FC issues on the basis of the bottom-up approach. The only noteworthy remark concerns *Defence Activities*, which in smaller countries – that is, using cross-country averages – appear to be less financially constrained in larger firms, but more financially constrained in smaller firms.

5.2 Financial Constraints by Sector: The Top-Down Approach (*Cross-country averages*)

Like *Target Sub-sectors*, *Target Sectors* too may be unevenly financially constrained across countries, so that an EU-level analysis risks being incomplete. For instance, if a sector is financially constrained in all countries except one, and in the latter country the firms of the sector are numerous and large, this will drive down the overall EU level FCs index, even though firms are subject to FCs in most countries. As a result, we may miss sectors that are “frequently” constrained in the EU, but not so much in aggregate EU data.

In order to address the issue, we perform a robustness check similar to the analysis in Section 4.2, but appropriately modified to accommodate the top-down approach. We first modify the top-down approach as follows. In each country we rank all 99 2-digit NACE *Target Sectors* and the 10 *Target Sub-sectors* by BBI or RBI values. We define a dummy variable that takes the value 1 if, e.g., a sector’s BBI is above the country median sector-level BBI. We then compute the average value of the dummy variable across all countries.⁵² The procedure may be summarised as follows, say for BBI:

1. Rank all sectors in a country by BBI value;
2. Assign the value 1 to the sectors whose BBI is above median, 0 to the others;
3. For each sector, take the simple average of all the 1s and 0s that it is assigned in all countries.

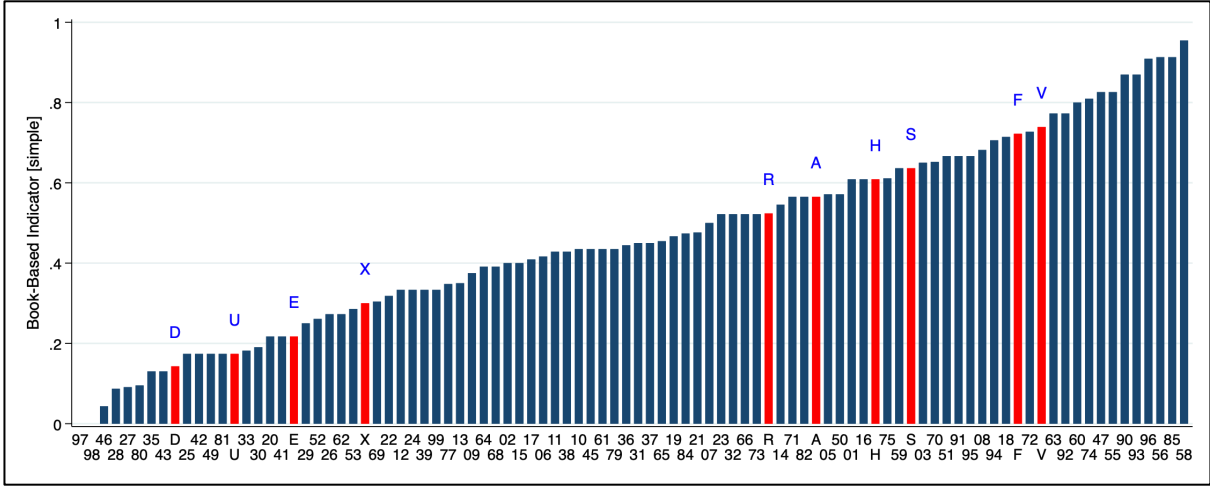
5.2.1 Book-based indicator – BBI (*Cross-country averages*)

The results for the BBI are reported in Figure 11, where we highlight in red the *Target Sub-sectors*.

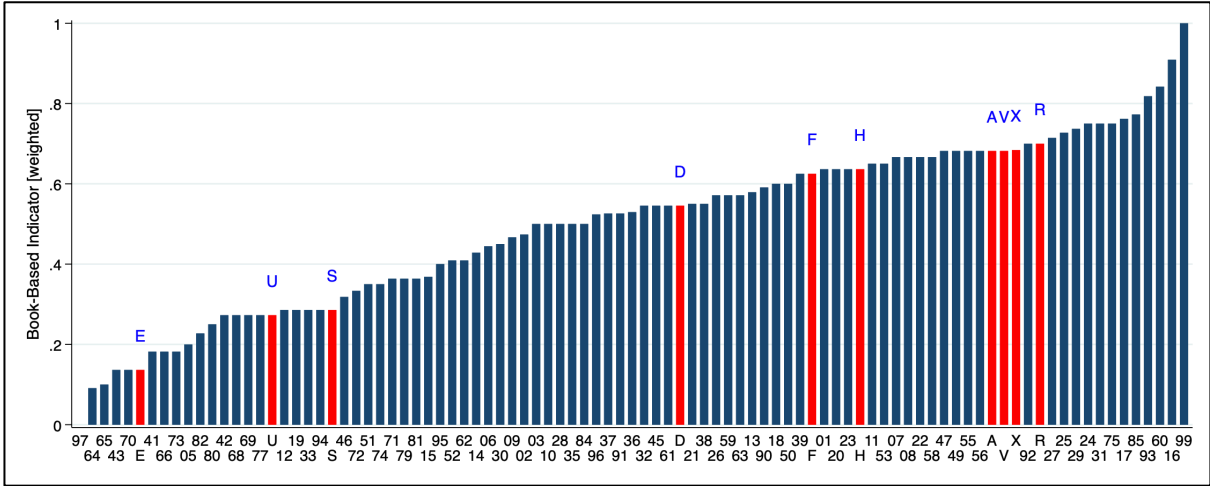
⁽⁵²⁾ Notice that we dismiss country-sectors whenever the number of reporting firms is less than ten.

Figure 11. Book-Based Indicator: Above Median Frequency

Panel A: Simple average



Panel B: Weighted average



Note: This figure reports the frequency of sector average Book-Based Indicator (BBI) values lying above country median of *Target Sub-sectors* (red) and 2-Digit NACE *Target Sectors* (blue). Abbreviations and definitions are reported in Table 2 and Table 4, respectively. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations

At the Sub-sector level, these results confirm that also from a frequency perspective, the 10 *Target Sub-sectors* do not exhibit severe FCs when compared with the 2-digit Sectors using the BBI. Two *Target Sub-sectors* rank in the top quartile in both the EU aggregate and the cross-country frequency estimates of the BBI, namely *Marine Fishing* (F) for smaller firms and *Residential Care* (R) for larger firms.

The frequency results should be compared with the sector ranking emerging from the EU aggregate view of the BBI (and Table 14). What emerges is that the top financially constrained sectors coincide only in 50% of the cases for smaller firms and in 30% of the cases for larger firms, confirming that the cross-sectional frequency methodology is able to bring out constrained sectors in smaller countries that would be overlooked by an EU-aggregate analysis. The results from Table 14 also confirm at the frequency level the different financial situation faced by smaller firms as compared with larger firms.

Table 14. Top ten financially constrained sectors according to BBI – comparison EU and cross-country level

EU level		Cross country	
Simple average	Weighted average	Simple average	Weighted average
Mining of coal and lignite (05)	Activities of extraterritorial organisations and bodies (99)	Publishing activities (58)	Activities of extraterritorial organisations and bodies (99)
Food and beverage service activities (56)	Telecommunications (61)	Education (85)	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials (16)
Other personal service activities (96)	Postal and courier activities (53)	Food and beverage service activities (56)	Programming and broadcasting activities (60)
Veterinary activities (75)	Publishing activities (58)	Other personal service activities (96)	Sports activities and amusement and recreation activities (93)
Activities of membership organisations (94)	Manufacture of basic metals (24)	Sports activities and amusement and recreation activities (93)	Education (85)
Mining of metal ores (07)	Manufacture of wood and of products of wood and cork, except furniture (16)	Creative, arts and entertainment activities (90)	Manufacture of paper and paper products (17)
Programming and broadcasting activities (60)	Gambling and betting activities (92)	Accommodation (55)	Veterinary activities (75)
Sports activities and amusement and recreation activities (93)	Food and beverage service activities (56)	Retail trade, except of motor vehicles and motorcycles (47)	Manufacture of furniture (31)
Retail trade, except of motor vehicles and motorcycle (47)	Mining of metal ores (07)	Other professional, scientific and technical activities (74)	Manufacture of basic metals (24)
Fishing and aquaculture (03)	Accommodation (55)	Programming and broadcasting activities (60)	Manufacture of motor vehicles, trailers and semi-trailers (29)

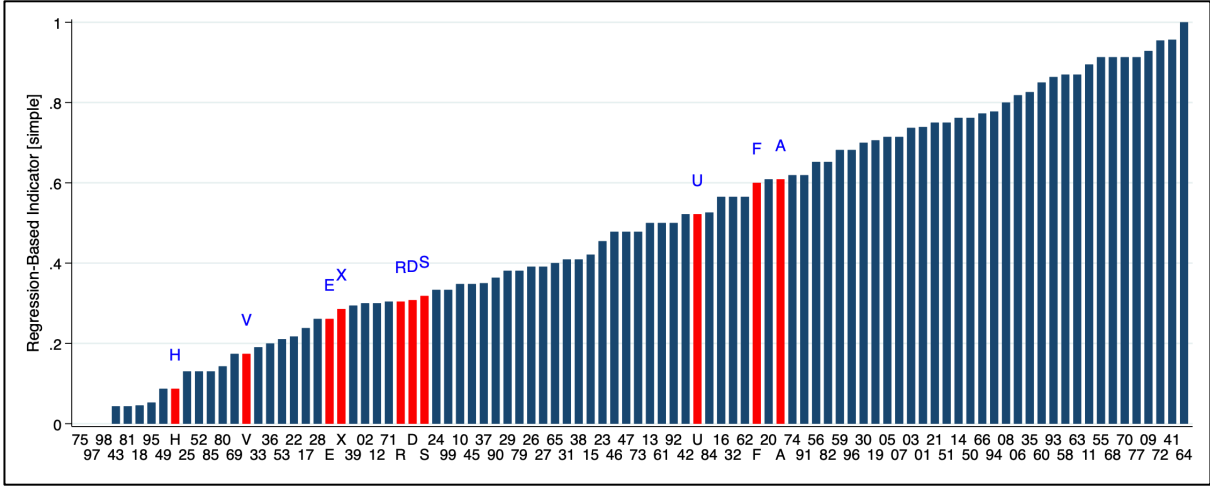
Source: Own elaborations

5.2.2 Regression-Based Indicator – RBI (*Cross-country averages*)

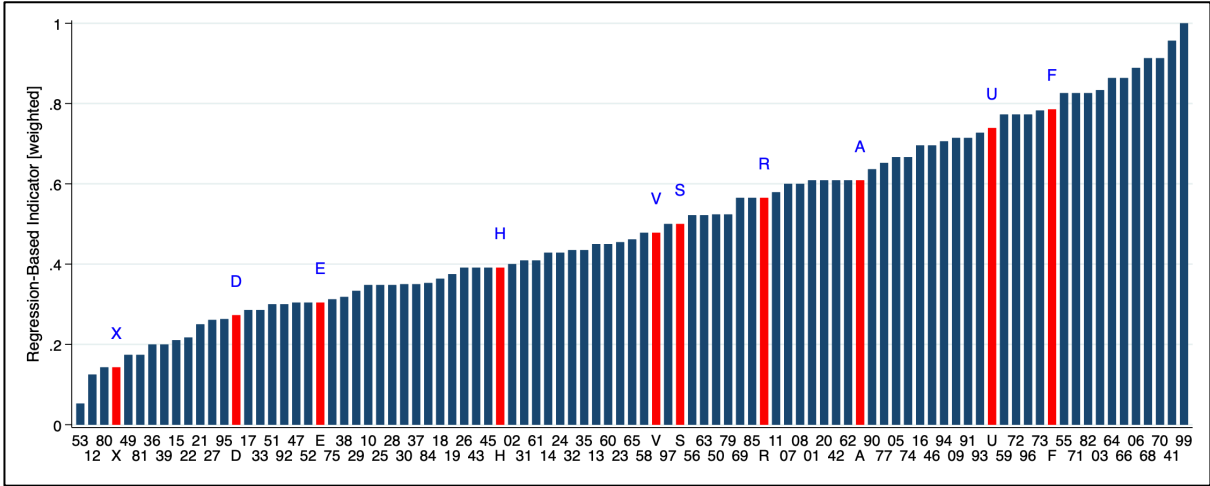
The results for the RBI are graphed in Figure 12, where we highlighted in red the Target Sub-sectors.

