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Assessing the financial and financing conditions of firms in Europe: the financial module in CompNet

CompNet The Competitiveness Research Network

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Abstract. This paper provides an encompassing description of the various indicators compiled in the financial module of CompNet using balance sheet information of European firms. We investigate whether and to which extent the heterogeneous financial positions of firms have affected firms' investment decisions, especially during the recent crisis. Our results confirm the relevance of leverage for investment, in addition to other common determinants, such as cash flow or sales growth. In particular, we find evidence that higher levels of indebtedness act as a drag on investment. We investigate cash holding policies and find significant differences across firm sizes and degrees of financial constraints. Furthermore, our data confirm the pro-cyclicality of firm profitability and its negative association with financial constraints. Finally, we exploit the richness of this new dataset to document the relationships between firms' financial and financing conditions and their productivity.

JEL codes: D22, D24, D92, G32.

Keywords: firm financing conditions and constraints, productivity, firm heterogeneity.

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Non-Technical Summary

In this paper we describe the new financial module of the Competitiveness Research Network (CompNet) database. The module is based on a set of indicators derived from balance sheet and profit and loss accounts by applying the same methodology of the other CompNet modules: i.e. a common protocol has been used to extract relevant financial indicators, aggregated in such a way as to preserve confidentiality, from existing firm-level datasets available within the institutions participating to the network. By using a common methodology the resulting set of indicators is harmonized across countries.

In the overall framework of the CompNet, the financial module represents a further important step as it relates the financial and financing conditions of firms to productivity measures. In the literature it is widely documented that firms' financing decisions are crucial in determining investment decisions, and that the existence of frictions in accessing external sources of finance, for instance due to imperfect information, significantly affects the ability of management of exploiting productive investment opportunities. In this setting, the financial position of a firm and the access to external funds stand out to be key factors in explaining its performance in terms of profitability and value added generated.

In this paper we provide an encompassing description of the various indicators which cover several aspects of the financial position of firms: performance, structure of external funding, financial fragility and independence. We devote particular attention to the construction of indicators of financial constraints both by exploiting the information derived from a survey on access to finance and by using an "a-priori classification" scheme based on information from balance sheets and profit and loss accounts.

We use the richness of the CompNet dataset to investigate heterogeneities in the financial position of firms in order to better understand the different degrees of intensity with which financing problems have affected them, in particular during the recent crisis. We investigate whether the lack of market confidence, reduced bank lending and financial fragility generally perceived for the stressed countries' productive systems throughout the crisis are indeed at the root of the different productivity performance in those groups of countries.

A first piece of evidence is that additional factors related to the low profitability of investment in stressed countries might have exacerbated the negative effects of the crisis. Leverage has also played an important role and we find evidence that higher borrowing represent a drag on investment. We supplement the descriptive findings with econometric analyses using different levels of aggregation of the dataset and applying panel data techniques.

The econometric analysis confirms the relevance of leverage for investment, besides other determinants, like cash flow or sales growth, identified by the economic literature. Our assessment then investigates cash holding policies. While we know that small firms keep more cash on their balance sheets and are more cautious than large firms, being financially constrained implies a reduction in the amount of cash at disposal across all firm sizes, most probably due to firms' worse financial situation. We also investigate the determinants of profitability: our data confirms the pro-cyclical nature of firm profitability as profits increase when the economy is growing but decline when the economy enters a recession. Moreover, the econometric results show that firms that are financially constrained are also less profitable and the significant and negative coefficient of the crisis dummy reinforces the descriptive results of a sharp drop of profitability across sectors since 2008 with still only few instances of recovery.

1. Introduction and brief overview of the literature

The overall aim of the Competitiveness Research Network of the EU System of Central Banks (CompNet) was to collect information to understand the drivers of competitiveness by recognising the crucial role played by micro-based data. A further step of the network was to expand the original database by including detailed information on critical determinants of competitiveness such as the financial position of the firms, their exporting intensity, employment creation or price-cost margins.

This paper reviews the work done to enhance the original database with information related to the financial and financing conditions of firms. In the literature it is widely documented that firms' financing decisions are crucial in determining investment decisions, and that the existence of frictions in accessing external sources of finance, for instance due to imperfect information, significantly affects the ability of management of exploiting productive investment opportunities. In this setting, the financial position of a firm and the access to external funds stand out to be key factors in explaining its performance in terms of profitability and value added generated.

A first aim of this paper is to provide an encompassing description of the various indicators included in the CompNet database that can provide the basis for the analysis of the link between productivity and financial factors. The indicators cover several aspects of the financial position of firms: performance, structure of external funding, financial fragility and independence.

We devote particular attention to the construction of indicators of financial constraints. As there are no specific items on the balance sheet of firms that could confirm whether a firm is financially constrained, several avenues have been suggested in the literature allowing for the identification and measurement of financial constraints. Most contributions have either used balance sheet data to show the link between (constrained) investment and financial characteristics (Fazzari et al., 1988, 2000; Carpenter and Petersen, 2002), or survey data to show the link between financing constraints and growth (Beck et al., 2006; Brown et al., 2011). Unfortunately, the first strand lacks direct information on the financing constraints that firms face, while the second strand lacks balance sheet and profit and loss account data of the firms investigated. Other avenues have been explored, as documented in Box 1 which includes a brief overview of the theoretical discussions.

In the CompNet database we fill this gap as we combined information on financing constraints and financial characteristics of firms by following two different directions. The first approach is to exploit the information derived from a survey on financing constraints while the second approach is a more traditional one: we create an indicator of financial constraints using an "a-priori classification" scheme based on information from balance sheets and profit and loss accounts.

BOX 1: Financing Constraints: A Brief Overview of Theoretical and Empirical Evidence

Under perfect financial markets, access to internal and external finance would be perfect substitutes and, as a consequence, the availability of internal funds would not influence investment options and investment decisions (Modigliani and Miller, 1958). However, in reality, financial market imperfections exist – mainly due to information asymmetries between lenders and borrowers - and these make access to external finance more costly than internal funding.

On the supply side, it is difficult for lenders to distinguish *ex-ante* between high- and low-risk entrepreneurs without incurring significant transaction costs. As a consequence, lenders base their decisions on collateral and track record rather than the economic viability of firms. On the demand side, borrowers lack complete information about external funding sources and investment opportunities. This information asymmetry limits the demand for external funding and thereby growth possibilities of firms, in particular for small firms who do not have the skills/capacity to assess investment opportunities. Furthermore, a number of firms do not apply for external finance due to fear of rejection (BIS, 2012, Siedschlag et al. 2014).

Firms face financing constraints when they have the ability to use funds productively but cannot get access to external financing from the formal financial system. As a result, due to restricted access to finance of some potentially viable firms, there will be underinvestment, a suboptimal allocation of capital and missed firm growth opportunities. Information asymmetries do not affect all types of firms and industries in the same way. Evidence based on theory, surveys and empirical analysis (Gertler and Gilchrist, 1993; Hall and Lerner, 2010) has established that financing constraints are likely to be more binding for certain types of firms, including start-ups, young, innovative, small scale, domestic firms and as well as for more technologically advanced industries.

