ISSN 1831-9424

European Commission

Study on the effectiveness of COVID-Aid on firms

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2024

Joint Research Centre

EUR 31945 EN

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JRC135571

EUR 31945 EN

PDF ISBN 978-92-68-16460-0 ISSN 1831-9424 doi:10.2760/618465 KJ-NA-31-945-EN-N

Luxembourg: Publications Office of the European Union, 2024

How to cite this report: European Commission, Joint Research Centre, Canzian, G., Crivellaro, E., Duso, T., Ferrara, A., Sasso, A. and Verzillo, S., *Study on the effectiveness of COVID-Aid on firms*, Publications Office of the European Union, Luxembourg, 2024, https://data.europa.eu/doi/10.2760/618465, JRC135571.

Contents

Abstract

The study examines the impact of COVID State aid measures (COVID aid) on firm performance for three Member States, namely Italy, Poland and Spain, for which national state aid registers are available. These data on aid recipients are merged with balance sheet data obtained from Bureau Van Dijk to create a panel of firms covering the period 2017-2021. The performance indicators analysed are turnover and probability of default. To assess the causal effect of the aid, a difference-in-differences approach is used, comparing firms that received only COVID aid with firms that did not receive any State aid during the period under analysis, thus excluding beneficiaries of other types of aid. Propensity score matching weighting (PSM) is used to account for pre-existing differences in financial characteristics between beneficiaries and non-beneficiaries that are likely to determine the probability of receiving aid. The basic model is estimated across different categories of (pre-crisis) firm size, economic sector and type of financial instrument received to assess the heterogeneity of impacts. The results show that, on average, COVID state aid led to a statistically significant increase in firms' turnover in 2021, suggesting that the aid helped firms to remain active despite the slack caused by the COVID crisis. However, aid recipients also experienced a slight increase in their probability of default in the same year. The impact of COVID aid also appears to be heterogeneous across countries, sectors, and firm size and according to the instrument adopted.

Acknowledgements

The authors would like to thank DG COMP colleagues Giuseppina Cannas, Daniele Vidoni, Sara Ferraro and Lorenzo Isella for the fruitful collaboration established. Moreover, the authors would like to thank Louis Ronchail for the valuable research assistance. All errors are our own.

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Executive summary

Policy context

The outbreak of the COVID-19 pandemic in March 2020 triggered an unprecedented crisis that had a severe negative impact on the EU economy. Lockdown policies created liquidity problems for all companies, especially small and medium enterprises (SMEs), as their access to financial markets became even more difficult. Sudden liquidity shortages affected short-term stability and threatened the long-term survival of firms. If left unaddressed, such difficulties could have led to a large number of bankruptcies, causing serious disturbances throughout the entire EU economy. Since the outbreak of the pandemic, the Commission has reacted swiftly to this emergency by introducing the so-called Temporary Framework (TF) for Member States, a temporary financial measure to support European firms during this crisis. The TF allowed Member States to provide substantial budgetary support to keep otherwise viable companies afloat through the various waves of the pandemic (see for instance, European Commission, Directorate-General for Competition, 2022a, 2022b, 2022c). In 2020, the average total State aid expenditure (in terms of aid element) in EU countries peaked at over 320 billion EUR, equivalent to 2.29% of the GDP, up from 0.96% in 2019.

Although sizable aid was necessary in such exceptional circumstances, the TF included safeguards to minimise the potential risk that the aid would distort competition in the single market. First, it limited the maximum amount of aid that could be granted to a firm. This was designed to ensure the survival of firms without increasing their competitiveness. Second, medium and large companies that were already in serious financial difficulties before the crisis could not benefit from COVID-related aid.

The TF has evolved to meet changing needs. While it was initially set to expire in June 2022, two tools remain in place until 31 December 2023 to support the ongoing economic recovery. Overall, Member States have implemented a wide range of instruments, from credit-based instruments such as guarantees and subsidised loans to direct grants, recapitalisations, and other non-repayable instruments.

The State aid Scoreboard (SARI2 data) (European Commission, Directorate-General for Competition 2023), which tracks State aid expenditure and its impact on businesses, highlights that State aid expenses increased in all Member States after the COVID-19 outbreak, with significant differences across countries, possibly due to the different economic impact of the pandemic. The Scoreboard shows that a significant portion of State aid was directed toward COVID-related measures (COVID aid) in 2020 and 2021, but the relative importance of these measures differed across countries. Spain, Italy, and Hungary stood out for allocating a significant percentage of their GDP for such measures. Overall, Member States provided COVID aid support mostly using repayable instruments (i.e. guarantee and loans). Guarantees were used extensively, particularly in Romania, Italy, France (only in 2020), and Spain, while Poland and Greece made a significant use of loans on favourable terms. However, some countries, such as Austria, Denmark, France (in 2021), Hungary, Slovenia and Slovakia, made also an extensive use of direct grants. Repayable forms of support are generally considered less distorting to competition, but they come with credit risk, which may necessitate loan restructuring in the future.

Background literature

The literature on the effectiveness of State aid is extensive but lacks consensus due to differences in methodology, variables, time periods and units of analysis. A systematic review of aid measures to SMEs in the EU by Dvouletý et al. (2021) found generally positive effects on firm survival, employment, assets and sales, but mixed results on productivity.

However, the framework for the implementation of the COVID aid was very specific, as some of the restrictions on the use of State aid were lifted in order to mitigate the increase in insolvencies and bankruptcies (OECD, 2021). This variety of measures undoubtedly helped firms cope with the crisis, although it may have affected the allocation of resources in the market. Identifying the unintended effects of aid to companies, especially in terms of aggregate productivity and the zombification of the economy, is beyond the aim of this study, although this is a relevant aspect that has been explored in the literature (Andrews et al. 2016, 2017).

Some recent studies consider the impact of the COVID-19 pandemic on productivity and debt, bankruptcy triggers and predicted firm exits, focusing on specific countries (Cros et al., 2021 for France and Tielens and Piette, 2022 for Spain). Other studies (Tielens et al., 2020; Chundkkadan et al., 2022) assess the impact on capital constraints, while Dhyne & Duprez (2021) look at the impact of COVID-19 on various firm outcomes in Belgium and find that the crisis led to greater differences in firm performance than in normal times. Other papers examine the impact of COVID-19 on labour market outcomes such as employment rates, job separations and firm survival (Adams-Prassl et al., 2020; Altomonte et al., 2021; Bennedsen et al., 2020; Bertschek et al., 2023), finding a broadly positive effect of COVID support measures and outlining some heterogeneity.

This report makes a specific contribution to the literature documenting the impact of COVID-related policy support on firm outcomes. Some papers (Harasztosi et al., 2022; Bighelli et al., 2021; and Zegel et al., 2021) have focused on the characteristics of beneficiaries to assess whether pre-crisis transfers were primarily targeted at weaker and less productive firms. In addition to academic contributions, the literature also includes some country-specific studies by national research institutes (the Netherlands in Davies et al., 2023; Belgium in Tielens et al., 2020, 2022; and Flanders in Zegel et al., 2021) across the EU.

More specifically, the present study focuses on the impact of COVID aid on firms' turnover and probability of default. The contribution to existing literature is twofold. First, the analyses are based on detailed information on the universe of COVID State aid granted in three EU Member States, namely Italy, Spain and Poland, obtained from their national State aid registers. Second, unlike previous studies that focused on the probability of default as an outcome, the current analysis uses the estimated probability of default, a novel indicator published by Bureau Van Dijk, which also allows to overcome the limitations of the Orbis data in studying the exit of firms. The results presented in this report are generally consistent with those papers that examine the short-term effects of public support to firms on their liquidity measures. The positive effect on sales is a recurring theme in the literature on State aid, as found by Dvouletý et al. (2021).

To some extent, the present study is comparable to Konings et al. (2023) in that it examines the short-term effects of aid to firms during the COVID-19 pandemic and finds largely positive effects on firm performance, although creative destruction and growth are not the main outcomes of interest.

Data

The analysis draws from several data sources that are the Italian, Spanish and Polish national State aid registers, and the Orbis dataset.

The national registers (NR) provide information on all State aid awards in the countries analysed. Specifically, they report the date on which each aid award was granted; the nominal amount of the aid; the aid element, the name, location, and the national identifier of the firm receiving the aid; the industry sector of the firm; the objective of the aid, and the reference to the aid measure. More importantly, NR include information about the type of financial instrument of the aid, distinguishing among guarantees; loans; direct grants; interest rate subsidies; tax advantages and other types of instruments.

Orbis is a comprehensive database widely used for economic and financial research, providing firm-level information on private and public companies in different countries. The coverage of this database varies according to the country, the company size, the industry sector, and the time period (Bajgar et al., 2020). As discussed in this report, this variability may affect the reliability of the information for specific groups of firms that are not adequately represented. This report focuses on four industry sectors that include enough observations for robust statistical analysis: manufacturing; construction; wholesale; and retail.

Among the three countries analysed, Italy and Spain have better data coverage in Orbis as a large share of their total output is covered in the data (Bajgar et al., 2020). Poland also has a good coverage in Orbis, however large firms seem particularly over-represented and there is a lack of precision for some variables (e.g. value added and number of employees) due to rounded values. Despite its limitations, Orbis remains the most comprehensive source of firm-level information available for cross-countries comparisons.

The final dataset is a balanced panel, meaning that only firms with non-missing variables in the period 2017--2021 are used for the analysis. The firm-level information in Orbis is merged with national registers to identify which firms are beneficiaries of State aid. For the purpose of this study, beneficiaries are defined as those firms that received COVID aid in 2020. This excludes from the analysis beneficiaries of other types of State aid, as well as firms that received a combination of COVID and non-COVID State aid in the period 2017-2021. This simplifies the analysis and allows a clear comparison between COVID aid beneficiaries and firms that never received any aid over the period 2017-2021.

Outcome variables

The analysis focuses on two indicators of economic performance of the firms. The first outcome is turnover, which describes the total operating income (including net sales, other operating revenues, and stock variations) reported at the end of the fiscal year. The second outcome is the estimated 'probability of default' provided in the Financial Strength module distributed by Moodys/BvD. This variable is predicted using a statistical model which considers both balance sheet information from the previous financial year and the current economic situation (accounting for specific sector and size economic trends).[1].

The samples

The samples analysed differ in the number of observations observed in each country: 76,738 firms in Italy, 142,395 firms in Spain, and only 7,213 firms in Poland (referring to the number of firms observed each year).

The main difference in the composition among these three samples is the average size of firms. Italy and Spain have a similar sample composition, with 86.7% and 84.7% of micro firms, respectively, whereas Poland has a lower share of micro firms at 59.9%.

The representativeness of the data also varies depending on whether firms received COVID aid. In Italy, the majority of beneficiaries were micro firms (90%) and small firms (9%). In Spain, 82% of micro firms and 15% of small firms received aid. In Poland, the firm size distribution was more diverse, with 64% of beneficiaries being micro, 27% small, and 8% were medium-sized firms. There are also differences in terms of economic activity. In Italy and Spain, aid is spread across sectors, whereas in Poland, it is more concentrated, particularly in sectors such as construction.

Across all the countries analysed, firms receiving COVID aid exhibit lower turnover, capital, total assets and loans compared to non-beneficiaries. Additionally, they have a lower probability of default, possibly due to Temporary Framework rules prohibiting aid to companies already in financial distress before the pandemic.

In terms of financial instruments used, Italy and Spain predominantly utilised guarantees during the first year of the pandemic, with over 91% of treated firms received this type of aid award, while direct grants were less commonly employed (fewer than 13% of treated firms). In contrast, Poland made a greater use of both direct grants and loans, with 83% and 75% of treated firms, respectively, receiving such aid.

Main findings

The empirical analysis primarily focuses on turnover as an outcome, as it is directly influenced by the type of aid designed to sustain firm survival. Other outcomes, such as profitability, may take longer to be affected by the aid. Furthermore, the analysis investigates the effect of COVID aid on the probability of default. Due to data constraints, which only provide information for one year after treatment, the analysis is limited to these outcomes.

Turnover

COVID aid have a generally positive and significant effect on turnover for beneficiary firms in both Italy and Spain. In Italy, the average increase in turnover for aid recipients in 2021 is nearly 9%, compared to control firms, while in Spain, the effect is smaller, at around 3%.

In both countries, the impact of COVID aid varies by firm size and sector. In Italy, the positive effect is primarily driven by micro-firms, with an increase in turnover of 16.2%, while a smaller yet significant effect is observed for medium-sized firms (5.1%). Conversely, in Spain, the impact is significant across micro, medium, and large-sized firms, with a greater effect observed for large firms (10.4%). In terms of sectoral composition, Italy exhibits a positive effect across all sectors, particularly in construction with a 14.6% increase in turnover. In Spain, a positive effect is observed across all sectors except for retail trade, where the impact is not statistically significant. In Poland, the overall impact of the aid is insignificant. However, there's a marginally significant effect for micro firms (5.6%) and those in construction (12.9%). Yet, due to limited representation in Orbis, comparing these results with Italy and Spain is challenging.

The analysis also explored heterogeneity to disentangle the interaction of the aid with firm size and sector. Difference-in-differences (DiD) estimation was conducted using separate subsamples based on firm size. Within each subsample, the role of size is examined by interacting the treatment variable with size indicators (micro, small, medium, and large). The results align with those discussed above.

An additional heterogeneity analysis is carried out taking into account the type of financial instrument used to provide the aid. The sample of beneficiaries is split according to the type of financial instrument used to provide

[1] However, the details on the statistical model to predict such variable are publicly unavailable.

the aid: repayable (e.g., guarantees or loans) or non-repayable (e.g. direct grants, interest rate subsidies) or a combination of both. These models also explore the mediating role of firm size and sector.

The results regarding the impact of repayable instruments on turnover closely mirror the main findings, with similar significance levels and effect magnitudes. This is not surprising, as repayable instruments were used to finance the vast majority of State aid in Italy and Spain. Instead, the effect of "non-repayable or both" instruments varies more widely across different sizes and sectors. In Italy, these instruments have benefited mainly micro and small enterprises, although the effect on the latter group is less precisely estimated. In Spain, small firms that received non-repayable aid (or a mix of repayable and non-repayable aid) performed significantly worse than their controls.

To validate these results, it is crucial to confirm the validity of a key assumption of the DiD models, known as the parallel trend assumption. This assumption implies that the average change in outcomes for the control group may be used as a credible counterfactual for the unobserved change in outcomes for the beneficiary group, as both outcomes would have evolved similarly in the absence of the pandemic. To formally test the parallel trend assumption, an event study analysis (Autor, 2003) is employed, as commonly done in the literature.

Reassuringly, the results of this test suggest that the lead terms are not statistically different from zero in all three countries considered, thus confirming that there was no anticipatory effect of the aid and validating the common trend hypothesis. This is confirmed for the full sample and for most of the subsamples considered in the three countries, including separate estimates by sector and size.

The validity of the DID estimation rests on the so-called parallel trend assumption. This assumption implies that the evolution of the pre-treatment performance of treated and control firms moves in parallel. It also implies that the average change in outcomes for the control group can be used as a credible counterfactual for the unobserved change in outcomes for the treated group if the COVID outbreak hadn't occurred. A formal test of the parallel trend assumption is to interact the treatment variable with time dummies, as suggested by Autor (2003). This allows to verify whether there was any anticipation of the aid prior to its adoption, while also showing the dynamics of the effect. Reassuringly, the results of these tests confirm the no anticipatory effect of the aid and validate the common trend hypothesis. This holds for both the full sample and most subsamples in the three countries, including separate estimates by sector and size.

Probability of default

The econometric method used to estimate the impact of the aid on the probability of default is the same as described above (DiD with propensity score matching). The probability of default is a continuous variable that assigns a risk of default to each firm. The variable is commonly utilised in financial markets to classify private firms into different categories of default risk, ranging from AAA (lowest risk of default) to D (highest risk of default). Consequently, the DiD models are also estimated for different subsampled of risk categories. Additionally, a heterogeneity analysis is conducted to capture the effect of the different types of instruments on the probability of default.

The results suggest that in Italy and Spain, there was a slight deterioration in the risk of default for aid recipients across most pre-existing risk categories. However, this effect is statistically insignificant for firms with both high and low pre-pandemic default risks. In Poland, there are marginally significant effects in the opposite direction. However, these results should be interpreted with caution. The receipt of aid, particularly repayable instruments affecting debt and interest, could influence the algorithm estimating the probability of default, potentially leading to a perception of riskier status.

In terms of heterogeneity of the impact, in Italy and Spain, the negative impact of COVID aid on the probability of default of beneficiaries seems to be driven by repayable instruments. Conversely, in Poland, the improving effect of repayable instruments is statistically significant only for firms with pre-pandemic risk categories A, CC, and D. Considering the magnitude of the results, the effects are slightly more pronounced for low to medium-risk firms (categories AA to B) in both Italy and Spain. This is expected, as these firms likely had easier access to guarantees and loans, resulting in higher recorded debt.

Conclusions and limitations

In all the samples analysed (Italy, Spain, and Poland), COVID aid beneficiaries had lower pre-pandemic values for turnover, capital and total assets compared to non-beneficiaries. They also exhibited lower pre-pandemic probability of default, in line with provisions of not supporting financially unstable firms.

The study reveals a positive overall effect of COVID aid on average turnover for beneficiaries in Italy (9%) and Spain (3.2%), while in Poland the effect was not statistically significant. However, this impact varied significantly by country, sector, firm size, and type of instrument used. In Italy, micro-firms, especially those in the construction sector, were most affected, while in Spain, larger firms initially benefited more, though this effect disappeared when considering sector-specific impacts.

The study also finds a small but significant increase in the probability of default in 2021 for some categories of COVID aid beneficiaries compared to non-beneficiaries in Italy and Spain. Given the size of the effect, such increase does not imply an exit of the firm from the market.

The distinctiveness of COVID-19 support schemes complicates direct comparisons with other forms of State aid. The study faces data limitations that prevented an examination of aid intensity and necessitates cautious interpretation of results for Poland due to the small sample size. Furthermore, it is important to note that the analysis relies on a selected sample from the entire population of enterprises, which should be taken into consideration when interpreting the results.

Overall, the results suggest that COVID aid played a significant role in helping firms throughout the crisis.

1 Introduction

The outbreak of the COVID-19 pandemic in March 2020 triggered an unprecedented crisis which had a severe negative impact on the entire EU economy. Lockdown policies created liquidity challenges for all companies, especially small and medium enterprises (SMEs) whose access to financial markets is typically more difficult than for larger firms. In addition, the impact of this crisis was uneven across sectors, being harder on sectors which required physical contact with customers or between workers (European Commission, Directorate-General for Economic and Financial Affairs 2021). Sudden liquidity shortages affected short-term stability and threatened the long-term survival of firms. If left unaddressed, the difficulties faced by companies during the pandemic could lead to a large number of bankruptcies, causing serious disruption to the EU economy as a whole.

Since the onset of the pandemic, the Commission has promptly responded to this emergency by putting in place the so-called Temporary Framework (TF) for Member States, a temporary financial measure to help European firms during this crisis. The TF has enabled Member States to employ sizable budgetary support to keep otherwise viable companies afloat through the various waves of the pandemic (see for instance, European Commission, Directorate-General for Competition (2022a, 2022b)). In 2020, the average total State aid expenditure (in terms of aid element)[2] in EU countries peaked at over 320 billion EUR, equivalent to 2.29% of the GDP, compared to 0.96% in 2019.

Although sizable aid was necessary in such exceptional circumstances, the TF included safeguards to minimise the potential risk that the aid would distort competition in the single market. First, it limited the maximum amount of aid that could be granted to a firm. This was to guarantee the survival of the undertakings without giving them a too strong advantage at the expenses of their competitors. Second, it prevented large companies that were already in serious financial distress before the crisis from benefitting from COVID aid. While essentially all Member States made use of the TF and despite its setting common rules for Member States to grant COVID aid, the choice of the financial instruments used for aiding firms differed by Member State due to their different financial situation in terms of indebtedness and budget constraints. This resulted in a different distribution of refundable (e.g. loans) and non-refundable (e.g. direct grants) aid measures across countries (see Section 2.2).

The main objective of this study is to present new causal evidence on whether the Temporary Framework was useful in helping viable firms to continue operating during the pandemic. Specifically, this study uses balance-sheet data from Bureau Van Dijk and National State aid Registers coupled with a sound causal assessment framework, with a three-fold aim. First, it descriptively analyses the financial characteristics of COVID aid beneficiaries with respect to non-beneficiaries. Second, it investigates the short-term causal impact of COVID aid on two measures of firms' performance: turnover (that is, the revenue generated by the operating activities); and a variable capturing the estimated probability of default of a firm. Third, the study examines whether these estimated effects vary across different dimensions of firm characteristics (economic sector of activity and size) and the type of financial instrument used. As the impact of the pandemic varied across sectors and sizes, and because Member States used different instruments to address these outcomes, this analysis of the heterogeneity of the impact of COVID aid is important to understand what worked best.

The study focuses on three EU Members namely Italy, Spain, and Poland, for which National Registers were made available by their national authorities. Although data were not available for all the EU countries, the three countries analysed are of particular interest as they represent more than 30% of the EU population and their nominal expenditure on COVID State aid in 2020 accounted for approximately 39% of the total State aid expenditure (European Commission, 2023; Eurostat, 2019).

Different data sources were collected, merged, and used for the different steps of the empirical analysis. First, the study used the Orbis database distributed by Bureau Van Dijk, a longitudinal data set to collect detailed information on firms' balance sheets. Orbis covers a large but selected sample of firms all over the world and it is commonly used for research purposes (e.g. Bajgar et al., 2020). Second, this data were matched to information from National State aid Registers, that include the records of all State aid awards granted in the

[2] The aid element measures the financial advantage obtained by an undertaking when receiving an aid award (for details on the definition of aid element, see Section 2.2).

period between 2017 and 2021.[3] The study focuses on a balanced sample of firms i.e., firms with non-missing information over the period between 2017 and 2021.

The study uses a variety of methodologies to address the objectives stated above. Summary statistics and basic regression models are used to compare the financial situation of COVID aid beneficiaries with respect to non-beneficiaries. A difference-in-differences (DiD) model combined with propensity score matching is employed to estimate the causal effect of receiving COVID State aid on the firms' turnover and probability of default in 2021. The identification strategy consists of comparing firms that received COVID State aid in 2020 with similar firms that did not receive any aid during the period of analysis.

The main findings of the study are as follows: COVID State aid had a generally positive and significant effect on turnover for both Italian and Spanish beneficiary firms. In Italy, the increase in turnover of COVID aid beneficiaries in 2021 was on average almost 9% higher than that of control firms, while in Spain the average effect of aid is smaller, at around 3.2%. While in Italy the result is mostly driven by micro enterprises, irrespective of their activity, the average result in Spain is largely driven by firms in the construction sector, irrespective of their size. The results for Poland do not show a significant effect, neither on average nor when considering the size and sector decomposition with an exception for medium firm-sized firms in construction sector. Regarding the effect on the probability of default, in both Italy and Spain, COVID aid seems to have had a small negative impact on beneficiary firms, as the latter appear to have a higher default category score on average than the controls. Nevertheless, the magnitude of the effect indicates that it does not pose a significant threat to the economic stability of the firm.

These results on the effectiveness of COVID aid are compared with related literature examining the impact of State aid on financial performance and firm survival (e.g. Dvouletý et al., 2021; Bertschek et al., 2023) and largely match them. This analysis represents a contribution to this literature as there are only a few studies that have examined the impact of COVID-19 State aid on firm performance.

Although this study does not directly assess whether COVID aid has had a negative impact on competition in the Single Market, which is a key element of State aid control, several elements may help to understand whether such an impact was to be expected. First, COVID aid was used more or less simultaneously by all Member States. This implies that the support offered to firms within the Common Market was not too asymmetric, even though some countries spent more in terms of aid per capita. This limits the potential for distortions of competition and trade. Second, the scope of aid measures in each Member State was quite broad, as such COVID aid was less selective than other aid measures given, in most cases, to several companies within a given product market. This feature of COVID aid also limits the potential for distortion of competition within each product market. Third, a large part of the COVID aid was targeted at micro and small enterprises, which have more difficulties to access finance, especially in such a crisis. Given their small size and limited involvement in cross-border transactions, aid to small companies is less likely to distort competition in the Single Market. Finally, COVID aid was granted to several sectors within each Member State, with the aid targeted at the most affected sectors. Therefore, COVID aid is less likely to have had a strong potential to distort competition as it supported a large part of the economy rather than a narrow sector.

While all these elements taken together reassures that the bulk of COVID aid may not have distorted competition, they do not necessarily mean that COVID aid could not have been problematic in certain sectors. This could be particularly the case in sectors where aid was concentrated on a small number of companies, where the initial market structure was particularly concentrated and where the amount of aid was disproportionately high. An example of this could be the airline sector, where major players such as Lufthansa or Air France have received substantial aid while some competitors such as Ryanair and EasyJet have not. A targeted assessment of the impact of State aid on competition in such sectors therefore seems important and justified but is beyond the scope of this study.

The remainder of the study is structured as follows: Section 2 discusses the institutional background and provides information on the Temporary Framework for State aid as well as first aggregate evidence from the European Commission's Scoreboard database. Section 3 presents a relevant literature review. Section 4

[3] As National Registers were not available for all EU Member States (MS), this study explored the possibility of using an additional source of data (the Transparency Award Module dataset) to expand the analysis to all the MS. However, the use of this dataset was found to be unfeasible for this analysis due to the poor data quality and the sample selection (representativeness) issues explained below in this study.

describes the data used and provides descriptive analyses. Section 5 discusses the methodology. Section 6 presents the results of the analysis, and Section 7 concludes with a few final considerations.