Figure 12. Regression-Based Indicator: Above Median Frequency

Panel A: Simple average



Panel B: Weighted average



Note: This figure reports the frequency of sector average Regression-Based Indicator (RBI) measures (left scale) lying above country median of *Target Sub-sectors* (red) and 2-Digit NACE *Target Sectors* (blue). Abbreviations and definitions are reported in Table 2 and Table 4, respectively. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations

At the Sub-sector level, these results confirm that also from a frequency perspective, the 10 Target Sub-sectors do not exhibit severe FCs when compared with the 2-digit Sectors using the RBI. Larger firms in Urban Regeneration (U) are among the most constrained Target Sub-sectors for both the EU aggregate and the cross-country frequency estimations of the RBI.

The frequency results should be compared with the sector ranking emerging from the EU aggregate view of the RBI. What emerges is that the top financially constrained sectors coincide only in 50% of the cases for smaller firms and in 30% of the cases for larger firms, confirming that the cross-sectional frequency methodology is able to bring out constrained sectors in smaller countries that would be overlooked by an EU-aggregate analysis. The results from Table 15 also confirm at the frequency level the different financial situation faced by smaller firms as compared with larger firms.

Once again, also from the frequency perspective the top constrained sectors partially coincide between the BBI and the RBI. In particular, only two Target Sectors are found with both indicators: Accommodation and Activities of extraterritorial organisations and bodies. Further, when comparing the categories of the sectors, the BBI indicates (again) more sectors related to services, while the RBI includes both service-related sectors and sectors related to manufacturing or resource extraction. This is again particularly clear for the simple averages, as in the analysis at EU-level. Therefore, again these diverging results can be explained by the different perspectives on FCs that the BBI and RBI provide, as illustrated in sub-section 3.1.3. For example, the resource extraction sectors tend to be capital intensive and highly leveraged, a feature that has a strong

effect on the probability of being financially constrained according to the RBI. On the contrary, service activities tend to have more difficulty in raising debt and equity finance, a feature that has a strong bearing on the degree of FC according to the BBI.

Table 15. Top ten financially constrained sectors according to RBI – comparison EU and Cross-Country levels

EU level		Cross country	
Simple average	Weighted average	Simple average	Weighted average
Extraction of crude petroleum and natural gas (06)	Activities auxiliary to financial services and insurance activities (66)	Financial service activities, except insurance and pension funding (64)	Activities of extraterritorial organisations and bodies (99)
Mining of metal ores (07)	Construction of buildings (41)	Construction of buildings (41)	Construction of buildings (41)
Financial service activities, except insurance and pension funding (64)	Programming and broadcasting activities (60)	Scientific research and development (72)	Activities of head offices; Management consultancy activities (70)
Activities of extraterritorial organisations and bodies (99)	Activities of membership organisations (94)	Mining support service activities (09)	Real estate activities (68)
Mining support service activities (09)	Activities of head offices; Management consultancy activities (70)	Rental and leasing activities (77)	Extraction of crude petroleum and natural gas (06)
Mining of coal and lignite (05)	Mining support service activities (09)	Activities of head offices; Management consultancy activities (70)	Activities auxiliary to financial services and insurance activities (66)
Scientific research and development (72)	Legal and accounting activities (69)	Real estate activities (68)	Financial service activities, except insurance and pension funding (64)
Construction of buildings (41)	Other professional scientific and technical activities (74)	Accommodation (55)	Fishing and aquaculture (03)
Real estate activities (68)	Scientific Research and Development (72)	Manufacture of beverages (11)	Office administration, office support and other business support activities (82)
Manufacture of tobacco (12)	Warehousing and support activities for transportation (52)	Information service activities (63)	Architectural and engineering activities; technical testing and analysis (71)

Source: Own elaborations

5.3 Summary of results (Cross-country averages)

When considering a (simple) average across countries – rather than an EU-level average – the main results in Table 11 change as reported in the following Table 16.

At the Sub-sector level, these results confirm that also from a frequency perspective, the 10 *Target Sub-sectors* do not exhibit severe FCs when compared with the 2-digit Sectors using either the BBI or the RBI. Smaller firms in *Marine Fishing* and larger firms in *Residential Care* are most constrained *Target Sub-sectors* for both the EU aggregate and the cross-country frequency estimations of the BBI; larger firms in *Urban Regeneration* are most constrained *Target Sub-sectors* for both the EU aggregate and the cross-country frequency estimations of the RBI.

At the sector level, the sector ranking emerging from the EU aggregate view of the BBI shows that the top financially constrained sectors coincide only in 50% of the cases for smaller firms and in 30% of the cases for larger firms, confirming that the cross-sectional frequency methodology is able to bring out constrained sectors in smaller countries that would be overlooked by an EU-aggregate analysis. The results from Table 16 also confirm at the frequency level the different financial situation faced by smaller firms as compared with larger firms.

Table 16. Financially constrained *Target Sectors* and *Target Sub-sectors* – Cross-country analysis

	Book Based Indicator BBI	Regression Based Indicator RBI
Target Sub-sectors		
Simple average	Human Health [*] Marine Fishing ^{**} Social Work ^{*/**} Urban Regeneration [*] Vocational Training ^{**}	Extra-Urban Transport [*]
Larger Firms	Agricultural SMEs ^{**} Defence Activities [*] Extra-Urban Transport ^{*/**} Human Health [*] Marine Fishing [*] Residential Care ^{*/**} Social Work [*] Urban Regeneration [*] Vocational Training ^{**}	Marine Fishing ^{**} Urban Regeneration ^{**}
Target Sectors		
Simple average	Accommodation ^{***} Creative, arts and entertainment activities ^{***} Education ^{***} Food and beverage service activities ^{***} Other personal service activities ^{***} Other professional, scientific and technical	Accommodation ^{***} Activities of head offices; Management consultancy activities ^{***} Construction of buildings ^{***} Financial service activities, except insurance and pension funding ^{***} Information service activities ^{***}

	Book Based Indicator BBI	Regression Based Indicator RBI
Larger firms	activities*** Programming and broadcasting activities*** Publishing activities*** Retail trade, except of motor vehicles and motorcycles*** Sports activities and amusement and recreation activities*** Activities of extraterritorial organisations and bodies*** Education*** Manufacture of basic metals*** Manufacture of furniture*** Manufacture of motor vehicles, trailers and semi-trailers*** Manufacture of paper and paper products*** Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials*** Programming and broadcasting activities*** Sports activities and amusement and recreation activities*** Veterinary activities***	Manufacture of beverages*** Mining support service activities*** Rental and leasing activities*** Real estate activities*** Scientific research and development*** Architectural and engineering activities; technical testing and analysis*** Activities auxiliary to financial services and insurance activities*** Activities of extraterritorial organisations and bodies*** Activities of head offices; Management consultancy activities*** Construction of buildings*** Extraction of crude petroleum and natural gas*** Financial service activities, except insurance and pension funding*** Fishing and aquaculture*** Office administration, office support and other business support activities*** Real estate activities***

Note: * Locally (financially) constrained *Target Sub-sectors*; ** Globally (financially) constrained; *** Globally (financially) constrained. See definition of terms.

Source: Own elaborations.

6 Conclusions

In this study we identify EU sectors with potential financial constraints (FCs), using state-of-the-art methods developed in the corporate finance literature. Our results are not clear-cut and univocal, as the various indicators do not all point to specific sectors. Indeed, our battery of robustness tests – listed in the Introduction – is so strict to challenge the validity of every individual method. However, some general conclusions can still be drawn, as they pass most robustness tests and/or hold across most indicators.

First, we compare 10 *Target Sub-sectors* to financial constraints to all NACE 2-digit sectors; the *Target Sub-sectors* are identified as vulnerable *a priori* based on desk research and expert opinions. Of these ten *Target Sub-sectors*, only **Urban Regeneration** appears once among the top ten constrained sectors using asset-weighted Regression Based Index (RBI) averages at EU-level. No other *Target Sub-sector* appears among the top 10 financially constrained sectors. This suggests that some sectors, other than the *a priori* identified *Target Sub-sectors*, may be more financially constrained. Part of the reason for the scarce presence of the 10 *a priori* identified *Target Sub-sectors* among the most financially constrained firms is probably the public good/externality features of those sub-sectors. In all likelihood, these *Target Sub-sectors* are already the target of effective public support – especially through grants – both at the national and international level. Therefore, their inherent financial difficulties may have already been addressed by European public institutions.⁵³

When ranking *Target Sectors*, NACE divisions in **mining, sports, transports and media and cultural services** stand out as particularly financially constrained. This is not surprising in light of our comment in the previous paragraph: activities like mining and sports do not belong to public goods typically supported by public grants – or at least not enough in proportion to the massive investments required.⁵⁴ As for media and cultural services, these activities suffer from the “curse of intangibles” – the difficulty of obtaining financing due to the difficulty of valuing the activities and the underlying assets.⁵⁵

The different analyses have shown that firstly, the factors for severe FCs differ between smaller and larger firms. This is evidently shown by the different rankings yielded by the simple and asset-weighted averages for the different methods. But even within the same *Target Sector* (or *Target Sub-sector*), smaller firms are confirmed to be more financially constrained than larger firms, as the corporate finance literature has long been arguing. Secondly, different factors for FCs apply to the different indicators: while the RBI focuses more on capital intensity, the BBI focuses more on difficulties to raise debt. These differences in perspective result in different financially constrained sectors and show that service-driven sectors are affected by different financially constraining factors than manufacturing or resource extraction related sectors.

An additional distinction should be made with reference to the aggregation method – which is the subject of the robustness test carried out in Chapter 5. When considering a (simple) average across countries – rather than an EU-level average – the main results in Table 7 change as reported in Table 16.

Beyond the results which are common across indicators and methodologies, specific elements of this study can be relevant for policy makers. For example, constrained sectors according to the BBI – which assesses the financing gap *in relation to investments* – can be of particular interest to EU investment policy as indicators of investment (financial) barriers. Similarly, constrained sectors according to the RBI – which looks forward to financial difficulties – can be of interest for financial stability forecasts. Furthermore, policy makers interested in the distribution of financial fragmentation issues across countries may find of relevance our cross-country analysis, which brings out financially constrained sectors in possibly under-represented smaller Member States. This difference may have been exacerbated in the post pandemic context, where countries may not be facing evenly the challenges posed by the supply-chain concerns and the relocation of the sourcing of inputs, which bear long-term implications for the single market and the capital market union: insufficient financial support to specific sectors may penalise economically some countries more than others.

⁽⁵³⁾ For example, *Human Health* provision is subsidized via the EU Health Programme, *Vocational Training* grants are financed by Erasmus+, *Urban Regeneration* through the European Regional Development Fund, etc.

⁽⁵⁴⁾ This conclusion is in line with the findings in Rajan and Zingales (1998) that some industries are more financially dependent than others since they have substantially larger liquidity needs, for example because of the initial project scale, the requirement for continuing investment, or the cash harvest period.

⁽⁵⁵⁾ Firms in sectors that are intrinsically associated with more tangible (harder) assets can pledge more collateral to access external funds (Braun, 2005; Claessens and Laeven, 2003).

Further analyses based on the present study could undertake different lines of research of interest to the policy maker. For example, it could be promising to explore the dynamics of the various indicators over time, to see whether the various indexes converge, or are more similar when looking at variations of FCs.⁵⁶ Another interesting line of research could explore in depth the factors which determine FCs at the sector level, including the already studied market structure, capital intensity and price, and intangible assets.⁵⁷

⁽⁵⁶⁾ Interesting first attempts in this direction have been carried out in Musso and Schiavo (2008) and Anesi (2019).

⁽⁵⁷⁾ These dimensions have been explored by papers like Braun and Raddatz (2016), and Ferrando, Pal, and Durante (2019).