Access to external financing may be also linked to other system-related factors such as institutional factors, financial market regulations, the tax regime, and the lack of an equity market culture (Oxera, 2005, BIS, 2012). In addition, demand-related factors may be linked to a shortage of viable projects BIS (2012). Additional financial market imperfections that restrict access to external finance include positive externalities, and moral hazard (Hall and Lerner 2010).

Externalities restrict access to external finance of good quality projects by viable firms particularly in the case of investment in R&D by innovative enterprises. This market failure is linked to the non-rival nature of knowledge and it has been established theoretically by Nelson (1959) and Arrow (1962). As a consequence, the returns to investment in R&D cannot be fully appropriated by firms leading to underinvestment in R&D. Empirical evidence shows that indeed social returns to R&D investment are higher than private returns (Griliches, 1992; Hall, 1996; Hall et al., 2010).

R&D investment is more difficult to fund relative to other types of investment due to a number of distinct characteristics of this type of investment (Hall and Lerner, 2010). Firstly, the outcome of R&D investments is knowledge embedded in employees' human capital, which is an intangible asset and cannot be used as collateral. Secondly, the uncertainty associated with the output of R&D investments makes them riskier than other projects. As a consequence, the required rate of return to R&D may be higher than that of conventional investment.

Moral hazard results from the separation of ownership and management. Conflicting goals between owners and managers lead to a principal-agency problem which could result in investment strategies that do not maximise the share value. (Hall and Lerner, 2010). Two types of agency costs may emerge. The first type relates to the tendency of mangers to finance certain projects that benefit themselves. The second type relates to the reluctance of risk-averse managers to invest in uncertain R&D projects. Evidence on such R&D investment-related agency costs has

been provided by Johnson and Rao (1997), Francis and Smith (1995) and Eng and Shackell (2001).

In recessions or in periods of financial crisis, financial market imperfections may increase financial constraints firms face. The presence and role of financial mechanisms that amplify financial constraints during recessions have been confirmed by empirical evidence for past recessions as well as the recent recession following the global economic and financial crisis (IMF 2013). These financial mechanisms include: (i) collateral constraints; (ii) debt overhang; (iii) relationship banking.

Collateral constraints. Following depressed stock or bond markets, a decline in asset prices leads to a lower value of collateral and thus a lower value of the loan that can be obtained with that collateral. Evidence from the recent financial crisis indicates that exporters were affected by collateral constraints and banking sector distress (Kalemli-Ozcan et al., 2010). Evidence for the UK shows that in comparison to the pre-crisis period, over the period 2007-2009 a larger number of small and medium sized enterprises (SMEs) have been asked for collateral (Fraser, 2012).

Debt overhang. Evidence indicates that banks' exposure to non-performing loans affects new lending (Gan, 2007) while banks' capital ratio and liquidity ratio impact the provision of loans to firms (Jiménez et al., 2012).

Relationship banking. In Europe, the quantity of firm-level credit is often influenced by firm-bank relationships, especially in the case of SMEs. During recessions these relationships can be affected by bankruptcies of banks and firms (Petersen and Rajan, 1994), which can then lead to an increase in the risk premium that banks charge, effectively reducing the supply of credit. In Eastern Europe, firms with relationships with Western banks were more negatively affected by the recent financial crisis then firms borrowing from locally-funded domestic banks (Ongena et al., 2013).

Empirical studies have used a range of methods to measure the extent to which firms face financing constraints. Firstly, numerous studies estimate the extent to which reliance on internal financing affects firm performance as measured by investment, exporting, inventory management or firm growth (for example Fazzari et al., 1988; Hubbard, 1998; Love, 2003; Bond and Soderbom, 2013). Reviews of this literature include Chirinko (1993) and Guariglia (2008).

A second method to measure financing constraints uses information on firm's financial factors (net worth, liquidity, interest coverage) to proxy firms' financial health in a structural model of firm performance outcomes such as Euler equation approaches (Whited, 1992; Bond and Meghir, 1994; Bond et al., 2003; and Whited and Wu, 2006).

Thirdly, financing constraints have been assessed by linking firm growth to the differential cost of capital between external financing sources (Kashyap et al, 1993; Huang, 2003; Bougheas et al., 2006; Guariglia and Mateut, 2010; O'Toole et al., 2014).

Finally, as detailed firm surveys have recently become available, one effective method to measure financing constraints is to use information relating to firms' perceptions of access to finance as an obstacle to growth and expansion (perceived financing constraints) and responses on credit applications and rejections (actual financing constraints) (Beck et al. 2006; Clarke et al. 2012; Byiers et al., 2010; Ferrando and Griesshaber (2011); Brown et al., 2012; Popov and Udell, 2012; Ferrando and Mulier 2015; Siedschlag et al. 2014).

Recent empirical evidence on financing constraints faced by firms in the European Union include Pál and Ferrando (2010), Coluzzi et al. (2015), Ferrando and Mulier (2013), Casey and O'Toole (2014), and Siedschlag et al. (2014). This evidence highlights that small and young firms have

access to less diversified financing sources and they face greater financing constraints. The recent financial crisis has amplified the financial challenges these types of firms face over and above demand conditions, in particular in the countries with the most severe banking and sovereign debt crises (Ireland, Greece, Spain) with negative implications for their investment, employment and productivity performance.

A second aim is to investigate heterogeneities in the financial position of firms in order to better understand the different degrees of intensity with which financing problems have affected them, in particular during the recent crisis. We distinguish between stressed and non-stressed countries[1] as the sovereign debt crisis and the subsequent fragmentation of financial markets along national lines should have affected firms in this country groups to a different degree.

The descriptive analyses aim at uncovering whether the lack of market confidence, reduced bank lending and financial fragility generally perceived for the stressed countries' productive systems throughout the crisis is actually confirmed when looking at aggregated micro-level data on the financial structure of firms operating in such countries. A first piece of evidence is that additional factors have played a role and these are related in particular to the low profitability of investment in stressed countries, which might have exacerbated the negative effects of the crisis. Another important factor is leverage which might have influenced sluggish investment in Europe

The econometric analysis confirms the relevance of leverage for investment, besides other determinants, like cash flow or sales growth, identified by the economic literature. Our assessment then investigates cash holding policies. While we know that small firms keep more cash on their balance sheets and are more cautious than large firms, being financially constrained implies a reduction in the amount of cash at disposal across all firm sizes, most probably due to firms' worse financial situation. We also investigate the determinants of profitability: our data confirms the procyclical nature of firm profitability as profits increase when the economy is growing but decline when the economy enters a recession. Moreover, the econometric results show that firms that are financially constrained are also less profitable and the significant and negative coefficient of the crisis dummy reinforces the descriptive results of a sharp drop of profitability across sectors since 2008 with still only few instances of recovery.