2 Institutional background

When a company receives government support through State aid, it gains a competitive advantage over the other market players.[4] Favouring some firms and not others might create competition distortions, potentially allowing less efficient companies to survive or expand at the expense of the more efficient ones. Due to these reasons, the Treaty on the Functioning of the EU (TFEU, or 'the Treaty') prohibits using State aid except for particular circumstances where the positive effect of the aid is expected to outweigh the negative impact on competition. In this context, the EU has adopted a stringent State aid regime that involves both an ex-ante screening procedure and an ex-post assessment mechanism and targets subsidies that distort the internal market. Any state aid should be proportionate and appropriate, and the Commission undertakes a 'balancing test', where the beneficial effects of state aid are weighted against their potential adverse effects on competition and trade. In particular, State aid is allowed in the EU when (i) it is well designed to appropriately solve the market failure, and (ii) distortions to competition are limited so that the overall balance is positive.

To ensure compliance with these principles, State aid control rules provide a harmonized framework enforced by the European Commission, focusing on factors such as necessity, appropriateness, incentive effect, proportionality, and avoidance of undue distortions to competition (Piechhuka et al 2023). These principles, incorporated into regulations, guidelines, and frameworks, guide the Commission's assessment of State aid measures, aiming to strike a balance between addressing market failures and minimizing distortions to competition within the single market. In some circumstances, it is recognised that government interventions are necessary for the functioning and fairness of an economy. Therefore, Member States can use State aid to achieve a wide range of policy objectives, including, among others, reducing regional disparities within a country; promoting research, development and innovation activities; and promoting a high level of environmental protection that might not be realised otherwise. The Treaty also explicitly permits aid "to remedy a serious disturbance in the economy of a Member State" as compatible with the internal market.[5]

2.1 The Temporary framework for State aid in Europe

The outbreak of the COVID-19 pandemic in March 2020 triggered an unprecedented crisis which has had a severe negative impact on the EU economy. Already during the first wave of the pandemic, the Commission, after close consultation with the Member States, promptly implemented the so-called Temporary Framework (TF) for State aid[6] based on Article 107(3)(b) TFEU. In line with the principle that exceptional measures are needed in exceptional times, these temporary measures enabled Member States to use the full flexibility under State aid rules to sustain their economy during the COVID-19 pandemic and accelerate its recovery, while preserving the level playing field in the EU Single Market. Governments were able to provide sizable budgetary support to keep otherwise viable companies afloat throughout the various waves of the pandemic (see for instance, European Commission, Directorate-General for Competition (2022a, 2022c).

The TF contains several provisions to ensure that beneficiaries receive aid in an amount proportionate to the minimum needed to ensure their viability (specific ceilings per beneficiary are set out for different categories of aid). Moreover, the TF establishes eligibility criteria to prevent companies that were in difficulty before the crisis from receiving COVID state aid. However, for micro or small enterprises that were already in difficulty before December 31, 2019, there is a derogation that considers the COVID-19 crisis as an additional threat to the ability of these small businesses to access finance compared to larger companies. If left unaddressed, these difficulties could lead to a significant number of bankruptcies of micro and small companies, causing instabilities for the entire EU economy. Given their limited size and limited involvement in cross-border transactions, temporary State aid to micro and small companies is less likely to distort competition in the Internal Market than State aid provided to larger companies. This is especially important for innovative start-

[4] The notion of State aid is an objective and legal concept defined directly by the Treaty on the Functioning of the European Union, which is narrower than the possibilities available to Member States to provide support to their economies. There are four constitutive elements for there to be State aid: (1) it must be granted by a Member State or through State resources; (2) there must be a selective advantage; (3) there must be a (threat of) distortion of competition; and (4) there must be an effect on trade between Member States. Therefore, subsidies granted to individuals or general measures open to all enterprises (e.g. temporary unemployment schemes, VAT reductions) are not State aid.

[5] Article 107(3)(b) TFEU.

[6] https://eur-lex.europa.eu/legal-content/EN/TXT/?uri=OJ%3AJOC_2020_091_I_0001

ups that may incur in losses during their initial high-growth phase. The survival of these firms is considered to be crucial for the economic recovery of the Union.

Member States have implemented a wide range of State aid measures, making use of different aid instruments, from credit-based instruments such as guarantees and subsidised loans to direct grants, recapitalisations and other non-repayable instruments. The TF has been amended seven times to adapt to the evolving needs during different waves of the pandemic. The TF expired at the end of June 2022, with the exception of the two new tools designed to support the ongoing recovery of the European economy: investment support (section 3.13) and solvency support (section 3.14), which remained in place until December 31, 2023. Additionally, the TF already includes provisions for a flexible transition, with clear safeguards, including options for converting and restructuring debt instruments, such as loans and guarantees, into other forms of aid, like direct grants, until June 30, 2023.

2.2 Evidence from the State aid Scoreboard

This section provides an overview of the actual expenditures incurred by the Member States on existing State aid measures, based on the evidence from the State aid Scoreboard (SARI2 data) (European Commission, Directorate-General for Competition 2023).[7]

The most recent version of the Scoreboard covers until 2021 and provides updates of State aid expenditure in the previous years (European Commission, Directorate-General for Competition 2023). Therefore, it includes the two years when the COVID-19 crisis was most significant (2020 and 2021), providing important insights on the implementation of COVID-19 State aid measures across Member States, as well as on all the other measures regularly implemented to address the other policy objectives foreseen by State aid control. Data include information on the instruments used.

The State Aid Scoreboard presents State aid expenditures in terms of aid element granted by the Member State to the recipient of the aid. The aid element measures the financial advantage obtained by an undertaking when receiving an aid award. For example, in the case of a loan, the aid element is the financial value saved by the firm when receiving a government loan (due to lower interest rate) as compared to receiving a loan in the private market. This is opposed to the nominal amount that measures the total value of the State aid that is the amount borrowed by the firm. In general, the way the aid element is computed depends on the type of instrument used: for grants, the advantage passed on to the beneficiary normally corresponds to the entire budgetary expenditure. For other repayable instruments such as loans or guarantees, the advantage to the beneficiary and the cost to government is respectively the lower interest rate and the reduced guarantee fee actually paid by the undertaking with respect to the one that should have been paid at market values (European Commission 2023).

2.2.1 State aid evolution from 2017 to 2021

Table 1 shows the evolution of State aid expenditure over the period 2017-2021. It illustrates that State aid expenditure, expressed as aid elements, have increased over time for all countries. In line with the expectations, State aid expenditure increased more after the Covid-19 outbreak, although with some sizable differences across countries. For instance, for Greece, Italy, Slovenia, Romania, and Portugal the normalized expenditure in 2020 was twice as much than in 2019. In contrast, the expenditure of Sweden, Lithuania, Estonia, Belgium, and Finland increased by less than 40%. Note that the State aid expenditure is normalized with respect to the 2019 GDP to net out the effect of the sharp drop in GDP in 2020 caused by the pandemic[8].

[7] SARI2 is an administrative tool used by Member States to fulfil the annual reporting obligations as per Commission Regulation (EC) 794/2004. The reporting obligations provide that Member States annually report to the Commission information on all existing State aid measures, including the actual expenditure (or actual revenue foregone in the case of tax expenditure). As such, SARI2 contains aggregate data on the total amounts disbursed to companies for all State aid measures.

[8] Figures normalized with respect to the current GDP are reported in the State aid Scoreboard of the European Commission (see European Commission (2022b, 2023)).

Table 1. *Total and Normalized State aid expenditure (based on aid element)* [1]

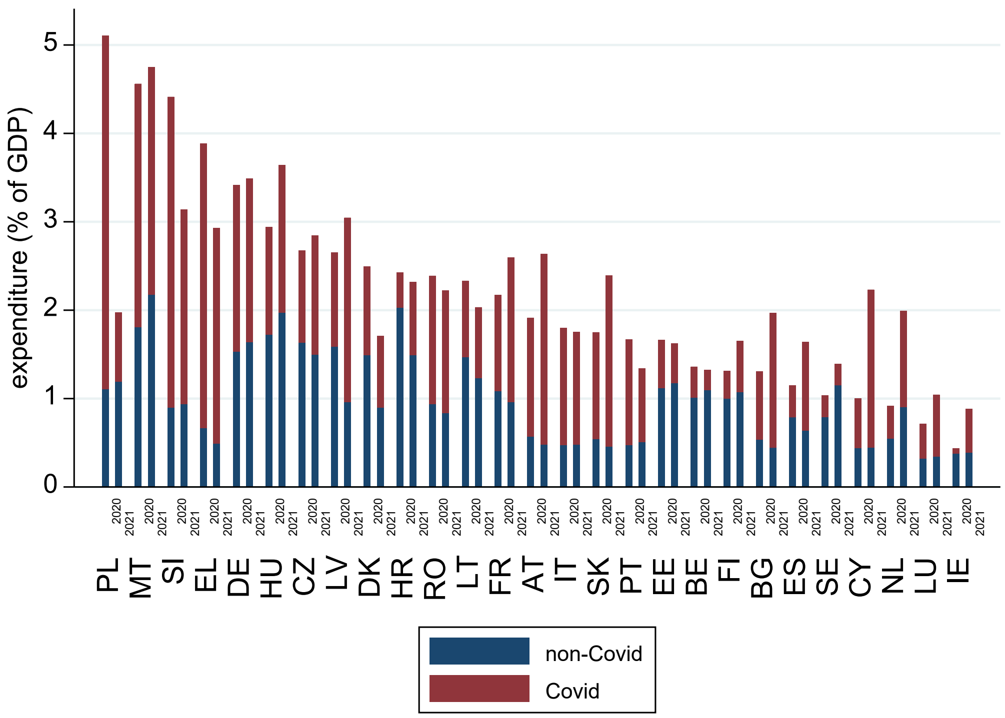
	Aid Elements (EUR Million) – at current prices					Normalized expenditure (% of 2019 GDP)				
	2017	**2018**	**2019**	**2020**	**2021**	**2017**	**2018**	**2019**	**2020**	**2021**
Austria	1948.1	1901.8	2008.1	7605.5	10477.6	0.49	0.48	0.51	1.91	2.64
Belgium	2400.8	3761.9	4605.3	6516.7	6337.6	0.50	0.79	0.96	1.36	1.32
Bulgaria	772.5	639.0	388.1	804.5	1210.8	1.25	1.04	0.63	1.31	1.97
Croatia	730.7	820.6	751.8	1350.5	1289.2	1.31	1.47	1.35	2.43	2.32
Cyprus	116.4	104.9	125.1	232.6	517.5	0.50	0.45	0.54	1.00	2.23
Czech Republic	2952.5	3715.7	3442.0	6032.2	6423.3	1.31	1.65	1.53	2.67	2.85
Denmark	4494.5	4677.0	4450.3	7716.3	5289.2	1.45	1.51	1.44	2.49	1.71
Estonia	247.2	278.7	344.9	461.8	451.0	0.89	1.00	1.24	1.66	1.62
Finland	2241.4	2347.3	2267.9	3151.3	3960.0	0.93	0.98	0.95	1.31	1.65
France	22317.4	21715.2	24056.3	52929.7	63299.3	0.92	0.89	0.99	2.17	2.60
Germany	45458.4	46480.1	52545.2	118694.1	121211.5	1.31	1.34	1.51	3.42	3.49
Greece	585.8	611.7	1047.9	7127.5	5369.4	0.32	0.33	0.57	3.89	2.93
Hungary	3414.8	2940.7	2620.0	4310.4	5337.7	2.33	2.01	1.79	2.94	3.64
Ireland	878.4	922.4	1236.3	1551.1	3143.7	0.25	0.26	0.35	0.43	0.88
Italy	5142.9	8008.0	8255.5	32328.4	31526.1	0.29	0.45	0.46	1.80	1.75
Latvia	981.2	319.0	327.1	813.9	934.7	3.20	1.04	1.07	2.65	3.05
Lithuania	531.4	740.0	899.7	1141.0	994.7	1.09	1.51	1.84	2.33	2.03
Luxembourg	157.8	164.5	193.7	446.8	651.5	0.25	0.26	0.31	0.72	1.04
Malta	178.4	352.1	305.3	646.8	673.1	1.26	2.48	2.15	4.56	4.75
Netherlands	2923.3	3274.6	3349.6	7470.6	16210.5	0.36	0.40	0.41	0.92	1.99
Poland	7243.9	6093.4	5966.1	27192.7	10498.9	1.36	1.14	1.12	5.11	1.97
Portugal	1082.1	1175.0	1084.5	3576.1	2879.3	0.50	0.55	0.51	1.67	1.34
Romania	968.5	1152.3	1470.0	5357.7	4984.6	0.43	0.51	0.66	2.39	2.22
Slovakia	274.0	463.0	612.6	1653.5	2260.6	0.29	0.49	0.65	1.75	2.39
Slovenia	381.4	432.7	417.1	2142.3	1524.1	0.79	0.89	0.86	4.41	3.14
Spain	3845.6	4921.0	8188.9	14297.7	20447.4	0.31	0.40	0.66	1.15	1.64
Sweden	4416.3	4301.2	3928.1	4947.3	6635.3	0.93	0.90	0.82	1.04	1.39
Total EU	116685.7	122314.0	134887.6	320498.9	334538.7	0.83	0.87	0.96	2.29	2.39

[1] The table shows the evolution of total aid expenditure – in terms of aid element – by Member States for the years 2017-2021- Normalized expenditure is computed as a percentage of the 2019 GDP (Eurostat). Totals are in Millions.

Source: Authors' calculations based on State Aid Reporting Interactive (SARI2) data and EUROSAT (GDP), May 2023 version.

As documented by (European Commission, Directorate-General for Competition 2022b), the total amount spent by Member States in 2020 exceeded 320 billion EUR, more than 2.5 higher than the expenditure in 2019. The increase is stable between 2020 and 2021 in all countries except Poland for which there is a relatively large drop in its 2021 normalized expenditure. Moreover, not only the amount, but also the distribution of instrument types has changed substantially between 2019 and the 2020-2021 period (see figure A1b in Appendix 1).

***Figure 1**. Total State aid expenditure (% of 2019 GDP), by policy objective (COVID vs. Non-COVID)* [1]



[1] The figure shows the total aid expenditure - in terms of aid element as share of the 2019 national GDP, by related objectives (COVID and non-COVID) and Member State. Totals are in EUR million.

Source: Authors' calculations based on State aid Reporting Interactive (SARI2) data and EUROSAT (GDP), May 2023 version.

Figure 1 provides an insight on the difference in State aid expenditure (aid element) for COVID-related and other State aid measures in 2020 and 2021. In both years, the expenditure is larger for COVID-related measures than for other aid types. The picture, however, is much nuanced across countries, with large differences in both the normalised and absolute (see figure A1 in Appendix 1) values of the expenditure, showing that the relative importance of COVID aid expenditure differs across countries (e.g. higher for Poland and Italy, lower for Belgium and Spain). This may be due to both the different mix of policy measures used by Member States to tackle the economic effects of the pandemic and the different types of instruments used in the context of COVID aid.

Table 2 focuses only on the COVID State aid, in particular, looking at the nominal values of the aid measures.[9] Differently from aid element which measures the economic advantage passed on to the beneficiaries, nominal amounts represent the nominal amount granted by the public authority. These figures therefore represent the nominal amounts of aid disbursed via different instruments, which should be interpreted with caution as different instruments have different economic impact on the distortion of competition (repayable forms of support are generally less distortive of competition).

[9] For COVID-19 related measures, State aid expenditures in terms of aid element are available in SARI.

Table 2. *Total COVID aid expenditure (based on nominal amounts)* [1]

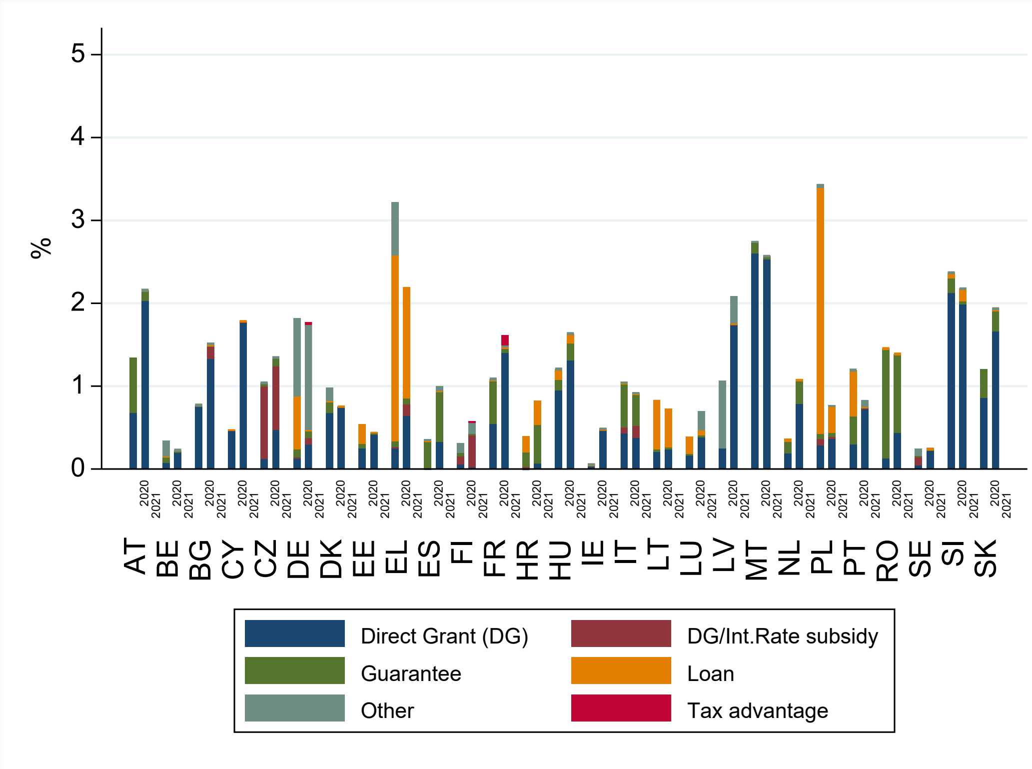
	Nominal Amount (EUR Million)		Normalized expenditure (% of 2019 GDP)	
	2020	**2021**	**2020**	**2021**
Austria	5999.2	8609.9	1.51	2.17
Belgium	4795.8	1603.6	1.00	0.34
Bulgaria	530.5	1068.3	0.86	1.74
Croatia	220.3	485.0	0.40	0.87
Cyprus	149.1	413.9	0.64	1.79
Czech Republic	3202.3	5183.6	1.42	2.30
Denmark	7352.4	3280.9	2.38	1.06
Estonia	536.3	184.1	1.93	0.66
Finland	1707.9	1805.0	0.71	0.75
France	142006.8	50432.9	5.83	2.07
Germany	123700.2	95159.2	3.56	2.74
Greece	7607.4	5944.7	4.15	3.24
Hungary	4497.7	6135.3	3.07	4.19
Ireland	303.0	2167.5	0.08	0.61
Italy	147635.5	91392.3	8.22	5.09
Latvia	438.3	661.0	1.43	2.15
Lithuania	519.7	392.5	1.06	0.80
Luxembourg	530.7	467.9	0.85	0.75
Malta	555.6	408.5	3.92	2.88
Netherlands	15533.3	30663.6	1.91	3.77
Poland	25435.6	8075.1	4.78	1.52
Portugal	9045.6	2017.7	4.22	0.94
Romania	3369.3	3528.8	1.50	1.57
Slovakia	1139.5	1828.9	1.21	1.94
Slovenia	1917.4	1093.3	3.95	2.25
Spain	41380.0	81314.4	3.32	6.53
Sweden	1492.3	1309.7	0.31	0.27
Total EU	551601.6	405627.5		

[1] The figure shows the total aid expenditure for COVID-related State aid, in terms of nominal amounts, by Member State. Totals are in Millions. Normalized expenditure is computed as a percentage of the 2019 GDP (Eurostat). Totals are in Millions

Source: Authors' calculations based on State Aid Reporting Interactive (SARI2) data.

In absolute terms, Germany has the largest amount of aid (123.7 EUR billion in 2020 and 95.16 EUR billion in 2021), corresponding to around less than a fourth (in 22.4% 2020 and 23.3% in 2021) of the total amount spent in the EU (551,601 EUR billion in 2020 and 405,627 EUR billion in 2021), followed by Italy with 147.6 EUR billion in 2020 (26.5% of the EU total) and 91.3 EUR billion in 2021 (22.5% of EU total), France with 160 in 2020 and 50 EUR billion in 2021 (19% and 25% of EU total), and Spain with 81.3 EUR billion in 2021 (20%, of EU total). Poland granted only 25.4 EUR billion, 4.6% of the total State aid. In relative terms, in 2021, Spain has the largest share of expenditure (6.5%) followed by Italy (5.9%), and Hungary (4.2%).

Figure 2. *Normalized COVID aid expenditure (% of GDP), by type of instrument 2020-2021*[1]



[1] The figure shows the COVID-related total aid expenditure (in nominal amounts) as share of 2019 national GDP, by type of financial instrument used and Member State.

Source: Authors' calculations based on State aid Reporting Interactive (SARI2) data and EUROSAT (GDP), May 2023 version.

Figure 2 illustrates that the majority of Member States provided most of their COVID-related support to undertakings via repayable instruments (i.e. guarantee and loans). Guarantees have been widely used, especially in Romania, Italy, France (only in 2020), and Spain, while Poland and Greece made a significant use of loans at favourable terms. Nonetheless, some countries, such as Austria, Denmark, France (in 2021), Hungary, Slovenia and Slovakia, made also an extensive use of direct grants. As the European Commission (2022b) indicates, the use of repayable forms of support is generally less distortive of competition and allows mobilising large volumes of aid with a relatively smaller direct and immediate budgetary cost for the State (subsidised loans), if any at all (guarantees only have a budgetary impact if they are called), as compared to direct grants. This explains the widespread use of repayable instruments to channel COVID-19 aid. Nonetheless, this type of measures expose the State to a credit risk, which may trigger a need to restructure the loans in the future.

3 Literature Review

The literature on the effectiveness and impact of State aid is extensive and long-standing. Previous studies differ in terms of the methodology used, the outcome variable of interest, the time period and the unit of analysis. There is no clear consensus on the State aid effectiveness. A systematic review of the existing studies focusing on the impact of grants on SMEs in the EU is provided by Dvouletý et al. (2021). Their results mostly indicate a positive effect of grants on firm survival, employment, tangible/fixed assets and sales/turnover, while the evidence on the effects on labour productivity and total factor productivity (TFP) is mixed. However, the study highlights that the effects are very heterogeneous depending on firm characteristics (such as age, size, and sector of activity) and the time elapsed since the intervention (short-term vs. long-term effects). The review focuses on longitudinal studies using firm-level data. In terms of methodology, the most commonly used methods are matching techniques combined with DiD, with propensity score being the preferred matching method. Notably, fewer studies use RDD or two-stage Heckman selection models.

The framework for the implementation of the COVID-19 aid differed compared to other forms of State aid as it included milder restrictions to access the aid, with the aim of mitigating the huge risk of insolvencies and bankruptcies (OECD, 2021). This variety of measures undoubtedly helped companies to cope with the crisis, although it may have affected the allocation of resources in the market. Identifying the unintended effects of aid to companies, especially in terms of aggregate productivity and zombification of the economy, is beyond the aim of this paper, albeit this is a relevant aspect that has been explored in the literature (Andrews et al. 2016, 2017).

Some recent studies consider the effects of the pandemic on productivity and debt, bankruptcy triggers and predicted firm exit, focusing on specific countries (Cros et al., 2021 for France; and Tielens and Piette, 2022 for Spain). Other studies (Tielens et al., 2020; Chundkkadan et al., 2022) assess the impact on capital constraints, while Dhyne & Duprez (2021) look at the impact of COVID-19 on several firm outcomes in Belgium and find that the crisis led to greater differences in firm performance than in normal times. Other related studies examine the impact of COVID-19 on labour market outcomes such as employment rates, job separation, and firms' survival. In particular, Adams-Prassl et al. (2020) present real-time survey evidence from the UK, the US and Germany showing that COVID-19 had significantly different effects on labour market outcomes (job loss and hours worked) across countries, and in some cases exacerbated existing inequalities within countries. Altomonte et al. (2021) assess the impact on employment and find that the measures were effective in containing unemployment, with some heterogeneity across the three countries considered (Italy, Germany and France).

Bennedsen et al. (2020) examine whether government support during the COVID-19 crisis reduced job separations (number of workers employed, laid off and on leave). Their results show that the support measures sorted effects in the expected direction, thus reducing the social impact of the pandemic. Bertschek et al. (2023) found that emergency assistance had a significant effect in (slightly) increasing the survival probability of the self-employed, using a sample of about 20000 observations in Germany with some heterogeneity in terms of education, risk tolerance and sectors.

Furthermore, a few recent studies document the effect of COVID-related policy support on different firm outcomes. The analysis presented in this report makes a specific contribution to this area of research. Some papers (Harasztosi et al., 2022, Bighelli et al., 2021 and Zegel et al., 2021) focus on the characteristics of the beneficiaries to assess whether the pre-crisis transfers were primarily targeting weaker and less productive firms. Additionally, there are some non-academic policy evaluations carried out by national research institutes in the Netherlands (Davies et al., 2023) and in Belgium (Tielens et al., 2020, 2022; Zegel et al., 2021). A broader geographical coverage is provided by Harasztosi et al. (2022), using EIBIS survey data on the entire EU area, and Bighelli et al. (2021) focusing on Croatia, Finland, Slovakia and Slovenia.

The results presented in this report are generally consistent with those papers focusing on short-term effects of public support to firms on their liquidity measures. The effect of State aid on turnover is usually positive, as found by Dvouletý et al. (2021), that identified this relationship in about ten of the examined studies (Bernini and Pellegrini, 2011; Hartšenko and Sauga, 2013; Cerqua and Pellegrini, 2014, 2017; Söderblom et al., 2015; Decramer and Vanormelingen, 2016), while a negative or non-significant effect is found in only four studies (Roper and Hewitt-Dundas, 2001; Mole et al., 2009; Brachert et al., 2018; Srhoj et al., 2019).