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List of abbreviations and definitions

Definitions of terms

Book-Based Indicator (BBI)	Indicator of a firm's degree of financial constraint, based on accounting books (Ferrando et al. 2015)
Bottom-up approach	Construction of <i>Target Sub-sectors</i> and associated <i>Control Sub-sectors</i>
Control Sectors	All 2-digit NACE sectors associated with a specific <i>Target Sector</i>
Control Sub-sectors	Single or groups of industries neighbouring a <i>Target Sub-sector</i> . They can be <i>Narrow Control Sub-sectors</i> or <i>Broad Control Sub-sectors</i>
Broad Control Sub-sector	<i>Control Sub-sector</i> "farther" from the associated <i>Target Sub-sector</i>
Globally (financially) constrained	Belonging to the top decile of the distribution of a financial constraint indicator
Glocally (financially) constrained	Belonging to the top quartile of the distribution of a financial constraint indicator
Industry	Generic group of firms belonging to the same category
Locally (financially) constrained	Belonging to a <i>Target Sub-sector</i> financially more constrained than its neighbouring <i>Control Sub-sectors</i> .
Narrow Control Sub-sector	<i>Control Sub-sector</i> "closer" to the associated <i>Target Sub-sector</i>
Regression-Based Indicator (RBI)	Indicator of a firm's degree of financial constraint, based on regression estimates (Ferrando et al. 2015)
Relatively constrained	The intermediate degree of financial constraint of a firm according to the <i>Book-Based Indicator</i> (BBI)
Strongly constrained	The highest degree of financial constraint of a firm according to the <i>Book-Based Indicator</i> (BBI)
Target Group	Specific group of firms of interest to the analysis
Target Sector	Any 2-digit NACE sector of interest
Target Sub-sector	Specific single or group of industries that may a priori suffer from market failures and hence be financially constrained
Top-down approach	Construction of <i>Target Sectors</i> with all associated <i>Control Sectors</i> – in practice, identifying the 99 2-digit NACE sectors
(Financially) unconstrained	The lowest degree of financial constraint of a firm according to the <i>Book-Based Indicator</i> (BBI)

Definitions of variables

The following table reports the definitions of the variables and the ORBIS items. The first column reports the name of the variable; the second column the definition of the variables and the financial constraint indicators that use the variable. The Orbis item code is indicated in square brackets.

Table 17. Definitions of Variables used for the Construction of the Book- and Regression-Based Indicators

Variable	Definition [Orbis Code]
Book-based indicator	
Δ Debt	Year-on-year change in total debt (long-term debt [LTDB] + short-term debt [LOAN]).
Δ Equity	Year-on-year change in book-value of equity [SHFD] minus net income, after depreciation, interests, taxes, and extraordinary items [P/L].
Financing Gap	Amount of long-term and short-term investments requiring external financing. It equals Total Investment minus cash-flow [CF].
Total Investment	Equals the sum of the year-on-year change in total fixed assets [FIAS], Depreciation [DEPR] and year-on-year change in current assets [CUAS] minus the year-on-year change in cash [CASH]. = Δ FIAS + DEPR + Δ CUAS - Δ CASH
Regression-Based Indicator RBI	
$RBI = -1.88 + 0.71 \times Leverage + 0.28 \times Coverage - 0.51 \times Profit\ Margin - 0.21 \times Collateral - 1.20 \times Cash - 0.05 \times \ln(Assets)$	
Collateral	Ratio of tangible fixed assets [TFAS] to total assets [TOAS].
Cash-Holding	Ratio of cash-holding [CASH] to total assets [TOAS]. KZ uses previous period total assets.
Coverage	Ratio of interest payments [INTE] to EBITDA; EBITDA is the sum of EBIT [OPPL] and depreciation [DEPR]. Replace with Orbis EBITDA [EBTA] if missing.
Leverage	Ratio of the sum of long-term debt [LTDB] and short-term debt [LOAN] to total assets [TOAS]. Replace with zero if missing.
Long-Term Debt	Ratio of long-term debt [LTDB] to total assets [TOAS].
Profit Margin	Ratio of earnings before interests and taxes [OPPL] to sales [TURN].
Assets	Total assets in euros [TOAS]; WW uses constant 1997-dollar values.

Additional Variables used for Kaplan-Zingales 1997, Whited-Wu 2006, and Hadlock-Pierce 2010 indicators.

Variable	Definition [Orbis Code]
Assets	Total assets in euros [TOAS]; WW uses constant 1997-dollar values. FC indicator: Hadlock-Pierce 2010, Whited-Wu 2006
Age	Equals the year of report minus the incorporation year. FC Indicator: Hadlock-Pierce 2010
Cash-Flow	Ratio of cash-flow [CF] to total assets [TOAS]; KZ uses previous period total assets. We substitute cash-flow with the sum of net income [PL] and depreciation [DEPR] if missing. FC Indicator: Kaplan-Zingales 1997, Whited-Wu 2006
Cash-Holding	Ratio of cash-holding [CASH] to total assets [TOAS]. KZ uses previous period total assets. FC indicator: Kaplan-Zingales 1997
Dividend	Ratio of dividend payments [Dividend] to total assets [TOAS]; dividend payments equal the change in total equity [SHFD] minus net income after interests, taxes, depreciation, and extraordinary items [P/L]. FC indicator: Kaplan-Zingales 1997
Dividend dummy	Dummy variable that takes the value one if Dividend is strictly positive. FC indicator: Whited-Wu 2006
Financial Leverage	Ratio of total debt (long-term debt [LTDB] + short-term debt [LOAN]) to total external financing (total debt [LTDB+LOAN] + book value of equity [SHFD]). FC indicator: Kaplan-Zingales 1997
Long-Term Debt	Ratio of long-term debt [LTDB] to total assets [TOAS]. FC indicator: Whited-Wu 2006
Growth	Year-on-year change in operating revenues [OPRE]; we use turnover [TURN] if the operating revenues item is missing. FC indicator: Whited-Wu 2006
Industry Growth	Year-on-year 2-digit NACE industry median sales [SALE] growth. FC indicator: Whited-Wu 2006

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Annexes

Annex 1. Comparison with other financial constraint indicators

For completeness purposes, our standard measures of financial constraints (FCs) are compared with alternative FCs indicators, including the Kaplan-Zingales (1997), the Whited-Wu (2006), and the Hadlock-Pierce (2010) indices. These indicators are briefly described below.

Kaplan-Zingales Indicator [KZ]

In their seminal paper, Kaplan and Zingales (1997) analysed firms' FCs and produced a predicting model of FCs. The authors capture FCs by screening management statements in annual reports and looking for explicit statements of loan request denials. Based on their sample, they estimate the predicting model of FCs using financial information of firms. Lamont et al. (2001) refined the model by using a wider set of companies. Yet, the method adopted by Lamont et al. (2001) and Kaplan and Zingales (1997) makes a firm being listed a prerequisite; they could include the market-to-book value of equity in their model (so-called Tobin's Q).

In a subsequent analysis, Baker et al. (2003) applied the model proposed by Lamont et al. (2001) to unlisted firms, and showed in a panel of listed companies that Q has a negligible impact on the coefficients of the other explanatory variables and on the results overall. We apply the Baker et al. (2003) version of the Kaplan-Zingales index model to our sample of unlisted companies, and define the KZ indicator accordingly as follows:

$$KZ = -1.002 \times \text{Cash-Flow} + 3.139 \times \text{Financial Leverage} \\ -39.368 \times \text{Dividend Ratio} - 1.313 \times \text{Cash-Holdings}$$

where all variables are scaled with respect to beginning-of-the-year total assets and winsorised at 1% and 99% tails. *Dividend* is the ratio of dividend payments to total assets. Since *Dividend* is not directly available from the Orbis dataset for all countries, we construct a proxy for dividend payments by subtracting the change in total equity (Orbis item: *shareholder's fund*) from net profits after interests, taxes, and extraordinary items (Orbis item: *P/L for period [=Net income]*).⁵⁸ *Financial leverage* is the ratio of total debts (sum of short and long-term loans; Orbis items: *Long-Term Debt + Loans*) to total external financing (total debts plus equity; Orbis item: *Shareholders funds*). A higher KZ-Indicator indicates tighter FCs.

The Kaplan and Zingales index is a continuous variable calculated as predicted parameters from the model estimated by Kaplan and Zingales (1997), using US listed firms' financial statements. Higher index values capture tighter FCs.

The main difference between the KZ index and the RBI index adopted in this study is that the former estimates predicted values of FCs based on parameters calibrated on a small sample of low-dividend listed manufacturing US firms for the period from 1970 to 1984; on the contrary, the latter estimates predicted values of FCs based on (different) parameters calibrated on a sample of non-financial Euro-area firms for the period from 2013 to 2015. In addition, the role played by the *Dividend Ratio* in KZ's listed firms is likely to be muted in our RBI's sample of listed and unlisted firms.

Kaplan-Zingales – Bottom-up approach

Table A1.1. Kaplan-Zingales Indicator of *Target* and *Control Sub-sectors*.

	Number of Firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Agricultural SMEs	30,707	69,920	171	0.523	0.529	0.523	0.350	0.410	0.446
Defence	1,397,0	322	1,023	0.467	0.468	0.441	0.351	0.463	0.583

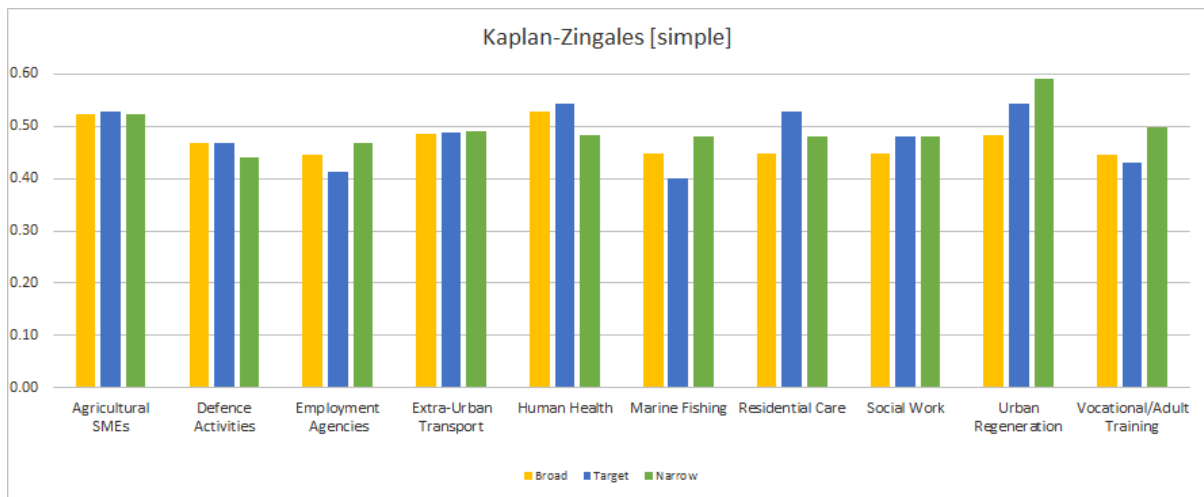
⁽⁵⁸⁾ Notice that the way we constructed dividend payments actually subtracts any recapitalisation (i.e., new equity injection) from dividend payments. Net negative dividend payments would thus suggest net recapitalisation – ignoring dividend payments. Our measure would correctly report no dividend payments. Thus, our measure is stronger than the standard dividend pay-out measure used in other studies.

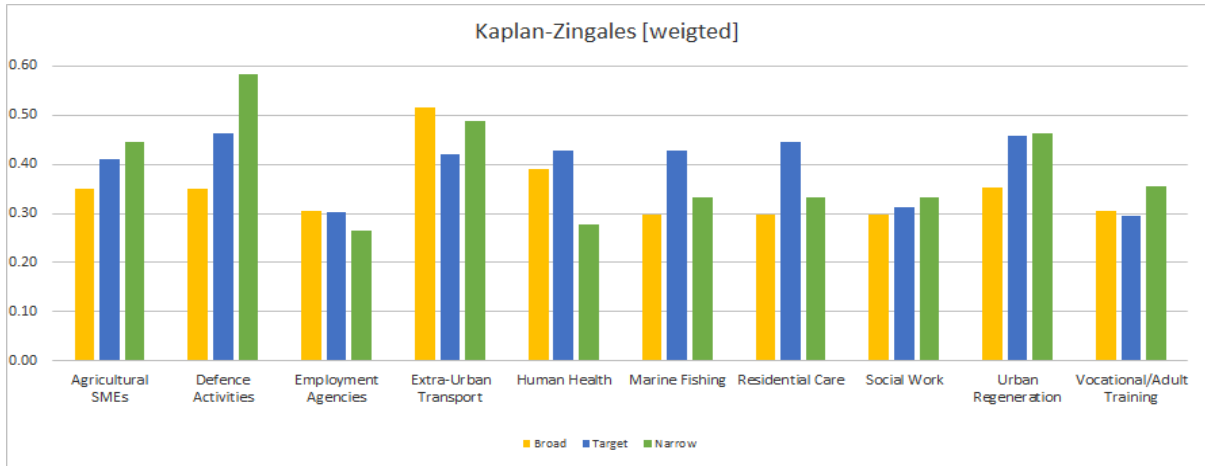
Activities	36								
Employment Agencies	918,847	8,702	166,059	0.444	0.413	0.469	0.305	0.302	0.265
Extra-Urban Transport	160,644	9,956	115,783	0.486	0.488	0.490	0.516	0.420	0.489
Human Health	97,059	3,568	1,131	0.527	0.544	0.483	0.390	0.428	0.278
Marine Fishing	801,616	101,935	260,713	0.447	0.399	0.480	0.298	0.428	0.333
Residential Care	801,616	11,079	260,713	0.447	0.528	0.480	0.298	0.445	0.333
Social Work	801,616	12,919	260,713	0.447	0.480	0.480	0.298	0.312	0.333
Urban Regeneration	534,550	172,046	86,977	0.483	0.542	0.591	0.352	0.458	0.462
Vocational/Adult Training	903,671	23,878	19,696	0.444	0.431	0.497	0.305	0.295	0.354

Note: This table reports the Kaplan-Zingales (KZ) index values of FCs for *Target* and *Control Sub-sectors*. Yellow-coloured cells indicate the *Target Sub-sectors* whose KZ value is larger than either their *Narrow Control Sub-sectors* or their *Broad Control Sub-sectors*. Red-coloured cells indicate the *Target Sub-sectors* whose KZ is larger than both their *Narrow* and *Broad Control Sub-sectors*.