The remainder of the paper is organized as follows. Section 2 describes the firm-level financial indicators that have been constructed for the CompNet database. Section 3 introduces the indicators of financial constraints. Section 4 presents all in-depth analysis of the dataset. We consider the capital structure of companies in the euro area and we empirically investigate the investment decisions of firms, the determinants of cash holding and profitability. Finally, we

[1] "Stressed economies" refers to the euro area countries which either are/were participating in a financial assistance programme (e.g. Spain) or, as in the case of Italy, Portugal and Slovenia, have macroeconomic imbalances which the European Commission has labelled as "excessive". These countries also experienced significant market turbulence from 2010 until at least summer 2012.

review the links between financial indicators and export status as well as firm productivity. Section 5 concludes.

This paper contains an extensive number of appendices which review in detail the various steps needed to create the financial module in the CompNet database. They include: 1) a description of the data treatment that was implemented before running the analyses; 2) the detailed definitions of each indicator available in the CompNet database with some descriptive analysis of the data across country/size and macrosectors; 3) a comparison of the CompNet dataset with previous ECB reports that made use of alternative publicly available data sources, e.g. the Structural Issues Report 2013 on Corporate Finance and Economic Activity in the euro area (based on BvD Amadeus database) and the 2015 Structural Issues Report on Savings and Investment in the euro area (based on BACH dataset). The last Appendix includes additional stylised facts which support the analyses in the main text on the link between productivity and financial indicators.

2. Financial indicators in the CompNet database: an overview

The financial module of the CompNet database includes a full set of indicators aimed at depicting both the financial and financing position of the firm. These indicators can be linked to those of the other modules of the CompNet database dealing with productivity, trade and mark-ups. [2]

In this section we briefly describe the main indicators constructed using information from the various firm-level databases of the network. More details on the raw financial variables derived from the balance sheets and profit and loss accounts are included in **Appendix A.1**. More generally, the choice of the set of indicators is driven by the aim of describing the financial and financing positions of firms in a parsimonious way. In this respect, we looked at the most common indicators used in the empirical literature by classifying them according to the following categories:

- Performance indicators
- Structure of external funding
- Financial fragility
- Financial independence
- Other financial indicators
- Credit constraints indicators

[2] For a full description of the CompNet dataset, please refer to Lopez-Garcia, di Mauro et al. (2015).

Once the ratios are computed using the firm-level data, they are aggregated along five dimensions: country level, sector level (NACE rev.2, 2-digits), macro-sector level, size-class level and macro-sector / size-class level. For the purpose of our analysis, the most disaggregated "cell" is given, for each indicator, by four dimensions: country / time / size class / economic sector. For instance, one cell could include small firms in the manufacturing sector in Belgium at a certain moment in time. This would allow performing econometric analyses using a "pseudo panel" as it will be described in the following sections. The individual ratios constructed at the firm level are checked using an outlier treatment which is illustrated in detail at the end of **Appendix A.1**. In a nutshell, for most indicators we drop values within the 1st (p1) and the 99th percentile (p99) in each sector, both in levels and in growth rates. In addition, values which are more than 10 interquartile ranges from the median of that value in that sector are also dropped. Finally, several financial indicators are ratios that logically should be bound between 0 and 1: values which do not satisfy this condition are also dropped.

The remaining data appendices review the definition of each indicator, its economic meaning and its availability across countries and over time (**Appendix A.2**). Some additional information on the developments of these indicators is also included.

In addition, in order to have a better understanding of the magnitude of the indicators in the financial module, we compared our indicators with similar indicators based on other firm-level data sources (see **Appendix A.3** for details). For this purpose, we consider two different samples based on alternative public data sources that have been used for two recent ECB publications: the ECB Structural issues reports 2013 "Corporate finance and economic activity in the euro area" and 2015 "Savings and investment in the euro area". The first sample is derived from the Amadeus database from Bureau van Dijk and the second one from the BACH (Bank for the Accounts of Companies Harmonised) database from the European Committee of Central Balance-Sheet Data Offices. It appears that most of the indicators share similar dynamics among the datasets, except for some minor discrepancies.

As explained in Lopez-Garcia, di Mauro et al. (2015) one of the novelties of the CompNet database is given by the presence of additional information on the different moments of the distribution of the indicators. This clearly enhances the usability of aggregated firm-level information for policy analysis when the direct (i.e. micro-level) sources of data are not available. In particular, the CompNet database includes information on the full distribution of the indicators and also on the bivariate or joint distribution of a selection of different combinations of variables. Most notably, productivity indicators' (or firm size) distributions are considered in parallel with most obvious covariates, such as financial position, exporting status, firm growth, etc. **Table 1** lists the available indicators and the information available for each of them. For each indicator in column two, the CompNet database provides mean, median, standard deviation, skewness of the distribution, interquartile range and

number of observation at the source. In addition, some of the financial indicators are provided with all the deciles of their distribution and two percentiles (p1 and p99). The last column of the table indicates the financial indicators for which CompNet has collected also information on the joint distribution, that is the dataset contains the median values for each decile of the distribution of: number of employees, labour costs, labour productivity, capital intensity, real capital, real value added, total factor productivity, unit labour costs.

Table 1, *List of the financial indicators by type*

Type of indicator	Short description	Full distribution	Joint distribution
Performance indicators	Cash flow over total assets		
	Investment ratio: change in the stock of fixed capital	9	9
	Profit margin: EBIT over turnover		
	Return on Assets	9	9
Structure of external funding	Equity over debt	9	9
	Equity over total assets		
	Debt over total assets	9	9
	Trade credit: accounts payable over total assets		
Financial fragility	Interest payments burden: interest paid over total assets		9
	Implicit interest rate: interest paid over the stock of debt		
	Inventory turnover: inventories as a fraction of turnover		
Financial independence	Financing gap: total investment minus cash flow, over turnover	9	9
Other financial indicators	Cash and cash equivalents over total assets	9	9
	Collateral: fixed assets over total assets	9	9
	Depreciation rate over total assets		
	Trade debt: accounts receivable over total assets		
Credit/investment constraints indicators	Indicator of investment constraints (FR indicator)	-	9
	Indicator of financial constraints (ICC indicator)	-	9

Another novelty of the CompNet financial module is given by the availability of firm-level indicators of credit constraints which have been constructed using both survey and balance sheet data. These indicators can be analysed together with the rest of the competitiveness indicators. The next section explains in detail the methodology used to construct these indicators.

The next step is to select those firms which can be considered as *credit constrained*; from now on, we will work with the datasets countries provided for the CompNet analysis. The underlying idea is to calibrate a threshold over the SAFE score distribution using the information from the survey data. In order to define the threshold we consider the distribution of the SAFE score by country, pulling together the years 2009-2012 which refer to the information used for the regression analysis. We select the top x% of the distribution of the SAFE score by country, where x is the average number of constrained firms over 2009-2012, directly taken from the SAFE survey (**Table 5**). These figures, which are weighted to take into consideration the population of firms within each country, are regularly published by the ECB. We then identify the value of the SAFE score at the x-percentile of its distribution.

