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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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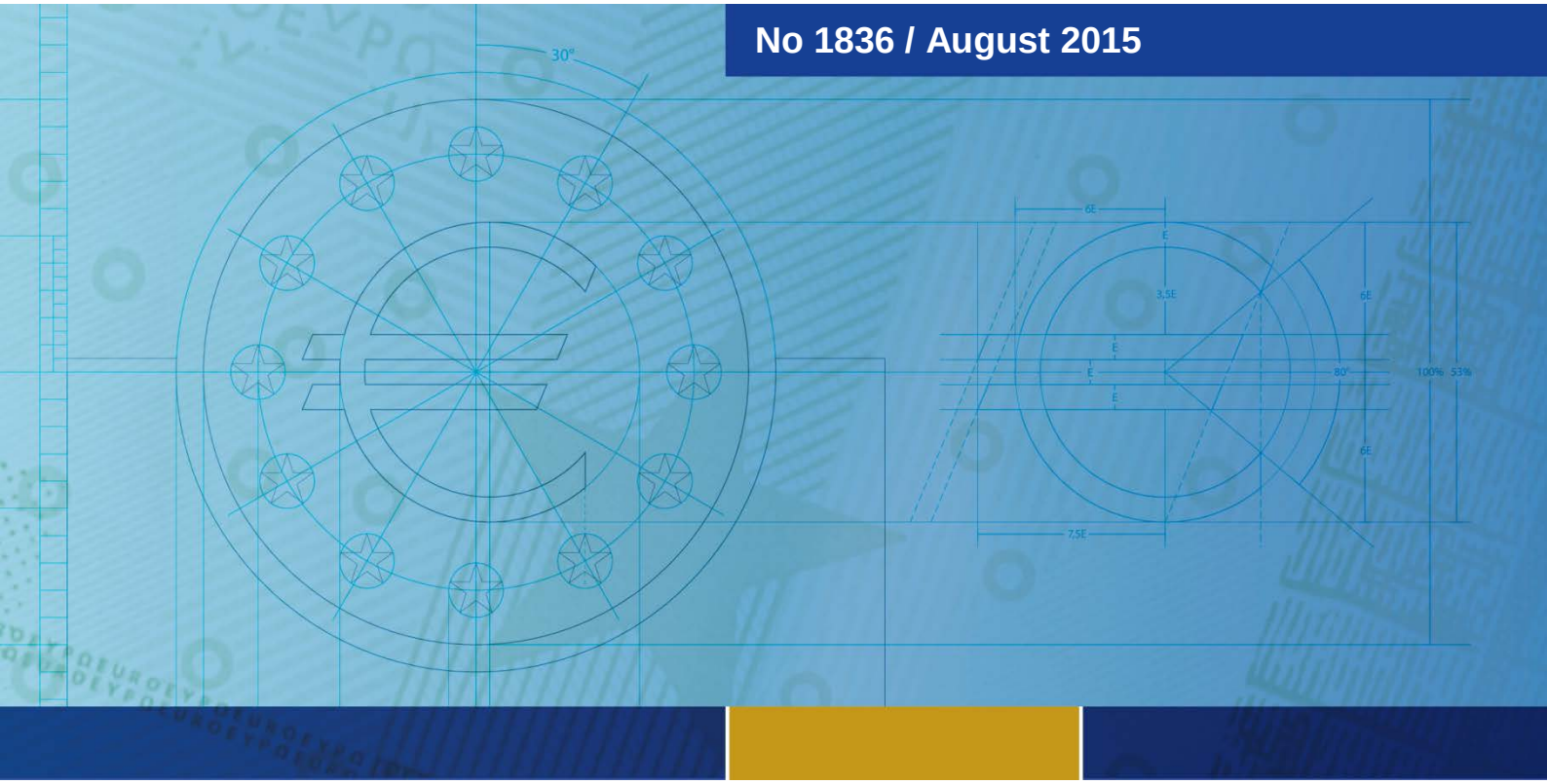