Source: Own elaborations

Figure A1.1. Kaplan-Zingales Indicator of Target and Control Sub-sectors: Simple average and Weighted average.



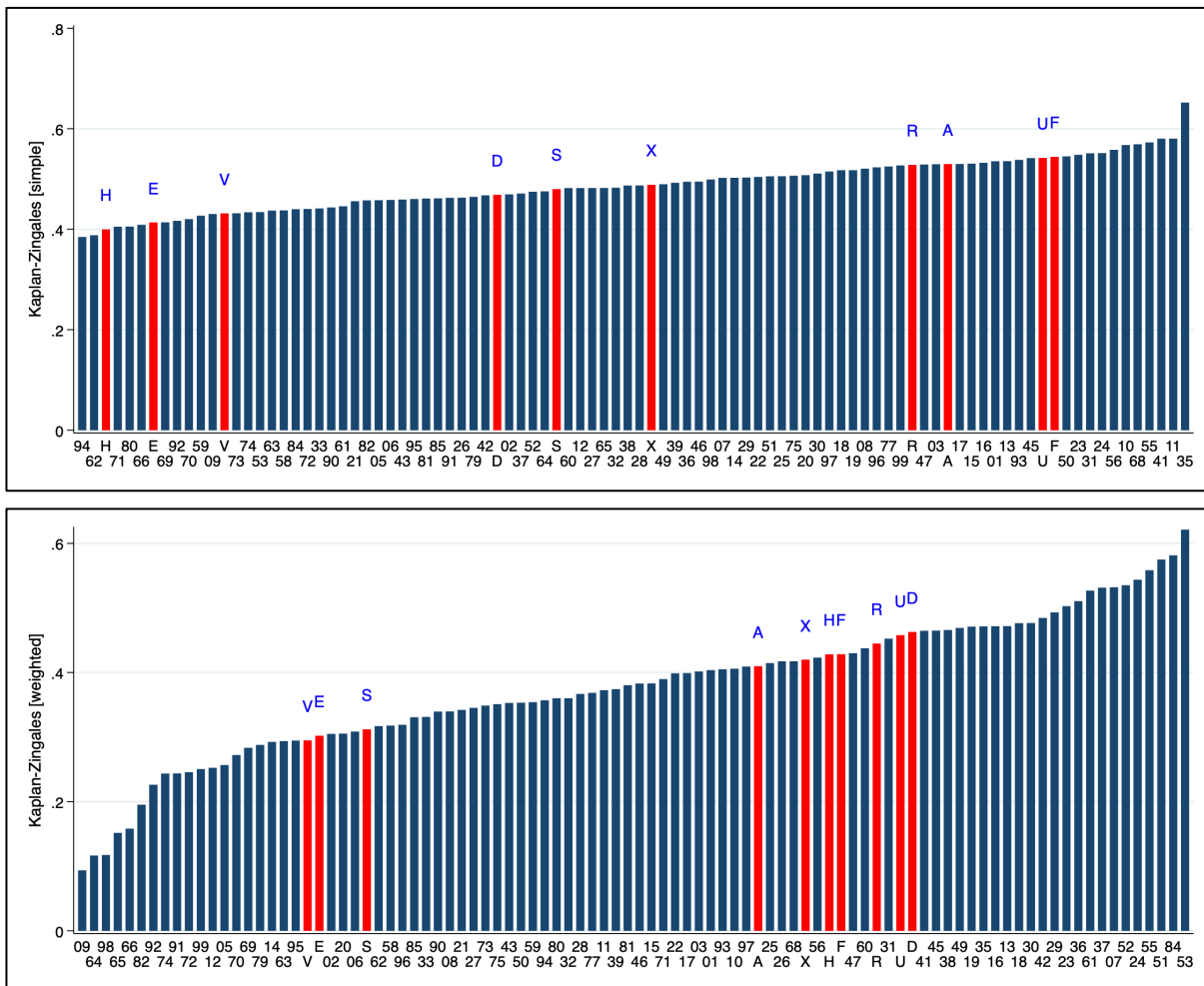


Note: Average Kaplan-Zingales (KZ) values of Target and Control Sub-sectors. Narrow Control Sub-sectors are represented by the right-hand green bars; Broad Control Sub-sectors are represented by the left-hand yellow bars; Target Sub-sectors are the middle blue bars. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations

Kaplan-Zingales – Top-down approach

Figure A1.2. Whited-Wu Indicator of Target and Control Sectors: Simple average and Weighted average.



Note: This figure reports the average Kaplan-Zingales (KZ) measures (left scale) of *Target Sub-sectors* (red) and 2-digit NACE *Target Sectors* (blue) – see abbreviations and definitions. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations.

Whited-Wu Indicator [WW]

The Whited and Wu index (WW) is a continuous variable, calculated as predicted values from the model estimated by Whited and Wu (2006). Like the KZ index, higher WW index values indicate tighter FCs, in particular equity. For easier comparability, we standardised both the KZ and WW indices.

We define the WW indicator as follows:

$$WW = -0.091 \times \text{Cash-Flow} + 0.062 \times \text{Dividend Dummy} + 0.021 \times \text{Long-Term Debt} \\ - 0.044 \times \text{Assets} + 0.102 \times \text{Industry Growth} - 0.035 \times \text{Growth}$$

Cash-flow is the ratio of operational cash flow to total assets and is provided by Orbis (Orbis item: *Cash flow*) and equals the sum of net profits after interests and taxes and before extraordinary items plus depreciation and amortisation. *Dividend Dummy* is a dummy variable that takes the value 1 if the firm paid dividends in the current year; dividend payment is estimated using the technique described in the KZ-Indicator. *Long-Term Debt* is long term financial debt (Orbis item: *Long-Term Debt*). *Assets* is the log of the total assets of the firm.⁵⁹ In order to match WW reported coefficients, we express the assets in 1997 million dollars; *Assets* captures the size of the firm. *Industry Growth* is the median sales growth in the industry of the firms at 2-digit NACE-Revision 2 code level. *Growth* is the firm's year-on-year sales growth. A higher WW-Indicator indicates tighter equity constraints.

The main differences between the WW index and the RBI index adopted in this report is that the former estimates predicted values of FCs based on parameters calibrated on a sample of non-financial listed US firms for the period from January, 1975 to April, 2001; on the contrary, the latter estimates predicted values of FCs based on (different) parameters calibrated on a sample of non-financial Euro area firms for the period from 2013 to 2015. In addition, the role played by the Dividend Dummy in WW's listed firms is likely to be muted in our RBI's sample of listed and unlisted firms.

Whited-Wu - Bottom-up approach

Table A1.2. Whited-Wu Indicator of *Target* and *Control Sub-sectors*.

	Number of Firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Agricultural SMEs	42,005	90,384	192	0.508	0.499	0.453	0.342	0.354	0.414
Defence Activities	1,803,178	358	1,321	0.509	0.484	0.494	0.329	0.395	0.335
Employment Agencies	1,217,106	13,013	214,334	0.513	0.506	0.510	0.279	0.308	0.274
Extra-Urban Transport	213,280	12,832	155,532	0.508	0.509	0.511	0.381	0.293	0.388
Human Health	128,233	4,156	1,843	0.502	0.504	0.513	0.351	0.342	0.273
Marine Fishing	1,089,872	113,989	347,447	0.514	0.509	0.516	0.276	0.364	0.285
Residential Care	1,089,872	11,214	347,447	0.514	0.493	0.516	0.276	0.338	0.285
Social Work	1,089,872	15,044	347,447	0.514	0.510	0.516	0.276	0.190	0.285

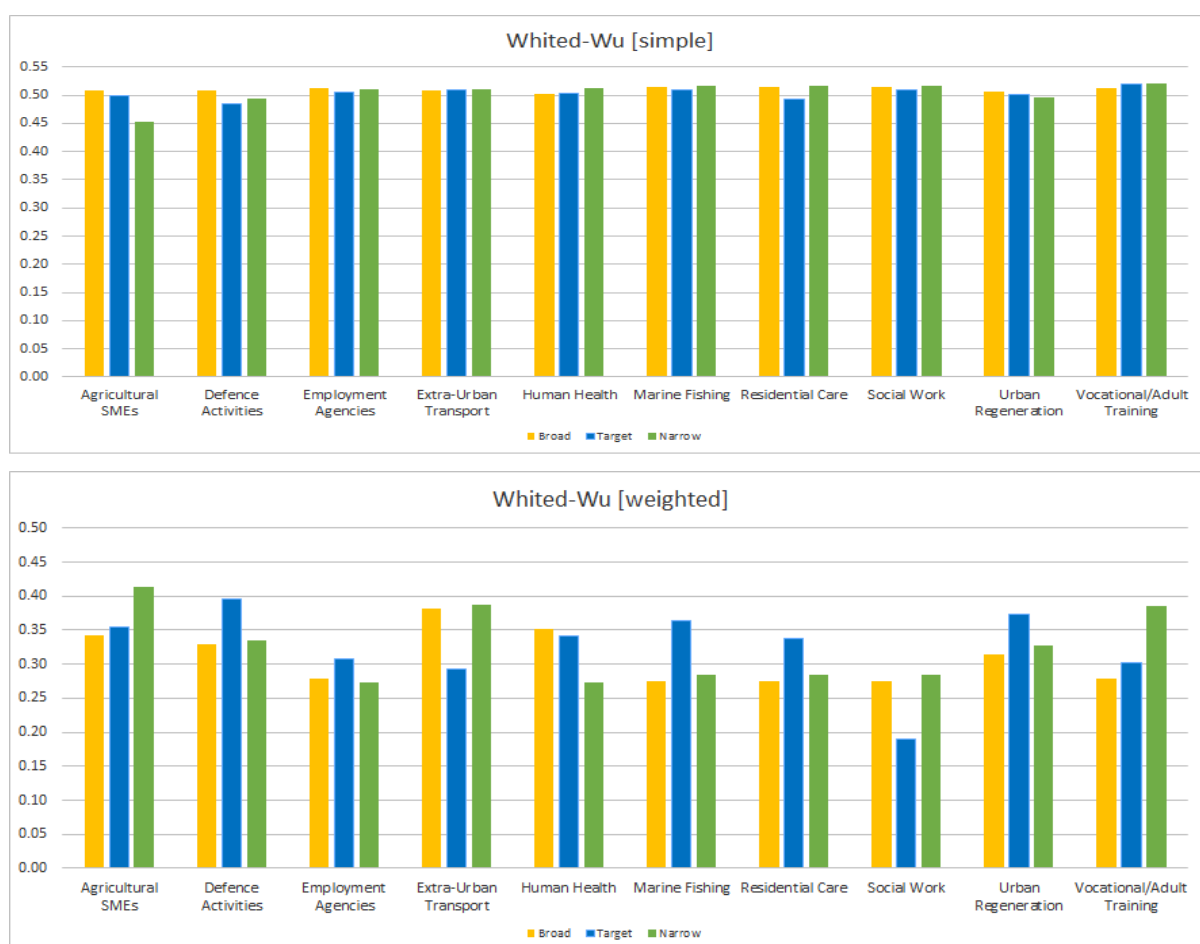
⁽⁵⁹⁾ As in the RBI, the negative coefficient attached to (log)Assets confirms a calibrated negative relation between a measure of firm size and the probability of financial constraints.