Table 5, *Average over 2009-2012 of the number of constrained firms in the economy, (as a percentage of the whole sample, taken from the SAFE survey)*

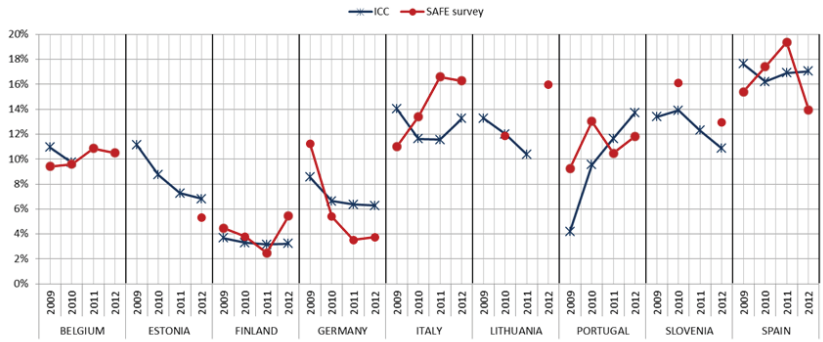
Country	*Credit_constrained*
BE	10.0%
DE	6.7%
ES	17.4%
FI	3.6%
FR	10.3%
IT	13.7%
PT	10.9%

Finally, for each year, constrained firms are identified as those with a value of the SAFE score greater than the threshold. The ICC indicator will be equal to 1 for them and zero otherwise. The above procedure is applied at the country level for the countries participating in CompNet. The usefulness of the procedure based on financial statements is that it can also be used to extrapolate the percentage of financially constrained firms before the beginning of the survey. This implies the introduction of two, admittedly strong, assumptions: 1) the estimated coefficients are time-invariant, as it is often the case for widely used indicators proposed in the literature[6] and 2) the threshold is fixed over time. When analysing the developments of the ICC index before 2009 researchers should therefore be fully aware of the two assumptions.m

The results of the ICC indicator estimation[7] are shown in **Figure 2** which makes a comparison among the data on credit constrained firms coming from the SAFE survey (available for 2009-2012) and the ICC estimated in CompNet (for the same years, using the full sample).

[6] For instance, examples of derived weighted combinations of time-varying coefficients are the Whited-Wu index (Whited-Wu, 2006) and the Kaplan-Zingales index (Kaplan and-Zingales, 1997).
[7] The results show the indicator built with the first definition of debt.

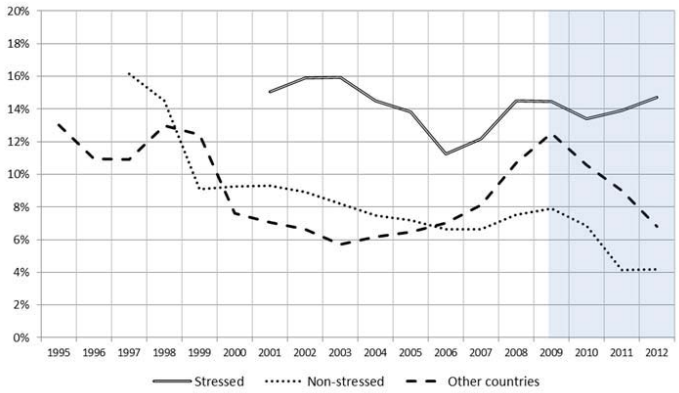
Figure 2, *Share of constrained firms by country: ICC (full sample) vs. SAFE survey*



Source for the survey data: ECB SAFE

Looking at the dynamics of the indicators over a longer horizon, **Figure 3** includes the extrapolated results. The figures refer to the full sample and the three plotted lines represent the share of constrained firms in the economy for three different groups of countries[8], obtained with a simple average: non-stressed countries (Belgium, Finland, France[9] and Germany), stressed countries (Italy, Portugal, Slovenia and Spain) and other countries (Estonia, Lithuania, Poland). The grey area of the graph indicates the years for which the SAFE survey data was available; the rest of the years can be considered as a sort of 'out of sample' estimation. According to the data, the percentage of credit constrained firms has been always higher among stressed countries while it has been always lower for non-stressed countries.[10] Moreover, the discrepancy among the two groups has been increasing in the last period of the sample with the ICC index increasing for stressed countries since 2010 and declining instead for non-stressed countries since 2009. Similarly, also the group of "other countries" show declining percentages since 2009 with values between the other two groups.

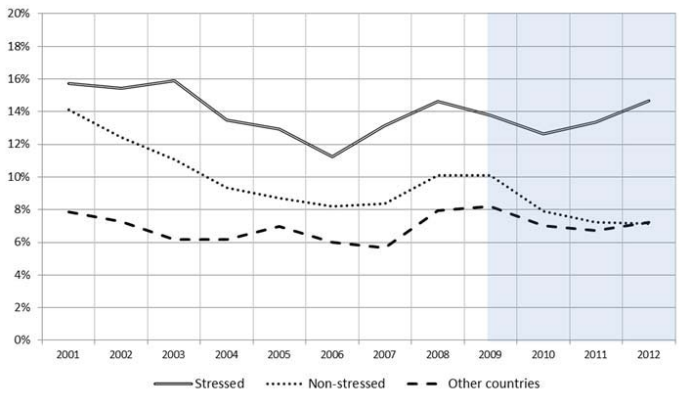
Figure 3, *Share of credit constrained firms in the economy, full sample*



[8] Note that not every country provided a complete time series for the indicators; averages include all the available years for each country. See the availability table in Appendix AA.2 to know which country is included in every year.
[9] Only for the 20E sample.
[10] Partly this is due to the weights but it also depends to the financial conditions of firms. For this reason a second measure of financial constraints based on financial ratios has been constructed (see section 3.2).

The developments of the index are confirmed when it refers to the weighted sample with medium to large enterprises (**Figure 4**).

Figure 4, *Share of credit constrained firms in the economy, 20E sample*



This size-effect is more evident when we consider the ICC index across firm sizes. **Figure 5** considers the two CompNet samples. On the left-hand side we have 5 size classes, while on the right-hand side the weighted sample has 3 size classes. In both samples as firm size is increasing the percentage of constrained firms is declining. The shaded area refers from now on (if not differently specified) to the crisis period.

Figure 5, *Share of credit constrained firms by size class, in the full (left) and 20E (right) sample*

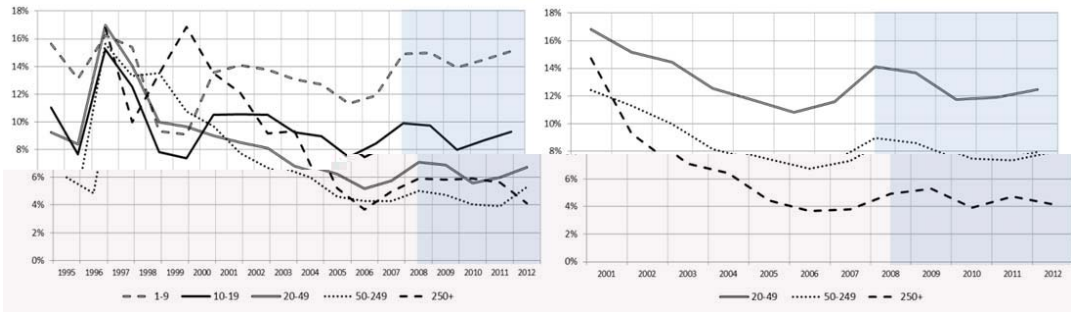


Figure 6 focuses on the ICC index across macro sectors. Here instead of the developments over time we average the years before the crisis (2001-2008) in what we called the "pre-crisis period" and the years of the crisis (2009-2012).