Triggered by the 2014 State aid Modernisation (SAM) initiative of the Directorate General of Competition that introduced the obligation for retrospective evaluations of aid schemes, the European Commission is increasingly recognising the role of economic analysis in the control of State aid to companies. Nonetheless, there are still no comprehensive retrospective studies performed on State aid control to date assessing the so-called balancing test. The only exception is the study by Duso et al 2021, which analysed whether a Broadband subsidy in Germany was effective in solving a market failure – low broadband coverage in rural areas – but also examined its impact on competition by assessing the aid effect on both rival firms and consumers (i.e. entry and market prices),.

Assessing the impact of COVID-aid on competition is beyond the scope of this study. The present study focuses on the impact of COVID Aid on firms' turnover and probability of default. The contribution to existing literature is twofold. First, the analyses rely on detailed information on the universe of State aid granted in three EU Member States namely Italy, Spain and Poland. This allows a much more cleaner definition of treated entities (e.g. firms receiving COVID aid) but, even more importantly, adequate controls (e.g. firms that did not receive *any* sort of aid in the years between 2017-2021) Second, the current analysis uses the estimated probability of default, a novel indicator published by Bureau Van Dijk that also allows to overcome the limitations of the Orbis data in studying the exit of firms.[10] To some extent, the present study is comparable with Konings et al. (2023) in that it examines the short-term effects of aid to firms during the COVID-19 pandemic and finds largely positive effects on firm performance, although creative destruction and growth are not the main outcomes of interest.

The COVID-19 support schemes were an emergency tool to avoid massive economic fallout. They were designed to be temporary and could therefore be loosely targeted (Gourinchas et al. 2021). They were not thought to boost growth or foster financial stability. This poses some challenges in terms of the comparability of the present results with existing literature.

[10] See Bajar et al (2020), pag. 9 "[Orbis] ability to capture evolution of the entire firm distribution remains limited, and it continues to perform poorly at measuring entry and exit"

4 Data

To gather accurate information on State aid beneficiaries the analysis combines data from National State aid Registers of Italy, Poland, and Spain, including all firm-level aid awards with firms' balance sheet data extracted from Orbis. Additionally, SARI2 has been used to complement information on State aid expenditures at an aggregate level as this does not include any information on single beneficiaries. The selected National State aid Registers are compiled by the Ministry of Economy and Finance of the respective Member States to keep track of all State aid awarded in these countries.[11]

The National Registers (NR) provide information on the date on which each individual aid award was granted; the nominal amount of the aid; the aid element, the name, location, and the national identifier of the firm receiving the aid; the industry sector of the firm; the objective of the aid, and the reference to the aid measure. Most importantly, the NR include information about the type of financial instrument of the aid, distinguishing among guarantees; loans; direct grants; interest rate subsidies; tax advantages and "other types" of instruments (a residual category grouping less commonly used instruments).

Firms can in principle receive more than one aid award per year, and each of them can be awarded under a different type of instrument. In other words, the NR datasets have a multi-level structure, with firms potentially reporting more than one row (aid) per year. To build a firm-year panel dataset, the information is collapsed to compute the total amount granted to a firm in a given year. In addition, the amount spent by type of instrument is also calculated.

Data from the NR cover the period between 2017 and 2022. COVID State aid schemes have been identified based on the case reference or, when this was not available, using the aid objective description. The aid was classified as a COVID measure whenever the words "COVID State aid" or the relevant legal basis (i.e. Remedy for a serious disturbance in the economy) for COVID aid were mentioned.

Overall, the number of aid interventions reported in the NR is: 7,871,867 for Italy (reported by 4,283,337 firms); 4,969,028 for Spain (1,200,782 firms) and 14,053,636 for Poland (3,830,540 firms).

Firm-specific financial data are obtained from the Orbis database distributed by Bureau Van Dijk (BvD)/Moody's. Orbis is a comprehensive database widely used for economic and financial research, providing information on private and public companies in different countries. As discussed later in this report, this variability may affect the reliability of the information for specific group of firms that are not adequately represented (Bajgar et al., 2020). It is important to note that Orbis focuses on the non-farm business economy, which includes all sectors except agriculture and public services. The data available covers approximately 10 years, which allows for the construction of a balanced firm-level panel.

Despite its limitations, Orbis remains the most comprehensive source of firm-level information available for cross-countries comparisons. The selection of countries for the analysis is determined by the availability of data from State aid NRs. The final dataset is a balanced panel meaning that only firms including non-missing variables in each year are used for analysis. The process of data selection is described in detail in Section 4.2.4. Financial information is measured at the firm level, by considering the "unconsolidated accounts". The firm-level information in Orbis is then merged with National registers using national identifiers of the beneficiaries of State aid.

Matching Orbis with the State aid NRs undoubtedly represents a unique advantage of the current analysis in terms of data granularity and accuracy. However, relying on a subset of countries could be considered a limitation of the study, given the heterogeneous coverage of Orbis across countries. Yet, 2 out of the 3 countries considered, namely Italy and Spain, are among those with better coverage (around 60% of total output and 40% of total value added) according to the comparison at the aggregated country-industry cell carried out in Bajgar et al. (2020), which refers to OECD-STAN. The third country considered, Poland, also shows a generally good coverage, but lacks precision for some variables (e.g. value added and number of employees) due to rounded values.

[11] The creation and maintenance of National State Aid Registers is not mandated by the European Commission. The initiative of single
Member States in this direction should be taken as a best practice. Please note that other National Registers, for example Romania and Slovenia, follow the transparency rules but only publish aid awarded above the reporting thresholds presented in Annex 2.

Examining the coverage and representativeness of Orbis is beyond the scope of the proposed analysis, which focuses on a specific and well-identified set of firms, as will be discussed in the following sections. Furthermore, the results of the matching procedure were reassuring, as Orbis covers a large number of firms present in the National Registers.[12] Specifically, Orbis covers 82.1% of firms recorded in the Italian National Register, 83.1% of firms of the Spanish Register, and 66.6% of firms in the Polish register.

In this study, the treatment group is defined as those firms that received COVID aid in 2020. This excludes from the analysis beneficiaries of other types of State aid, as well as firms that received a combination of COVID and non-COVID State aid over the period 2017-2022. This simplifies the analysis and allows a clear comparison between COVID aid beneficiaries and firms that never received any aid over the period 2017-2022.

4.1 Sample selection

The following section discusses the representativeness of the sample used in the analysis with respect to the Orbis population, focusing on two issues: 1) the sample selection due to excluding observations with missing values; 2) the selection due to attrition i.e. observations not being observed in some specific years.

4.1.1 Missing values

Table 3 compares the characteristics of the unbalanced sample (i.e. the sample excluding missing values in the variables of interest) with the raw data.

In all the countries, micro firms are more likely to be excluded from the analysis due to missing values. In Italy, firms in the retail sector are under-represented with respect to the wider Orbis population, whilst in Spain and Poland firms are under-represented in the construction sector.

Table 3. *Firms characteristics of analysed samples compared to excluded observations*

Panel A - Italy								
	Analysed sample		Excluded observations		Diff.	p-value	N analysed sample	N excluded observations
Firm type	**%**		**%**					
Size[1]								
Micro	90.2%		99.6%		-0.090	0.000	131,878	834,131
Small	7.7%		0.3%		0.070	0.000	131,878	834,131
Medium	1.6%		0.0%		0.020	0.000	131,878	834,131
Large	0.5%		0.0%		0.000	0.000	131,878	834,131
Sector[2]								
Manufacturing	22.0%		13.9%		0.080	0.000	131,878	834,131
Construction	33.6%		30.0%		0.040	0.000	131,878	834,131
Wholesale	27.8%		23.4%		0.040	0.000	131,878	834,131
Retail	16.6%		32.7%		-0.160	0.000	131,878	834,131
Financial variables[3]	**Mean**	**SD**	**Mean**	**SD**	**Diff.**	**p-value**		
Turnover (€M)	2.60	116.01	0.31	9.45	2.290	0.000	131,878	834,131
Capital (€M)	0.17	7.76	0.15	4.80	0.020	0.308	131,878	335,355
Loans (€M)	0.15	12.18	0.10	2.18	0.050	0.165	131,878	117,624
Total assets (€M)	2.57	72.85	1.24	26.44	1.330	0.000	131,878	117,624
EBITD margin (M)	5.10	22.92	6.15	27.95	-1.050	0.000	131,878	65,415
Probability of default	9.67	17.90	24.46	29.27	-14.790	0.000	131,799	117,518

(continue in the next page)

Table 3 (continued). Firms characteristics of analysed samples compared to excluded observations

[12] Firms excluded from the merging are mainly beneficiaries that are not obliged to publish their balance sheet. This may happen for partnerships, for example.

Panel B - Spain								
	Analysed sample		**Excluded observations**		**Diff.**	**p-value**	**N analysed sample**	**N excluded observations**
Firm type	**%**		**%**					
Size[1]								
Micro	84.8%		94.3%		-0.090	0.000	194,144	103,393
Small	12.0%		4.5%		0.070	0.000	194,144	103,393
Medium	2.6%		0.9%		0.020	0.000	194,144	103,393
Large	0.6%		0.2%		0.000	0.000	194,144	103,393
Sector[2]								
Manufacturing	21.4%		15.4%		0.060	0.000	194,144	103,393
Construction	28.5%		38.0%		-0.100	0.000	194,144	103,393
Wholesale	31.4%		27.8%		0.040	0.000	194,144	103,393
Retail	18.7%		18.7%		0.000	0.747	194,144	103,393
Financial variables[3]	**Mean**	**SD**	**Mean**	**SD**	**Diff.**	**p-value**		
Turnover (€M)	2.71	48.17	1.23	57.25	1.480	0.000	194,144	93,218
Capital (€M)	0.29	11.19	0.28	9.83	0.010	0.810	194,144	103,385
Loans (€M)	0.13	1.42	0.10	3.45	0.020	0.017	194,144	97,483
Total assets (€M)	2.35	33.07	1.93	91.30	0.420	0.073	194,144	103,393
EBITD margin (M)	3.93	17.79	3.55	26.64	0.390	0.000	194,144	81,384
Probability of default	10.53	20.66	21.06	29.97	-10.530	0.000	194,077	103,301

Panel C - Poland								
	Analysed sample		**Excluded observations**		**Diff.**	**p-value**	**N analysed sample**	**N excluded observations**
Firm type	**%**		**%**					
Size[1]								
Micro	68.4%		91.7%		-0.230	0.000	19,708	44,559
Small	22.1%		6.5%		0.160	0.000	19,708	44,559
Medium	7.5%		1.5%		0.060	0.000	19,708	44,559
Large	2.0%		0.3%		0.020	0.000	19,708	44,559
Sector[2]								
Manufacturing	24.3%		21.0%		0.030	0.000	19,708	44,559
Construction	23.5%		31.8%		-0.080	0.000	19,708	44,559
Wholesale	37.2%		32.2%		0.050	0.000	19,708	44,559
Retail	15.1%		14.9%		0.000	0.614	19,708	44,559
Financial variables[3]	**Mean**	**SD**	**Mean**	**SD**	**Diff.**	**p-value**		
Turnover (€M)	6.82	64.66	1.50	15.97	5.320	0.000	19,708	38,418
Capital (€M)	0.50	8.34	0.16	5.14	0.340	0.000	19,708	44,099
Loans (€M)	0.21	2.28	0.21	2.26	0.000	0.961	19,708	16,251
Total assets (€M)	3.79	25.96	1.20	12.11	2.590	0.000	19,708	44,267
EBITD margin (M)	5.55	21.50	8.02	32.33	-2.470	0.000	19,708	32,400
Probability of default	10.33	19.71	21.90	29.77	-11.570	0.000	19,568	43,791

1 Firm size is based on the average turnover for 2017-2019. Size categories are defined as: *Micro*: average turnover < 2 EUR Millions; *Small*: average turnover between 2 and 10 Millions of EUR; *Medium*: average turnover between 10 and 50 Millions of EUR; *Large*: average turnover over 50 Millions of EUR.

2 The sectoral classification is based on the NACE Rev. 2 system

3 Turnover, Capital, Loans and Total assets are expressed in millions of EUR.

Firms that are excluded from the analysis have, on average, lower turnover, lower profitability (EBIT margin) and higher probability of default as compared to the analysed samples. In particular, the probability of default of excluded firms is more than double with respect to those included in the analysis. This is in line with the fact that excluded firms are relatively smaller and have worse financial parameters as compared to those included in the analysis.

4.1.2 Firms not appearing in Orbis after 2019

Since the focus of the analysis is on a balanced panel of firms, this section investigates the representativeness of the latter as compared to firms that disappeared in the post-treatment period (2020 and 2021). This is to facilitate the interpretation of results, given that the goal of COVID aid was to support firms at risk of going bankrupt. It should be noted, however, that Orbis data are unsuitable for survival analysis - i.e. estimating the probability of a firm surviving over time (Bajgar et al., 2020) - due well-known reporting problems. Specifically, firms may not report information in a particular year or report with a lag of up to 5 years. Therefore, it is not possible to distinguish whether firms disappear from the sample because of bankruptcy or due to reporting issues.

Table 4 presents two separate probit estimations, modelling the probability of disappearing in a given year (e.g. 2020) as compared to being observed in the entire period of analysis (e.g. 2017-2020).

In all the countries analysed, firms that disappear in the post-treatment period are more likely to have lower turnover, capital, and EBIT, and be smaller in size. There are also some significant differences in their sectoral and geographical distributions and these differences are larger in 2021. This year is more likely to be affected by reporting lags, as this is the most recent one.

Finally, the sample used for the analysis is a selected sample of the total population of firms. This needs to be taken into account when reading the results. For example, the exclusion of small firms, which may have worse financial performance and are more likely to be misreported in the 2021 Orbis data, could lead to an overestimation of the (positive) effect of the aid on firm performance.

Table 4. *Probit models. Dependent variable = 1 if firm is not reported in a given year (see table); marginal effects[1]. Year: 2019*

Outcome[2]	**Firms disappearing from 2021**			**Firms disappearing from 2020**		
Country	**IT**	**ES**	**PL**	**IT**	**ES**	**PL**
Turnover[3]	-0.004***	-0.022***	-0.013***	-0.018***	-0.009***	-0.026***
	(0.001)	(0.001)	(0.002)	(0.000)	(0.000)	(0.002)
Capital						
2nd quartile	-0.055***	-0.010***	-0.021*	0.011***	-0.001*	-0.000
	(0.005)	(0.003)	(0.012)	(0.002)	(0.001)	(0.008)
3rd quartile	-0.099***	-0.024***	-0.067***	0.013***	-0.000	-0.005
	(0.005)	(0.003)	(0.009)	(0.002)	(0.001)	(0.006)
4th quartile	-0.107***	-0.014***	-0.064***	0.025***	0.009***	-0.006
	(0.005)	(0.003)	(0.009)	(0.002)	(0.001)	(0.006)
EBIT margin						
2nd quartile	-0.029***	-0.054***	-0.013	-0.057***	-0.027***	-0.035***
	(0.004)	(0.003)	(0.010)	(0.002)	(0.001)	(0.007)
3rd quartile	-0.018***	-0.058***	-0.024**	-0.056***	-0.026***	-0.032***
	(0.004)	(0.003)	(0.009)	(0.002)	(0.001)	(0.007)
4th quartile	0.031***	-0.047***	0.004	-0.030***	-0.020***	-0.012*
	(0.004)	(0.003)	(0.010)	(0.002)	(0.001)	(0.007)
Sector[4]						
Construction	0.031***	0.004	0.005	-0.003*	0.004***	0.044***
	(0.004)	(0.003)	(0.009)	(0.002)	(0.001)	(0.006)
Wholesales	0.007*	0.002	-0.002	-0.008***	0.002***	0.024***
	(0.004)	(0.003)	(0.008)	(0.002)	(0.001)	(0.006)
Retail	0.016***	0.011***	0.016	-0.008***	0.001	0.015**
	(0.004)	(0.003)	(0.010)	(0.002)	(0.001)	(0.007)
Firm size[5]						
Small	-0.082***	0.077***	0.005	0.018***	0.015***	0.021***
	(0.005)	(0.004)	(0.010)	(0.004)	(0.002)	(0.008)
Medium	-0.114***	0.228***	0.021	0.034***	0.024***	0.068***
	(0.010)	(0.009)	(0.016)	(0.011)	(0.006)	(0.015)
Large	-0.124***	0.321***	0.050*	0.059*	0.065***	0.068**
	(0.019)	(0.016)	(0.029)	(0.031)	(0.021)	(0.031)
NUTS 2 Regions						
Region 2	0.010	0.021***	-0.017	0.005	0.005**	-0.020**
	(0.033)	(0.007)	(0.014)	(0.014)	(0.002)	(0.010)
Region 3	0.007	0.015*	0.008	0.003	0.010***	-0.014
	(0.010)	(0.009)	(0.014)	(0.005)	(0.003)	(0.010)
Region 4	-0.073***	0.050***	-0.000	0.000	0.004**	0.011
	(0.006)	(0.005)	(0.019)	(0.003)	(0.002)	(0.014)
Region 5	0.113***	0.004	0.056**	0.009*	0.002	-0.004
	(0.012)	(0.007)	(0.027)	(0.005)	(0.002)	(0.018)
Region 6	0.042*	0.193***	-0.004	-0.007	0.001	-0.002
	(0.024)	(0.014)	(0.016)	(0.008)	(0.003)	(0.011)
Region 7	0.107***	0.040***	0.000	-0.001	0.004**	0.019
	(0.007)	(0.005)	(0.026)	(0.003)	(0.002)	(0.020)

(continue in the next page)

Table 4 (continued)

Country	IT	ES	PL	IT	ES	PL
Region 8	0.100***	0.127***	-0.024	0.005	0.011***	-0.004
	(0.008)	(0.004)	(0.019)	(0.003)	(0.001)	(0.014)
Region 9	0.098***	0.111***	-0.006	0.002	0.001	0.003
	(0.020)	(0.005)	(0.026)	(0.007)	(0.001)	(0.019)
Region 10	0.104***	0.067***	-0.011	-0.005	0.001	0.016
	(0.012)	(0.005)	(0.016)	(0.004)	(0.001)	(0.012)
Region 11	0.125***	0.051***	-0.001	0.002	0.001	0.001
	(0.009)	(0.009)	(0.017)	(0.004)	(0.002)	(0.013)
Region 12	0.271***	0.092***	0.051	0.011**	0.006***	-0.022
	(0.012)	(0.003)	(0.031)	(0.005)	(0.001)	(0.020)
Region 13	-0.071***	0.064***	-0.016	-0.003	0.007***	-0.013
	(0.007)	(0.004)	(0.020)	(0.003)	(0.001)	(0.014)
Region 14	-0.051***	0.249***	0.010	-0.002	0.022***	-0.027*
	(0.012)	(0.007)	(0.022)	(0.005)	(0.003)	(0.014)
Region 15	-0.046***	0.133***	0.021	0.003	0.006***	0.009
	(0.007)	(0.004)	(0.026)	(0.003)	(0.001)	(0.019)
Region 16	-0.006	0.022***	0.030**	0.004	0.004**	0.011
	(0.007)	(0.005)	(0.013)	(0.003)	(0.002)	(0.009)
Region 17	0.066***	0.035	0.001	0.008	0.020	-0.026*
	(0.012)	(0.031)	(0.022)	(0.005)	(0.015)	(0.015)
Region 18	-0.006	0.330***		0.004	0.055***	
	(0.009)	(0.039)		(0.004)	(0.020)	
Region 19	0.072***	0.104***		0.008***	0.010***	
	(0.006)	(0.006)		(0.003)	(0.002)	
Region 20	-0.056***			-0.012***		
	(0.012)			(0.005)		
Observations	131,878	194,144	19,708	131,878	194,144	19,708

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

2 Base category of the outcome variable: whether the firm has being observed up to the 2021 (or 2020).

3 Reference categories of the independent variables: - Size: Micro; Sector: Manufacturing; Region: Region 1 of the NUTS2 classification in each country. Capital and EBIT margin: 1st quartile of their distribution.

4 The sectoral classification is based on the NACE Rev. 2 system

5 Firm size is based on the average turnover for 2017-2019. Size categories are defined as: *Micro*: average turnover < 2 EUR Millions; *Small*: average turnover between 2 and 10 Millions of EUR; *Medium*: average turnover between 10 and 50 Millions of EUR; *Large*: average turnover over 50 Millions of EUR.

4.2 Descriptive evidence

The analysis presented in this study focuses on the four economic sectors that are better represented in Orbis, namely manufacturing, construction, wholesale and retail. As discussed in Section 4.1.1 above, the study focuses on the balanced sample of firms that are observable throughout the period 2017-2021, and therefore have observations for all five years.

4.2.1 Firms' characteristics by country

Table 5 shows the average sample characteristics of firms in the countries analysed.

The distributions of firm size and sector differ by country. However, Italy and Spain are more similar in their sample compositions with respect to Poland. For example, in Poland, there is lower share of micro firms (59.9%) than Italy and Spain, where these shares are 86.7% and 84.7%. There is also a lower share of firms in construction (20%) as compared to Italy and Spain (>27%), and a higher proportion of firms in wholesales (39.4%) than in Italy and Spain (<32%). Finally, the samples of Italy and Spain also have, on average, firms with lower levels of turnover, capital, and total assets.

In principle, these figures may partly reflect differences in sectoral specialisation and business demography across countries. However, Eurostat (2019) shows that the proportion of small firms (defined as those with less than 10 employees) is 95% in all the countries analysed. Hence, these figures – and in particular the higher proportion of medium and large firms for Poland - are more likely to reflect Orbis' well-known differences in data representativeness (Bajgar, et al., 2020).

Table 5. *Firm's 2019 characteristics, by country*

Country	Italy				Spain				Poland			
Firm type	**%**				**%**				**%**			
Size[1]												
Micro	86.7				84.7				59.9			
Small	10.3				12.5				26.6			
Medium	2.3				2.4				10.6			
Large	0.7				0.5				2.9			
Sector[2]												
manufacturing	24.2				22.2				25.7			
construction	29.2				27.3				20.0			
wholesale	29.9				31.9				39.4			
retail	16.6				18.7				14.9			
Financial Variables[3]	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**	**Mean**	**SD**	**Min**	**Max**
Turnover	3.8	151.3	0.0	30,670	2.5	51.5	0.0	16,494	10.2	97.6	0.0	6,214
Capital	0.2	9.9	0.0	2,347	0.2	6.4	0.0	1,517	0.6	8.6	-261.7	389
Loans	0.2	15.9	0.0	4,367	0.1	1.3	0.0	154	0.3	2.7	0.0	110
Total assets	3.3	89.3	0.0	18,504	2.1	29.9	0.0	6,005	5.3	35.0	0.0	1,697
EBIT margin	5.6	16.9	-99.9	100	4.6	14.8	-99.9	100	5.6	16.3	-100.0	100
Probability of default	7.1	14.5	0.1	100	9.0	18.6	0.1	100	8.6	17.5	0.1	100
Observations	76,738				142,395				7,213			

1 Firm size is based on the average turnover for 2017-2019. Size categories are defined as: *Micro*: average turnover < 2 € Millions; *Small*: average turnover between 2 and 10 Millions of €.

2 The sectoral classification is based on the NACE Rev. 2 system

3 Turnover, Capital, Loans and Total assets are expressed in millions of EUR.

Source: Authors' computations based on ORBIS data.

4.2.2 Financial characteristics of COVID aid beneficiaries with respect to non-beneficiaries

To minimize distortions to competition in the EU, the Temporary Framework COVID aid set rules to prevent firms in financial difficulty before the pandemic to receive State aid. Hence, financial characteristics of beneficiaries are expected to be different from those of non-beneficiaries. Table 6 presents the descriptive statistics for beneficiaries and non-beneficiaries separately. As explained above, beneficiaries are defined as firms that received COVID aid in 2020.

The table reveals systematic differences between treated (i.e. firms that received COVID aid) and non-treated firms across all countries. Treated firms tend to be smaller in size and in other financial indicators such as turnover, capital, loans, EBIT margin, and total assets. On the other hand, non-beneficiaries had higher probability of default. Differences in firm characteristics between beneficiaries and non-beneficiaries also vary by country, with more pronounced differences observed in Poland and relatively milder differences in Spain. For instance, in Poland, the average total assets of beneficiaries are 10,670 EUR million lower than those of non-beneficiaries. In Italy and Spain, these differences amount to 4,460 and 1,240 EUR million, respectively. Regarding the sector of activity, COVID aid beneficiaries in Italy are over-represented in retail compared to non-beneficiaries (+6pp), while in Poland, beneficiaries are over-represented in both the wholesale and retail sectors (-7pp). This is in line with the evidence that the sectors mostly hit by the pandemic were the wholesale and retail ones, as they suffered more prolonged and strict containment measures. To summarize, these figures shows that COVID beneficiaries were distinct from non-beneficiaries, and one needs to account for this selection into treatment when assessing the impact of the aid (see section 5).

Table 6 also shows that the characteristics of treated firms vary by country analysed. In Italy, mainly micro firms received COVID aid (90% of the treated firms) and only 9% of the treated firms were small. In Spain, there were 82% of micro firms and 15% of small firms among those receiving COVID aid. In Poland, the sample size of firms receiving COVID aid was more mixed (64% of treated firms are micro, 27% are small, and 8% are medium-sized). [13]

Some differences arise also in terms of sector of activity. In Italy and Spain, aid is more spread across sectors while in Poland it is more concentrated in some specific sectors such as construction. For instance, in Poland the proportion of beneficiaries in wholesale is 40% whist in Spain and Italy this proportion is lower than 33%.

[13] Please note that these figures are based on the analysed samples and therefore the results cannot be generalized to the entire firms' population. The representativeness of the analysed samples is discussed in this section (4).

In all the countries analysed, firms that received COVID aid exhibit lower turnover, and have lower levels of capital, total assets and loans than their non-beneficiary counterparts. They also have a lower probability of default, and this might reflect the fact that the Temporary Framework rules prohibited to grant aid to companies that where in difficulty before the pandemic.

4.2.3 Characteristics of COVID aid beneficiaries by firm size and sector

This section investigates how the figures presented in Table 6 differ by firm size and industry sector. Differences by size are of interest as the requirements to access COVID aid were looser for micro and small firms (as explained above). Moreover, these firms may experience more difficulties in accessing financial markets during periods of crisis. On the other hand, differences by sector are useful as the pandemic has had a different impact depending on the sectors of activity. These statistics are summarized here and reported in Appendix (Tables A2 and A3).