	Number of Firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Urban Regeneration	644,925	231,420	101,010	0.507	0.502	0.497	0.314	0.374	0.328
Vocational/Adult Training	1,192,541	37,578	27,254	0.513	0.519	0.520	0.279	0.303	0.385

Note: This table reports the Whited-Wu (WW) index values of FCs for *Target* and *Control Sub-sectors*. Yellow-coloured cells indicate the *Target Sub-sectors* whose WW value is larger than either their *Narrow Control Sub-sectors* or their *Broad Control Sub-sectors*. Red-coloured cells indicate the *Target Sub-sectors* whose WW value is larger than both their *Narrow* and *Broad Control Sub-sectors*.

Source: Own elaborations

Figure A1.3. Whited-Wu Indicator of Target and Control Sub-sectors: Simple average and Weighted average.

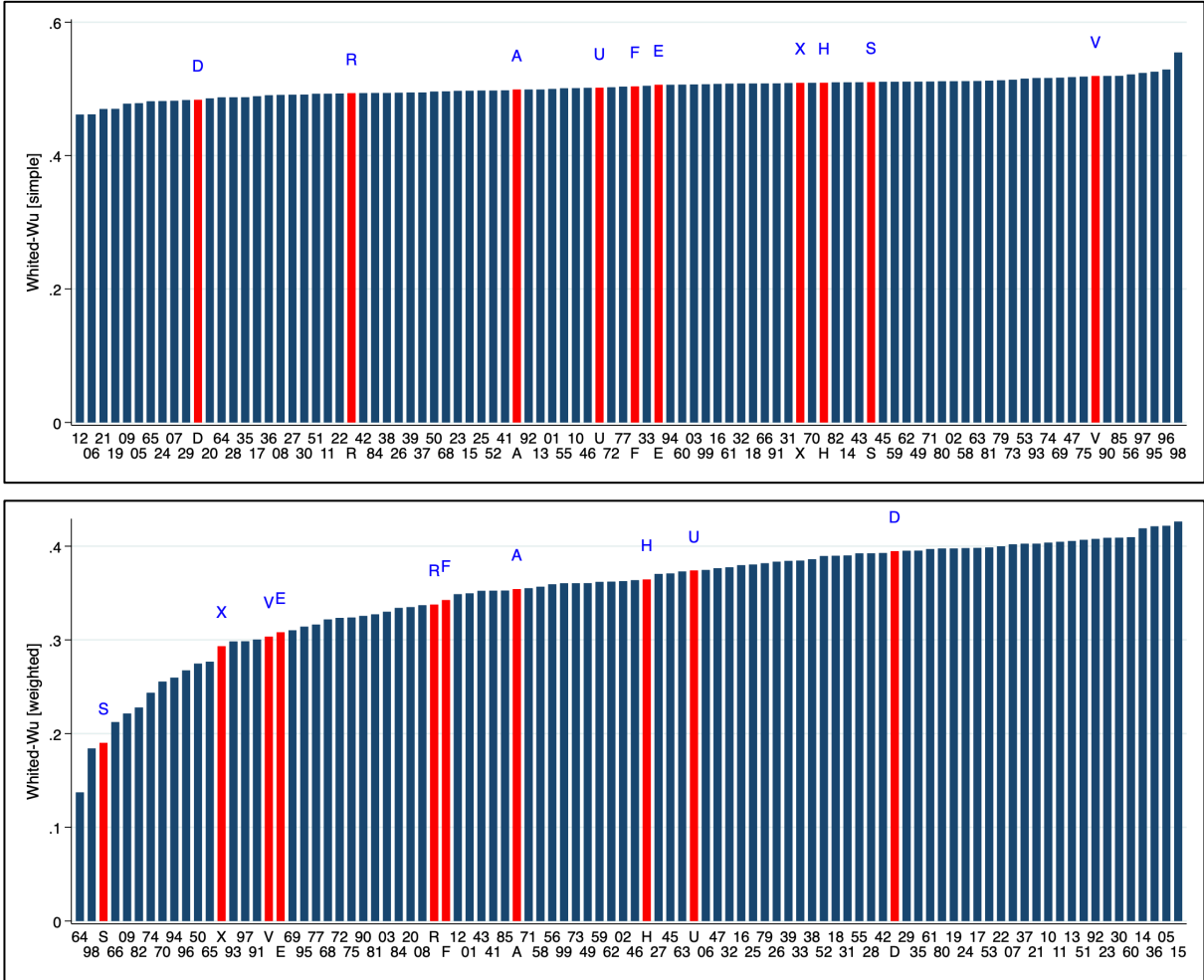


Note: Average Whited-Wu (WW) values of Target and Control Sub-sectors. Narrow Control Sub-sectors are represented by the right-hand green bars; Broad Control Sub-sectors are represented by the left-hand yellow bars; Target Sub-sectors are the middle blue bars. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations

Whited-Wu – Top-down approach

Whited-Wu Indicator of Target and Control Sectors: Simple average and Weighted average



Note: This figure reports the average Whited-Wu (WW) measures (left scale) of *Target Sub-sectors* (red) and 2-digit NACE *Target Sectors* (blue) – see abbreviations and definitions. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations

Hadlock-Pierce Indicator [HP]

Hadlock and Pierce (2010) suggest a measure of FCs using a strategy similar to Kaplan and Zingales (1997), and construct a wider and updated sample of listed firms. The authors identify age and size as the best and unbiased predictors of FCs. Their prediction model is as follows:

$$HP = -0.737 \times Size + 0.034 \times Size^2 - 0.040 \times Age$$

where *Size* is total assets in 2004-dollar values, and *Age* is the number of years since incorporation.⁶⁰ Higher index values indicate more severe FCs.⁶¹

The main differences between the HP index and the RBI index adopted in this report is that the former estimates predicted values of FCs based on parameters calibrated on a sample of non-financial listed US firms for the period from 1995 to 2004; on the contrary, the latter estimates predicted values of FCs based

⁶⁰ The model we use is the model reported by Hadlock and Pierce (2010) in Column (2) of Table 6. Because they use Compustat, a databank of US listed companies, the original model proxies the Age variable with the number of years since first appearance in the dataset (which roughly captures the number of years since listing date). We use instead the number of years since incorporation, as reported in Orbis; see the definitions of all variables.

⁶¹ Note that the HP index coefficients confirm the negative relationship between firm size and the probability of financial constraints.

on (different) parameters calibrated on a sample of non-financial Euro area firms for the period from 2013 to 2015.

Hadlock-Pierce- Bottom-up approach

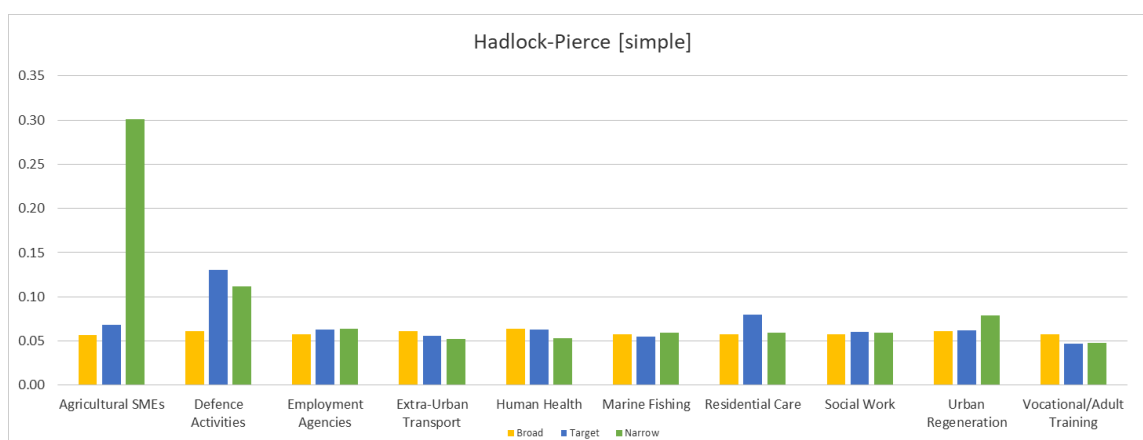
Table A1.2. Hadlock-Pierce Indicator of *Target* and *Control Sub-sectors*.

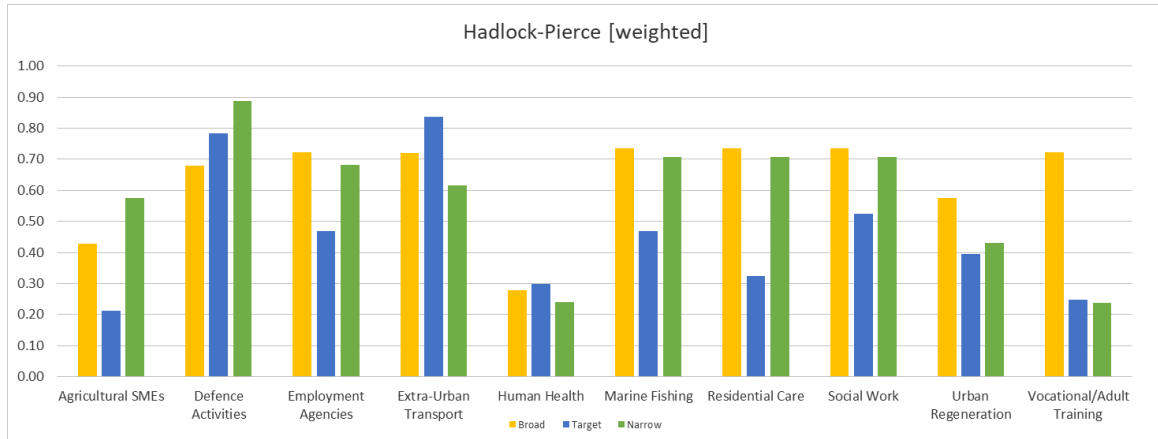
	Number of Firms			Simple average			Weighted average		
	Broad	Target	Narrow	Broad	Target	Narrow	Broad	Target	Narrow
Agricultural SMEs	70,407	122,205	211	0.057	0.068	0.301	0.429	0.212	0.576
Defence Activities	2,986,343	506	3,578	0.061	0.130	0.112	0.679	0.783	0.887
Employment Agencies	2,149,475	34,464	388,490	0.058	0.063	0.064	0.722	0.469	0.682
Extra-Urban Transport	312,657	17,659	213,402	0.061	0.056	0.052	0.719	0.836	0.616
Human Health	186,470	6,142	3,059	0.064	0.063	0.053	0.278	0.300	0.241
Marine Fishing	1,959,079	178,389	616,218	0.058	0.055	0.059	0.736	0.469	0.708
Residential Care	1,959,079	18,515	616,218	0.058	0.080	0.059	0.736	0.324	0.708
Social Work	1,959,079	27,956	616,218	0.058	0.060	0.059	0.736	0.524	0.708
Urban Regeneration	1,086,522	343,878	181,912	0.061	0.062	0.079	0.576	0.396	0.430
Vocational /Adult Training	2,127,609	56,330	38,591	0.058	0.047	0.048	0.722	0.248	0.239

Note: This table reports the Hadlock-Pierce (HP) index values of FCs for *Target* and *Control Sub-sectors*. Yellow-coloured cells indicate the *Target Sub-sectors* whose HP value is larger than either their *Narrow Control Sub-sectors* or their *Broad Control Sub-sectors*. Red-coloured cells indicate the *Target Sub-sectors* whose HP value is larger than both their *Narrow* and *Broad Control Sub-sectors*.

Source: Own elaborations

Figure A1.5. Hadlock-Pierce Indicator of Target and Control Sub-sectors: Simple average and Weighted average.