We call the collapse of the two categories the Investment and Financing Indicator (IFC Indicator). The results of the IFC indicator estimation are shown in the charts below.[13] **Figure 7**, left panel, shows the percentage of firms in the IFC Indicator at the country level before and after 2009. In most countries, the percentages have increased after the crisis with the exception of Lithuania where it appears that they have declined. In Germany, Italy and Slovenia the average percentages between the two periods are almost the same. One major difference with respect to the ICC is given by the relatively high percentage of Finnish companies in the IFC Index. This is quite different from the results obtained with the ICC, where Finland is among those countries with very low percentages of credit constrained firms. The same type of discrepancy is found by Ferrando and Ruggieri (2015) and also in their case it seems that the financial conditions of Finnish firms would point to much higher financial constraints than those reported by the survey. The right panel of **Figure 7** displays the index only for the sample of companies with at least 20 employees, for which the percentages are generally lower (in particular in Spain, Hungary and Estonia) than in the case when all firms are included in the analysis.

Figure 7, *IFC Indicator before and after 2009 in the full (left) and 20E (right) sample*

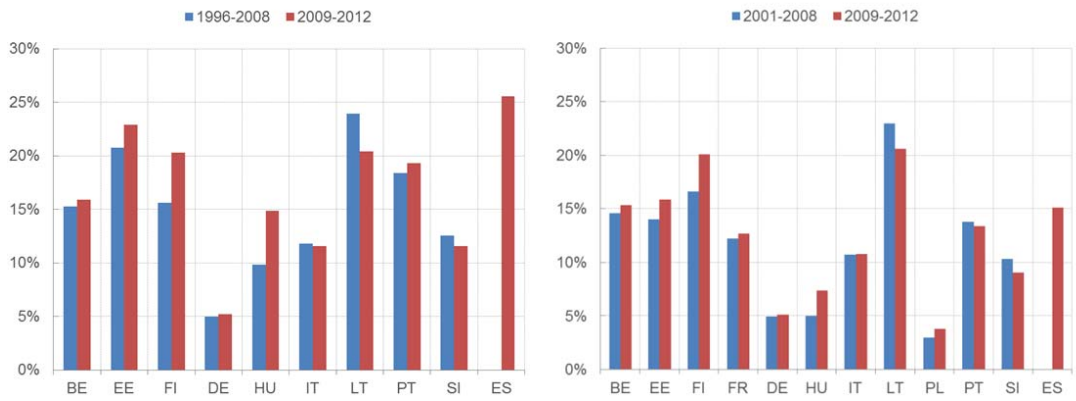


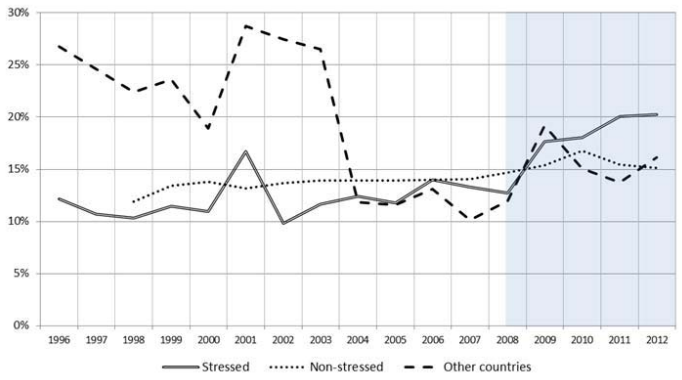
Figure 8 refers to the full sample and the three plotted lines represent the IFC index in the economy for non-stressed countries (Belgium, Finland and Germany), stressed countries (Italy, Portugal, Slovenia and Spain (from 2009 only)) and transition economies (Estonia, Hungary and Lithuania). The grey area indicates the crisis period.

A general caveat should apply here as in the previous indicators due to the fact that not all countries are present at the same time. However, if we consider the period just before the crisis (from 2007 where only Spain is missing[14]) we can see a persistent increase of the percentages of the financially fragile firms in countries under stress and a more moderate developments in the other two groups. Before that date, the strong increase and subsequent drop for the 'other' countries is mainly related to

[13] Note that not every country provided a complete time series needed for the calculation of the indicators; averages include all the available years for each country. See the availability table in Appendix A.2.for the availability of countries by year.
[14] The series starts for Spain in 2009 when official data for leverage is available.

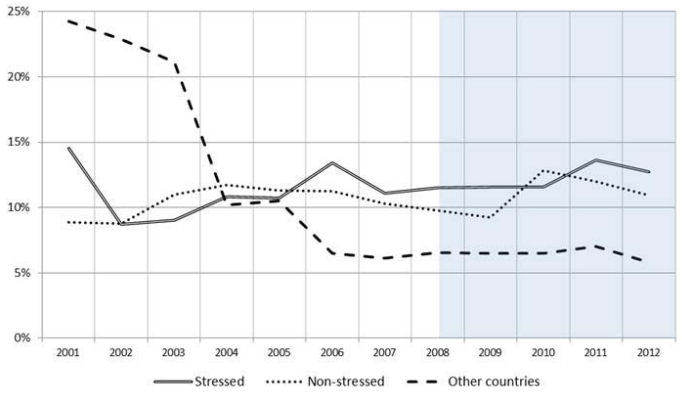
developments in Lithuania (which entered the CompNet sample in 2001 recording 34% of financially fragile firms and showed a decline to 20% in 2004). Finnish data, instead, heavily influence the time development of the non-stressed countries, given their relatively high percentages of investment constrained firms as derived from the IFC index.

Figure 8, *IFC index across groups of countries, full sample*



In the sample of large companies, two more countries are considered: France among the non-stressed and Poland among the group of other countries. **Figure 9** below presents the results on the 20E sample; the grey area is the crisis period. The differences among stressed and non-stressed countries (all euro area countries) are smaller over time. Among non-stressed countries, Finnish companies should have been quite constrained, in particular in 2010 following the "a-priori" classification.