Abstract. This paper provides an encompassing description of the various indicators compiled in the financial module of CompNet using balance sheet information of European firms. We investigate whether and to which extent the heterogeneous financial positions of firms have affected firms' investment 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	✓	✓
	Profit margin: EBIT over turnover		
	Return on Assets	✓	✓
Structure of external funding	Equity over debt	✓	✓
	Equity over total assets		
	Debt over total assets	✓	✓
	Trade credit: accounts payable over total assets		
Financial fragility	Interest payments burden: interest paid over total assets		✓
	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	✓	✓
Other financial indicators	Cash and cash equivalents over total assets	✓	✓
	Collateral: fixed assets over total assets	✓	✓
	Depreciation rate over total assets		
	Trade debt: accounts receivable over total assets		
Credit/investment constraints indicators	Indicator of investment constraints (FR indicator)	-	✓
	Indicator of financial constraints (ICC indicator)	-	✓

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.

3. Indicators of financial constraints at the firm level

Financial constraints are not readily observable empirically. As there are no specific items on the balance sheet of firms that could tell whether a firm is financially constrained, several avenues have been suggested in the literature to allow for the identification and measurement of financial constraints (See Silva and Carreira, 2012, for a survey.). In the CompNet database, we apply two different approaches to calculate the percentages of financially constrained firms across countries over time. The first approach is to exploit the information derived from a survey on financing constraints and to link it with the financial characteristics of firms. This is the ICC (Indicator of Credit Constraints) indicator. The second approach is a more traditional one. We create an indicator of financial fragility based on the financial conditions of firms using an "a-priori" classification scheme based on information from the balance sheet and profit and loss account. This is the IFC Indicator (Ferrando and Ruggieri, 2015). Both indicators of credit constraints provide an approximation of the share of firms that are credit and investment constrained in the economy. Moreover, using the information derived from the joint distribution, it is possible to analyse a variety of firms' characteristics for the two subsets of constrained and non-constrained firms (see an example in paragraph 3.3).

3.1. Credit constrained firms: the ICC indicator

The Indicator of Credit Constraints (ICC indicator) defines firms that can be considered credit constrained using information derived on their financial situation. The analysis is based on a novel dataset from the European Central Bank, which matches firms that participated in the Survey on Access to Finance of Enterprises (SAFE) with their financial statements from the second quarter of 2010 till the first quarter of 2013 (i.e. from wave 3 of SAFE till wave 8). The ECB's SAFE[3] covers micro, small, medium-sized and large firms, and it provides evidence across branches of economic activity, euro area countries, firm age, financial autonomy of the firms, and ownership of the firms. The database containing the answers of the SAFE has been matched (using the tax identification code) with the Bureau van Dijk Amadeus dataset, which includes information on the balance sheet and profit and loss accounts. For the econometric analysis we used data for the following countries: Belgium, Germany, Spain, France, Italy, Portugal and Finland.

The construction of the index is based on several steps. The first step is the estimation of the equation which will be used in order to rank the firms according to their probability of being credit constrained or not. This is done on the novel dataset mentioned above. Then, a threshold is obtained using the

[3] https://www.ecb.europa.eu/stats/money/surveys/sme/html/index.en.html.

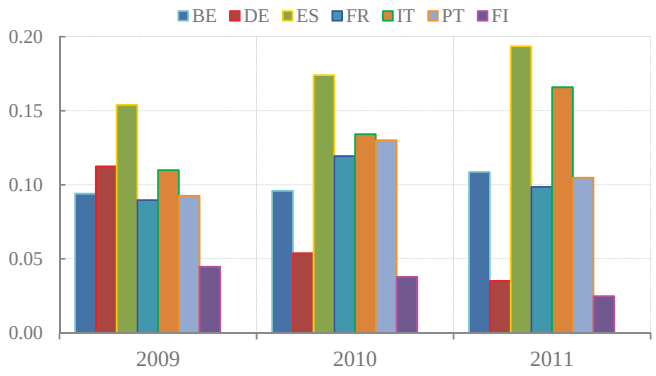
exogenous averages of credit constrained firms by country, taken from the SAFE. This second step is performed directly on the CompNet dataset.