Differences by firm size

In Spain, beneficiaries had a higher level of loans than non-beneficiaries, and this difference was more pronounced for medium and large firms. In contrast, beneficiaries had lower total assets than non-beneficiaries, for all firm dimensions. In Italy, small and medium-sized beneficiaries had higher loans than non-beneficiaries (positive difference), while this difference was not significant among large firms. Italian beneficiaries also had lower levels of total assets as compared to non-beneficiaries, across all analysed firm dimensions. In contrast, the difference in EBIT margin was negative only for micro and small firms. In Poland, beneficiaries had lower loans than non-beneficiaries, which contrasts with the cases of Italy and Spain. Additionally, beneficiaries in Poland had lower total assets and EBIT margin.

Across all analysed countries and firm dimensions, beneficiaries had lower levels of capital than non-beneficiaries. As noted before, the probability of default was lower for firms that received COVID aid as compared to non-beneficiaries. Furthermore, this difference varied across countries, ranging from 0.27 percentage points (pp) of Spain to 4.8 pp of Poland. Table A2 also indicates that in Italy and Spain, the difference in the probability of default between beneficiaries and non-beneficiaries did not significantly vary with firm size. In contrast, in Poland, this gap was higher among micro and small firms.

Differences by sector

Table A3 also reveals some interesting differences based on the sector of economic activity. For example, in all analysed countries, differences in turnover between beneficiaries and non-beneficiaries were larger in the wholesale sector. In Italy, the difference in probability of default between these two groups was larger in the wholesale sector, while in Poland, it was larger in the retail sector. In Italy and Spain, beneficiaries were less capitalised than non-beneficiaries in the manufacturing sector. This pattern was also observed in other sectors but with smaller gaps.

In summary, there were substantial differences in firm characteristics between sector, firm size, and the interaction between the two. This heterogeneity will be considered in the econometric analysis.

Table 6. *Descriptive statistics of firm pre-treatment characteristics (2019), by treatment status and country*

Country	**Italy**						**Spain**						**Poland**					
	Beneficiaries		Non-beneficiaries				Beneficiaries		Non-beneficiaries				Beneficiaries		Non-beneficiaries			
Variable	**%**		**%**		**Diff.**[3]	**p-value**	**%**		**%**		**Diff.**	**p-value**	**%**		**%**		**Diff.**	**p-value**
<u>*Size*</u>[1]																		
Micro	89.6%		83.1%		0.07	0.000	82.2%		86.7%		-0.05	0.000	64%		50%		0.14	0.000
Small	8.6%		12.5%		-0.04	0.000	15.1%		10.2%		0.05	0.000	27%		24%		0.03	0.007
Medium	1.6%		3.2%		-0.02	0.000	2.4%		2.4%		0.00	0.984	8%		18%		-0.10	0.000
Large	0.3%		1.2%		-0.01	0.000	0.3%		0.7%		0.00	0.000	1%		8%		-0.07	0.000
<u>*Sector*</u>																		
Manufacturing	24.5%		23.9%		0.01	0.067	23.4%		21.1%		0.02	0.000	25%		28%		-0.04	0.002
Construction	26.9%		32.1%		-0.05	0.000	24.4%		29.7%		-0.05	0.000	19%		22%		-0.03	0.002
Wholesale	29.4%		30.6%		-0.01	0.001	33.0%		30.9%		0.02	0.000	40%		37%		0.04	0.004
Retail	19.2%		13.4%		0.06	0.000	19.2%		18.2%		0.01	0.000	16%		13%		0.03	0.001
Financial variables[2]	**Mean**	**SD**	**Mean**	**SD**	**Diff.**	**p-value**	**Mean**	**SD**	**Mean**	**SD**	**Diff.**	**p-value**	**Mean**	**SD**	**Mean**	**SD**	**Diff.**	**p-value**
Turnover (€M)	1.47	9.71	6.70	225.68	-5.23	0.000	1.98	10.72	2.97	69.04	-0.99	0.000	5.70	87.42	22.09	119.98	-16.39	0.000
Capital (€M)	0.07	1.02	0.41	14.67	-0.34	0.000	0.10	0.67	0.33	8.65	-0.23	0.000	0.26	1.57	1.55	16.25	-1.28	0.000
Loans (€M)	0.13	1.25	0.27	23.74	-0.14	0.218	0.17	1.30	0.06	1.22	0.11	0.000	0.22	1.78	0.68	4.34	-0.46	0.000
Total assets (€M)	1.29	10.02	5.75	132.97	-4.46	0.000	1.38	6.59	2.62	40.04	-1.24	0.000	2.35	13.15	13.02	62.83	-10.67	0.000
EBITD margin (M)	5.39	12.92	5.79	20.76	-0.40	0.001	3.09	9.72	5.94	17.90	-2.85	0.000	5.37	14.24	6.28	20.84	-0.91	0.034
Probability of default	6.37	13.22	7.90	15.93	-1.54	0.000	8.81	17.49	9.07	19.53	-0.27	0.007	7.27	15.97	12.02	20.81	-4.75	0.000
Observations	42,352		34,386				64,827		77,568				5,246		1,967			

[1] Firm size is based on the average turnover for 2017-2019. Size categories: micro: average turnover < 2 EUR Millions; small: average turnover between 2 and 10 Millions of EUR *Medium*: average turnover between 10 and 50 Millions of EUR; *Large*: average turnover over 50 Millions of EUR.

[2] Turnover, Capital, Loans and Total assets are expressed in Millions of EUR.

[3] the table reports average differences between beneficiaries and non-beneficiaries and the associated p-value.

Source: Authors' computations based on ORBIS and State Aid National registry data.

4.2.4 Relationship between the probability of receiving COVID aid in 2020 and pre-pandemic financial hardship

The analysis also seeks to investigate whether COVID aid was granted to firms that were less likely to be in financial difficulties before the pandemic, as outlined in the objectives of the EC Temporary Framework. In this section, firms in financial difficulty are defined as those undertakings that experienced a drop in turnover greater than 20% between 2019 and 2018.[14] To descriptively analyse the relationship between receiving COVID aid and having experienced financial difficulties, a probit model is estimated. The outcome is a variable equal to one if the firm received COVID aid in 2020 and the independent variable is a binary indicator capturing whether the firm was in financial difficulty in 2019. Other control variables capturing pre-treatment characteristics such as capital, EBIT margin, loans, total assets, firm size, sector, and region in 2019 are also included. The same regression model is also estimated on different subsamples of firm sizes (micro, small, medium, and large size) and industry sectors (manufacturing, construction, wholesales, and retail).

Table 7. *Probit model: relationship between having had a large decrease in turnover in 2019 and the probability of receiving Covid Aid in 2020; marginal effects.*

	Country	IT	ES	PL
	All firms	-0.110***	-0.051***	-0.020
		(0.004)	-0.004	(0.015)
By size	Micro	-0.113***	-0.053***	-0.026
		(0.005)	(0.004)	(0.017)
	Small	-0.092***	-0.050***	-0.008
		(0.015)	(0.012)	(0.031)
	Medium	-0.056*	0.020	-0.015
		(0.032)	(0.031)	(0.061)
	Large	-0.167***	0.058	0.017
		(0.037)	(0.069)	(0.110)
By sector	Manufacturing	-0.124***	-0.045***	-0.005
		(0.009)	(0.008)	(0.031)
	Construction	-0.105***	-0.047***	-0.019
		(0.007)	(0.006)	(0.029)
	Wholesales	-0.117***	-0.057***	-0.025
		(0.008)	(0.007)	(0.024)
	Retail	-0.079***	-0.057***	-0.011
		(0.013)	(0.011)	(0.042)

Notes: Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Dependent variable = 1 if the firm was a COVID aid beneficiary in 2020-2021 (and 0 otherwise). The main independent variable for which the coefficient estimates are reported is a binary variable equal to 1 if the firm had a drop in turnover of at least 20% between 2019 and 2018 (and 0 otherwise). Other control variables included: capital, EBIT margin, loans, total assets, firm size, sector, and region. The estimation is based on data from 2019.

Table 7 reports the coefficients of interest for different specifications estimated on different sub-samples. Overall, they show that there is a negative association between having experienced financial difficulties in 2019 and receiving COVID aid in 2020-2021. While the analysis only identifies a correlation, this descriptive evidence aligns with the fact that COVID aid should have been granted to firms that were not in financial distress before the pandemic. Additionally, there are differences by country. For example, these associations are larger in magnitude for Italy and statistically insignificant for Poland, probably due to the lower sample size. In Italy, the negative association between receiving COVID aid and having experienced financial distress is also stronger for large firms. This is not surprisingly as the requirements to access COVID aid (i.e. not being in financial difficulty in 2019) were stricter for larger firms. In contrast, the association between receiving COVID aid and having experienced financial distress in 2019 is non-significant for large firms in Spain and Poland.

[14] Due to the complexity of the TF and data limitations, we are not able to identify the exact eligibility criteria to access the funding. The 20% threshold used here is arbitrary but the results are robust to changing the threshold to 30% or above.

4.2.5 Distribution of COVID-19 State aid by the type of financial instrument

Although the Temporary Framework set the rules to access State aid awards in all the EU countries, Member States could decide to provide support using different financial instruments (direct grant, loans, etc.). This choice might have reflected different liquidity constraints and levels of indebtedness by country (as discussed above). Table 8 presents the distribution of single State aid awards by type of instrument (i.e. whether direct grant, guarantee, loan, or other) and the average nominal aid amount–- as reported in the National Registers–- for each type of instrument. To investigate whether a firm received more than one type of instrument, aid instruments were then grouped into two broader categories: non-repayable instruments (including direct grants, interest rate subsidies, and other non-repayable grants), and repayable instruments (including guarantees and loans). Table 9 reports whether a firm received only repayable aid awards, only non-repayable aid awards, or a combination of both repayable and non-repayable aid.

Table 9 shows that Italy and Spain made considerable use of guarantees (as more than 91% of treated firms received this type of aid award) and resorted much less to direct grants (less than 13% of treated firms). In contrast, Poland made a greater use of both direct grants and loans (83% and 75% of treated firms, respectively). The average nominal amounts awarded in Poland is larger than in Spain and Italy (Table 8), for each type of instrument. This probably reflects differences in sample characteristics given that Polish firms are larger. In addition, Polish firms were more likely to receive more than one type of aid award. In particular, 60% of them received a combination of repayable and non-repayable instruments while in Italy and Spain these percentages were 6% and 3%, respectively, (see Table 9).

Table 8. *Proportions of aids received by beneficiaries and nominal aid amount by type of instrument (2020)*

	Instrument type			Average Aid Amount by instrument type[2]					
Country	**IT**	**ES**	**PL**	**IT**		**ES**		**PL**	
Type of instrument	**%**[1]	**%**	**%**	**Mean**	**SD**	**Mean**	**SD**	**Mean**	**SD**
Direct Grants[3]	12.6	4.8	83.3	0.01	0.04	0.01	0.02	0.04	0.05
Guarantee	91.8	95.1	1.2	0.42	2.55	1.04	7.30	3.30	4.71
Loan (aid)	0.7	0.1	74.7	0.07	0.27	0.16	0.44	0.13	0.20
Other aid	0.1	0.0	0.9	0.00	0.00	-	-	0.00	0.00
Only de-minimis	2.6	50.5	0.0						
Observations	42,352	64,827	5,246	42,352		64,827		5,246	

1 The proportions results do not sum up to 100 as a firm may receive more than one type of aid in the same year.
2 The nominal amounts are expressed in millions of €.
3 Includes Interest Rate subsidies.

Source: Authors' computations based on ORBIS and State Aid National registry data. Year: 2020.

Table 9. *Aid awards combinations.*

Country	**IT**	**ES**	**PL**
Instruments combination	**%**	**%**	**%**
Repayable only	87.2	93.4	16.2
Non-repayable only	6.5	3.3	24.4
Both repayable and non-repayable	6.3	3.3	59.4
Observations	42,352	64,827	5,246

1 Repayable instruments include guarantees and loans.
2 Non-repayable instruments include direct grants, interest rate subsidies and other non-repayable grants.

Source: Authors' computations based on ORBIS and State Aid National registry data. Year: 2020.

Finally, Table 10 investigates differences across sectors and firm dimensions. It shows that the distribution of instruments across countries does not vary substantially by sector and size. Notably, in Poland a very small number of guarantees were used to assist large firms (see Table 9). In Italy and Spain, large firms were less likely to receive aid in the form of de-minimis as compared to smaller firms.

Table 10. *Distribution of instrument type by country (Panel A) and firm dimension (Panel B)*

PANEL A	**Italy**				**Spain**				**Poland**			
Firm size[1]	**Micro**	**Small**	**Medium**	**Large**	**Micro**	**Small**	**Medium**	**Large**	**Micro**	**Small**	**Medium**	**Large**
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Direct Grants[2]	13.1	8.3	6.3	0.0	5.6	1.4	0.8	1.0	84.0	86.4	70.0	50.9
Guarantee	91.6	93.2	93.8	100.0	94.4	98.6	99.2	98.5	0.0	0.8	9.2	27.3
Loan (aid)	0.7	0.3	0.2	0.0	0.1	0.0	0.1	0.5	78.9	70.0	62.1	36.4
Other aid	0.1	0.2	0.3	0.0	0.0	0.0	0.0	0.0	0.8	0.9	2.0	1.8
Only de-minimis	2.8	1.1	1.2	0.0	52.8	42.8	28.1	5.4	0.0	0.0	0.0	0.0
Observations	37,945	3,623	666	118	53,280	9,810	1,533	204	3,348	1,439	404	55

PANEL B	**Italy**				**Spain**				**Poland**			
Sector[3]	**C**	**M**	**W**	**R**	**C**	**M**	**W**	**R**	**C**	**M**	**W**	**R**
	%	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**	**%**
Direct Grants	9.2	14.4	11.0	16.8	6.0	4.3	3.4	6.5	82.4	83.2	83.5	84.1
Guarantee	93.6	89.6	92.9	90.9	94.0	95.7	96.5	93.4	1.7	0.6	1.6	0.1
Loan (aid)	0.5	0.7	0.6	0.9	0.1	0.0	0.0	0.1	75.0	79.8	72.3	74.4
Other aid	0.2	0.1	0.1	0.3	0.0	0.0	0.0	0.0	1.0	1.4	0.8	0.5
Only de-minimis	1.7	4.1	2.3	2.3	47.6	54.1	48.5	52.9	0.0	0.0	0.0	0.0
Observations	10,378	11,378	12,459	8,137	15,140	15,832	21,405	12,450	1,297	1,005	2,120	824

1 Firm size is based on the average turnover for 2017-2019. Size categories: micro: average turnover < 2 EUR Millions; small: average turnover between 2 and 10 Millions of EUR; *Medium*: average turnover between 10 and 50 Millions of EUR; *Large*: average turnover over 50 Millions of EUR.

2 Includes Interest Rate subsidies.

3 M = manufacturing; C = construction; W = wholesales; R = retail.

Source: Authors' computations based on ORBIS and State Aid National registry data. Year: 2020.

5 Methods

To identify the causal effects of receiving a COVID State aid on different indicators of firms 'performance, a difference-in-differences (DiD) estimation strategy is adopted. Firms that applied for and received COVID aid – the treated group –are compared with firms that did not receive any State aid in the considered period from 2017 to 2021 (the control group).

A standard DiD model would allow to identify the Average Treatment Effect (ATE) of COVID aid only if the treatment was assigned randomly. However, the assignment of COVID aid was clearly not a random process, given the large heterogeneity in COVID-19 exposure across sectors, geographical areas, and types of firms. Furthermore, according to the TF rules, large firms with worse pre-pandemic financial conditions were less likely to receive aid. Thus, simply comparing treated and non-treated firms without considering firm characteristics would bear a risk of introducing systematic bias in the estimated impact. This was evident from the descriptive analysis (Section 4) showing significant differences in financial characteristics between the two groups. To address this key identification issue, the study adopts a matching procedure which is discussed in the next section.

5.1 Matching

A matching approach tries to reduce the selection bias into the treatment due to observable characteristics. For each aided firm, the method selects one (or more) non-aided firm(s) with similar observable pre-treatment characteristics. In this way, the firms that did not received the aid provide the counterfactual outcome for how the beneficiaries would have performed without the subsidy. Assuming that there are no additional differences across these firms in terms of non-observable characteristics, this approach would therefore mimic a situation in which the treatment, i.e., the aid, was randomly assigned.

To implement the matching procedure, the likelihood that a firm received COVID aid based on its observable characteristics, i.e., the so-called "propensity score" it is first estimated. Second, each treated firm is matched to a non-treated one[15] with similar observable characteristics, thus having a similar propensity score. It is worth noting that this regression does not aim at explaining why a specific firm was awarded the aid, rather it seeks to develop a metric that synthetise information from several characteristics into a one-dimensional indicator: the propensity score.

The matching is performed based on 2019 variables to avoid any spurious correlation with the effect of the aid (received in 2020). The estimated logit regression takes the following form:

$$\Pr(AID_i \mid Z_i) = F(a_i + \beta Z_i) \qquad (1)$$

Where AID_i is an indicator for firm *i* having received COVID aid and F(.) is the logit function; Zi is a vector of pre-treatment firm characteristics. The observable characteristics considered are as follows: firm sector of activity, based on the NACE Rev. 2 two-digit classification reported in Orbis; four macro-categories of industry sectors are considered, namely manufacturing, construction;[16].firm's size, which is important as it relates to firm financial structure, indebtedness, productivity, and the ability to respond to external shocks. To account for geographical effects, a dummy variable identifying the region is included in the analysis using the Nomenclature of Territorial Units for Statistics (NUTS) at level-2 classification. The remaining financial variables used in the logit model are capital, loans, total assets, and EBIT margin. These variables are defined in Table A1 in Annex 1. In addition, following the existing literature, the regressions conditioned on the value of the pre-treatment outcome (Heckman, Ichimura, and Todd, 1997) and hence it is done separately for the two dependent variables of interest.

Propensity scores measuring the probability of receiving COVID aid for both treated and non-treated firms are computed based on model (1).

The frequency distributions of the propensity scores for the treated and untreated firms will be shown in Figure 3 (Section 5.2).

[15] Importantly, as the State Register provides a complete mapping of all State aid measures implemented in the selected countries, we can be sure that the pool of firms in the control groups consists of firms that did not receive any form of aid in the period 2017-2021. This is a major advantage as it allows for cleaner inference.

[16] Only sectors with sample size that was large enough for statistical analysis were included.

The propensity score can be used in different ways in a difference-in-difference setting. It can be used to constrain the control group to only those firms that are similar enough to the beneficiaries. It can however also be used as a weight in a DiD regression using all observations.[17] In this way, the observations are reweighted so that the treated and control firms have identical reweighted distributions of receiving COVID aid.

The weights are calculated for each firm *i* as follows:

$$\begin{cases} \dfrac{1}{ps_i} & for\ aided\ firms \\ \dfrac{1}{1-ps_i} & for\ non-aided\ firms \end{cases}$$

To ensure the internal validity of the DiD estimand, the common support condition is enforced restricting attention to the set of firms that belong to the intersection of the supports of the propensity score distributions for both treated and controls.

5.2 Quality of Matching

This section checks the performance of the matching procedure in terms of covariate balancing and overlap of the propensity score distribution between treated and untreated firms. This is to verify whether differences in observable characteristics between the two groups are removed after applying the matching procedure. For the first outcome, the exact set of matching covariates includes turnover in the three years before the pandemic (2017-2018-2019), firm's size (split in three categories: Small, Medium, Large), firm's sector (divided in Constructions, Wholesales, Retails), firm's region, capital (in quartiles), loans (in quartiles), EBIT margin (in quartiles) plus interactions between firms' sector with size and loans and interactions of region with size and sector.

The covariate balancing is assessed in Table A11 (Panels (a) to (c)) of the Annex 4 for the three countries analysed. The composition of firms by size (Small, Medium and Large) is non-statistically different between treated and untreated with a percentage of remaining bias after matching always lower than 2%[18] and with the p-values of the corresponding two samples t-tests (Rosenbaum and Rubin, 1985) in each class and country which are always non-significant.

The composition of firms by sector (Construction, Wholesale and Retail) is perfectly balanced for Poland, while there are small differences in the proportion of firms in construction in Spain and wholesale in Italy, but with level of bias close to 1.6%. Italy also exhibits small significant differences in turnover during the three years before the pandemic (2017, 2018, 2019), with a level of bias close to 3%, while this is not the case for Spain and Poland that are perfectly balanced.

Finally, there are some minor differences in the regional distributions of firms after matching, with one or two regions in each country (out of about 20 regions) not being perfectly matched. However, the standardized bias is always below 5% and in most of the cases is even below 3% which is usually considered sufficient in the relevant literature (see Caliendo and Kopeinig, 2008).

The Pseudo-R^2, a measure of how well the covariates explain the probability of receiving treatment, is also low after matching (Pseudo-R^2= 0.001 for Italy and Spain, 0.003 for Poland) as opposed to a Pseudo-R^2> 0.100 for the three countries before matching.[19]

All this evidence suggests that the proposed matching strategy almost completely and significantly reduces the differences between treated and untreated firms in terms of observable characteristics.

To analyse the issue of overlap (or common support), Figure 3 shows that the distribution of the propensity scores by treatment status, for the three countries. The figures illustrate areas in the distributions where there are either only treated or only untreated firms. To avoid issues related to lack of common support, we exclude

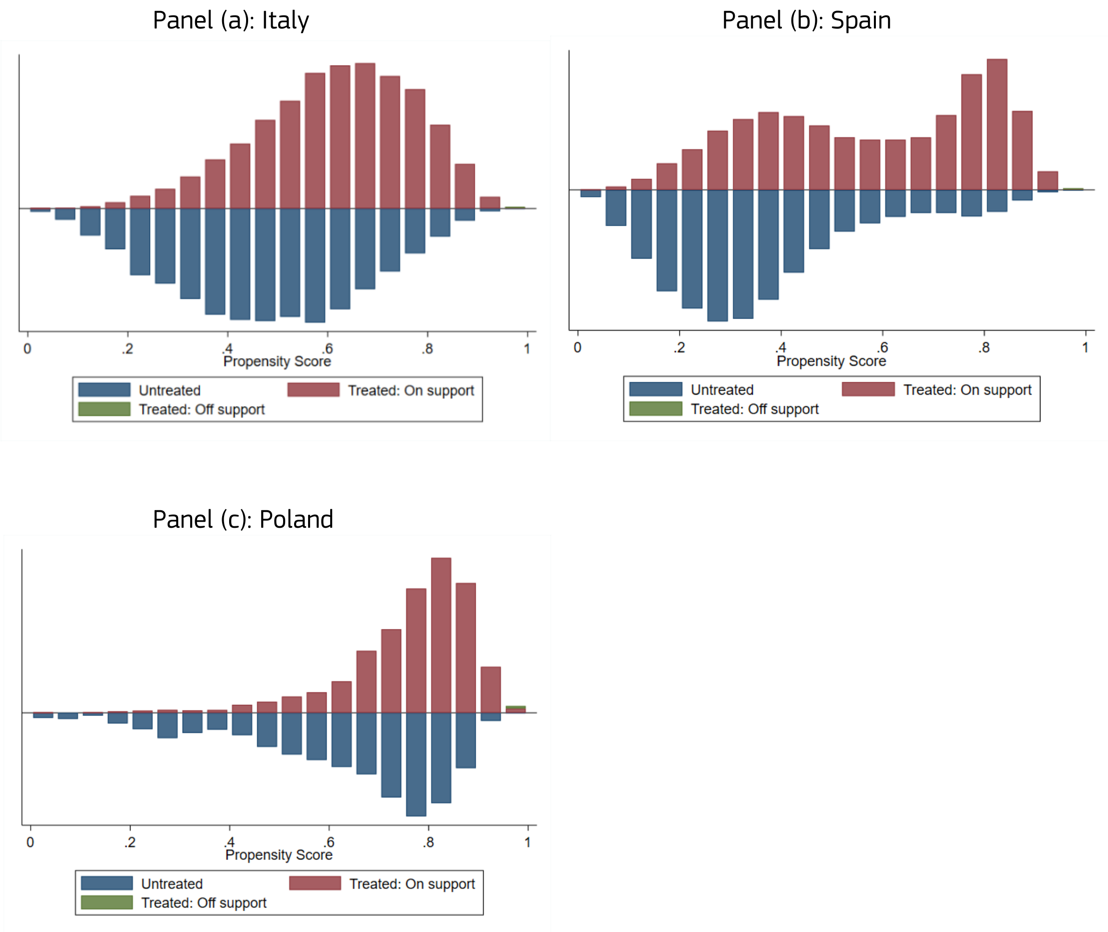
[17] Kernel weights were computed following Heckman, Ichimura, and Todd (1997, 1998) using psmatch2 Stata package.

[18] In most empirical studies a standardized bias below 3% or 5% after matching is considered as sufficient (see Caliendo and Kopeinig, 2008)

[19] Specifically, the Pseudo-R^2 was 0.1050 for Italy, 0.1707 for Spain, 0.1088 for Poland)

firms in the 1st and 99th percentiles of the distribution, following Imbens (2015)[20]. The results presented in this study are robust across different matching techniques.

Figure 3. *Propensity score distribution and common support for Italy, Spain, and Poland*



5.3 The difference-in-differences approach

In the difference-in-differences framework, the baseline empirical model to estimate the effect of COVID aid on outcome Y takes the form of the following equation:

$$Y_{it} = \alpha + \beta\ year_t + \delta\ Aid_i \times post_t + \lambda\ X_{it} + \mu_i + \varepsilon_{it} \qquad (2)$$

where the outcome Y of firm *i* in year *t* is a function of firms' characteristics (X_{it}), firm fixed-effects (μ_i) to account for time-invariant unobserved heterogeneity across firms, year fixed effects ($year_t$) and an error term ε_{it} which is assumed to be heteroskedastic. The dummy Aid_i x $post_t$ is equal to one for the firms that received the COVID aid in the post-intervention years, and zero otherwise. In our study, we consider 2021 as the post-treatment period, excluding 2020, as we cannot identify whether the treatment has already been implemented

[20] In the case of Poland, which exhibits a greater imbalance in the left side of the propensity score distribution, we conduct additional analyses by excluding a wider range of propensity score scores. The results consistently align with the main specification.

by the end of 2020. This is due to the fact that the payment of the aid (treatment) may, in some cases, be delayed.