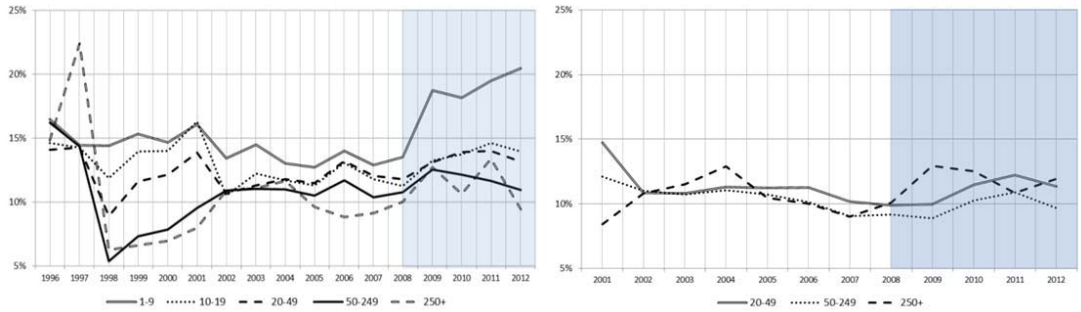
Figure 9, *IFC index across groups of countries, 20E sample*



Differently from the ICC Indicator, the IFC index reports firms which are mostly financially fragile: hence we cannot exploit the information on whether they indeed applied for external funds and whether they have been objectively rejected. Furthermore we cannot control for interactions between the financial position of firms and other characteristics detected in the literature to signal financial constraints, such as size or structural differences related to the economic sector. Looking at the results across firm size, the indicator confirms that smaller-sized firms, in particular micro firms, are more

constrained in their sources of external funds (**Figure 10**) and this divergence has increased since 2008 (grey area indicates crisis period). The differences in the figure between the two samples, even among the same size classes, arises from the different composition in terms of countries and from the weights applied to the 20E sample (see Lopez-Garcia, di Mauro et al, 2015).

Figure 10, *IFC index by size class, in the full (left) and 20E (right) sample*



Finally, we also report results for the indicator by macro sectors for the two different samples (**Figure 11**). Two main conclusions can be drawn from the simple descriptive analysis. First, when looking at the overall sample, the figures indicates that there were no major differences across sectors in the period between 2001 and 2008, with the percentage of investment constrained firms being the highest in the accommodation sector (16%) and the lowest in manufacturing (11%). However, these differences have accentuated in the period after the crisis: considering the accommodation sector and manufacturing, the difference between the two sectors reached 8 percentages points (24% and 16%, respectively). Second, looking at the two samples together, size seems to matter more to explain the increase of fragile firms after 2009 as no major differences are discernible in the sample of large companies between the two time periods.

Figure 11, *IFC index by macro sector, in the full (left) and 20E (right) sample*

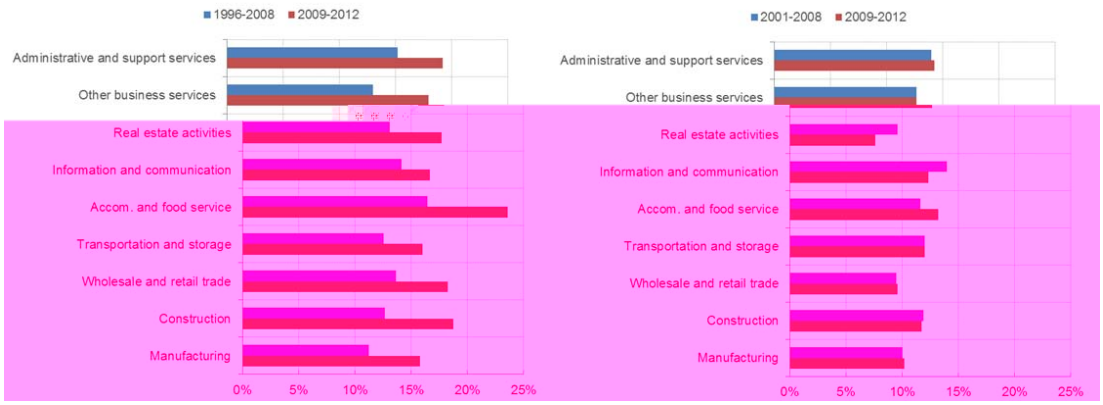
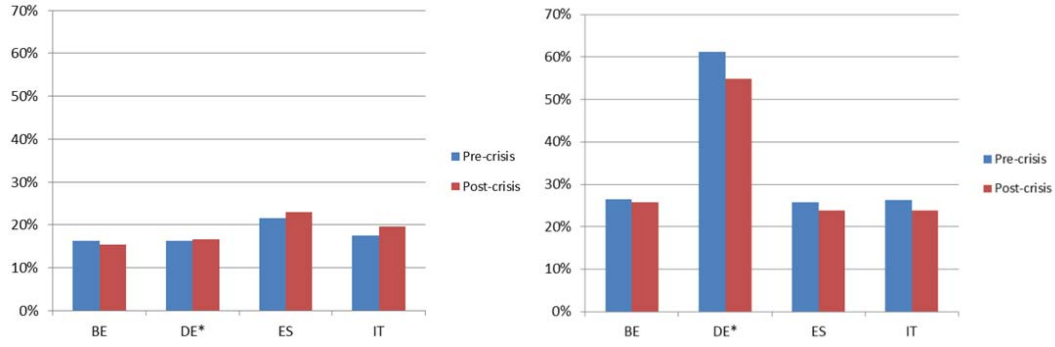


Figure 74, *Leverage by country in BACH (left) and CompNet full sample (right)*[45]



In the next set of figures, by macro sector, the difference in levels emerges again.

Figure 75, *Invest ratio by macro sectors in BACH (left) and CompNet full sample (right)*