Using the answers from the SAFE, constrained firms are defined as those:

- reporting loan applications which were rejected,
- reporting loan applications for which only a limited amount was granted,
- reporting loan applications which were rejected by the firms because the borrowing costs were too high,
- which did not apply for a loan for fear of rejection (i.e. discouraged borrowers).

This indicator is regularly used by the ECB for policy purposes. All the firms belonging to one of the above groups are flagged as 'credit constrained' and a dummy variable is created (1 if a firm is credit constrained; 0 otherwise). **Figure 1** shows the share of credit constrained firms in the countries available for the analysis, i.e. the ones used for the estimation of the ICC index.

Figure 1, *Share of credit constrained firms (in percentages of all firms)*



Source: ECB SAFE.

We estimate the probability of firms to encounter financing obstacles as a function of their financial situation. In particular, we consider financial leverage, financial pressure, profit margin, collateral, cash holdings[4], and we control for other possible determinants like time, sector and country-specific effects as well as the size of the firm. The probit model is defined as follows:

$$Prob\,(credit\_constraint) = \alpha + \beta_1 \cdot finlev + \beta_2 \cdot ifp + \beta_3 \cdot profitmargin + \beta_4 \cdot collateral + \beta_5 \cdot cash\_holdings + \\ + \beta_6 \cdot lnTA + \gamma \cdot control\ var + \varepsilon$$

[4] These variables are the most commonly used in the literature when explaining the determinants of financial constraints. See, for a review of the literature and for a previous example of the use of these variables to explain survey-based indicators of financing obstacles, Ferrando and Mulier (2013) *"Firms' Financing Constraints: Do Perceptions Match the Actual Situation?"*, ECB WP n.1577.

where *financial leverage* is a ratio of financial debt over total assets and indicates how much the firm is indebted.[5] The expected relation between leverage and financing constraint is positive as a high level of debt on the balance sheet might make it difficult or costly for the firm to find new debt; *ipf* is the index of financial pressure and it is computed as a ratio between interests payments and the sum of profits and depreciation (if the ratio is high, a firm is already paying a significant amount of interest, either because it is too indebted or it is paying a high interest rate on the existing debt; in both cases, banks will probably be more reluctant to grant credit to it). *Profit margin* is calculated as operating profits/losses over turnover: when the value is high, firms should have a higher probability to obtain credit as high profitability increases the likelihood that they will be able to repay their loans. *Collateral* is the ratio between fixed assets and total assets. When the value is high, firms should have a higher probability to obtain credit as collateral serves as protection for a lender against a borrower's default. *Cash holdings*, computed as cash and cash equivalents over total assets, represents the liquidity position of firms and higher amounts of cash increase the probability to obtain credit. We consider also the logarithm of total assets (*lnTA*) which is used as a proxy for the size of the firm. Our set of control variables includes: sectoral dummies, country dummies, and time dummies. All errors are robust. **Table 2** presents some descriptive statistics of the sample used for the analysis.

Table 2, *Descriptive statistics of the sample used for the estimation of the ICC*

Variable	*N*	*Mean*	*Std. Dev.*	*Min*	*Max*
Employment	42890	125.496	1541.235	1	250000
Listed	42895	0.041	0.199	0	1
Financing problems	30543	0.167	0.373	0	1
Index of financial pressure	22406	0.366	0.476	0	2.417
Profit margin	22967	0.004	0.114	-0.593	0.336
Financial leverage	27588	0.219	0.230	0	0.946
Collateral	31763	0.246	0.231	0	0.917
Cash holdings	31220	0.132	0.169	0	0.785
Logarithm of total assets	32406	7.617	2.072	0	17.900

Table 3 reports the results of the estimation. The financial indicators are strongly significant and with the expected signs, indicating that they indeed play a role into the decision of a bank to grant credit or not. Also the size of a firm, approximated by the logarithm of total assets, is statistically significant. The pseudo R^2 (10%) is in line with other analyses obtained using the survey-based dataset.