The coefficient of interest (δ) measures the average change in the outcome of aided firms relative to the average change in the outcome of non-aided firms after treatment. Therefore, this coefficient quantifies the variation in the outcome of beneficiaries that is due to the aid.

This basic DiD model can then be expanded to estimate heterogeneous treatment effects by partitioning the coefficient δ between different sub-groups. Specifically, separate regressions to identify the treatment effect for different firm size and different sectors are estimated. Moreover, the analysis also investigates the heterogeneity of the aid's effect depending on the instrument through which the aid is provided.

The DiD relies on the validity of the common or parallel trend assumption, ensuring that the change in the outcome for beneficiary firms after treatment is solely attributable to the aid. In other words, this assumption implies that in the absence of the treatment, treated firms would have experienced the same trends in their potential outcome as firms in the control group. While this is not testable, an event-study analysis (Autor, 2003) can shed some light on the validity of the research design. In this framework, the treatment variable is interacted with year time dummies (excluding t-1 which would serve as baseline) and it is verified that the respective coefficients in the pre-treatment period are not statistically different from zero. Finally, it should be noted that the proposed approach –which is standard in the policy evaluation literature– controls for selection issues based on firms' observable characteristics and it is valid as long as the implemented propensity score matching procedure allows to account for the main drivers of the selection into the treatment. It however cannot control for unobservable differences between treated and control firms which are assumed to be uncorrelated with the assignment mechanism and the outcomes of interests.

6 Results

The COVID-19 outbreak posed unprecedented challenges for firms worldwide. The generous aid measures approved by national governments and the European Commission might have played a significant role in mitigating firms' default risk and market exit.

Given the nature of COVID aid scheme and the limited time elapsed from the intervention, the study seeks to uncover the impact of receiving COVID aid by looking first at the ability of firms to continue their usual operating activities, proxied by the revenues generated by such activity (turnover). Secondly, the focus will be on a measure capturing the estimated 'probability of the default' provided in Orbis.

6.1 Impact of Covid Aid on firms' performance

To investigate whether the aid helped firms navigate through the crisis, the analysis considers turnover as the most appropriate outcome indicator in the short run, notwithstanding its limitations in terms of comparability across different size classes.[21] Turnover is a continuous variable describing the total operating income (including net sales, other operating revenues, and stock variations) reported in the current year. The variable is gathered from firms' balance-sheet information reported in Orbis and shows a good coverage across countries. Table 11 reports the results of the estimation of the Average Treatment Effect on the Treated (ATT) for turnover as obtained from a DID model reweighted by propensity scores, as explained in the previous section. Turnover is transformed using the Inverse Hyperbolic Sine (HIS) function to deal with the non-normality of the distribution.

Table 11. *The effects of COVID State aid on firms' turnover*[1]

	Country	IT	ES	PL
	Average treatment effect	0.091***	0.032***	0.029
		(0.006)	(0.004)	(0.027)
Effect by Size	Micro	0.102***	0.037***	0.056*
		(0.006)	(0.004)	(0.029)
	Small	0.015	-0.002	-0.021
		(0.011)	(0.006)	(0.029)
	Medium	0.051**	0.044***	0.006
		(0.023)	(0.017)	(0.046)
	Large	0.034	0.104***	0.035
		(0.055)	(0.037)	(0.106)
Effect by Sector	Manufacturing	0.096***	0.057***	0.046
		(0.011)	(0.008)	(0.045)
	Construction	0.146***	0.031***	0.129*
		(0.014)	(0.006)	(0.073)
	Wholesale	0.065***	0.029***	-0.037
		(0.010)	(0.006)	(0.040)
	Retail	0.032**	0.002	0.048
		(0.013)	(0.008)	(0.068)
	Constant	13.592***	13.782***	14.636***
		(0.001)	(0.000)	(0.003)
	Observations	298,248	551,276	27,956
	R-squared	0.926	0.957	0.944

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The average treatment effects is obtained as in equation (2). The effects by size and sector are estimated in separate equations. The outcome variable, turnover is in log form (Inverse Hyperbolic Sine Transformation). Standard errors clustered at the firm level.

2 The effects by size and sector are estimated interacting the treatment variable with an indicator of either the NACE code of activity of the firm or an indicator of its size, in two separate equations.

[21] To mitigate these issues, the impact is estimated within size-sectoral groups.

COVID aid has a general positive and significant effect on Italian and Spanish beneficiary firms. In Italy, the change in turnover of aid recipients in 2021 results to be, on average, more than 9% higher as compared to the control group, whilst in Spain the effect of the aid is smaller (3.2%). The two countries differ for the composition of the impact in terms of size and sector. Indeed, in Italy the positive effect is mainly driven by the impact on micro-firms (16.2%) and a more contained significant effect is found for medium-sized firms (5.1%). In Spain, micro, medium and large-sized firms positively contribute to the average result, with the impact being greater for large firms (10.4%). The change in turnover for small Spanish beneficiaries is about 4% smaller compared to non-beneficiaries.

In terms of sectoral composition, in Italy the positive effect is observed across all sectors, with construction firms showing an increase in turnover of up to 14.6% compared to non-treated firms. In Spain, the effect is positive across all sectors except for retail trade where the effect is not statistically significant.

In Poland, the average impact of the aid is not statistically different from zero. However, a marginally significant effect is observed for micro firms (5.6%) and those in the construction sector (12.9%). The results for Poland have the limitation that this sample is not well represented in Orbis (as explained in the previous section) and are therefore difficult to compare with the results for Italy and Spain.

6.2 Heterogeneity analysis

To analyse the effect of the aid within specific intersections of firm size and sector of activity, the DiD model is estimated on separate sectors and it includes an interaction term between the treatment variable and different categories of size (i.e. micro, small, medium and large). Table 12 presents the results of these estimations.

In Italy, for firms operating in manufacturing, the positive effect of COVID aid is widespread across micro, small and medium- sized firms. For the remaining sectors, the impact is concentrated on micro firms with a larger impact on construction. Specifically, for micro firms in the construction sector the effect of receiving COVID aid is an increase in turnover in 2021 compared to the pre-COVID period which is 7% higher with respect to their respective controls. In Spain, in the manufacturing sector, the effect is positive and significant only for micro and medium-sized firms. The effect on micro firms is also positive in construction and wholesales. A small negative effect, but only significant at 10% confidence level, is found for small firms operating in construction and retail trade. In Poland, the impact is statistically significant only for micro and medium firms in the construction sector.

Overall, the results confirm a prevailing positive but small impact of COVID State aid on turnover. This aligns with the objective of the guiding principles of the Temporary Framework, which aimed to sustain firms during the pandemic while minimizing interference with market competition.

Table 12. *The effects of COVID State aid on firms' turnover, by different combinations of sector/size groups*[1]

Sector	**Manufacturing**			**Construction**			**Wholesales**			**Retail**		
Country	**IT**	**ES**	**PL**	**IT**	**ES**	**PL**	**IT**	**ES**	**PL**	**IT**	**ES**	**PL**
Treat x	0.074***	0.029***	0.059	0.191***	0.077***	0.206***	0.068***	0.031***	-0.030	0.041***	0.011	0.078
Micro	(0.011)	(0.007)	(0.050)	(0.014)	(0.009)	(0.078)	(0.011)	(0.007)	(0.047)	(0.013)	(0.008)	(0.075)
Treat x	0.066***	-0.001	-0.010	-0.050	-0.041**	0.015	-0.008	0.019**	-0.060	-0.017	-0.032*	0.015
Small	(0.016)	(0.011)	(0.049)	(0.037)	(0.019)	(0.097)	(0.017)	(0.009)	(0.049)	(0.025)	(0.017)	(0.066)
Treat x	0.102***	0.068***	0.094	-0.041	0.055	0.220*	0.024	0.037**	-0.070	-0.057	0.048	0.030
Medium	(0.030)	(0.023)	(0.087)	(0.163)	(0.087)	(0.116)	(0.028)	(0.018)	(0.067)	(0.096)	(0.044)	(0.237)
Treat x	0.029	-0.120	0.133	-0.136	0.167		0.099*	0.141**	-0.052	0.012	0.151*	0.106
Large	(0.057)	(0.116)	(0.169)	(0.638)	(0.121)		(0.055)	(0.057)	(0.130)	(0.030)	(0.083)	(0.293)
Constant	13.906***	13.856***	14.655***	13.069***	13.348***	13.984***	13.858***	14.129***	14.984***	13.405***	13.620***	14.230***
	(0.001)	(0.001)	(0.006)	(0.002)	(0.001)	(0.009)	(0.001)	(0.001)	(0.006)	(0.002)	(0.001)	(0.009)
Observations	72,528	122,816	7,020	85,932	149,136	5,464	89,684	176,208	10,924	49,620	102,992	4,144

[1] The average treatment effects is obtained as in equation (2). The effects by size and sector are estimated in separate equations. The outcome variable, turnover is in log form (Inverse Hyperbolic Sine Transformation). Standard errors clustered at the firm level. Standard errors clustered at the firm level. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

An additional heterogeneity analysis was conducted with respect to the type of financial instrument used to deliver the aid. The sample of beneficiaries was split according to whether the financial instrument adopted was repayable (i.e. taking the form of guarantees or loans) or whether it was non-repayable (i.e. being a direct grant, an interest rate subsidy or other types on non-repayable grants) or a combination of the two types.[22] Again, the DiD estimation was run within each subsample, and the treatment variable was interacted with size and sector indicators to assess the role of the two characteristics in mediating the effect. Results are reported in Table 13.

Table 13. *The effects of COVID State aid on firms' turnover, by type of aid instrument*[1]

	Instrument type	**Repayable**			**Non-Repayable or both**		
	Country	**IT**	**ES**	**PL**	**IT**	**ES**	**PL**
	Average effect	0.094***	0.035***	0.049	0.068***	0.029	0.021
		(0.006)	(0.004)	(0.040)	(0.026)	(0.021)	(0.027)
Effect by Size	Treat x Micro	0.105***	0.040***	0.089*	0.067**	0.030	0.051*
		(0.007)	(0.004)	(0.051)	(0.029)	(0.022)	(0.030)
	Treat x Small	0.020*	-0.001	-0.055	0.057	-0.091*	-0.018
		(0.011)	(0.006)	(0.060)	(0.035)	(0.048)	(0.030)
	Treat x Medium	0.040	0.042**	0.064	0.125	0.575***	-0.030
		(0.026)	(0.017)	(0.062)	(0.113)	(0.116)	(0.057)
	Treat x Large	0.062	0.105***	0.033	0.136**	0.212**	-0.053
		(0.054)	(0.038)	(0.121)	(0.068)	(0.090)	(0.165)
Effect by Sector	Treat x Manufacturing	0.102***	0.034***	0.071	0.111***	0.032*	0.035
		(0.011)	(0.006)	(0.060)	(0.019)	(0.017)	(0.048)
	Treat x Construction	0.142***	0.059***	0.210*	-0.010	0.043	0.120*
		(0.014)	(0.008)	(0.110)	(0.069)	(0.054)	(0.073)
	Treat x Wholesale	0.070***	0.032***	-0.044	0.083**	-0.006	-0.044
		(0.011)	(0.007)	(0.058)	(0.035)	(0.029)	(0.041)
	Treat x Retail	0.036***	0.004	-0.017	0.144***	0.057	0.042
		(0.013)	(0.008)	(0.081)	(0.035)	(0.039)	(0.071)
	Constant	13.647***	13.791***	14.769***	13.560***	13.791***	14.674***
		(0.000)	(0.000)	(0.005)	(0.003)	(0.000)	(0.003)
	Observations	277,064	534,576	10,584	152,008	534,576	24,584

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The average treatment effects is obtained as in equation (2). The effects by size and sector are estimated in separate equations. The outcome variable, turnover is in log form (Inverse Hyperbolic Sine Transformation). Standard errors clustered at the firm level.

2 Repayable instruments includes guarantees and loans. Non-repayable instruments includes direct grants, interest rate subsidies, and other non-repayable grants.

For the three countries, the results only considering repayable instruments are very similar to the main findings presented in Table 7, both in terms of the accuracy of the estimates and the magnitude of the effects. This is not surprising as the vast majority of COVID state aid were provided under form of repayable instruments. Looking at the subsample of "non-repayable or both" instruments, the effect in Italy is positive and is only observed for micro firms, which experienced an increase of around 10%. Moreover, the effect is statistically different from zero in all sectors, with the largest effect (14%) in construction.

When looking at the sub-sample of non-repayable or combined instruments, the results are slightly different from those presented above. While the effect in Italy is broadly comparable between the two types of instruments, except for the existence of a significant effect (13%) on large enterprises, the results in Spain show a large effect on medium and large enterprises. This may be due to the nature of non-repayable

[22] This might have happened since firms could have received multiple aids during 2020. It could have been the case that some aids were granted in the form of repayable instruments and others as non-repayable. In the latter case, we identify the firm as having received a combination of the two (what in the estimation is referred to as "both").

instruments, which are specifically targeted at larger enterprises. There are no relevant effects for Poland in this sub-sample.

6.3 Impact of Covid Aid on the probability of default

To dig deeper into the effect of Covid aid scheme in supporting firms during the pandemic, this section takes a measure of the 'probability of default' as outcome.

The considered probability of default is an estimated measure of the likelihood a firm has to go bankrupt and exit the market. The variable is extracted from the Financial Strength module of Orbis, computed by the private company modeFinance® using Transition Matrix theory. More specifically, the probability of default is predicted using a statistical model which takes into account both balance sheet information from the previous financial year and the current macroeconomic situation (accounting for specific sector and size economic trends). As such, the variable ranges from 0 to 100. The estimated probability of default is also commonly used to classify private firms in different categories of risk of default, varying from AAA (lowest risk of default) to D (highest risk of default). An increase in the probability of default has a negative impact on firms if such increase is large enough to produce a shift in the default risk category, making access to credit more difficult. The relationship between the probability of default and the index describing the risk of default is reported in the following table:

Table 14. *Categories of Risk of Default*

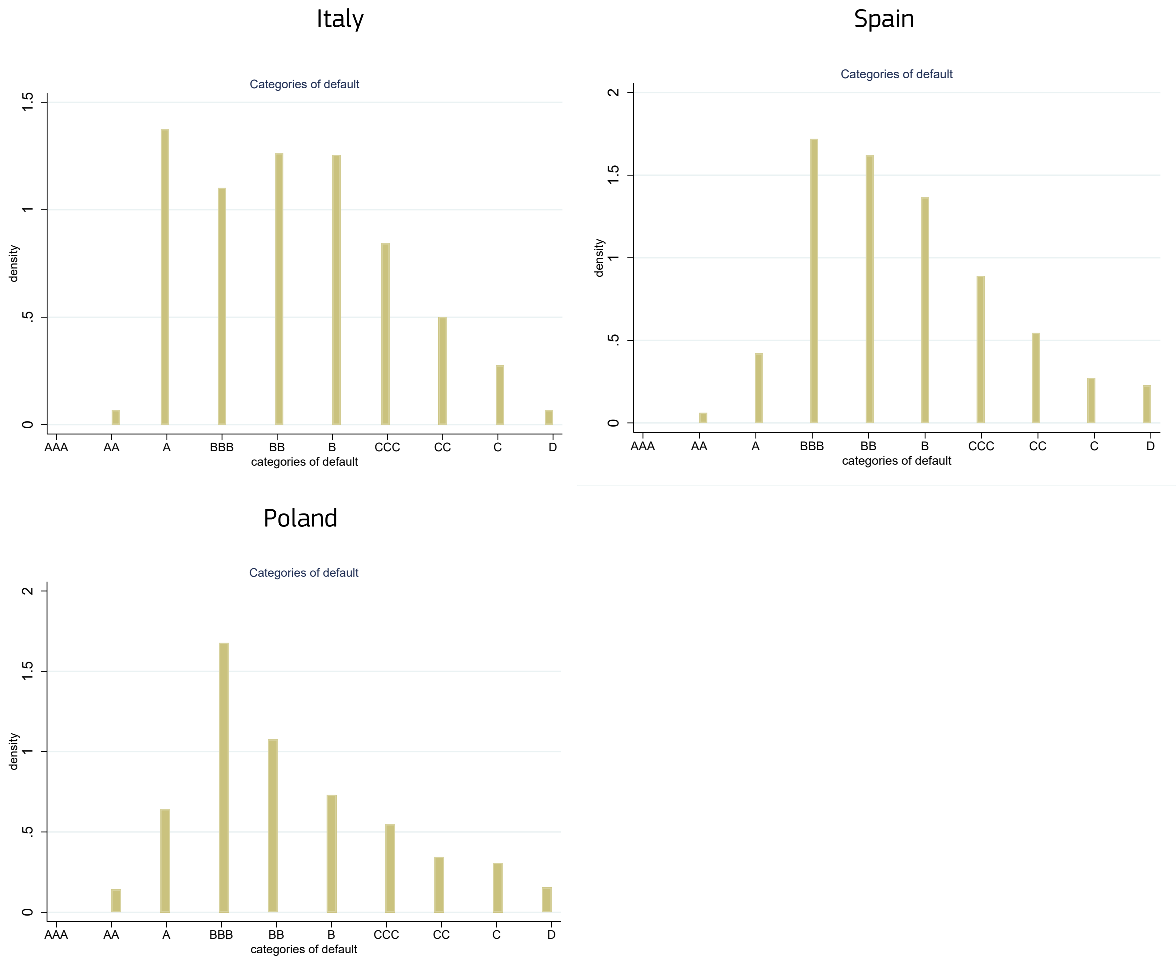
Numerical value	Risk of default	Probability of default
1	AAA	0.00 - 0.05%
2	AA	0.05 - 0.12%
3	A	0.12 - 0.21%
4	BBB	0.21 - 0.45%
5	BB	0.45 - 1.27%
6	B	1.27 - 4.47%
7	CCC	4.47 - 17.76%
8	CC	17.76 - 43.66%
9	C	43.66 - 68.30%
10	D	68.30 – 100.00%

The width of the intervals of the probability of default associated with each category of default risk is not homogeneous across the distribution and tends to be larger as the probability of default increases. This might pose some issues when pooling together data across different categories of default and implies that the relationship between these two variables is not linear (i.e. it is easier to switch from AAA to AA than from CCC to CC).

Figure 4 presents the distribution of firms according to categories of default for the three countries investigated.

While this variable is certainly useful as it allows a short-term assessment of the *probability of default* without having a long post-aid period that would be needed to observe an *actual default*, it should be recognised that it also has important limitations. The outcome under consideration is not a true measure of firm survival, nor is it a precise and objective measure of default risk. Being based upon balance sheet data, it is influenced by debt and interest rate dynamics, which may in turn raise some problems in the way the variable accounts for firms' investments. Therefore further research and a more nuanced approach are needed to properly isolate the effect of Covid aid on firm survival.

Figure 4. *Distributions of category of default by country*



Source: Authors' calculations based on 2019 Orbis data.

Bearing this in mind, the impact of Covid aid on the probability of default is identified applying the DiD specification presented in equation (2) over homogeneous groups of firms identified by their category of default in 2019.

The analysis aims at measuring the average change in percentage points of the probability of default that treated firms have experienced after receiving COVID aid, with respect to their respective controls, both belonging to the same default category. A positive (negative) coefficient for the *Treat x Post* dummy in the DiD regression would signal that, after receiving the aid, the average probability of default of treated firms is higher (lower) than the average for controls.

The results of the DiD estimation are reported in Table 15. They suggest that in all countries, except Poland, there was a little deterioration in the risk of default for aid recipients for most of the pre-existing risk categories. The effect is not statistically different from zero for firms that had a high pre-pandemic risk of default (category D in Spain, D, C, CC in Italy) and for those with the lowest category (AA). In contrast, Poland shows marginally significant effects in the opposite direction.[23] However, these results should be treated with caution, as the receipt of aid as an instrument affecting debt and interest (repayable instruments) could in turn feed into the algorithm estimating the probability of default and be considered as a riskier status.

[23] Results are omitted for brevity but available upon request.

To tentatively tackling this concern, Table 15 shows the heterogeneity of the impact according to the type of instrument through which the aid is provided. Hence, the table presents the coefficients of the interactions between the treatment variable with the instrument type (repayable only and non-repayable or both) and the constant that informs about the mean value of the probability of default in each category for the baseline group. On average, in Italy and Spain, a negative impact of COVID State aid on the probability of default of beneficiary firms supported by a repayable instrument is observed, especially for those belonging to categories ranging from A to C, except for CC and C in Italy. Conversely, in Poland, the effect is not statistically different from zero for all categories, except for firms in categories A, CC and D, for which the effect is negative and significant.

In terms of non-repayable instruments (or both), the coefficients are largely negative and indistinguishable from zero for all countries considered.

Considering the magnitude of the results, the effect is more pronounced, in relative terms, for low-medium risk firms (categories AA to B) in both Italy and Spain. This is not surprising as firms in these categories may have had easy access to guarantees and loans, thus recording higher debt in their balance sheets.

Table 15. *The relationship between COVID State aid and category of default*[1]

Panel (a) – Italy									
Category of default	**AA**	**A**	**BBB**	**BB**	**B**	**CCC**	**CC**	**C**	**D**
Repayable only	0.374	0.526***	0.504***	0.480**	0.887***	1.145***	0.729	2.085*	4.337
	(0.396)	(0.117)	(0.148)	(0.200)	(0.259)	(0.402)	(0.656)	(1.125)	(3.263)
Non-repayable	-0.008	-0.106	0.150	-0.402	0.284	-0.882	-1.878	-4.259**	-8.599*
(or both)	(0.121)	(0.184)	(0.328)	(0.376)	(0.480)	(0.735)	(1.275)	(2.075)	(4.899)
Constant	0.303***	0.849***	1.446***	2.710***	5.139***	10.026***	19.919***	34.134***	50.957***
	(0.027)	(0.011)	(0.016)	(0.027)	(0.037)	(0.054)	(0.080)	(0.127)	(0.340)
Observations	2,166	57,972	47,585	55,724	57,858	39,446	22,648	12,418	2,724
Panel (b) – Spain									
Category of default	**AA**	**A**	**BBB**	**BB**	**B**	**CCC**	**CC**	**C**	**D**
Repayable only	0.338	1.900***	1.658***	1.693***	2.809***	3.021***	3.427***	3.498***	1.973
	(0.685)	(0.355)	(0.267)	(0.284)	(0.278)	(0.477)	(0.746)	(1.331)	(1.628)
Non-repayable	-1.818	0.203	0.492	1.782	0.983	1.975	4.607*	5.000	-14.340**
(or both)	(1.354)	(0.771)	(1.303)	(1.400)	(1.031)	(1.412)	(2.463)	(3.594)	(5.766)
Constant	0.478***	1.408***	1.830***	3.083***	5.349***	10.868***	25.073***	40.301***	62.926***
	(0.043)	(0.032)	(0.028)	(0.037)	(0.041)	(0.070)	(0.097)	(0.155)	(0.182)
Observations	3,724	74,285	78,553	64,017	87,541	51,215	36,525	19,205	13,392
Panel (c) – Poland									
Category of default	**AA**	**A**	**BBB**	**BB**	**B**	**CCC**	**CC**	**C**	**D**
Repayable only	0.694	-1.818*	0.539	-1.729	-1.467	-3.718	-7.654***	0.971	-17.750*
	(0.796)	(1.099)	(1.042)	(1.133)	(1.370)	(2.513)	(2.786)	(4.399)	(10.651)
Non-repayable	0.185	-1.108**	-0.361	-0.561	-0.609	-0.494	-0.901	4.932	-15.832
(or both)	(0.340)	(0.466)	(0.727)	(0.689)	(1.165)	(1.899)	(2.308)	(3.991)	(9.883)
Constant	0.828***	1.547***	1.912***	2.695***	4.780***	9.974***	24.799***	38.986***	64.429***
	(0.060)	(0.064)	(0.094)	(0.080)	(0.140)	(0.220)	(0.237)	(0.463)	(1.402)
Observations	460	2,771	7,134	3,954	5,090	2,165	2,448	1,308	400

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The outcome variable is the probability of default. Standard errors clustered at the firm level. Repayable instruments includes guarantees and loans. Non-repayable instruments includes direct grants, interest rate subsidies, and other non-repayable grants.

6.4 DiD validity

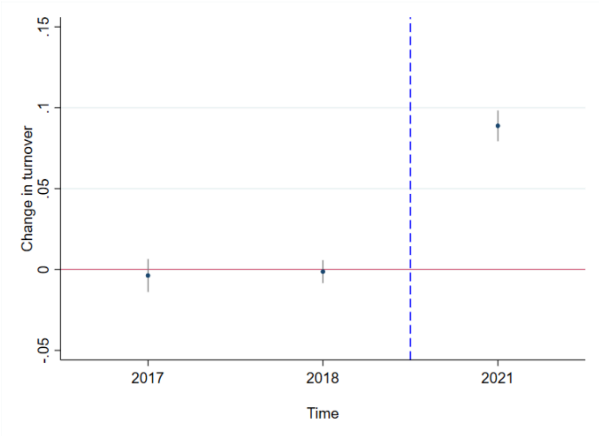
The validity of the DID estimation relies on the so-called parallel trend assumption. This assumption implies that the evolution of the pre-treatment performance of treated and control firms moves in parallel. This also implies that the average change in outcomes for the control group can be used as a credible counterfactual for the unobserved change in outcomes for the treated group if the COVID outbreak had not happened. Figure A2 in the Appendix plots the evolution of turnover as a dependent variable for the treated and control groups across pre-treatment and post-treatment periods. Outcome variables show very similar trends before the treatment starts, but also after it for both Spain and Poland, while this is not the case for Italy where trends are substantially divergent.