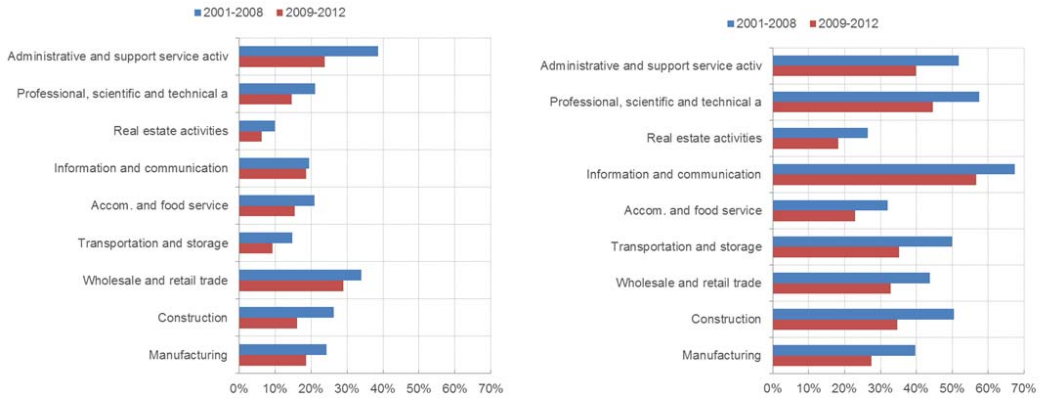
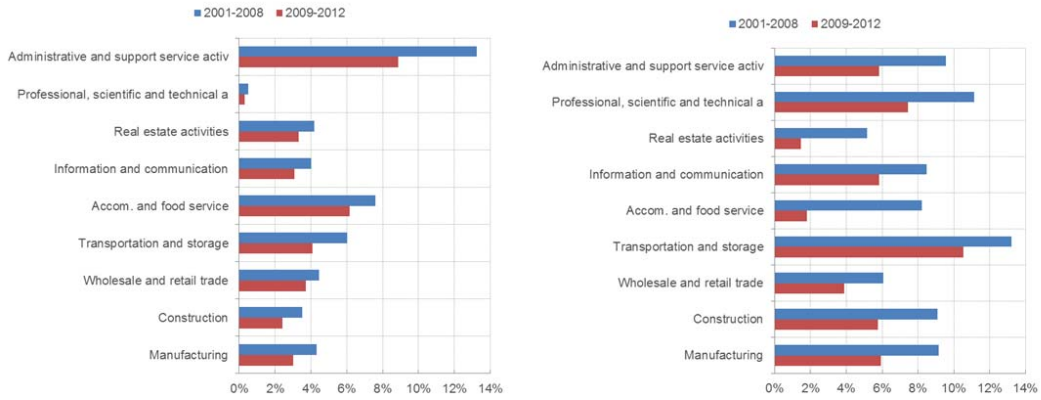
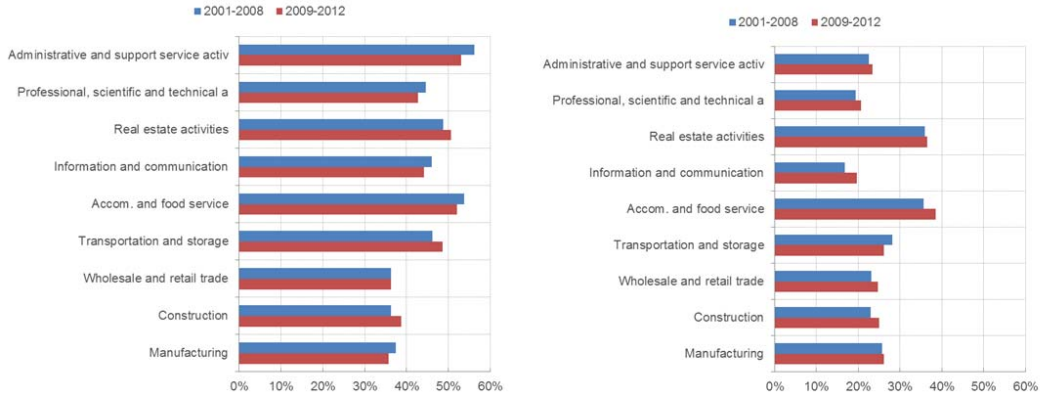


Figure 76, *Cash flow over TA by macro sectors in BACH (left) and CompNet full sample (right)*



[45] The countries with an asterisk after their names use the alternative definition of debt (see paragraph A.1.1).

Figure 77, *Leverage without DE and SI by macro sector in BACH (left) and CompNet full sample (right)*



The last part of the comparison, the one by size class, is not shown here because of a different definition in size classes among the two datasets: BACH selects small and large firms depending on their turnover; CompNet uses instead the number of employees.

A.4. *Additional analyses of firms' financial characteristics*

In this section, we provide some additional figures and comments to extend and complement the analyses presented in Chapter 4.

A.4.1. Financial position of firms related to their productivity

This subsection will link indicators on the financial position of firms to their relative position in the productivity distribution. This is one of the most interesting features of the CompNet dataset, which contains information on different moments of the distribution of specific variables for firms in a certain percentile of another variable's distribution. More precisely, the dataset contains the median values of the financial indicators included in **Table 12** for each decile of the distribution of the following variables: number of employees, labour costs, labour productivity, capital intensity, real capital, real value added, total factor productivity and unit labour costs.

Table 12, *Financial indicators in the joint distributions*

Type of indicator	Indicator
Performance indicators	Investment ratio: change in the stock of fixed capital
	Return on Assets
Structure of external funding	Equity over debt
	Debt over total assets
Financial fragility	Interest payments burden: interest paid over total assets
Financial	Financing gap: total investment minus cash flow, over

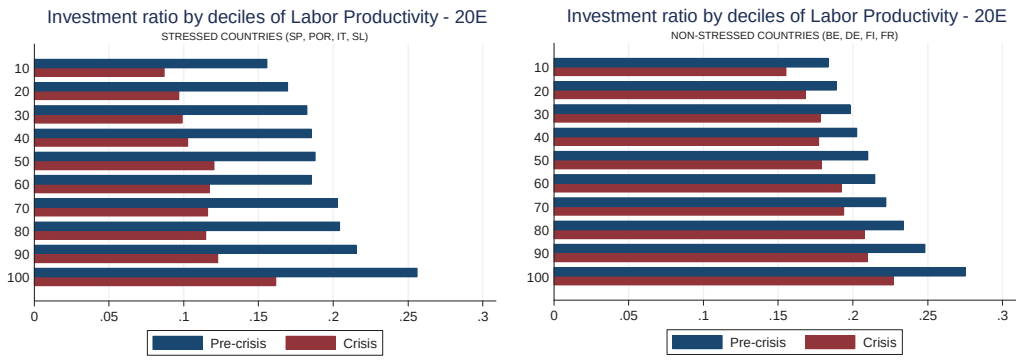
independence	turnover
Other financial indicators	Cash holdings: Cash and cash equivalents over total assets
	Collateral: fixed assets over total assets
Credit constraints indicators	Indicator of financial constraints (FR indicator)
	Indicator of credit constraints (ICC indicator)

Due to the wealth of available indicators on financial characteristics and richness of productivity distributions to which they can be linked, this section will only provide a snapshot of the available results for two of the most important indicators: the investment ratio and the ICC. It should be recalled that analyses can be made using the two different datasets, the one containing firms of all sizes with respect to the number of employees (full sample) and the other one containing firms with 20 or more employees (20E sample). In section 4.5 we presented the analysis based on the 20E sample.

A.4.2. Investment and TFP Labour Productivity

In addition to the results in Paragraph 4.5, here we show a supplementary analysis using a productivity measure different from the TFP: Labour Productivity. In **Figure 78** investment ratio is spread over the labour productivity for firms in the 20E. As in Paragraph 4.5, the impact of the crisis on the investment ratio was very strong for stressed countries, while non-stressed economies managed to maintain the level of their investment high also during the crisis. Using this productivity definition, the positive relation of investment and productivity is much more straightforward. The accumulation of new fixed capital and the dismissal of old assets reflect much more on the company's productivity when it is calculated as workers' productivity.