[5] We use two different definitions of debt due to the different availability of data across countries in the CompNet database. A first definition applies to all countries except for Germany and Slovenia, for which a second definition is used. See Appendix AA.1.1 for detailed description.

Table 3, *Probit regression results (SE in parentheses)*

Variables	***Credit_constrained***
Financial leverage	0.7060*** (0.0617)
IFP	0.2845*** (0.0281)
Profit margin	-0.5088*** (0.1229)
Collateral	-0.2141*** (0.0662)
Cash holdings	-1.2030*** (0.1459)
Logarithm of total assets	-0.0455*** (0.0074)
Controls	macro sector, country, time (wave)
N	17710

The coefficients of the estimated probit, which cannot be interpreted directly, can be used to compute the predicted SAFE score. This is a score defined at the firm level, which varies across time. Again, this score cannot be directly interpreted but can be used in order to rank firms, from the less to the more financially distressed. Based on the estimated coefficients of the probit analysis, the SAFE score is defined as:

$$SAFE_{score} = -1.88 + 0.71 \cdot finlev + 0.28 \cdot ifp - 0.51 \cdot profitmargin - 0.21 \cdot collateral - 1.20 \cdot cash_{holdings} - \\ -0.05 \cdot lnTA$$

A second probit regression, with the same specification of the one above, is run using the alternative definition of debt. The results are similar to the previous ones, except for the effect of the collateral which appears to be insignificant. **Table 4** below reports the results of the estimation.

Table 4, *Probit regression results (with the alternative definition of debt, SE in parentheses)*

Variables	***Credit_constrained***
Financial leverage	0.5058*** (0.0554)
IFP	0.3149*** (0.0279)
Profit margin	-0.2230* (0.1280)
Collateral	-0.0853 (0.0649)
Cash holdings	-1.2619*** (0.1474)
Logarithm of total assets	-0.0228*** (0.0077)
Controls	macro sector, country, time (wave)
N	17694

Finally, a second SAFE score is computed with the coefficients of the regression above and it is used, instead of the one calculated first, only for the countries adopting the alternative definition of debt.

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)*

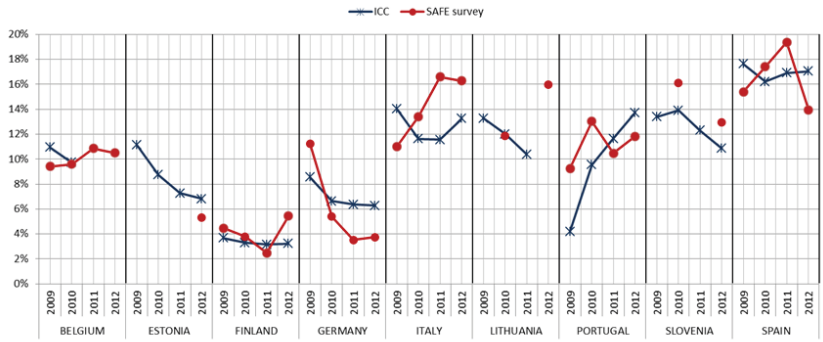
Country	*Credit_constrained*
BE	10.0%
DE	6.7%
ES	17.4%
FI	3.6%
FR	10.3%
IT	13.7%
PT	10.9%

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.