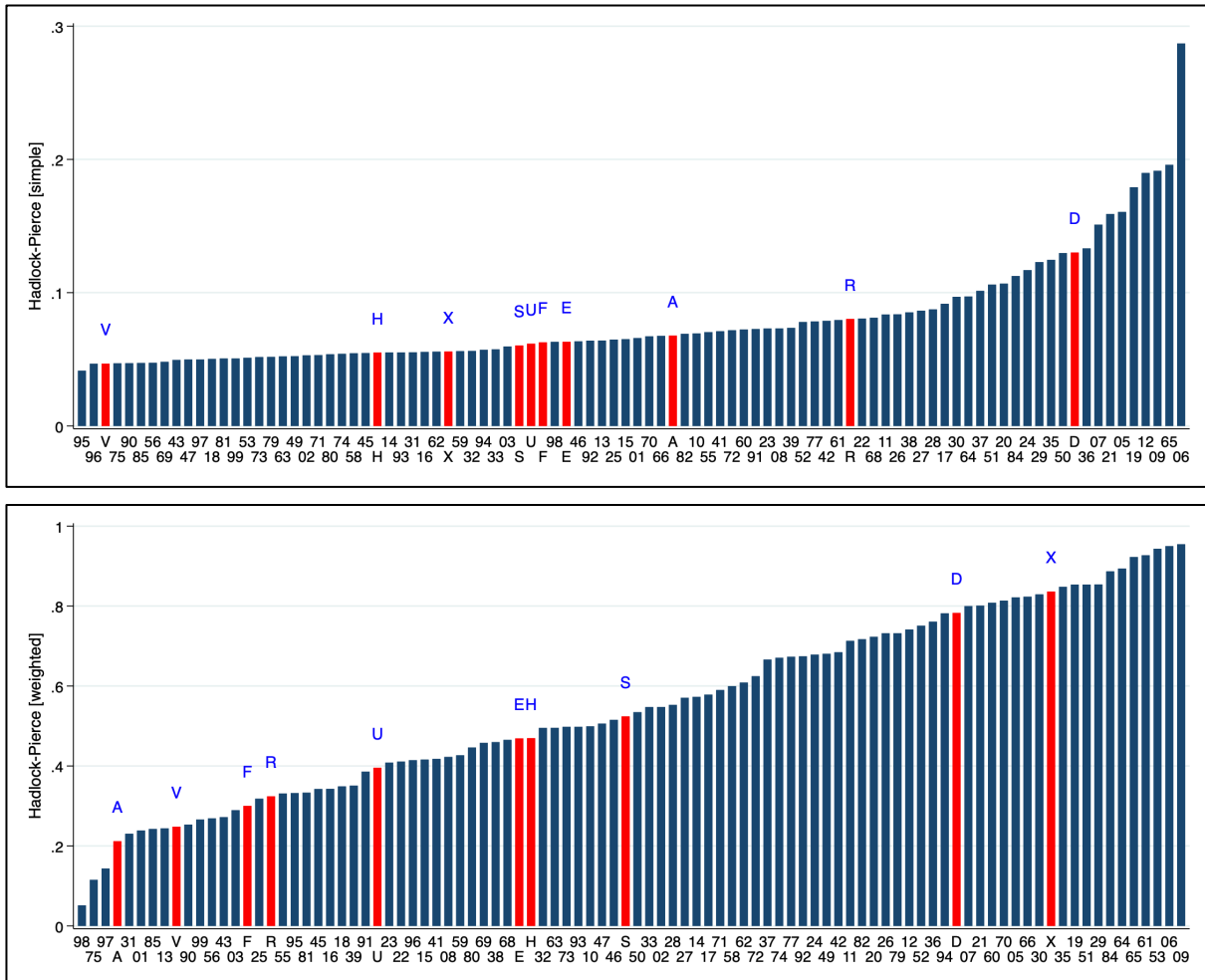


Note: Average Hadlock-Pierce (HP) values of Target and Control Sub-sectors. Narrow Control Sub-sectors are represented by the right-hand green bars; Broad Control Sub-sectors are represented by the left-hand yellow bars; Target Sub-sectors are the middle blue bars. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations

Hadlock-Pierce - Top-down approach

Figure A1.6. Hadlock-Pierce Indicator of Target and Control Sectors: Simple average and Weighted average.



Note: This figure reports the average Hadlock-Pierce (HP) measures (left scale) of Target Sub-sectors (red) and 2-digit NACE Target Sectors (blue) – see abbreviations and definitions. Panel A reports the simple averages; Panel B reports the asset-weighted averages.

Source: Own elaborations

Comparing All Indicators – the Bottom-Up Approach

In order to highlight the most financially constrained Sub-sectors with respect to the controls, Table A1.4 summarises the five FCs measures of the ten *Target Sub-sectors*, and summarises the results obtained in the *bottom-up* approach. The table highlights in yellow the FC indicators with values higher than either the *Narrow* or the *Broad Control Sub-sectors*, and in red the FC indicators with values higher than both the *Narrow* and the *Broad Control Sub-sectors*. Then, after assigning a FC score equal to 1 to the yellow values, and equal to 2 to the red values, in column “FC score” the table reports the total score of FC values for each of the 10 *Target Sub-sectors* (5 indices); Column “RBI & BBI” reports the sum of RBI and BBI indicators only.

Table A1.3. Financial Constraints for the 10 EU *Target Sub-sectors* – All Indicators

	BBI		RBI		KZ		WW		HP		FC Score	
	Smaller	Larger	Smaller	Larger	Smaller	Larger	Smaller	Larger	Smaller	Larger	RBI & BBI	5 indices
Agricultural SMEs	0.228	0.148	0.053	0.041	0.529	0.410	0.499	0.354	0.068	0.212	3	6
Defence Activities	0.200	0.118	0.040	0.061	0.468	0.463	0.484	0.395	0.130	0.783	3	9
Employment Agencies	0.201	0.091	0.038	0.013	0.413	0.302	0.506	0.308	0.063	0.469	2	5
Extra-Urban Transport	0.237	0.123	0.035	0.008	0.488	0.420	0.509	0.293	0.056	0.836	3	6
Human Health	0.245	0.157	0.060	0.028	0.544	0.428	0.504	0.342	0.063	0.300	2	8
Marine Fishing	0.244	0.158	0.026	0.029	0.399	0.428	0.509	0.364	0.055	0.469	4	8
Residential Care	0.220	0.163	0.039	0.020	0.528	0.445	0.493	0.338	0.080	0.324	2	10
Social Work	0.212	0.093	0.043	0.007	0.480	0.312	0.510	0.190	0.060	0.524	2	7
Urban Regeneration	0.209	0.127	0.069	0.078	0.542	0.458	0.502	0.374	0.062	0.396	3	9
Vocational/Adult Training	0.233	0.131	0.042	0.018	0.431	0.295	0.519	0.303	0.047	0.248	2	5

Note: This table presents, for each *Target Sub-sector*, the FC values of all indicators; then a score of 1 is assigned to values greater than either their *Narrow Control* or their *Broad Control Sub-sector* (coloured in yellow) and a score of 2 is assigned to the values greater than both their *Narrow* and their *Broad Controls*. The last two columns sum the FC scores over only the RBI & BBI indicators, and over all the indicators, respectively

Source: Own elaborations

Two results are worth stressing: first, some *Target Sub-sectors* clearly emerge as highly financially constrained; second, the results of the BBI and RBI indicators are broadly in line with those stemming from the other three indicators, thus confirming the robustness of our estimates.

Comparing All Indicators – the Top-Down Approach

Table A1.5 presents a comparison of all indicators for EU *Target Sectors*, both unweighted (panel A) and asset-weighted (panel B). Summary measures of FCs for each *Target Sector* are indicated in column "Mean Quintile 5 Indicators" – which reports the mean quintile for all 5 indicators – and in column "BBI-RBI Mean Quintile"– which reports the mean quintile for only the BBI&RBI indicators.

Table A1.4. Financial Constraints by NACE 2-digit – All Indicators

Panel A: Simple average

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
01	Agriculture	0.23	0.06	3.50	0.53	0.50	0.07	3.60
02	Forestry	0.25	0.04	3.00	0.47	0.51	0.05	2.80
03	Fishing	0.26	0.07	4.50	0.53	0.51	0.06	3.60
05	Mining	0.31	0.12	5.00	0.46	0.48	0.16	3.60
06	Nat. Gas	0.24	0.24	4.50	0.46	0.46	0.29	3.40
07	Mine Metal	0.27	0.19	5.00	0.50	0.48	0.15	3.80
08	Mine Other	0.24	0.07	4.50	0.52	0.49	0.07	3.60
09	Mine Service	0.24	0.13	4.50	0.43	0.48	0.19	3.20
10	Man. Food	0.25	0.04	3.50	0.57	0.50	0.07	3.60
11	Man. Beverages	0.21	0.07	3.00	0.58	0.49	0.08	3.40
12	Man. Tobacco	0.21	0.08	3.50	0.48	0.46	0.19	3.20
13	Man. Textile	0.22	0.05	2.50	0.54	0.50	0.06	3.20
14	Man. Apparel	0.23	0.05	4.00	0.50	0.51	0.06	3.60
15	Man. Leather	0.20	0.04	1.50	0.53	0.50	0.07	2.60
16	Man. Wood	0.24	0.05	3.50	0.53	0.51	0.06	3.40
17	Man. Paper	0.22	0.04	2.00	0.53	0.49	0.09	2.80
18	Man. Media	0.23	0.04	2.00	0.52	0.51	0.05	2.60
19	Man. Coke	0.22	0.07	4.00	0.52	0.47	0.18	3.60
20	Man. Chem.	0.21	0.05	2.00	0.51	0.49	0.11	2.80
21	Man. Pharma	0.22	0.06	3.00	0.46	0.47	0.16	2.80
22	Man. Rubber	0.22	0.04	1.50	0.50	0.49	0.08	2.60
23	Man. Mineral	0.24	0.05	4.00	0.55	0.50	0.07	3.80

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
24	Man. Metal	0.21	0.04	2.00	0.55	0.48	0.12	3.00
25	Man. Fabricated	0.21	0.03	1.00	0.51	0.50	0.06	2.20
26	Man. Computer	0.20	0.05	2.00	0.46	0.49	0.08	2.40
27	Man. Electr.	0.20	0.05	2.00	0.48	0.49	0.09	2.60
28	Man. Machinery	0.19	0.04	1.50	0.49	0.49	0.09	2.20
29	Man. Motor	0.21	0.04	1.50	0.50	0.48	0.12	2.60
30	Man. Transport	0.20	0.08	3.00	0.51	0.49	0.10	3.20
31	Man. Furniture	0.24	0.05	3.50	0.55	0.51	0.06	3.60
32	Man. Other	0.23	0.05	3.00	0.48	0.51	0.06	3.00
33	Repair	0.20	0.03	1.00	0.44	0.50	0.06	1.80
35	Electricity	0.21	0.08	3.00	0.65	0.49	0.12	3.40
36	Water Treatment	0.22	0.04	1.50	0.49	0.49	0.13	2.40
37	Sewerage	0.21	0.03	1.50	0.47	0.49	0.10	2.60
38	Waste	0.23	0.05	3.00	0.49	0.49	0.09	3.00
39	Remediation	0.21	0.05	2.00	0.49	0.49	0.07	2.60
41	Construction	0.22	0.09	3.50	0.58	0.50	0.07	3.60
42	Civil Eng.	0.20	0.05	2.50	0.47	0.49	0.08	2.60
43	Spec. Constr.	0.21	0.03	1.50	0.46	0.51	0.05	2.00
45	Wholesale-Retail	0.24	0.04	3.00	0.54	0.51	0.05	3.40
46	Wholesale	0.21	0.04	2.00	0.49	0.50	0.06	2.60
47	Retail	0.26	0.04	3.50	0.53	0.52	0.05	3.40
49	Transport	0.23	0.03	2.00	0.49	0.51	0.05	2.60
50	Transport Water	0.24	0.06	4.00	0.54	0.50	0.13	4.00
51	Transport Air	0.25	0.07	5.00	0.51	0.49	0.11	4.20
52	Warehousing	0.21	0.04	1.50	0.47	0.50	0.08	2.40
53	Postal	0.23	0.04	2.50	0.43	0.52	0.05	2.40
55	Accommodation	0.25	0.06	4.50	0.57	0.50	0.07	4.00

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
56	Food service	0.29	0.05	4.00	0.56	0.52	0.05	3.80
58	Publish.	0.25	0.06	4.50	0.44	0.51	0.05	3.40
59	Video, TV.	0.24	0.07	4.00	0.43	0.51	0.06	3.00
60	Broadcasting	0.27	0.08	5.00	0.48	0.51	0.07	3.80
61	Telecom.	0.24	0.05	3.50	0.45	0.51	0.08	3.20
62	Computer Prog.	0.22	0.05	2.50	0.39	0.51	0.06	2.40
63	Information	0.21	0.06	2.50	0.44	0.51	0.05	2.40
64	Financial services	0.23	0.17	4.00	0.48	0.49	0.10	3.40
65	Insurance	0.20	0.04	1.50	0.48	0.48	0.20	2.40
66	Aux. fin. services	0.23	0.05	3.50	0.41	0.51	0.07	3.00
68	Real Estate	0.22	0.09	3.50	0.57	0.50	0.08	3.60
69	Legal	0.22	0.03	1.50	0.41	0.52	0.05	2.00
70	Head offices	0.24	0.07	4.50	0.42	0.51	0.07	3.40
71	Architecture	0.23	0.04	2.50	0.40	0.51	0.05	2.40
72	Research	0.23	0.10	4.00	0.44	0.50	0.07	3.20
73	Advertising	0.23	0.04	2.50	0.43	0.51	0.05	2.40
74	Oth. Professional	0.24	0.05	3.50	0.43	0.52	0.05	3.00
75	Veterinary	0.27	0.03	3.00	0.51	0.52	0.05	3.20
77	Rental	0.23	0.07	3.50	0.52	0.50	0.08	3.60
78	Employment	0.20	0.04	1.00	0.41	0.51	0.06	1.80
79	Travel	0.22	0.05	3.00	0.46	0.51	0.05	2.80
80	Security	0.21	0.03	1.50	0.41	0.51	0.05	2.00
81	Landscaping	0.21	0.03	1.00	0.46	0.51	0.05	2.00
82	Administrative	0.23	0.05	3.50	0.46	0.51	0.07	3.20
84	Public admin.	0.24	0.04	3.00	0.44	0.49	0.11	3.00
85	Education	0.25	0.04	3.00	0.46	0.52	0.05	2.80
86	Human health	0.24	0.03	2.50	0.40	0.51	0.06	2.40