6.4.1 Event study for turnover

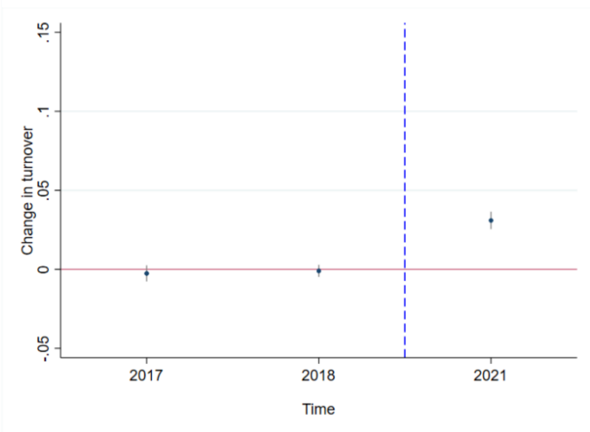
The credibility of the parallel assumption is tested by implementing an event study analysis following Autor (2003), as explained in Section 5. The estimated coefficients for the models including turnover as an outcome variable and the respective confidence intervals are shown in Figure 5.[24]

Figure 5. *Event study analysis–turnover, full sample*

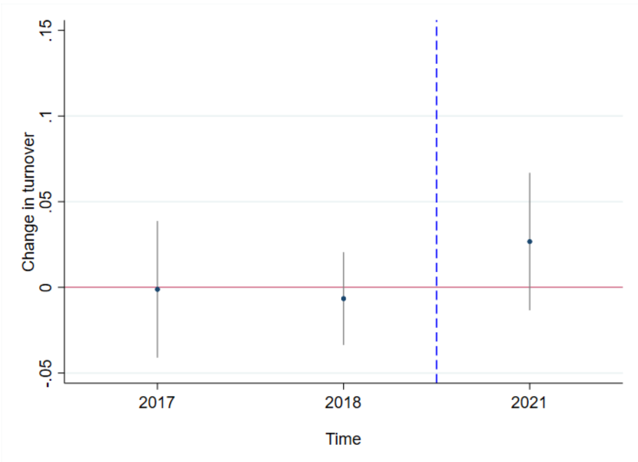
Panel A: Italy



Panel B: Spain



Panel C: Poland



1 The figures show the effect of receiving aid on firm performance. The blue dots are the point estimates of the effect of the aid in each year; vertical lines represent the respective 90%, 95% and 99% confidence intervals. Regressions include fixed effects and controls as from Equation (1).

Source: Authors' elaboration based on ORBIS and State Aid National registry data

Reassuringly, results suggest that the lead terms are not statistically different from zero in all the three countries considered, thus confirming there was no anticipatory effect of the aid and validating the common trend hypothesis. This is the case for the full sample and for the majority of the subsamples considered in both Italy and Spain. To ensure that the results discussed above are not driven by a single group of observations, all estimates are run separately by sector and size. These are presented in Figures A3 and A4 in Appendix,

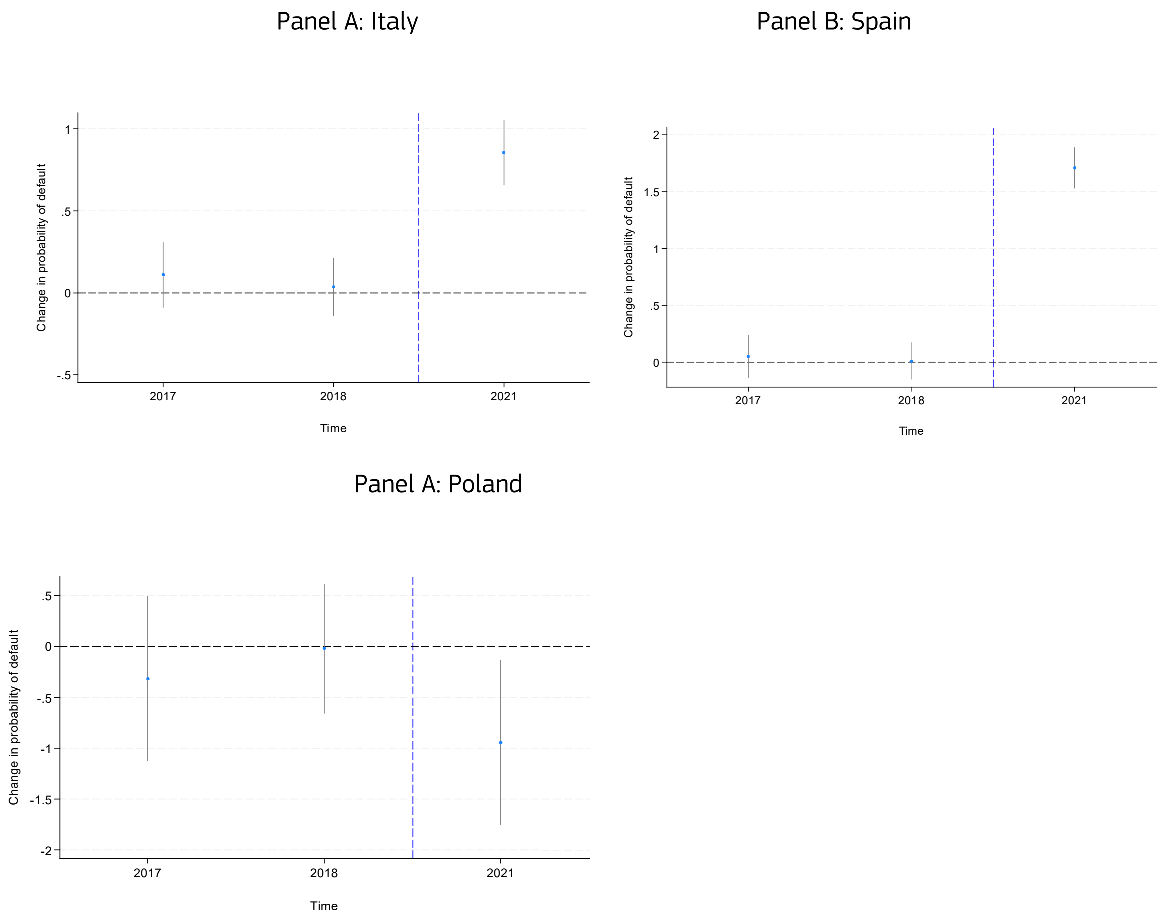
[24] 2020 is excluded from the analysis and 2019 is taken as reference period.

respectively. The effect in the post treatment period is always positive and statistically significant, except for the retail sector in Spain and for large firms in Italy for which the effect is not precisely estimated. Unfortunately, the data available cannot provide insights on the dynamics of the effects, showing how the impact of the aid changes over time.

6.4.2 Event study for probability of default

The Autor's test is also performed for the models using the probability of default as an outcome (see Figure 5). These results further validate the common trend assumption. Moreover, the results separated by sector and size are consistent with this hypothesis and can be provided upon request.

Figure 6. *Event study analysis – probability of default, full sample*



[1] The figures show the effect of receiving aid on firm performance. The blue dots are the point estimates of the effect of the aid in each year; vertical lines represent the respective 90%, 95% and 99% confidence intervals. Regressions include fixed effects and controls as from Equation (1).

Source: Authors' elaboration based on ORBIS and State Aid National registry data

Conclusions

At the onset of the COVID-19 pandemic, the European Commission approved the Temporary Framework (TF), enabling Member States to provide immediate support to companies using different financial instruments (e.g. direct grants, guarantees, etc.). This study has investigated whether the Temporary framework was useful in helping viable firms to continue operating during the pandemic, using data available for three EU Member States (Italy, Poland, and Spain). Specifically, it has analysed the pre-pandemic financial characteristics of COVID aid beneficiaries and it has examined the causal short-term impact of the policy measure on two firms' outcomes, namely turnover and firms' risk of default. Additionally, it has explored how the measure heterogeneously impacted firms depending on their sector (manufacturing, construction, wholesales, and retail), size (micro, small, medium and large), and the type of aid instrument used by the national authorities to support them.

The descriptive evidence shows that in the first year of the pandemic, Italy and Spain made an extensive use of guarantees and lighter use of direct grants, whereas Poland resorted to both type of instruments. In fact, more than 91% of beneficiaries received aid in the form of a guarantee in the two southern countries, while less than 13% received direct grants. Poland made greater use of both direct grants and loans (83% and 75% of treated firms, respectively).

Firms that received COVID aid had lower pre-pandemic values of turnover, capital and total assets than non-beneficiaries, in all the countries analysed. COVID Aid beneficiaries also had lower probability of default before the pandemic and lower risk of being under financial stress (as defined in Section 4.2.3), in line with the TF provisions that envisaged support only for companies that had no financial difficulties before the pandemic. The results also show specific-country differences in the (pre-pandemic) characteristics of beneficiaries and non-beneficiaries. In Italy and Spain, where State aid was primarily provided in the form of guarantees, beneficiaries had higher level of loans and often lower total assets compared to non-beneficiaries. In Poland, where COVID State aid was provided in the form of loans and direct grants, beneficiaries had (pre-pandemic) lower loans, total assets and EBIT margin.

The proposed study compares beneficiaries of COVID aid with firms that did not receive any aid in the reference period (2017-2021), therefore excluding firms that received other forms of aid. The impact of COVID aid is estimated in 2021 with respect to the pre-treatment period, comparing treated and untreated firms. To address the potential selection-based endogeneity, Propensity Score Matching is used to account for differences in pre-treatment observed characteristics between beneficiaries and non-beneficiaries.

The study finds an overall positive effect of COVID Aid on the turnover of beneficiaries. In Italy, the average increase in turnover for aid recipients in 2021 was nearly 9%, compared to control firms, while in Spain the effect was smaller, at around 3%. In Poland, there is no evidence indicating a positive effect of the aid on the turnover of beneficiaries, as the estimated coefficients are statistically insignificant.

The impact of COVID aid did not only vary by country but also depended on the firm size and sector. In Italy, the positive effect was primarily driven by micro-firms (especially in the construction sector), with an increase in turnover of 16.2%, while a smaller yet significant effect was observed for medium-sized firms (5.1%). Conversely, in Spain, the impact was significant across micro, medium, and large-sized firms, with a greater effect observed for large firms (10.4%). However, this effect was not significant when considering sector-specific impacts. There were also some interesting differences in terms of financial instrument used. For instance, non-repayable instruments primarily benefited micro and small enterprises in Italy, whereas in Spain, small firms receiving non-repayable instruments performed worse compared to controls.

The results on turnover are in line with previous studies that found positive short-term effects of State aid on firms' turnover, with some heterogeneity by firm size and sector (Bernini and Pellegrini, 2011; Hartšenko and Sauga, 2013; Cerqua and Pellegrini, 2014, 2017; Söderblom et al., 2015; Decramer and Vanormelingen, 2016).

The present study also assessed the effect of COVID aid on a measure of firms' exposure to default. Unfortunately, due to data limitations, it was not possible to examine firms' market exit, as conducted in other comparable studies. Instead, the analysis focused on the estimated probability of default provided by Moodys/Bureau Van Dijk, computed using firms' balance sheet data from previous year adjusted for the economic cycle.

The results outline a small and significant increase in the probability of default for COVID aid beneficiaries in 2021, as compared to non-beneficiaries, both in Italy and Spain, in all the sectors and firms' dimensions considered. On the contrary, there does not appear to be any association between receiving COVID aid and the risk of default in Poland. However, the receipt of aid as an instrument affecting debt and interest (repayable instruments) could in turn feed into the algorithm estimating the probability of default and lead to a riskier status. To confirm this hypothesis, the analysis examines the heterogeneity of the impact according to the type of instrument (only repayable and non-repayable or both) through which the aid is provided. In this setting, an increase in the probability of default due to COVID aid is confirmed only for beneficiaries of repayable instruments in Italy and Spain.

It is important to highlight that the study has few weaknesses. In particular, data limitations did not allow for an investigation of the impact according to different aid intensities, i.e. how the effect varied with the amount of aid spent, which is scope for future research. Furthermore, the analysis for Poland should be take cautiously and due to the limited sample size and the restricted coverage of the economy by the Orbis database Similarly, it is important to be cautious when interpreting results that focus on specific subsamples, such as combinations of size, sectors, and instrument types, as these often have low counts. These findings should be approached with care. For the sample of large firms, which exhibits a greater deal of heterogeneity in terms of firm size and turnover, an analysis on aid intensity could be particularly beneficial. Finally, it has to be acknowledged that the sample used for the analysis, although extremely rich and broad, represents only a selected sample of the overall population of firms. Specifically, it excludes small firms which might have a worse financial performance and were more likely to be misreported in 2021 Orbis data. This could potentially lead to an overestimation of the (positive) effect of the aid on firms' performances. Despite these limitations, the results suggest that COVID aid substantially helped companies cope with the crisis.

Two important points need to be considered when interpreting the results and have potential policy implications. Firstly, this study analyses the causal impact of the aid by estimating the average treatment effect on the beneficiaries. The counterfactual (i.e. comparison scenario) is what would have happened to the beneficiaries had they not received the treatment. Therefore, these results cannot be extended to non-beneficiaries. In other words, the study does not provide evidence of what would have happened to non-beneficiaries if they had received the benefit. Similarly, the conclusions of the study cannot be extended to the wider population of treated firms in Italy, Spain and Poland, as the sample used for analysis is a restricted, selected, subsample of the overall population of treated firms.

Secondly, it is important to note that this study does not provide an analysis of State aid Control as it is not possible to assess the impact on competition. While there may be a potential for distortions of competition in some specific sectors where the COVID aid was concentrated on a small number of firms, the initial market structure was highly concentrated, and the amount of aid was disproportionately high, this does not appear to be the case for the bulk of COVID aid for several reasons. COVID aid was employed simultaneously by all Member States, the scope of aid measures in each Member State was quite broad, affecting many firms in many sectors, and a large part of it was targeted at micro and small enterprises. All these aspects make it less likely that COVID aid had a distortive effect on competition in the Single Market. However, a targeted assessment of its impact on competition in potentially problematic sectors would be important. In addition, the data used for the analysis does not allow verification of whether firms that received COVID aid were eligible to apply for such benefits (i.e., whether large firms were not in difficulty before the pandemic) and whether the eligibility criteria were respected. Despite these caveats, there is suggestive evidence that, in the sample analysed, non-beneficiaries had, on average, a lower probability of default than beneficiaries.

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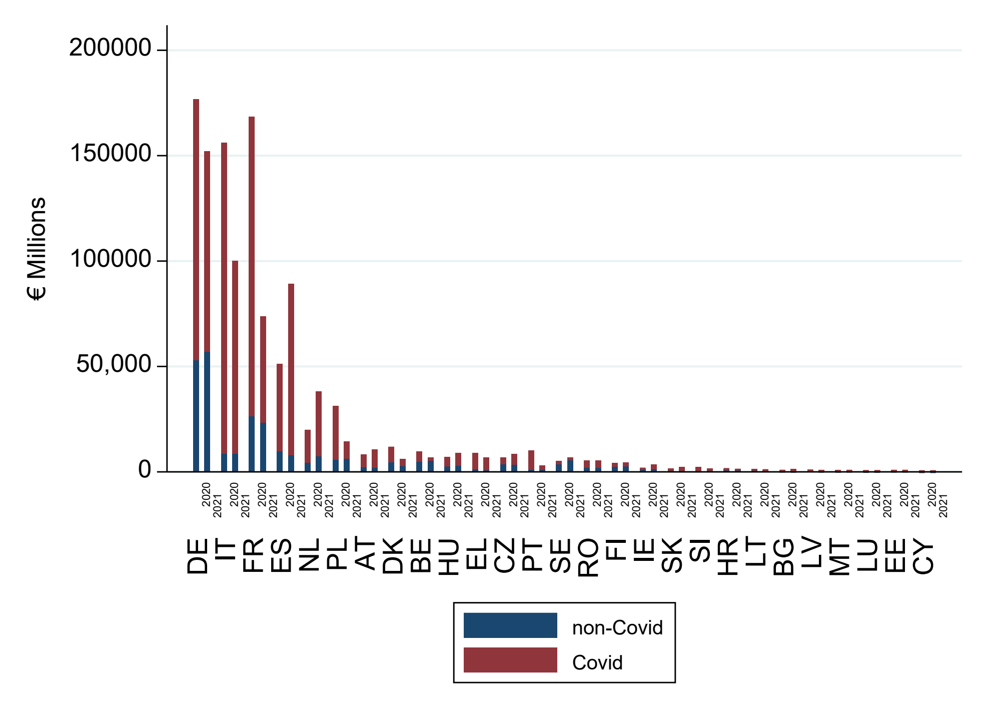
Annexes

Annex 1. Additional tables and figures

Table A 1. *Variables definition*

Outcome variables	**Description**
Turnover	Continuous Variable. Total operating revenues (including net sales, other operating revenues, and stock variations) expressed in millions of EUR.
Probability of default	Continuous Variable (range 0-100). Firm's probability of default
Explanatory variables	
Size (Micro)	Binary variable (0-1). 1 if the firm had an average turnover lower than 2 € Millions in the pre-treatment period; 0 otherwise.
Size (Small)	Binary variable (0-1). 1 if the firm had an average turnover between 2 and 10 € Millions in the pre-treatment period; 0 otherwise.
Size (Medium)	Binary variable (0-1). 1 if the firm had an average turnover between 10 and 50 € Millions in the pre-treatment period; 0 otherwise.
Size (Large)	Binary variable (0-1). 1 if the firm had an average turnover over 50 € Millions in the pre-treatment period; 0 otherwise.
Sector (Manufacturing)	Binary variable (0-1). 1 if the firm operates in the manufacturing sector; 0 otherwise.
Sector (Construction)	Binary variable (0-1). 1 if the firm operates in the construction; 0 otherwise.
Sector (Wholesale)	Binary variable (0-1). 1 if the firm operates in the wholesale sector; 0 otherwise.
Sector (Retail)	Binary variable (0-1). 1 if the firm operates in the retail sector; 0 otherwise.
Capital	Continuous Variable. Issued Share capital (Authorized capital). Expressed in millions of EUR
Loans	Continuous Variable. Short term financial debts such as bonds, fractions of long term financial debts payable within the year, debts to credit institutions, etc. Expressed in millions of EUR
Total assets	Continuous Variable. Total assets (including fixed assets and current assets. Expressed in millions of EUR
EBIT margin	Continuous Variable. Firm's profitability computed as: (earnings before interest and tax + depreciation + amortization) / total revenue Expressed in units (-100;100)

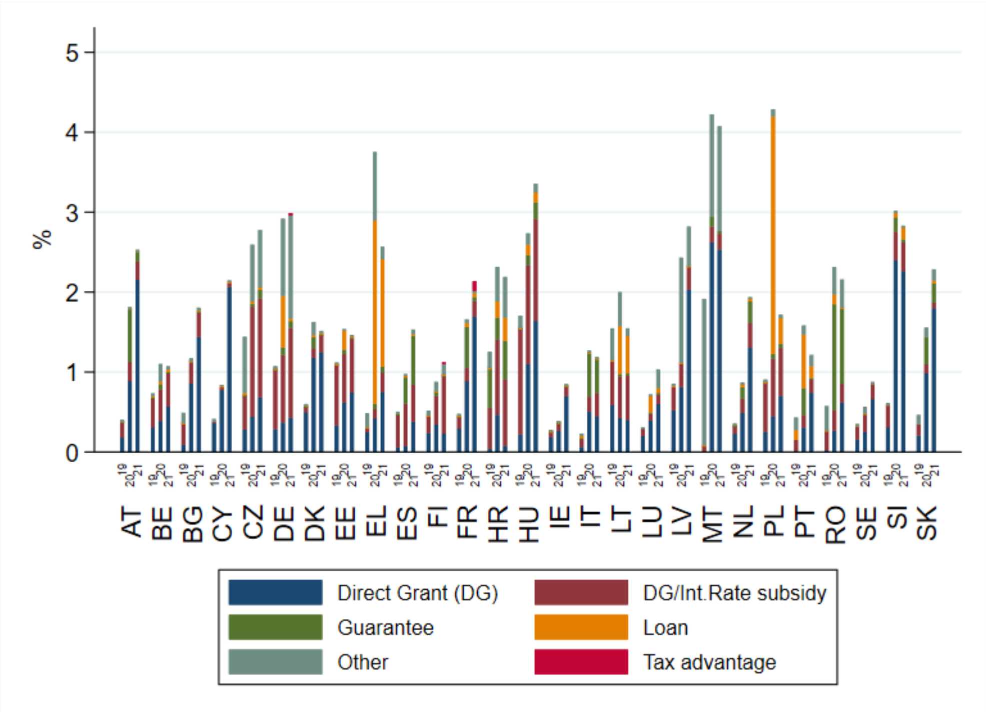
Figure A 1. *Total State aid expenditure (aid elements), by policy objective (COVID vs. Non-COVID)* [1]



[1] The figure shows the total aid expenditure - in terms of aid element by related objectives (COVID and non-COVID) and Member State. Totals are in EUR million.

Source: Authors' calculations based on State aid Reporting Interactive (SARI2) data.

Figure A 1b*. Normalized COVID aid expenditure (% of GDP), by type of instrument 2020-2021*[1]

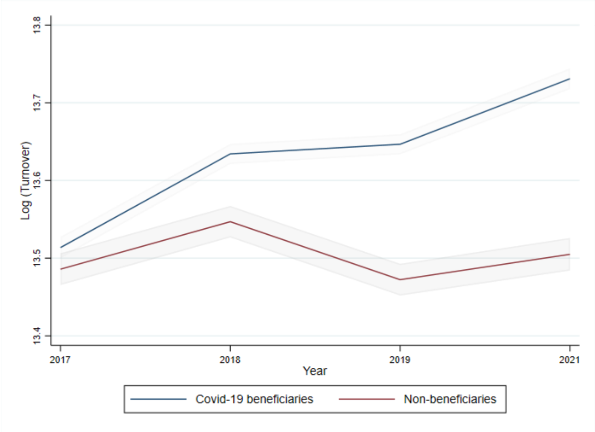


[1] The figure shows the COVID-related total aid expenditure (in nominal amounts) as share of 2019 national GDP, by type of financial instrument used and Member State.

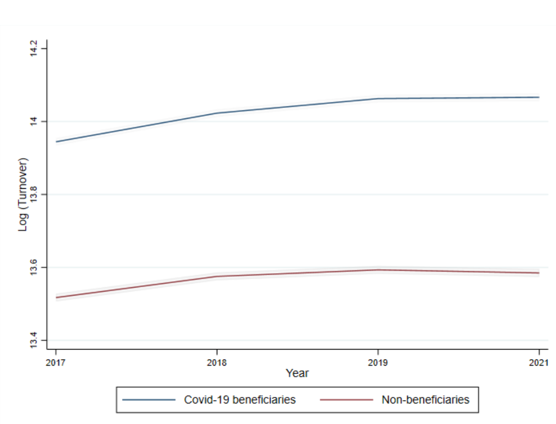
Source: Authors' calculations based on State aid Reporting Interactive (SARI2) data.