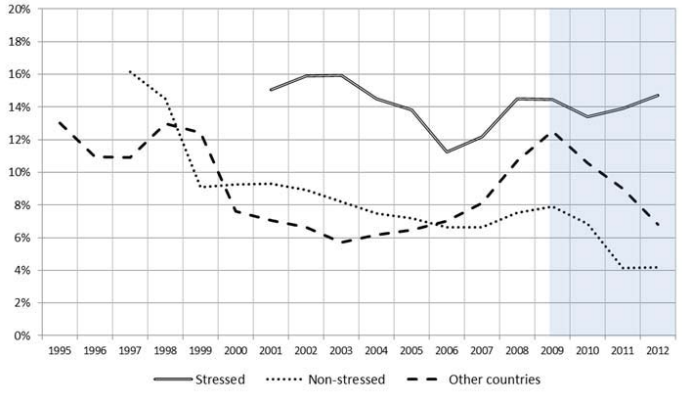
Figure 2, *Share of constrained firms by country: ICC (full sample) vs. SAFE survey*



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.

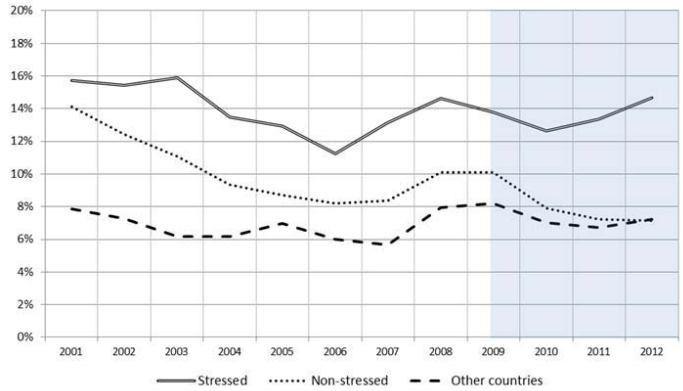
Figure 3, *Share of credit constrained firms in the economy, full sample*



[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*

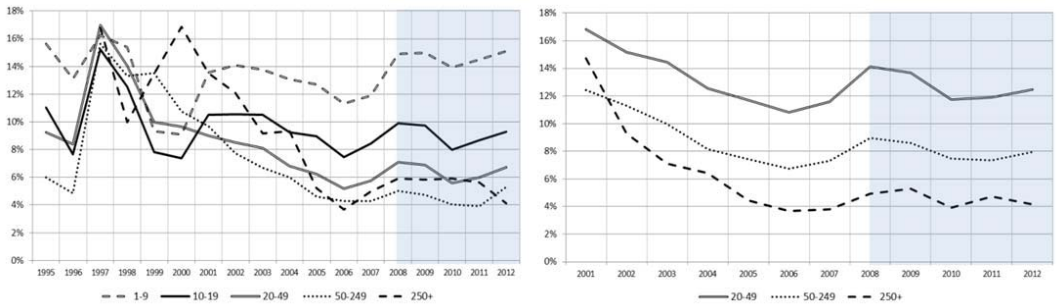
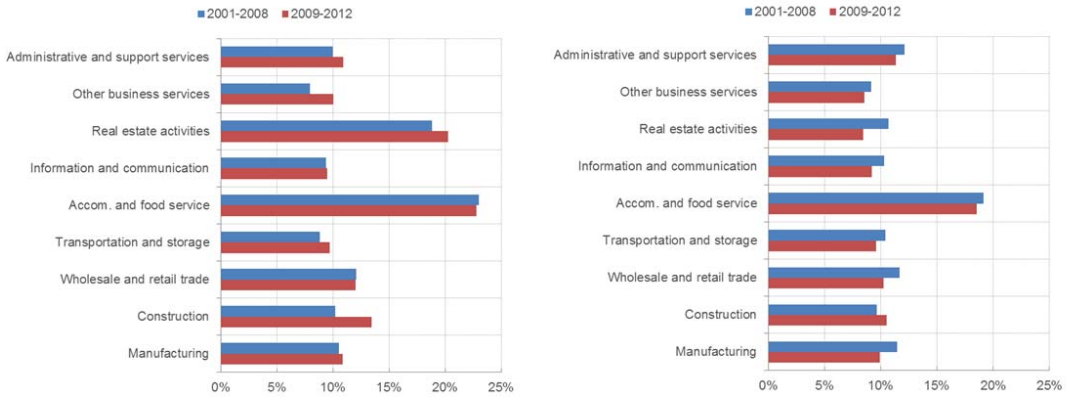


Figure 6 focuses on the ICC index across macro sectors. Here instead of the developments over time we average the years before the crisis (2001-2008) in what we called the "pre-crisis period" and the years of the crisis (2009-2012).