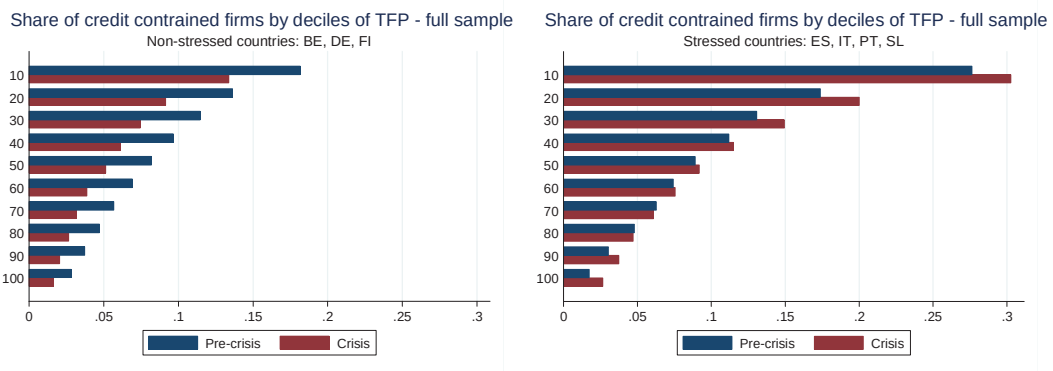
Figure 78, *Investment ratio by deciles of TFP for stressed (left) and non-stressed (right) economies, 20E sample*



A.4.3. Credit Constraints Indicators

In this subsection we present a graphical comparison (**Figure 79**) between stressed and non-stressed countries, distributed over their productivity analysing the pre- and post-crisis periods. These results are now contrasted with the ones from the 20E sample (**Figure 12**) including only firms with more than 20 employees. In the full sample, there is a clear 'ranking' across firms: the more productive (measured in terms of the decile of the TFP distribution they belong to), the less credit constrained. This holds true for the stressed as well as for the non-stressed countries, though differences are even more pronounced across the stressed ones. This indicates that it was especially the small firms who suffered (and in some countries still suffer) from being denied proper access to the credit market, as is consistent with anecdotal evidence

Figure 79, *Share of credit constrained firms (ICC) in the different deciles of the distribution of TFP. Full sample. Non-stressed countries (left) and stressed countries (right).*



Findings for the ICC presented so far are contrasted with the ones using the IFC index. Results for the 20E sample (**Figure 80**) look rather different in comparison with the ICC, as the IFC index yields similar results for both country groups (firms in non-stressed countries seem to be even slightly more credit-constrained). However, one note of caution has to be given as the pre-crisis values for Spain could not be calculated due to a lack in data availability. In addition, when switching to the sample including all firm sizes (**Figure 81**), results are again in line with those found for the ICC, with firms becoming increasingly less credit constrained the more productive they are.

Figure 80, *Share of financially constrained firms (IFC Index) in the different deciles of the distribution of TFP. 20E sample. Non-stressed countries (left) and stressed countries (right).*

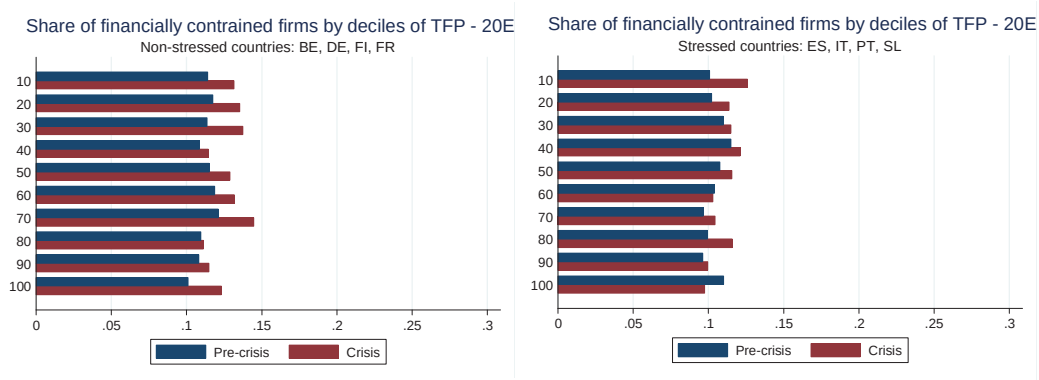
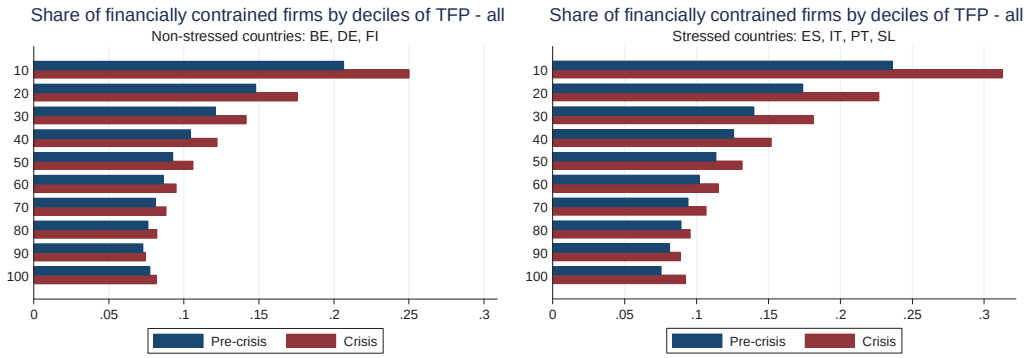


Figure 81, *Share of financially constrained firms (IFC Index) in the different deciles of the distribution of TFP. Full sample. Non-stressed countries (left) and stressed countries (right).*



Competitiveness Research Network

This paper presents research conducted within the Competitiveness Research Network (CompNet). The network is composed of economists from the European System of Central Banks (ESCB) - i.e. the 29 national central banks of the European Union (EU) and the European Central Bank – a number of international organisations (World Bank, OECD, EU Commission) universities and think-tanks, as well as a number of non-European Central Banks (Argentina and Peru) and organisations (US International Trade Commission). The objective of CompNet is to develop a more consistent analytical framework for assessing competitiveness, one which allows for a better correspondence between determinants and outcomes. The research is carried out in three workstreams: 1) Aggregate Measures of Competitiveness; 2) Firm Level; 3) Global Value Chains CompNet is chaired by Filippo di Mauro (ECB). Workstream 1 is headed by Pavlos Karadeloglou (ECB) and Konstantins Benkovskis (Bank of Latvia); workstream 2 by Antoine Berthou (Banque de France) and Paloma Lopez-Garcia (ECB); workstream 3 by João Amador (Banco de Portugal) and Frauke Skudelny (ECB). Monika Herb (ECB) is responsible for the CompNet Secretariat. The refereeing process of CompNet papers is coordinated by a team composed of Filippo di Mauro (ECB), Konstantins Benkovskis (Bank of Latvia), João Amador (Banco de Portugal), Vincent Vicard (Banque de France) and Martina Lawless (Central Bank of Ireland). The paper is released in order to make the research of CompNet generally available, in preliminary form, to encourage comments and suggestions prior to final publication. The views expressed in the paper are the ones of the author(s) and do not necessarily reflect those of the ECB, the ESCB, and of other organisations associated with the Network.

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