Figure A 2. *Firms' Turnover in time, across treated and control firms*[1]

Panel A: Italy



Panel B: Spain



Panel C: Poland

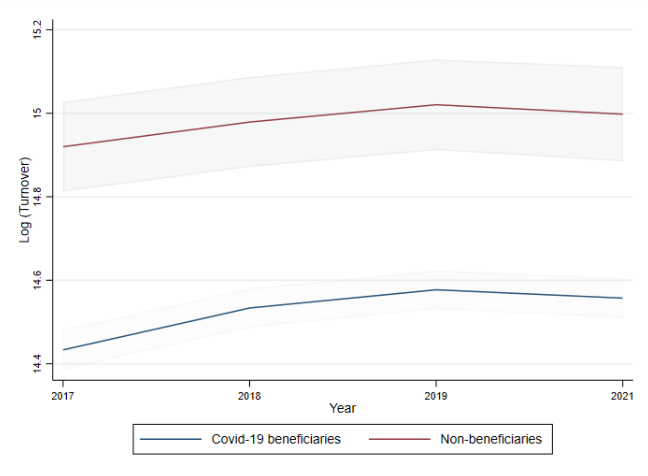
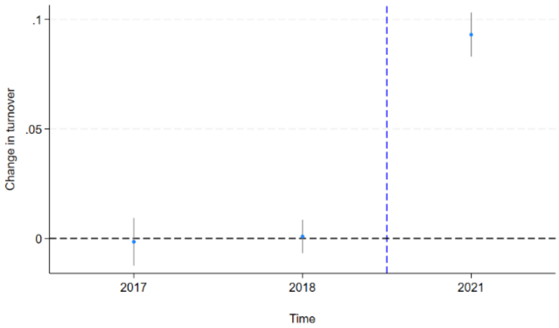


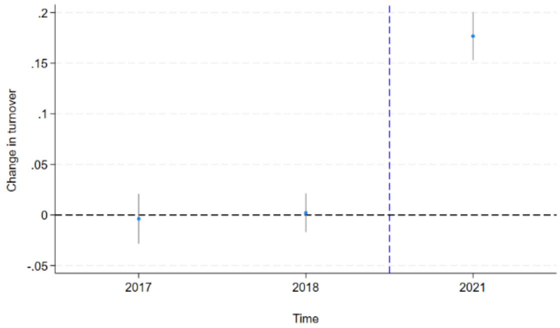
Figure A 3. *Event study analysis, Turnover by sector*

Panel A: Italy

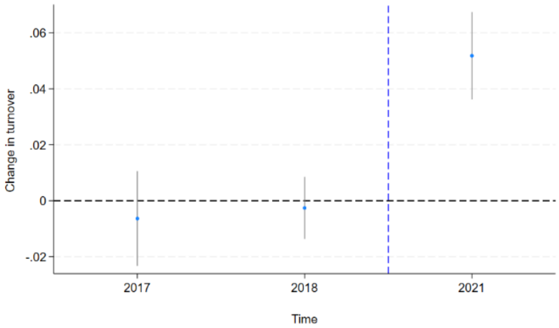
1 – Manufacturing



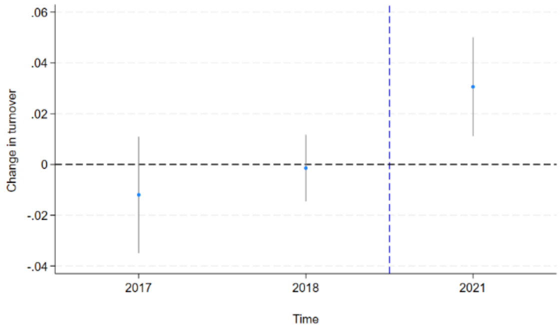
2 - Construction



3 – Wholesale

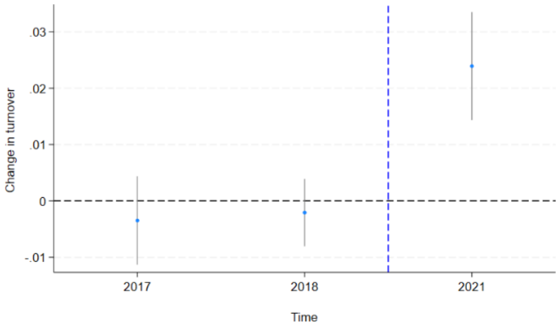


4- Retail

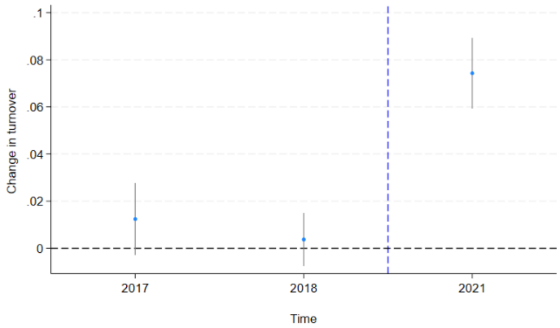


Panel B: Spain

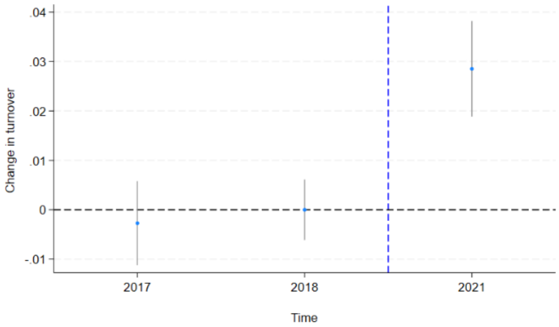
1 – Manufacturing



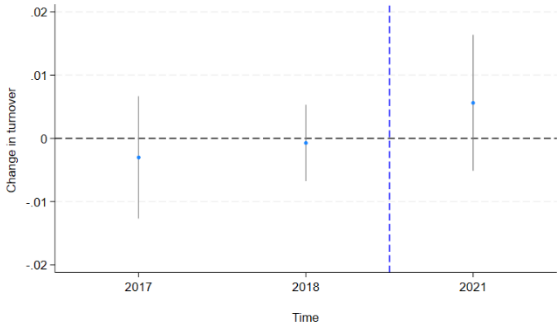
2 - Construction



3 – Wholesale

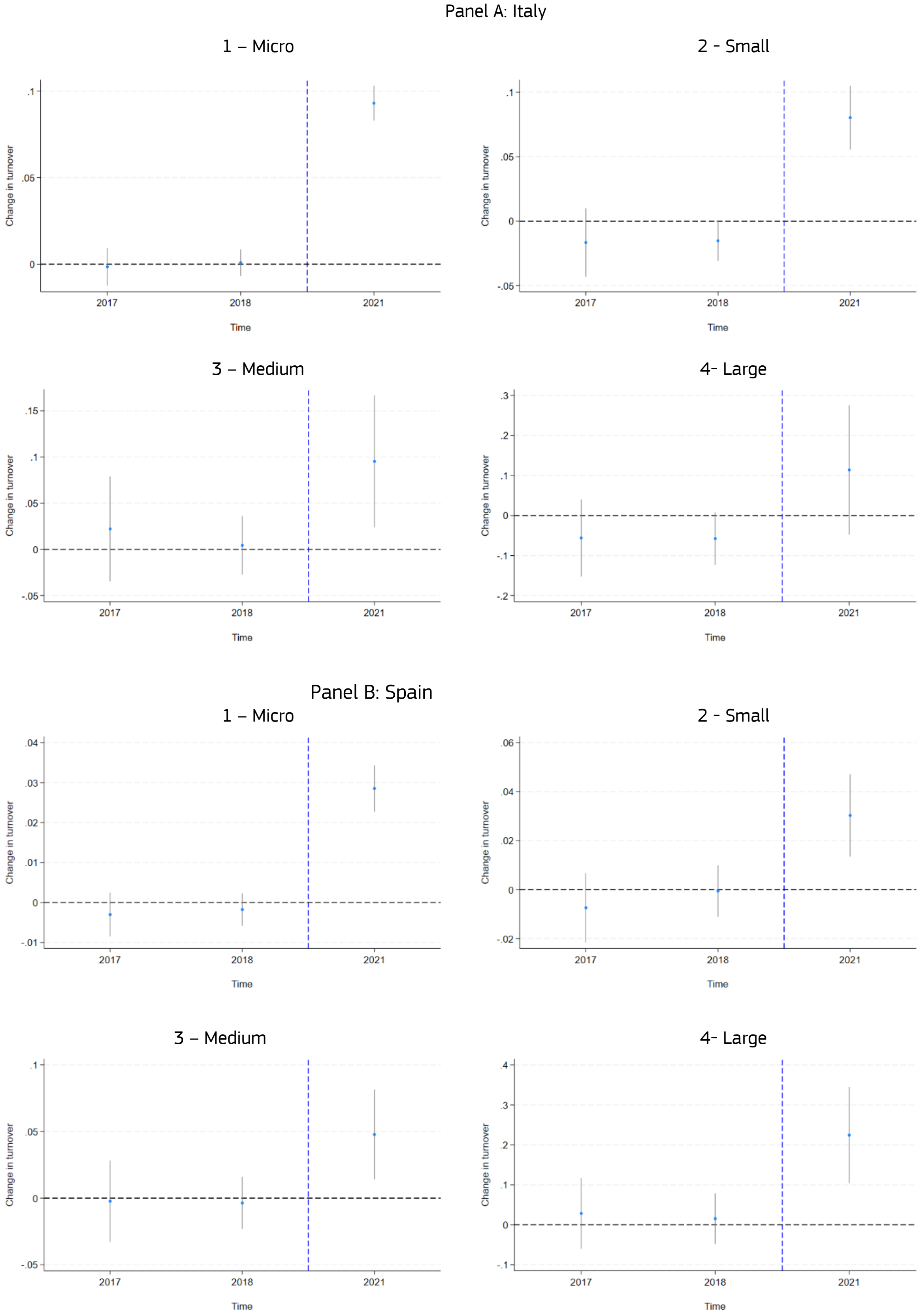


4- Retail



Source*: Authors' elaboration based on ORBIS and State aid National registry data*

Figure A 4. *Event study analysis, Turnover by size*



Source*: Authors' elaboration based on ORBIS and State aid National registry data*

Table A 2. *Firms characteristics by size and country*

Size = Micro[1]									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non-Benef.**	
Variable[2]	**Mean / %**	**Mean / %**	**Diff.**[3]	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Manufacturing	28.6%	36.1%	-0.08*	23.5%	20.7%	0.03*	25.4%	24.7%	0.01*
Construction	23.6%	22.3%	0.01*	26.3%	32.5%	-0.06*	23.2%	29.0%	-0.06*
Wholesale	27.7%	27.8%	0.00	29.6%	28.0%	0.02*	34.1%	31.8%	0.02*
Retail	20.1%	13.7%	0.06*	0.20	0.19	0.02*	17.2%	14.5%	0.03*
Turnover (€M)	0.51	0.43	0.08*	0.61	0.43	0.18*	0.68	0.55	0.12*
Capital (€M)	0.03	0.05	-0.03*	0.06	0.11	-0.05*	0.08	-0.11	0.19*
Loans (€M)	0.03	0.03	0.00*	0.04	0.01	0.03*	0.04	0.10	-0.07*
Total assets (€M)	0.56	0.86	-0.31*	0.54	0.68	-0.14*	0.55	0.99	-0.44*
EBITD margin (M)	5.62	6.11	-0.49*	3.01	5.95	-2.94*	5.44	6.96	-1.52*
Z-score	6.53	8.27	-1.74*	9.90	9.90	-0.01	8.90	16.75	-7.85*
	37,945	28,569		53,277	67,268		3,326	969	

Size = Small									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non-Benef.**	
Variable	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Manufacturing	13.1%	13.6%	-0.01	22.3%	22.8%	-0.01	24.1%	29.3%	-0.05*
Construction	31.3%	30.4%	0.01	16.7%	12.1%	0.05*	13.6%	23.4%	-0.1*
Wholesale	42.7%	43.4%	-0.01	46.9%	48.6%	-0.02*	47.1%	32.4%	0.15*
Retail	12.9%	12.6%	0.00	0.14	0.17	-0.02*	15.2%	14.9%	0.00*
Turnover (€M)	4.01	4.17	-0.16*	4.20	4.25	-0.06	4.63	5.21	-0.58*
Capital (€M)	0.13	0.25	-0.12*	0.19	0.41	-0.22*	0.34	0.81	-0.46*
Loans (€M)	0.29	0.17	0.12*	0.34	0.11	0.23*	0.18	0.37	-0.19*
Total assets (€M)	3.39	4.91	-1.51*	2.88	4.19	-1.31*	2.71	5.52	-2.81*
EBITD margin (M)	3.21	4.33	-1.13*	3.51	6.02	-2.51*	5.62	6.25	-0.63*
Z-score	5.24	6.24	-1.01*	3.66	3.49	0.17	4.58	10.48	-5.9*
	3,623	4,298		9,805	7,922		1,428	475	

Size = Medium									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non- Benef.**	
Variable	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Manufacturing	5.3%	9.0%	-0.04*	23.4%	26.6%	-0.03*	22.8%	36.6%	-0.14*
Construction	38.0%	34.1%	0.04	11.0%	10.1%	0.01	7.7%	9.5%	-0.02*
Wholesale	49.5%	46.9%	0.03	58.3%	53.5%	0.05*	63.6%	44.7%	0.19*
Retail	7.2%	9.9%	-0.03	0.07	0.10	-0.02*	5.9%	9.2%	-0.03*
Turnover (€M)	20.66	20.18	0.48	20.47	21.56	-1.09*	20.46	24.70	-4.25*
Capital (€M)	1.05	3.81	-2.75	0.88	3.25	-2.37*	0.93	1.50	-0.58*
Loans (€M)	2.39	0.94	1.45*	2.44	0.76	1.68*	0.84	1.41	-0.56*
Total assets (€M)	17.16	40.33	-23.17	13.24	21.26	-8.02*	9.71	17.35	-7.64*
EBITD margin (M)	4.13	3.57	0.55	3.25	5.52	-2.26*	4.40	5.51	-1.11*
Z-score	3.85	6.33	-2.48*	4.45	4.11	0.34	3.79	4.81	-1.02*
	666	1,110		1,530	1,832		401	357	

Size = Large									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non-Benef.**	
Variable	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Manufacturing	5.1%	5.4%	0.42	21.1%	30.3%	-0.09*	1.8%	7.7%	-0.06*
Construction	42.4%	40.1%	0.00	8.8%	5.0%	0.04	10.9%	28.8%	-0.18*
Wholesale	50.0%	45.5%	0.05	62.7%	56.6%	0.06	80.0%	61.5%	0.18*
Retail	2.5%	9.0%	-0.07*	0.07	0.08	-0.01	7.3%	1.9%	0.05*
Turnover (€M)	125.96	435.33	-309.37	114.13	239.04	-124.9*	231.15	202.36	28.79
Capital (€M)	5.77	17.31	-11.53	2.38	17.12	-14.74*	4.39	14.27	-9.88*
Loans (€M)	13.94	16.58	-2.64	10.95	3.76	7.19*	7.34	3.54	3.80
Total assets (€M)	82.17	262.38	-180.21*	59.03	159.43	-100.41*	49.13	101.27	-52.14*
EBITD margin (M)	3.62	4.44	-0.82	3.07	5.12	-2.06*	1.77	3.95	-2.18*
Z-score	2.81	4.28	-1.47	4.37	4.81	-0.44	3.93	3.79	0.14*
	118	409		204	533		54	155	

1 Firm size is based on the average turnover for 2017-2019. Size categories: micro: average turnover < 2 EUR Millions; small: average turnover between 2 and 10 Millions of EUR *Medium*: average turnover between 10 and 50 Millions of EUR; *Large*: average turnover over 50 Millions of EUR.

2 Turnover, Capital, Loans and Total assets are expressed in Millions of EUR.

3 The table reports average differences between beneficiaries and non-beneficiaries and the associated p-value.

Source: Authors' computations based on ORBIS and State Aid National registry data.

***Table A 3**. Firms characteristics by sector and country.*

Sector = Manufacturing									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non-Benef.**	
Variable[2]	**Mean / %**	**Mean / %**	**Diff.**[3]	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Micro[1]	86.2%	77.5%	0.09*	88.5%	94.9%	-0.06*	65.7%	43.3%	0.22*
Small	10.9%	15.9%	-0.05*	10.4%	4.2%	0.06*	26.8%	25.1%	0.02*
Medium	2.4%	4.6%	-0.02*	1.1%	0.8%	0.00*	7.1%	23.5%	-0.16*
Large	0.5%	2.0%	-0.02*	0.1%	0.1%	0.00	0.5%	8.1%	-0.08*
Turnover (€M)	2.03	7.99	-5.96*	1.28	0.82	0.46*	3.48	17.10	-13.62*
Capital (€M)	0.12	0.87	-0.75*	0.10	0.53	-0.43*	0.36	0.74	-0.38*
Loans (€M)	0.20	0.21	-0.01*	0.09	0.05	0.03*	0.16	0.84	-0.68*
Total assets (€M)	1.90	10.06	-8.15*	1.26	2.67	-1.41*	2.23	12.61	-10.38*
EBITD margin (M)	4.38	5.78	-1.40*	4.29	8.45	-4.17*	6.06	5.47	0.59
Z-score	6.80	6.70	0.10*	8.28	9.21	-0.93*	6.41	10.07	-3.66*
	10,378	8,230		15,832	23,055		1,297	557	

Sector = Construction									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non-Benef.**	
Variable	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Micro	95.5%	93.6%	0.02*	82.9%	85.0%	-0.02*	77.4%	64.2%	0.13*
Small	4.2%	5.3%	-0.01*	14.5%	11.0%	0.03*	19.4%	25.4%	-0.06*
Medium	0.3%	0.9%	-0.01*	2.4%	3.0%	-0.01*	3.1%	7.7%	-0.05*
Large	0.1%	0.2%	0.00*	0.3%	1.0%	-0.01*	0.1%	2.7%	-0.03*
Turnover (€M)	0.70	0.88	-0.18*	1.92	2.85	-0.93*	1.99	6.16	-4.17*
Capital (€M)	0.05	0.25	-0.20*	0.14	0.34	-0.20*	0.23	1.09	-0.87*
Loans (€M)	0.06	0.12	-0.06*	0.19	0.05	0.14*	0.12	0.70	-0.59*
Total assets (€M)	1.18	3.44	-2.26*	1.59	2.92	-1.33*	2.12	15.12	-12.99*
EBITD margin (M)	8.50	7.99	0.51	3.15	5.05	-1.91*	8.58	13.32	-4.74*
Z-score	5.00	9.61	-4.61*	7.98	8.01	-0.03	6.03	11.24	-5.21*
	11,378	11,033		15,140	16,405		1,005	441	

Sector = Wholesale									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non-Benef.**	
Variable	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Micro	84.5%	75.5%	0.09*	73.7%	78.6%	-0.05*	53.8%	43.0%	0.11*
Small	12.4%	17.7%	-0.05*	21.5%	16.1%	0.05*	32.0%	21.5%	0.10*
Medium	2.6%	5.0%	-0.02*	4.2%	4.1%	0.00	12.1%	22.2%	-0.10*
Large	0.5%	1.8%	-0.01*	0.6%	1.3%	-0.01*	2.1%	13.3%	-0.11*
Turnover (€M)	2.16	12.71	-10.55*	2.98	5.70	-2.72*	7.13	41.39	-34.25*
Capital (€M)	0.07	0.27	-0.20*	0.11	0.28	-0.16*	0.24	2.82	-2.58*
Loans (€M)	0.19	0.56	-0.38*	0.30	0.10	0.19*	0.35	0.71	-0.36*
Total assets (€M)	1.32	5.99	-4.67*	1.67	3.30	-1.63*	2.68	15.76	-13.08*
EBITD margin (M)	5.03	5.09	-0.07*	2.85	5.61	-2.77*	4.20	3.77	0.43*
Z-score	5.63	6.30	-0.67*	7.80	7.87	-0.06	7.12	11.60	-4.48*
	12,459	10,515		21,405	23,996		2,120	721	

Sector = Retail									
Country	**Italy**			**Spain**			**Poland**		
	Benef.	**Non-Benef.**		**Benef.**	**Non-Benef.**		**Benef.**	**Non-Benef.**	
Variable	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**	**Mean / %**	**Mean / %**	**Diff.**
Micro	93.6%	85.0%	0.09*	87.9%	89.2%	-0.01*	70.0%	56.9%	0.13*
Small	5.8%	11.8%	-0.06*	11.0%	9.2%	0.02*	26.6%	28.6%	-0.02*
Medium	0.6%	2.4%	-0.02*	0.9%	1.3%	0*	2.9%	13.3%	-0.1*
Large	0.0%	0.8%	-0.01*	0.1%	0.3%	0*	0.5%	1.2%	-0.01*
Turnover (€M)	0.79	4.67	-3.88*	1.23	1.96	-0.74*	10.03	5.49	4.55
Capital (€M)	0.03	0.26	-0.23*	0.07	0.10	-0.04*	0.19	0.45	-0.26*
Loans (€M)	0.03	0.05	-0.02*	0.06	0.02	0.03*	0.08	0.18	-0.1*
Total assets (€M)	0.60	3.07	-2.47*	0.79	1.04	-0.26*	1.99	2.25	-0.26*
EBITD margin (M)	2.87	2.08	0.78	1.91	3.42	-1.51*	3.38	2.90	0.48*
Z-score	8.86	9.64	-0.78*	12.21	12.14	0.07	10.51	18.95	-8.44*
	8,137	4,608		12,450	14,112		824	248	

1 Firm size is based on the average turnover for 2017-2019. Size categories: micro: average turnover < 2 EUR Millions; small: average turnover between 2 and 10 Millions of EUR *Medium*: average turnover between 10 and 50 Millions of EUR; *Large*: average turnover over 50 Millions of EUR.

2 Turnover, Capital, Loans and Total assets are expressed in Millions of EUR.

3 The table reports average differences between beneficiaries and non-beneficiaries and the associated p-value.

Source: Authors' computations based on ORBIS and State Aid National registry data.

Annex 2. Transparency reporting thresholds

The relevant threshold varies according to the legal basis of the State aid measure and the economic sector of the beneficiary. More specifically, the thresholds are defined as follows.

For cases under the Block Exemption Regulations, the thresholds are:

i. EUR 60,000 for aid granted under the ABER;
ii. EUR 30,000 for aid granted under the FIBER;
iii. EUR 500,000 for aid granted under the GBER (before the enter into force of the Green Deal GBER amendment), except as follows:
    - EUR 60,000 for aid granted under the GBER to companies active in primary agricultural production
    - EUR 30,000 for aid granted under the GBER to companies active in the fishery and aquaculture sector.

For notified COVID-19 aid, the thresholds are:

iv. EUR 10,000 for aid granted to companies active in primary agriculture and in the fisheries sectors;
v. EUR 100,000 for aid granted to companies active in all other economic sectors.

For aid granted under all the other legal bases, the thresholds are:

vi. EUR 60,000 for aid to companies active in the agriculture sector;
vii. EUR 30,000 for aid to companies active in the fisheries sector;
viii. EUR 500,000 for aid to companies active in all other economic sectors.

TAM data

TAM (Transparency Award Module) is a tool developed by the EC allowing Member States fulfil their obligations to publish information on the largest individual aid awards (known as 'the transparency obligations'). In this IT tool, Member States report all firm-level aid awards that exceed the above reporting thresholds. The information reported in TAM includes the reference to the aid measure, the name of the company and its identifier, the nominal amount of the awards, the aid element, the type of aid instrument, the location and size of the company, the objective of the aid, and the award date. Currently, 23 Member States plus Iceland use the TAM to fulfil their transparency obligations. Poland, Romania, Spain and Slovenia use their own national transparency websites.

Although the initial plan ofthis study was to use TAM[25] to assess the impact of COVID aid on firms' performance in all EU Member States, this was not possible due to the representativeness issues caused by the reporting thresholds. To get a sense of the magnitude of the missing data, it is necessary to compare TAM data with the national registers hat include information on all aid awards. Italy represents a good case study to test TAM coverage as it voluntarily opted for full transparency and publishes a well-structured national register. This exercise is shown in detail in Annex 3 below. The partial non-random coverage of aid awards in TAM, makes this dataset not suitable to perform a robust impact evaluation of State aid.

[25] As complemented by the information from the national Registers of Poland, Romania, Spain and Slovenia.

Annex 3. Comparison between TAM and national registry (NR) for Italy

Table A4 analyses the overlap between the information on TAM relating to Italian firms and the Italian NR, for the period of analysis between 2017 and 2021. This can be done by verifying that the firms' national identifiers appear in both datasets. We do not compare the amounts or the number of aids per firms as the focus on this analysis is on the intensive margin (the impact of receiving State aid) rather than on the extensive margin (the impact of the amount of the State Aid) of using State aid. Most of the observations (aid awards) in TAM have a corresponding identifier in the NR while only 2,129 awards in TAM do not have an identifier matching with the National Registry. This mismatch is possibly due to coding errors. After some quick investigation, we exclude this small number of unmatched observations from the analysis, as it is not possible to identify the corresponding entry in the NR[26].

Table A 4. *Overlap of observations in NR and TAM data: 2017-2021 data*

	Obs.	%
NR only	4,223,684	98.56
TAM only	2,129	0.05
NR and TAM	59,653	1.39
Total	4,285,466	100

Source: Authors' computations based on TAM and State Aid National registry data.

The next section investigate how the distribution of firm size and sector differ between TAM and the NR. Specifically, Table A5 present the distribution of State aid awards by firm size. As expected, there is a higher proportion of awards (8%) reported by large firms in TAM than in the National Registry (0.4%). Large firms are overrepresented in TAM due to the legal reporting thresholds, as they are more likely to receive larger aid awards.

Table A 5. *Distribution of State aid awards by firm size*

Size[1]	NR only	%	TAM & NR	%	Total	%
Large firms	15,651	*0.4*	4,832	*8.1*	20,483	*0.5*
SMEs[2]	4,182,415	*99.0*	54,405	*91.2*	4,236,820	*98.9*
Missing info	25,618	*0.6*	416	*0.7*	26,034	*0.6*
Total	4,223,684	100	59,653	100	4,283,337	100

Source: Authors' computations based on TAM and State aid National registry data. Year: 2017-2021.

1 The definition of firm size used here is the one adopted by the European commission, available at: https://single-market-economy.ec.europa.eu/smes/sme-definition_en

2 SME= small and medium enterprise.

26 We also test whether the aid amounts received by the excluded observations are statistically significantly different from those matching with the NR. Specifically, we run an OLS regression of the aid amounts on a dummy variable capturing whether the observation is present in TAM only (as compared to whether the observation is in both samples) and a set of year binary variables. The results show that the difference is not statistically significant.

To investigate the role of COVID State aid, table A6 also presents the distribution of aid awards by size and over time. After 2019, there is a higher proportion of small firms and this may be due to lower reporting thresholds for Covid State aid, and a wider use of State aid during the COVID pandemic.

Table A 6. *Number of State aid awards by firm size*

Year	2017			2018			2019			2020			2021		
Size[1]	NR only	TAM & NR	Total	NR only	TAM & NR	Total	NR only	TAM & NR	Total	NR only	TAM & NR	Total	NR only	TAM & NR	Total
Large	1,637	340	1,977	3,306	688	3,994	2,534	586	3,120	2,733	1,129	3,862	5,441	2,089	7,530
	1.2%	*23.4%*	*1.4%*	*0.9%*	*21.5%*	*1.1%*	*1.0%*	*22.7%*	*1.2%*	*0.2%*	*3.9%*	*0.2%*	*0.3%*	*8.9%*	*0.4%*
SME[2]	138,599	917	139,516	371,953	2,442	374,395	258,557	1,940	260,497	1,655,107	27,796	1,682,903	1,758,199	21,310	1,779,509
	97.5%	*63.1%*	*97.2%*	*99.0%*	*76.3%*	*98.8%*	*98.9%*	*75.2%*	*98.7%*	*99.7%*	*95.9%*	*99.6%*	*98.5%*	*90.9%*	*98.5%*
Missing info	1,878	196	2,074	343	71	414	324	55	379	2,537	54	2,591	20,536	40	20,576
	1.3%	*13.5%*	*1.4%*	*0.1%*	*2.2%*	*0.1%*	*0.1%*	*2.1%*	*0.1%*	*0.2%*	*0.2%*	*0.2%*	*1.2%*	*0.2%*	*1.1%*
Total	142,114	1,453	143,567	375,602	3,201	378,803	261,415	2,581	263,996	1,660,377	28,979	1,689,356	1,784,176	23,439	1,807,615
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Source: Authors' computations based on TAM and State Aid National registry data. Year: 2017-2021.

[1] The definition of firm size used here is the one adopted by the European commission, available at: https://single-market-economy.ec.europa.eu/smes/sme-definition_en

[2] SME= small and medium enterprise.