Figure 6, *Share of credit constrained firms by macro sector, in the full (left) and 20E (right) sample*



According to the figure above, the percentage of credit constrained firms is relatively higher in the Accommodation and food services sector and in the real estate activities in the full sample (left panel of **Figure 6**). Looking at the sample with larger firms (right panel of **Figure 6**) the differences across sectors are much smaller. Furthermore, while in the case of the full sample there is evidence that financial constraints have increased after 2008, this is not true for the 20E sample.

3.2. Investment and financing conditions of firms: the IFC indicator

The second indicator constructed to detect whether firms are affected by financial restrictions when planning their investments is closely related to the strand of the economic literature that suggests using "a-priori classifications" of being constrained, based on firms' financial conditions. For the CompNet database we revised the approach of Ferrando and Ruggieri (2015)[11] and we applied the revised classification scheme at the firm level. The advantage of the classification is that it takes into consideration a set of variables derived from balance sheet and profit and loss accounts and their interrelations within some investment/financing scenarios. According to the various scenarios, we are able to attach to each firm a different degree of financial constraints, which varies over time. This classification allows us to overcome the usual criticism found in the literature related to the choice of single a-priori indicators of financial constraints (Musso and Schiavo, 2008).

Table 6 reports a revised classification of the one suggested by Ferrando and Ruggieri (2015). In the table we distinguish strongly constrained, relatively constrained and unconstrained firms. Strongly constrained firms are those that cannot get external finance, relatively constrained are those that can access only expensive external sources and unconstrained firms are those that get new debt financing whenever they need it. We construct the various scenarios based on the interrelation of total investment, financing gap (defined as fixed investment plus the change in the net increase in working

[11] A similar classification was proposed by Pal and Ferrando (2010) and Vermeulen (2002).

capital minus cash flow), financial debt and issuance of new shares in the given year.[12] The underlying idea is that if firms decrease their investment and report financing surpluses, they are financially unconstrained if they are able to increase their debt and issue new shares (case 1U) or even if they are reducing their debt (case 2U). In the case that they are reporting investment plans, they do not encounter financially problems if their financing gap is still negative and financial debt is increasing (case 3U). In the last case for financially unconstrained firms, we consider firms that are investing, have a financing gap but are able to increase their debt (case 4U). Among relatively constrained firms, we group firms that are investing, and do not need to get external sources of finance as their financing gap is negative but that are still reimbursing their debt (case 1RC) or, by contrast, they have a positive financing gap and they finance their investment not through credit but through new share issuance, which is more costly due to the presence of asymmetric information (case 2RC). Finally, firms are also relatively constrained when they are liquidating their assets, they face a financing surplus but they are increasing their debt and reducing their capital (case 3RC). Among strongly constrained firms we consider mainly two cases. Case 1SC occurs when firms are investing but their total investment is higher than the current cash flow and at the same time they are reducing their debt and capital. Case 2SC considers the group of firms that, although they are disinvesting, they have a positive financing gap.

Table 6, *Classification scheme to detect financially constrained firms*

Financing conditions	*Total investment*	*Financing gap*	*Changes in total debt*	*Issuance of new shares*
		Strongly constrained (SC)		
1	≥ 0	≥ 0	≤0	≤0
2	< 0	≥ 0	-	-
		Relatively constrained(RC)		
1	≥ 0	<0	≤0	
2	≥ 0	≥ 0	≤0	>0
3	<0	<0	>0	≤0
		Unconstrained (U)		
1	<0	<0	>0	>0
2	<0	<0	≤0	-
3	≥ 0	<0	>0	-
4	≥ 0	≥0	> 0	-

Source: based on Ferrando and Ruggieri (2015)

Once firms are grouped according to the classification, the program in the financial module generates the percentage of firms that are strongly constrained out of the total sample (categories 1SC and 2SC) for the various dimensions of the database: by country, by size classes and by sector.