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
87	Residential care	0.22	0.04	2.00	0.53	0.49	0.08	2.80
88	Social work	0.21	0.04	2.00	0.48	0.51	0.06	2.80
90	Creative, Art.	0.25	0.05	4.00	0.44	0.52	0.05	3.20
91	Libraries	0.25	0.06	4.50	0.46	0.51	0.07	3.80
92	Gambling	0.25	0.06	4.50	0.42	0.50	0.06	3.20
93	Sports	0.27	0.07	4.50	0.54	0.52	0.06	4.20
94	Membership	0.27	0.05	4.00	0.38	0.51	0.06	2.80
95	Repair	0.26	0.03	3.00	0.46	0.53	0.04	2.80
96	Pers. Service.	0.28	0.05	4.00	0.52	0.53	0.05	3.60
97	Househ. employers	0.23	0.03	2.00	0.51	0.52	0.05	2.80
98	Undiff. Goods	0.22	0.10	3.50	0.50	0.55	0.06	3.60
99	Extraterritorial	0.25	0.15	4.50	0.53	0.51	0.05	3.40

PANEL B: Weighted average

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
01	Agriculture	0.15	0.04	4.00	0.40	0.35	0.24	2.80
02	Forestry	0.15	0.06	4.50	0.30	0.36	0.55	3.40
03	Fishing	0.15	0.03	3.50	0.40	0.33	0.29	2.60
05	Mining	0.07	0.03	2.00	0.26	0.42	0.82	3.00
06	Nat. Gas	0.05	0.05	2.50	0.31	0.37	0.95	3.00
07	Mine Metal	0.18	0.03	4.50	0.53	0.40	0.80	4.60
08	Mine Other	0.14	0.03	3.00	0.34	0.34	0.42	2.40
09	Mine Service	0.07	0.09	3.00	0.09	0.22	0.95	2.60
10	Man. Food	0.14	0.02	2.00	0.41	0.40	0.50	3.20
11	Man. Beverages	0.13	0.04	3.50	0.37	0.40	0.71	3.80
12	Man. Tobacco	0.07	0.01	1.00	0.25	0.35	0.74	1.80

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
13	Man. Textile	0.17	0.03	4.00	0.47	0.41	0.24	3.80
14	Man. Apparel	0.12	0.03	2.00	0.29	0.42	0.57	2.60
15	Man. Leather	0.12	0.02	2.00	0.38	0.43	0.42	2.80
16	Man. Wood	0.19	0.04	4.50	0.47	0.38	0.34	3.80
17	Man. Paper	0.15	0.02	3.00	0.40	0.40	0.58	3.20
18	Man. Media	0.18	0.04	4.50	0.48	0.39	0.35	4.00
19	Man. Coke	0.09	0.02	1.50	0.47	0.40	0.85	3.20
20	Man. Chem.	0.13	0.03	3.00	0.31	0.33	0.72	2.80
21	Man. Pharma	0.08	0.04	2.50	0.34	0.40	0.80	3.40
22	Man. Rubber	0.16	0.02	3.00	0.40	0.40	0.41	3.20
23	Man. Mineral	0.18	0.02	3.50	0.50	0.41	0.41	3.80
24	Man. Metal	0.19	0.03	4.00	0.54	0.40	0.68	4.20
25	Man. Fabricated	0.16	0.02	3.00	0.41	0.38	0.32	3.00
26	Man. Computer	0.12	0.04	3.00	0.42	0.38	0.73	3.60
27	Man. Electr.	0.16	0.05	4.50	0.35	0.37	0.57	3.40
28	Man. Machinery	0.15	0.02	2.50	0.37	0.39	0.55	3.00
29	Man. Motor	0.14	0.03	3.00	0.49	0.40	0.85	4.00
30	Man. Transport	0.11	0.03	2.50	0.48	0.41	0.83	4.00
31	Man. Furniture	0.16	0.03	3.50	0.45	0.39	0.23	3.20
32	Man. Other	0.13	0.02	2.00	0.36	0.38	0.50	2.60
33	Repair	0.10	0.05	3.00	0.33	0.38	0.55	3.00
35	Electricity	0.17	0.02	3.50	0.47	0.40	0.85	4.00
36	Water Treatment	0.12	0.06	3.50	0.51	0.42	0.76	4.20
37	Sewerage	0.16	0.01	2.50	0.53	0.40	0.67	3.80
38	Waste	0.16	0.02	3.00	0.47	0.39	0.46	3.20
39	Remediation	0.14	0.02	3.00	0.37	0.38	0.35	3.00
41	Construction	0.13	0.10	4.00	0.46	0.35	0.42	3.20

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
42	Civil Eng.	0.11	0.04	3.00	0.48	0.39	0.68	3.80
43	Spec. Constr.	0.12	0.02	1.50	0.35	0.35	0.27	1.80
45	Wholesale-Retail	0.14	0.02	2.50	0.46	0.37	0.34	2.80
46	Wholesale	0.14	0.03	2.50	0.38	0.36	0.52	2.80
47	Retail	0.18	0.03	3.50	0.43	0.38	0.51	3.40
49	Transport	0.14	0.01	2.00	0.47	0.36	0.68	3.00
50	Transport Water	0.11	0.03	2.50	0.35	0.27	0.53	2.40
51	Transport Air	0.14	0.02	2.00	0.57	0.41	0.85	3.80
52	Warehousing	0.16	0.07	4.50	0.53	0.39	0.75	4.40
53	Postal	0.20	0.01	3.00	0.62	0.40	0.94	4.20
55	Accommodation	0.18	0.04	4.50	0.56	0.39	0.33	3.80
56	Food service	0.18	0.03	3.50	0.42	0.36	0.27	3.00
58	Publish.	0.19	0.07	5.00	0.32	0.36	0.60	3.60
59	Video, TV.	0.16	0.05	4.00	0.35	0.36	0.43	3.20
60	Broadcasting	0.14	0.09	4.00	0.44	0.41	0.81	4.40
61	Telecom.	0.22	0.04	4.50	0.53	0.40	0.93	4.60
62	Computer Prog.	0.13	0.02	2.50	0.32	0.36	0.61	2.80
63	Information	0.13	0.03	2.50	0.29	0.37	0.50	2.40
64	Financial services	0.03	0.07	3.00	0.12	0.14	0.89	2.60
65	Insurance	0.03	0.03	2.00	0.15	0.28	0.92	2.20
66	Aux. fin. services	0.03	0.12	3.00	0.16	0.21	0.82	2.60
68	Real Estate	0.12	0.05	3.50	0.42	0.32	0.47	3.00
69	Legal	0.12	0.07	3.50	0.28	0.31	0.46	2.20
70	Head offices	0.07	0.09	3.00	0.27	0.26	0.81	2.60
71	Architecture	0.11	0.03	2.50	0.39	0.36	0.59	2.60
72	Research	0.12	0.07	3.50	0.25	0.32	0.62	2.80
73	Advertising	0.11	0.03	2.50	0.35	0.36	0.50	2.60

Sector	Abbr.	BBI	RBI	Mean Quintile BBI-RBI	KZ	WW	HP	Mean Quintile 5 Indicators
74	Oth. Professional	0.08	0.07	3.00	0.24	0.24	0.67	2.40
75	Veterinary	0.15	0.03	3.50	0.35	0.32	0.12	2.40
77	Rental	0.09	0.03	2.00	0.37	0.32	0.67	2.60
78	Employment	0.09	0.01	1.00	0.30	0.31	0.47	1.40
79	Travel	0.14	0.01	2.00	0.29	0.38	0.73	2.60
80	Security	0.11	0.01	1.50	0.36	0.40	0.45	2.40
81	Landscaping	0.11	0.02	1.50	0.38	0.33	0.33	1.80
82	Administrative	0.06	0.03	2.50	0.20	0.23	0.72	2.20
84	Public admin.	0.04	0.04	2.50	0.58	0.33	0.89	3.40
85	Education	0.16	0.03	3.00	0.33	0.35	0.24	2.20
86	Human health	0.16	0.03	3.50	0.43	0.36	0.47	3.20
87	Residential care	0.16	0.02	2.50	0.44	0.34	0.32	2.40
88	Social work	0.09	0.01	1.00	0.31	0.19	0.52	1.60
90	Creative, Art.	0.14	0.04	3.50	0.34	0.33	0.25	2.40
91	Libraries	0.16	0.03	3.50	0.24	0.30	0.39	2.20
92	Gambling	0.19	0.02	3.00	0.23	0.41	0.67	3.20
93	Sports	0.17	0.05	4.50	0.40	0.30	0.50	3.40
94	Membership	0.14	0.09	4.00	0.36	0.26	0.78	3.20
95	Repair	0.12	0.03	3.00	0.29	0.31	0.33	2.00
96	Pers. Service.	0.11	0.05	3.00	0.32	0.27	0.41	2.20
97	Househ. employers	0.06	0.15	3.00	0.41	0.30	0.14	2.40
98	Undiff. Goods	0.11	0.01	1.50	0.12	0.18	0.05	1.20
99	Extraterritorial	0.22	0.06	5.00	0.25	0.36	0.27	3.00

Note: The table reports the Book-Based Indicators, Regression-Based Indicators, Mean Quintile Indicators of Book- and Regression-Based Indicators, Kaplan-Zingales, Whited-Wu, Hadlock-Pierce, and the Mean Quintile Indicators of all five measures. Note that the two Mean Quintile Indicators are in a different unit than the other indicators, but are comparable between themselves.

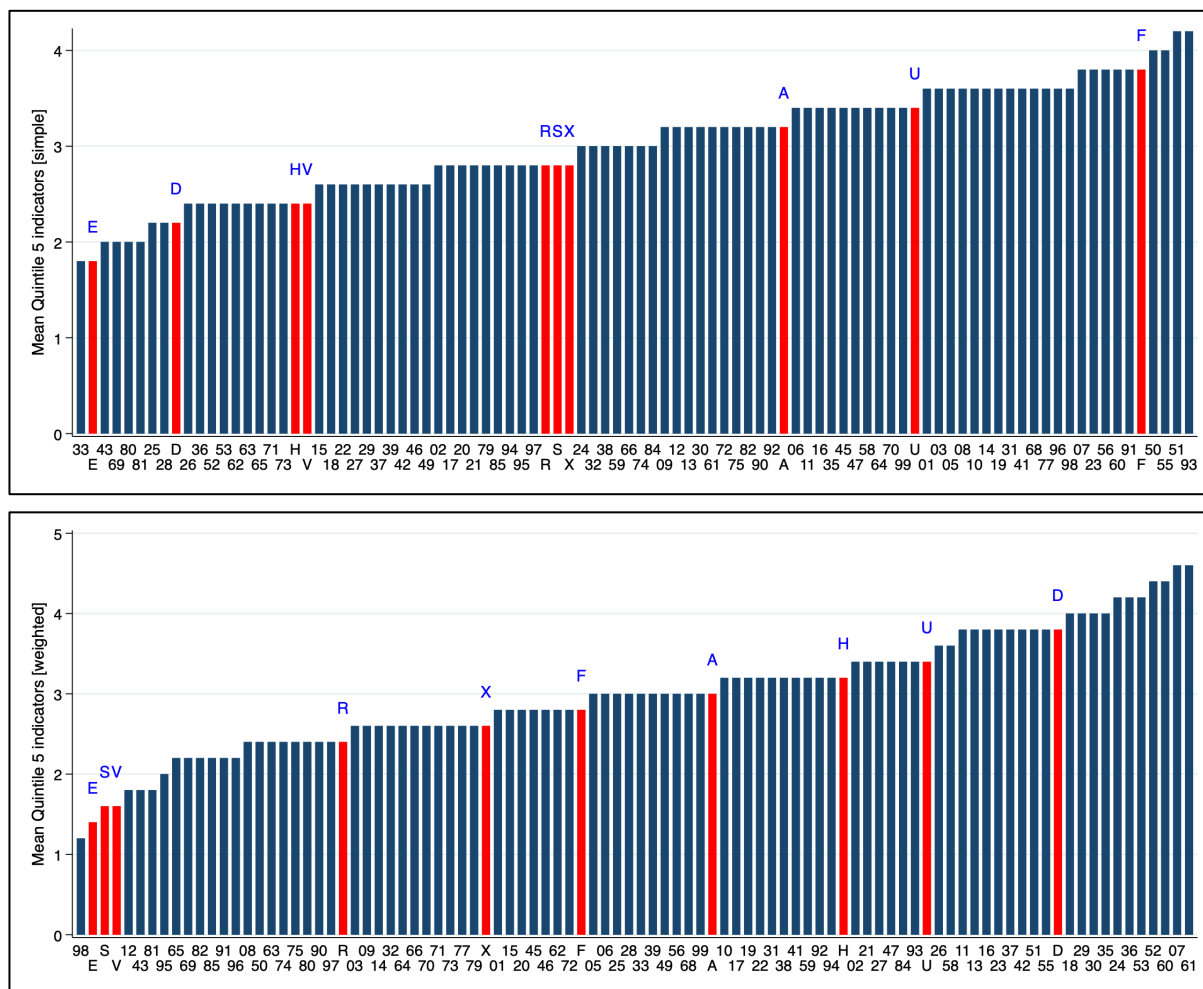
Source: Own elaborations

The above table shows that, despite the BBI and RBI indexes offer different results in some cases compared to the KZ, WW and HP indicators, some sectors exhibit high degrees of FCs across all the indicators. The most likely sectors to be constrained according to the majority of the adopted indexes are for smaller firms (Panel