***Table A 7**. Distribution of State aid awards by sector and firm size*

	TAM & NR				NR only			
	Size[1]				Size			
Sector[2]	Large	SME[3]	Missing info	Total	Large	SME	Missing info	Total
Agriculture, forestry	32	709	4	745	144	66,217	549	66,910
& fishing	*0.7%*	*1.3%*	*1.0%*	*1.3%*	*0.9%*	*1.6%*	*2.1%*	*1.6%*
Mining & quarrying	4	169	0	173	24	3,220	2	3,246
	0.1%	*0.3%*	*0.0%*	*0.3%*	*0.2%*	*0.1%*	*0.0%*	*0.1%*
Manufacturing	2,632	21,312	3	23,947	6,009	537,773	757	544,539
	54.5%	*39.2%*	*0.7%*	*40.1%*	*38.4%*	*12.9%*	*3.0%*	*12.9%*
Electricity & gas	67	1,178	155	1,400	285	8,739	445	9,469
	1.4%	*2.2%*	*37.3%*	*2.4%*	*1.8%*	*0.2%*	*1.7%*	*0.2%*
Water supply, sewerage	81	768	0	849	308	13,517	10	13,835
& waste management	*1.7%*	*1.4%*	*0.0%*	*1.4%*	*2.0%*	*0.3%*	*0.0%*	*0.3%*
Construction	96	4,709	7	4,812	365	494,742	1,054	496,161
	2.0%	*8.7%*	*1.7%*	*8.1%*	*2.3%*	*11.8%*	*4.1%*	*11.8%*
Wholesale & retail trade	377	11,763	0	12,140	2,376	1,038,886	1,523	1,042,785
	7.8%	*21.6%*	*0.0%*	*20.4%*	*15.2%*	*24.8%*	*6.0%*	*24.7%*
Transporting and storage	287	2,338	1	2,626	876	163,331	166	164,373
	5.9%	*4.3%*	*0.2%*	*4.4%*	*5.6%*	*3.9%*	*0.7%*	*3.9%*
Accommodation	65	2,488	2	2,555	295	524,386	402	525,083
& food services	*1.4%*	*4.6%*	*0.5%*	*4.3%*	*1.9%*	*12.5%*	*1.6%*	*12.4%*
Information	182	1,964	14	2,160	672	106,717	604	107,993
& communication	*3.8%*	*3.6%*	*3.4%*	*3.6%*	*4.3%*	*2.6%*	*2.4%*	*2.6%*
Financial & insurance	236	55	0	291	734	40,615	266	41,615
	4.9%	*0.1%*	*0.0%*	*0.5%*	*4.7%*	*1.0%*	*1.0%*	*1.0%*
Real estate	53	1,500	0	1,553	266	151,190	532	151,988
	1.1%	*2.8%*	*0.0%*	*2.6%*	*1.7%*	*3.6%*	*2.1%*	*3.6%*
Professional, scientific	289	2,145	145	2,579	829	386,092	9,472	396,393
& technical activities	*6.0%*	*3.9%*	*34.9%*	*4.3%*	*5.3%*	*9.2%*	*37.0%*	*9.4%*
Administrative	181	1,495	1	1,677	962	159,483	361	160,806
& support services	*3.8%*	*2.8%*	*0.2%*	*2.8%*	*6.2%*	*3.8%*	*1.4%*	*3.8%*
Public administration	7	3	7	17	42	468	325	835
	0.1%	*0.0%*	*1.7%*	*0.0%*	*0.3%*	*0.0%*	*1.3%*	*0.0%*
Education	64	168	64	296	367	54,515	520	55,402
	1.3%	*0.3%*	*15.4%*	*0.5%*	*2.3%*	*1.3%*	*2.0%*	*1.3%*
Human health and	134	832	2	968	695	123,070	3,770	127,535
& social work activities	*2.8%*	*1.5%*	*0.5%*	*1.6%*	*4.4%*	*2.9%*	*14.7%*	*3.0%*
Arts, entertainment	31	556	10	597	219	87,061	1,076	88,356
& recreation	*0.6%*	*1.0%*	*2.4%*	*1.0%*	*1.4%*	*2.1%*	*4.2%*	*2.1%*
Other	14	253	1	268	183	222,393	3,784	226,360
	0.3%	*0.5%*	*0.2%*	*0.5%*	*1.2%*	*5.3%*	*14.8%*	*5.4%*
Total	4,832	54,405	416	59,653	15,651	4,182,415	25,618	4,223,684
	100%	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*	*100%*

Source: Authors' computations based on ORBIS, TAM, and State aid National registry data. Year: 2017-2021.

[1] The definition of firm size used here is the one adopted by the European commission, available at: https://single-market-economy.ec.europa.eu/smes/sme-definition_en

[2] SME= small and medium enterprise.

[3] The sector definition is based on the NACE 2 classification

Table A7 compares the distribution of aid awards by sector and firm size.

Construction, a sector with a high prevalence of large firms, is overrepresented in TAM (40.1%) as compared to the NR (12.9%). In contrast, the sector "accommodation and food" that has received large support during the pandemic is under-represented in TAM (4.6%) as compared to the NR (12.4%). Focusing on large firms only, there is still a higher proportion of aids awarded in the construction sector in TAM (54.5%) as compared to the NR (38.%) while the proportion of aids awarded in the "wholesale and retail" sector is smaller in TAM (7.8%) as compared to the NR (15.2.%).

Match Orbis with NR and TAM

For the analysis of the causal impact of COVID-19 State aid, we use Orbis data along with information from the National Registry and TAM. Orbis is a large longitudinal dataset containing detailed firm-level information on balance sheet data for millions of firms across the world, including those in the European Union. The national representativeness of Orbis with respect to the universe of firms in each country is discussed elsewhere (Bajgar et al., 2020). In this section, we show the number of firms in TAM and in the NR matching with the information in Orbis.

Table A 8. *Quality of match between Orbis and the registry data*

Match Orbis with TAM	**N**	**% of TAM un/matched**
Not matching observations	25,972,004	
(in Orbis only)	25,954,915	
(in TAM only)	17,089	24.4%
Matching observations both (in Orbis and TAM)	55,884	*76.6%*

Match Orbis with NR	**N**	**% of NR un/matched**
Not matching observations	24,102,579	
(in Orbis only)	23,692,395	
(in NR only)	410,184	15%
Matching observations both (in Orbis and TAM)	2,318,404	*85.0%*

Source: Authors' computations based on ORBIS, TAM, and State Aid National registry data. Year: 2017-2021.

In the NR, 15% of firms do not match with Orbis while 24.4% of the firms in TAM do not match with Orbis. In addition, the number of firms matching with the Orbis dataset is much higher in the NR than in TAM (2,318,404 vs. 55,884) showing that using TAM to analyse the impact of COVID State aid leave out over 2 millions of State aid. This means that in the period between 2017 and 2021 almost 98% of the aid awards would be excluded from the analysis.

Hence, this section aims at quantifying what would be the potential selection bias of using TAM along with Orbis data (as compared to using Orbis along with the NR) to analyse the causal impact of the COVID State aid on firms. Given that TAM has information only on a subsample of State aid beneficiaries, some firms may be identifies non-beneficiaries in TAM despite having received some State aid in the real world (and cannot therefore be considered as a real comparison group). We can identify these firms by comparing TAM with the NR within the Orbis sample.

To do this, we identify four categories of beneficiaries:

- ***COVID and non-COVID beneficiaries*** are those firms that received any type of State aid in the period 2017-2021
- ***Only COVID beneficiaries*** are firms that received COVID State aid in the period 2019-2021 but did not receive other type of aids over the period 2017-2021
- ***Only non-COVID beneficiaries*** received any type of State aid in the period 2017-2021 different from COVID
- ***Non-beneficiaries*** are firms who did not received any State aid in the period 2017-2021

Table A9 compares the number of beneficiaries identified using TAM and the real beneficiary status identified using the NR. There is a large number of firms (46%) which are seen in TAM as non-beneficiaries but received some kind of State aid during 2017-2021 (the orange cells). The blue cells represent beneficiaries for which there is some under-reporting (e.g. firms identified as COVID only beneficiaries but they received both COVID and Non-COVID State aid in the real world). Note that grey cells represent mismatches probably due to coding errors but represent 0.2% of the sample.

***Table A 9**. Comparing beneficiaries in TAM and in the NR; Sample: all firms in 2019*[1]

		TAM data				
		COVID and non-COVID	COVID only	Non-COVID only	Non-beneficiaries	Total
National Registry data	COVID and non-COVID	1461	21,580	859	231,185	255,085
	COVID only	8	5,982	30	679,249	685,269
	Non-COVID only	444	4,496	1,611	179,415	185,966
	Non-beneficiaries	0	46	9	1,235,959	1,236,014
	Total	1,913	32,104	2,509	2,325,808	2,362,334

Source: Authors' computations based on ORBIS, TAM, and State Aid National registry data.

1 Orange cells represent "false non-beneficiaries" (firms receiving aids but are recorded in TAM as non-beneficiaries). Blue cells represent under-reported beneficiaries (e.g. received both COVID and non-COVID aid but only reported COVID aid in TAM). Green cells represent TAM beneficiaries with matching information in the NR. Grey cells are mismatches probably due to coding errors.

It is clear that an analysis of the effect of COVID Aid using TAM data only would be problematic as half of firms are "false controls" , that is they appear as non-beneficiaries but are instead treated i.e. have some State aid reported in the NR. The number of false beneficiaries (1,089,849, i.e. the sum of the orange cells) is also much (about 30 times) bigger than the number of beneficiaries (36,526) recorded in TAM.

A possible solution to use TAM data for a plausible causal-impact analysis is to focus on large firms to reduce the mismatch between TAM and the NR as large firms are better represented in TAM. To explore the feasibility of this solution, we analysed the two following subsamples: 1) firms with turnover > 2 millions of €; and 2) firms with turnover > 50 millions of € (see Tables A10 and A11). Table A12 also compare the proportions of the different beneficiary types in these subsamples.

Table A10 shows that restricting the analysis to firms with turnover above 2 Millions € reduces the number of non-beneficiaries (the control group) from 1,236,014 to 16,074 observations (or, as shown in Table A12, from 52% to 12% of the analysed samples). In addition, the proportion of false zeros increases from 46 to 62% (see Table A12). The results are not considerably better when focusing on firms with Turnover > 50 of € Millions.

***Table A 10**. Comparing beneficiaries in TAM and in the NR; Sample: firms with turnover >2 Millions €* [1]

		TAM data				
		COVID and non-COVID	COVID only	Non-COVID only	Non-beneficiaries	Total
National Registry	COVID and non-COVID	1,347	20,455	604	33,869	56,275
	COVID only	7	5,124	16	17,962	23,109
	Non-COVID only	409	4,225	1,192	28,428	34,254
	Non-beneficiaries	0	34	8	16,074	16,116
	Total	1,763	29,838	1,820	96,333	129,754

Source: Authors' computations based on ORBIS, TAM, and State Aid National registry data.

1 Orange cells represent "false non-beneficiaries" (firms receiving aids but are recorded in TAM as non-beneficiaries). Blue cells represent under-reported beneficiaries (e.g. received both COVID and non-COVID aid but only reported COVID aid in TAM). Green cells represent TAM beneficiaries with matching information in the NR. Grey cells are mismatches probably due to coding errors.

Table A 11. *Comparing beneficiaries in TAM and in the NR; Sample: firms with turnover >50 Millions €*

		TAM data				
		COVID and non-COVID	COVID only	Non-COVID only	Non-beneficiaries	Total
National Registry	COVID and non-COVID	167	1,100	89	422	1,778
	COVID only	1	341	1	353	696
	Non-COVID only	84	405	482	1,576	2,547
	Non-beneficiaries	0	4	1	1,062	1,067
	Total	252	1,850	573	3,413	6,088

Source: Authors' computations based on ORBIS, TAM, and State Aid National registry data.

[1] Orange cells represent "false non-beneficiaries" (firms receiving aids but are recorded in TAM as non-beneficiaries). Blue cells represent under-reported beneficiaries (e.g. received both COVID and non-COVID aid but only reported COVID aid in TAM). Green cells represent TAM beneficiaries with matching information in the NR. Grey cells are mismatches probably due to coding errors.

Table A 12. *Proportion of beneficiaries in the subsamples of interest*

Sample	All Firms in Orbis	Firms with Turnover > 2 € Millions	Firms with Turnover > 50 € Millions €
Matched	52.7%	18.3%	33.7%
False zeros	46.1%	61.9%	38.6%
Mismatched	1.0%	16.2%	19.5%
Coding errors	0.2%	3.6%	8.1%
Non-beneficiaries	52.3%	12.4%	17.5%

Source: Authors' computations based on ORBIS, TAM, and State Aid National registry data.

1 Orange cells represent "false non-beneficiaries" (firms receiving aids but are recorded in TAM as non-beneficiaries). Blue cells represent under-reported beneficiaries (e.g. received both COVID and non-COVID aid but only reported COVID aid in TAM). Green cells represent TAM beneficiaries with matching information in the NR. Grey cells are mismatches probably due to coding errors.

Annex 4. Matching Balance Tests

Table A 13. *Matching Balance Tests for Italy, Poland, and Spain*

Panel (a) - Italy

	Mean			t-test	
Variable	**Treated**	**Control**	**%bias**	**t**	**p>t**
turnover (HIS) 2017	13.513	13.567	-3.2	-5.300	0.000
turnover (HIS) 2018	13.637	13.689	-3.1	-5.320	0.000
turnover (HIS) 2019	13.652	13.703	-3.1	-5.350	0.000
Size					
Small	0.086	0.088	-0.8	-1.230	0.218
Medium	0.016	0.014	0.9	1.650	0.099
Large	0.003	0.003	0.3	0.670	0.505
Capital					
2nd quartile	0.402	0.401	0.3	0.370	0.713
3rd quartile	0.154	0.155	-0.3	-0.480	0.631
4th quartile	0.349	0.352	-0.6	-0.910	0.364
Loans					
Above median	0.360	0.352	1.8	2.480	0.013
EBIT margin					
2nd quartile	0.389	0.387	0.3	0.370	0.714
3rd quartile	0.303	0.302	0.2	0.250	0.799
4th quartile	0.141	0.138	0.7	1.080	0.281
Regions					
Region 2	0.001	0.001	0.9	1.400	0.161
Region 3	0.024	0.024	0.2	0.330	0.743
Region 4	0.254	0.254	0.1	0.170	0.862
Region 5	0.012	0.011	1.3	1.850	0.064
Region 6	0.003	0.003	-1.2	-1.620	0.105
Region 7	0.078	0.085	-2.8	-3.580	0.000
Region 8	0.030	0.030	0.2	0.250	0.801
Region 9	0.003	0.003	0.3	0.400	0.687
Region 10	0.016	0.015	0.6	0.840	0.398
Region 11	0.032	0.030	0.9	1.210	0.226
Region 12	0.006	0.006	-0.5	-0.740	0.459
Region 13	0.099	0.103	-1.2	-1.770	0.076
Region 14	0.015	0.014	0.5	0.720	0.470
Region 15	0.101	0.103	-0.5	-0.740	0.457
Region 16	0.102	0.097	1.7	2.340	0.019
Region 17	0.014	0.014	0.5	0.630	0.527
Region 18	0.032	0.030	1.0	1.430	0.152
Region 19	0.106	0.107	-0.1	-0.130	0.894
Region 20	0.013	0.013	-0.3	-0.520	0.604
Sector					
Construction	0.268	0.262	1.2	1.870	0.062
Wholesales	0.294	0.302	-1.6	-2.390	0.017
Retail	0.192	0.188	1.2	1.600	0.109

Panel (b) - Spain

	Mean			t-test	
Variable	**Treated**	**Control**	**%bias**	**t**	**p>t**
turnover (HIS) 2017	13.948	13.955	-0.5	-0.920	0.355
turnover (HIS) 2018	14.028	14.036	-0.5	-1.040	0.297
turnover (HIS) 2019	14.069	14.077	-0.6	-1.070	0.283
Size					
Small	0.152	0.152	0	-0.060	0.951
Medium	0.024	0.022	1	1.830	0.067
Large	0.003	0.003	-0.5	-1.040	0.298
Capital					
2nd quartile	0.207	0.212	-1.3	-2.390	0.017
3rd quartile	0.287	0.282	0.9	1.640	0.101
4th quartile	0.243	0.239	1.1	1.920	0.055
Loans					
2nd tercile	0.152	0.152	-0.1	-0.100	0.917
3rd tercile	0.493	0.491	0.5	0.700	0.482
EBIT margin					
2nd quartile	0.364	0.355	2.1	3.640	0.000
3rd quartile	0.332	0.330	0.4	0.690	0.489
4th quartile	0.150	0.157	-1.7	-3.440	0.001
Regions					
Region 2	0.018	0.018	-0.4	-0.710	0.478
Region 3	0.012	0.011	0.9	1.540	0.124
Region 4	0.041	0.041	0.1	0.180	0.856
Region 5	0.013	0.014	-0.2	-0.460	0.646
Region 6	0.005	0.006	-0.6	-1.050	0.292
Region 7	0.039	0.039	-0.1	-0.120	0.908
Region 8	0.117	0.115	0.9	1.650	0.100
Region 9	0.040	0.040	-0.1	-0.180	0.854
Region 10	0.066	0.068	-0.7	-1.200	0.229
Region 11	0.012	0.013	-0.7	-1.210	0.227
Region 12	0.224	0.221	0.6	1.110	0.267
Region 13	0.130	0.131	-0.2	-0.360	0.719
Region 14	0.019	0.019	-0.4	-0.680	0.496
Region 15	0.117	0.118	-0.5	-0.840	0.403
Region 16	0.035	0.038	-1.4	-2.410	0.016
Region 17	0.001	0.001	0.8	1.440	0.150
Region 18	0.001	0.001	-0.5	-0.830	0.404
Region 19	0.032	0.032	-0.2	-0.280	0.776
Sector					
Construction	0.244	0.237	1.6	3.060	0.002
Wholesales	0.330	0.329	0.3	0.540	0.586
Retail	0.192	0.197	-1.3	-2.320	0.020

Panel (c) - Poland

	Mean			t-test	
Variable	**Treated**	**Control**	**%bias**	**t**	**p>t**
turnover (HIS) 2017	14.443	14.402	1.9	1.150	0.249
turnover (HIS) 2018	14.546	14.528	0.8	0.510	0.613
turnover (HIS) 2019	14.590	14.568	1.0	0.610	0.541
Size					
Small	0.273	0.265	1.8	0.920	0.360
Medium	0.077	0.077	0.2	0.130	0.898
Large	0.010	0.012	-0.6	-0.660	0.512
Capital					
2nd quartile	0.104	0.113	-3.1	-1.500	0.135
3rd quartile	0.342	0.350	-1.8	-0.870	0.382
4th quartile	0.390	0.369	4.4	2.290	0.022
Loans					
2nd tercile	0.127	0.137	-3.2	-1.460	0.144
3rd tercile	0.369	0.352	3.6	1.880	0.061
EBIT margin					
2nd quartile	0.369	0.378	-1.8	-0.920	0.357
3rd quartile	0.320	0.315	1.2	0.600	0.549
4th quartile	0.156	0.151	1.3	0.680	0.497
Regions					
Region 2	0.150	0.148	0.8	0.380	0.700
Region 3	0.113	0.110	0.7	0.370	0.709
Region 4	0.038	0.039	-1.0	-0.510	0.611
Region 5	0.014	0.018	-3.1	-1.550	0.122
Region 6	0.080	0.076	1.6	0.820	0.411
Region 7	0.017	0.017	0.3	0.150	0.880
Region 8	0.043	0.052	-4.8	-2.260	0.024
Region 9	0.016	0.010	4.9	2.710	0.007
Region 10	0.062	0.065	-1.5	-0.740	0.458
Region 11	0.052	0.046	2.5	1.290	0.197
Region 12	0.013	0.016	-2.8	-1.250	0.210
Region 13	0.034	0.042	-4.8	-2.180	0.029
Region 14	0.031	0.026	2.7	1.290	0.196
Region 15	0.019	0.020	-0.7	-0.360	0.722
Region 16	0.209	0.216	-1.5	-0.830	0.409
Region 17	0.035	0.030	2.4	1.160	0.246
Sector					
Construction	0.190	0.199	-2.0	-1.060	0.288
Wholesales	0.403	0.394	1.7	0.880	0.379
Retail	0.158	0.159	-0.2	-0.120	0.904

Annex 5. Heterogeneity analysis for Poland

Table A 14. *The effects of COVID State aid on firms' turnover, by different combinations of sector/size groups*[1]

Size category	Micro	Small	Medium	Large
Treat x Manufacturing	-0.144	-0.154	0.306	-0.365***
	(0.103)	(0.124)	(0.265)	(0.017)
Treat x Construction	-0.169	0.121	0.564**	
	(0.141)	(0.209)	(0.266)	
Treat x Wholesales	-0.155	-0.099	0.196	-0.021
	(0.107)	(0.111)	(0.128)	(0.362)
Treat x Retail	0.041	0.033	-0.257	
	(0.176)	(0.134)	(0.412)	
Constant	13.484***	15.888***	17.407***	19.273***
	(0.001)	(0.000)	(0.001)	(0.004)
Observations	16,616	7,208	2,736	624

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The average treatment effects is obtained as in equation (2). The effects by size and sector are estimated in separate equations. The outcome variable, turnover is in log form (Inverse Hyperbolic Sine Transformation). Standard errors clustered at the firm level. Standard errors clustered at the firm level.

Table A 15. *The effects of COVID State aid on firms' turnover, by type of aid instrument*[1]

	Instrument type	Repayable[2]	Non-Repayable or both
	Average effect	-0.028	-0.100*
		(0.081)	(0.055)
Effect by Size	Treat x Micro	-0.278**	-0.071
		(0.122)	(0.069)
	Treat x Small	0.159	-0.102
		(0.144)	(0.071)
	Treat x Medium	0.259**	-0.405
		(0.107)	(0.258)
	Treat x Large	-0.217	0.006
		(0.217)	(0.081)
Effect by Sector	Treat x Manufacturing	0.067	-0.080
		(0.147)	(0.081)
	Treat x Construction	0.263**	-0.200*
		(0.130)	(0.118)
	Treat x Wholesale	-0.161	-0.074
		(0.135)	(0.086)
	Treat x Retail	-0.156	-0.101
		(0.190)	(0.143)
	Constant	14.776***	14.678***
		(0.001)	(0.000)
	Observations	10,584	24,584

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The average treatment effects is obtained as in equation (2). The effects by size and sector are estimated in separate equations. The outcome variable, turnover is in log form (Inverse Hyperbolic Sine Transformation). Standard errors clustered at the firm level. Standard errors clustered at the firm level.

2 Repayable instruments includes guarantees and loans. Non-repayable instruments includes direct grants, interest rate subsidies, and other non-repayable grants.

Table A 16. *The relationship between COVID State aid and category of default, by different combinations of sector/size groups* [1]

Size category	Micro	Small	Medium	Large
Treat x Manufacturing	0.361	-0.449	-0.873*	-1.569*
	(0.298)	(0.374)	(0.469)	(0.913)
Treat x Construction	-0.254	1.010	0.037	
	(0.383)	(0.785)	(0.733)	
Treat x Wholesales	0.036	0.029	-0.112	0.291
	(0.267)	(0.276)	(0.187)	(0.404)
Treat x Retail	0.124	-0.149	0.239	
	(0.281)	(0.409)	(0.221)	
Constant	5.561***	4.794***	4.676***	4.998***
	(0.001)	(0.001)	(0.001)	(0.005)
Observations	16,628	7,161	2,675	622

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The associations are obtained as in equation (2). The effects by size and sector are estimated in separate equations. The outcome variable (category of default) is measured with a numerical variable ranging from 0 to 10. Standard errors clustered at the firm level. Standard errors clustered at the firm level.

Table A 17. *The relationship between COVID State aid and category of default, by type of aid instrument*[1]

	Instrument type	Repayable[2]	Non-Repayable or both
	Average effect	-0.180	0.135
		(0.212)	(0.118)
Effect by Size	Treat x Micro	-0.147	0.205
		(0.464)	(0.149)
	Treat x Small	0.334	-0.049
		(0.516)	(0.206)
	Treat x Medium	-0.558**	0.034
		(0.250)	(0.272)
	Treat x Large	-0.044	0.254*
		(0.349)	(0.136)
Effect by Sector	Treat x Manufacturing	-0.650	0.205
		(0.396)	(0.235)
	Treat x Construction	0.525	0.014
		(0.441)	(0.388)
	Treat x Wholesale	-0.276	0.156
		(0.362)	(0.172)
	Treat x Retail	0.075	0.101
		(0.460)	(0.233)
	Constant	5.677***	5.193***
		(0.002)	(0.001)
	Observations	10,672	24,584

1 Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. The associations are obtained as in equation (2). The effects by size and sector are estimated in separate equations. The outcome variable (category of default) is measured with a numerical variable ranging from 0 to 10. Standard errors clustered at the firm level. Standard errors clustered at the firm level.

2 Repayable instruments includes guarantees and loans. Non-repayable instruments includes direct grants, interest rate subsidies, and other non-repayable grants.

Annex 6. Data and scripts

The following files contain the scripts for the injection of Orbis data in the ElasticSearch infrastructure and to perform specific companies searches within the infrastructure:

- Check errors
- Companies matching
- Configuration
- To split files
- Infer
- Infer mapping
- Insert
- Insert in ElasticSearch
- Match
- Search
- Search in ElasticSearch

Two additional reports produced by the contractor who took care of implementing the data handling in ElasticSearch give an overview of how inserting information in ElastiSearch (first file) and how to perform companies searches (second file).

For what the main econometric analysis is concerned, the database are available for all countries following the country specific links: Italy, Spain and Poland.

Moreover, the Stata do-files for turnover as an outcome are available here: for Italy, for Spain and for Poland. Regarding the probability of default as outcome, the Stata do-files are the following: Italy, Spain and Poland

The extensive literature review can be found at this link.

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