[12] The original classification includes also a comparison with average interest payments on debt reported at firm level relative to interest rates charged in the local credit market. Due to difficulties to define a comparable interest rate across euro area and non-euro area countries over time, it was decided to drop this additional requirement.

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*

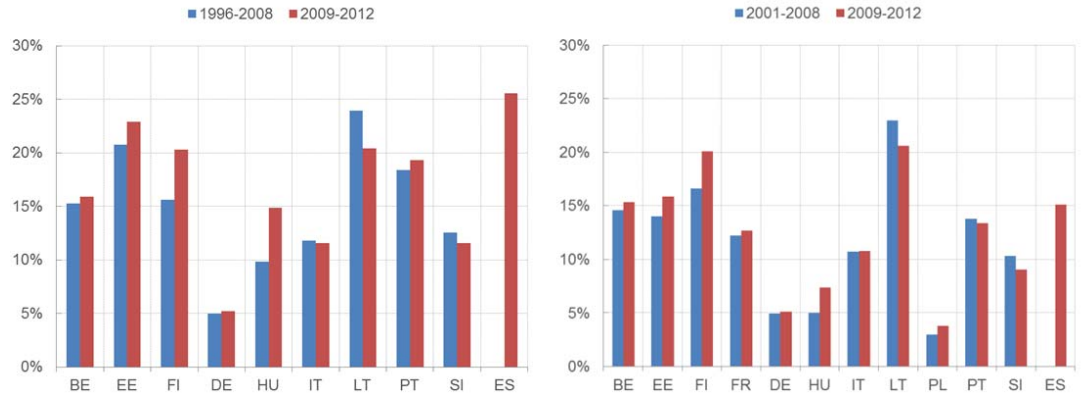


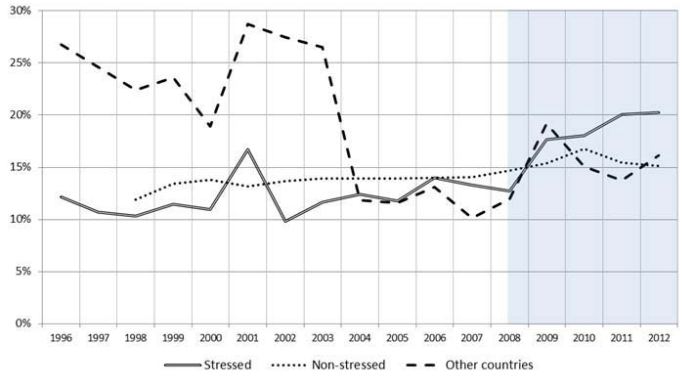
Figure 8 refers to the full sample and the three plotted lines represent the IFC index in the economy for non-stressed countries (Belgium, Finland and Germany), stressed countries (Italy, Portugal, Slovenia and Spain (from 2009 only)) and transition economies (Estonia, Hungary and Lithuania). The grey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

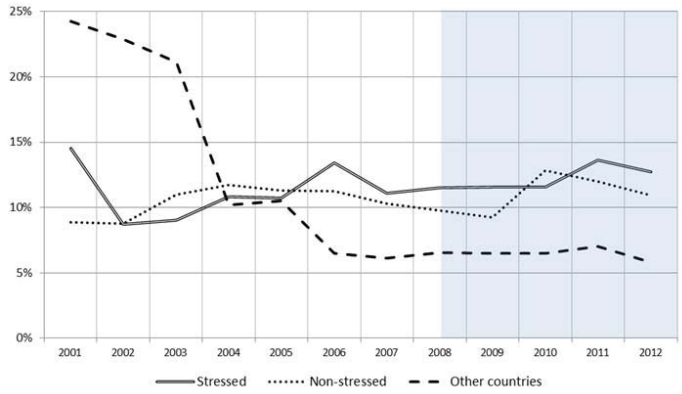
developments in Lithuania (which entered the CompNet sample in 2001 recording 34% of financially fragile firms and showed a decline to 20% in 2004). Finnish data, instead, heavily influence the time development of the non-stressed countries, given their relatively high percentages of investment constrained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