A): [mean=4.20] *Air transport* (51), *Sports activities and amusement and recreation activities* (93); [mean=4.00] *Water Transport* (50), *Accommodation* (55); [mean=3.80] *Mining of metal ores* (07), *Manufacturing of other non-metallic mineral products* (23), *Food and beverage service activities* (56), *Programming and broadcasting activities* (60), *Libraries, archives, museums and other cultural activities* (91).

Panel B, focussing on larger firms, shows that the most likely sectors to be constrained are: [mean=4.60] *Mining of metal ores* (07), *Telecommunications* (61); [mean=4.40] *Warehousing and support activities for transportation* (52), *Programming and broadcasting activities* (60); [mean=4.20] *Manufacture of basic metals* (24), *Water collection, treatment and supply* (36), *Postal and courier activities* (53); [mean=4.00] *Printing and reproduction of recorded media* (18), *Manufacture of motor vehicles, trailers and semi-trailers* (29), *Manufacture of other transport equipment* (30), *Electricity, gas, steam and air conditioning supply* (35).

Figure A1.7. Financial Constraints by NACE 2-digit – Mean Quintile Indicator of all indicators: Simple average and Weighted average.



Source: Own elaborations

Top sectors are reported in Table A1.5 (bis) together with the average of the simple and asset-weighted mean quintiles. Overall, *Mining of metal ores* (07), *Programming and broadcasting activities* (60), *Air transport* (51), *Accommodation* (55) and *Telecommunications* (61) appear to be financially constrained for most indicators using both simple and asset-weighted averages.

Table A1.5 (bis). Top financially constrained sectors, quintiles 5 indicators

		Smaller	Larger	Average			Smaller	Larger	Average
07	Mine Metal	3.80	4.60	4.20	30	Man. Transport	3.20	4.00	3.60
60	Broadcasting	3.80	4.40	4.10	24	Man. Metal	3.00	4.20	3.60
51	Transport Air	4.20	3.80	4.00	52	Warehousing	2.40	4.40	3.40
55	Accommodation	4.00	3.80	3.90	56	Food service	3.80	3.00	3.40
61	Telecom.	3.20	4.60	3.90	18	Man. Media	2.60	4.00	3.30
93	Sports	4.20	3.40	3.80	29	Man. Motor	2.60	4.00	3.30
23	Man. Mineral	3.80	3.80	3.80	36	Water Treatment	2.40	4.20	3.30
35	Electricity	3.40	4.00	3.70	53	Postal	2.40	4.20	3.30
11	Man. Beverages	3.40	3.80	3.60	50	Transport Water	4.00	2.40	3.20
16	Man. Wood	3.40	3.80	3.60	91	Libraries	3.80	2.20	3.00

Note: The table reports the sectors with the highest mean quintile indicators of all five measures using simple or asset-weighted averages, and the average of the two means. The mean using simple averages is equal to 3.80 or higher; the mean using asset-weighted averages is equal to 4.00 or higher.

Source: Own elaborations

Annex 2. Cross-country frequencies: 3-digit level.

In order to uncover more information on the most frequently constrained EU sectors, we investigated the composition of the top 20% financially constrained 2-digit sectors from section 4.2, by computing RBI and BBI values also for the nested 3-digit NACE sub-sectors. Therefore, for each of the 2-digit NACE industries and countries, we compute the mean financial constraints (FCs) index, by taking the BBI and RBI simple- and weighted-average values (i.e., four FCs indicators). Within each country, we flag a 2-digit NACE sector if it ranks among the top 20% financially constrained sectors. Then, we compute how frequently a NACE 2-digit sector is “flagged” across countries, and retain 2-digit NACE industries with frequencies ranking amongst the top 20%.⁶² Table A2.1 reports all 3-digit NACE sectors composing these most frequently financially constrained 2-digit sectors.

The results show that, according to the average ranking of the four indicators, the five most frequently financially constrained 3-digit sectors are:

- Activities of trade unions (S-94.2),
- Provision of services to the community as a whole (O-84.2),
- Manufacture of military fighting vehicles (C-30.4),
- Compulsory social security activities (O-84.3), and
- Manufacture of coke oven products (C-19.1).

⁽⁶²⁾ The final results flag the following NACE 2 sectors: 07, 12, 33, 39, 49, 53, 75, 78, 80, 81, 97, 98.

Table A2.1. 3-digit NACE sectors of the 20% most frequently financially constrained 2-digit NACE sectors

NACE 3	NACE 3 text description	Mean Ranking	RBI			BBI		
			Smaller	Larger	Number of Firms	Smaller	Larger	Number of Firms
B-05.1	Mining of hard coal	128	0.122	0.172	94	0.262	0.207	74
B-05.2	Mining of lignite	92	0.196	0.126	76	0.353	0.243	56
B-06.1	Extraction of crude petroleum	108	0.203	0.083	174	0.253	0.128	149
B-06.2	Extraction of natural gas	112	0.248	0.093	87	0.254	0.172	77
B-07.1	Mining of iron ores	120	0.427	0.125	25	0.282	0.161	24
B-07.2	Mining of non-ferrous metal ores	152	0.144	0.077	175	0.155	0.106	183
B-09.1	Support activities for petroleum and natural gas extraction	101	0.169	0.088	428	0.241	0.180	301
B-09.9	Support activities for other mining and quarrying	97	0.117	0.142	292	0.246	0.185	251
C-19.1	Manufacture of coke oven products	159	0.062	0.078	54	0.218	0.130	40
C-19.2	Manufacture of refined petroleum products	119	0.075	0.068	641	0.269	0.138	570
C-20.1	Manufacture of basic chemicals, fertilisers and nitrogen compounds, plastics and synthetic rubber in primary forms	105	0.059	0.044	4,266	0.224	0.162	3,815
C-20.2	Manufacture of pesticides and other agrochemical products	148	0.030	0.018	357	0.268	0.180	305
C-20.3	Manufacture of paints, varnishes and similar coatings, printing ink and mastics	146	0.032	0.010	2,066	0.281	0.147	1,936
C-20.4	Manufacture of soap and detergents, cleaning and polishing	130	0.053	0.015	3,928	0.244	0.174	3,456

NACE 3	NACE 3 text description	Mean Ranking	RBI			BBI		
			Smaller	Larger	Number of Firms	Smaller	Larger	Number of Firms
	preparations, perfumes and toilet preparations							
C-20.5	Manufacture of other chemical products	113	0.058	0.043	3,343	0.233	0.134	3,080
C-20.6	Manufacture of man-made fibres	120	0.050	0.029	219	0.231	0.212	208
C-30.1	Building of ships and boats	115	0.061	0.088	3,230	0.242	0.123	2,521
C-30.2	Manufacture of railway locomotives and rolling stock	125	0.052	0.043	416	0.236	0.208	365
C-30.3	Manufacture of air and spacecraft and related machinery	134	0.085	0.036	748	0.183	0.112	687
C-30.4	Manufacture of military fighting vehicles	161	0.043	0.028	26	0.208	0.210	27
C-30.9	Manufacture of transport equipment n.e.c.	108	0.060	0.025	1,085	0.257	0.140	988
E-38.1	Waste collection	130	0.035	0.014	6,123	0.276	0.157	4,857
E-38.2	Waste treatment and disposal	118	0.047	0.040	3,188	0.248	0.163	2,891
E-38.3	Materials recovery	109	0.056	0.032	7,191	0.250	0.133	5,768
H-50.1	Sea and coastal passenger water transport	114	0.091	0.051	1,197	0.294	0.143	1,086
H-50.2	Sea and coastal freight water transport	133	0.065	0.048	1,187	0.230	0.097	1,255
H-50.3	Inland passenger water transport	130	0.052	0.026	575	0.279	0.147	505
H-50.4	Inland freight water transport	127	0.035	0.018	547	0.275	0.186	553
I-55.1	Hotels and similar accommodation	71	0.057	0.035	48,023	0.276	0.164	44,010

NACE 3	NACE 3 text description	Mean Ranking	RBI			BBI		
			Smaller	Larger	Number of Firms	Smaller	Larger	Number of Firms
I-55.2	Holiday and other short-stay accommodation	72	0.076	0.079	16,411	0.275	0.149	13,910
I-55.3	Camping grounds, recreational vehicle parks and trailer parks	98	0.090	0.038	5,541	0.292	0.165	5,338
I-55.9	Other accommodation	96	0.061	0.058	4,378	0.277	0.148	2,973
J-60.1	Radio broadcasting	93	0.059	0.032	1,926	0.311	0.162	1,674
J-60.2	Television programming and broadcasting activities	78	0.065	0.050	1,893	0.309	0.229	1,595
M-72.1	Research and experimental development on natural sciences and engineering	86	0.088	0.097	11,094	0.264	0.129	9,885
M-72.2	Research and experimental development on social sciences and humanities	134	0.044	0.031	1,932	0.226	0.117	1,698
O-84.1	Administration of the State and the economic and social policy of the community	111	0.089	0.075	995	0.280	0.197	861
O-84.2	Provision of services to the community as a whole	174	0.031	0.026	392	0.267	0.098	298
O-84.3	Compulsory social security activities	160	0.042	0.091	99	0.290	0.159	105
R-91.0	Libraries, archives, museums and other cultural activities	97	0.055	0.037	2,419	0.276	0.144	2,063
R-92.0	Gambling and betting activities	107	0.061	0.023	8,020	0.294	0.187	6,577
R-93.1	Sports activities	61	0.064	0.061	27,083	0.309	0.161	23,793
R-93.2	Amusement and recreation activities	75	0.055	0.048	21,740	0.287	0.205	16,775

NACE 3	NACE 3 text description	Mean Ranking	RBI			BBI		
			Smaller	Larger	Number of Firms	Smaller	Larger	Number of Firms
S-94.1	Activities of business, employers and professional membership organisations	137	0.038	0.060	875	0.321	0.187	976
S-94.2	Activities of trade unions	176	0.017	0.042	36	0.205	0.107	30
S-94.9	Activities of other membership organisations	102	0.077	0.105	4,519	0.269	0.120	5,003

Note: This Table reports the 3-digit NACE groups of the top 15 most frequently financially constrained 2-digit NACE divisions. For each country and four FCs indicators – namely RBI, weighted RBI, BBI, and weighted BBI – we rank 2-digits NACE divisions and retain the top 20%. We then compute the average rank for each industry across FCs indicators and countries. We retain the top 15 2-digit sectors. The columns are as follows. Nace3 is the 3-digit NACE code. Text description is the NACE 3-digit description. Mean ranking is the average ranking of the four indicators (that is, we rank each 3-digit NACE code for each indicator and average out the ranking across all indicators). Then for each indicator (RBI and BBI), we report the simple average, the asset-weighted average, and the number of observations.

Source: Own elaborations.

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