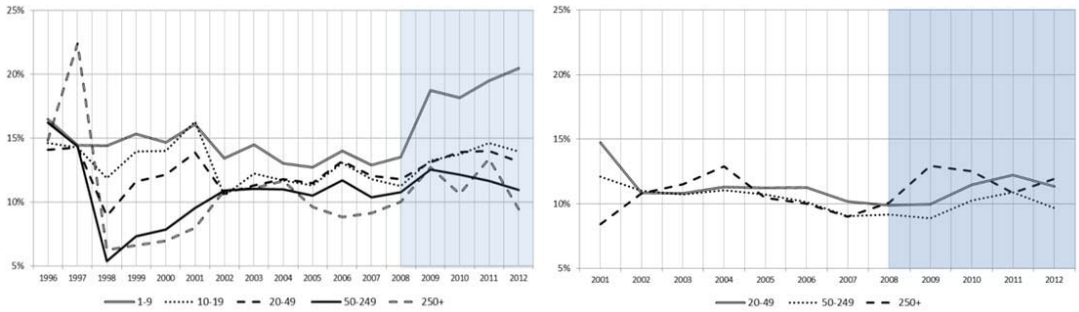
Figure 9, *IFC index across groups of countries, 20E sample*



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

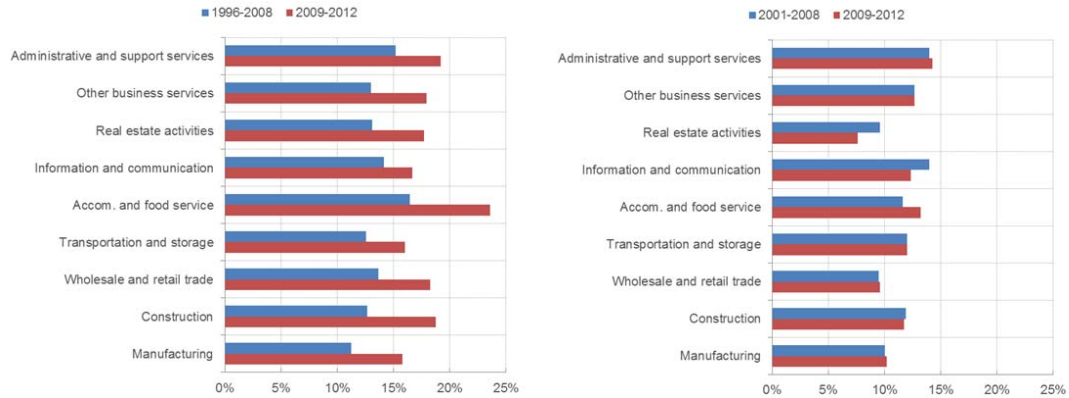
constrained in their sources of external funds (**Figure 10**) and this divergence has increased since 2008 (grey area indicates crisis period). The differences in the figure between the two samples, even among the same size classes, arises from the different composition in terms of countries and from 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*



3.3. ICC indicator and productivity

One of the most interesting features of the CompNet dataset is that it contains information on different moments of the distribution of specific variables for firms in a certain percentile of another variable's distribution. **Table 12** in Appendix **A.4.1** reports the list of financial indicators that are combined with the distribution of the productivity variables.

In this section we deal with a topic that has been hotly debated during the crisis and is still very high up on the agenda for the periphery countries – access to credit and its impact on productivity. The existence of frictions in accessing external sources of finance - for instance due to imperfect information- would significantly affect the independence of management to exploit productive investment opportunities.[15] As investment underpins growth by bringing more inputs to the production process, the resulting productivity gains are crucial for the growth of an economy.

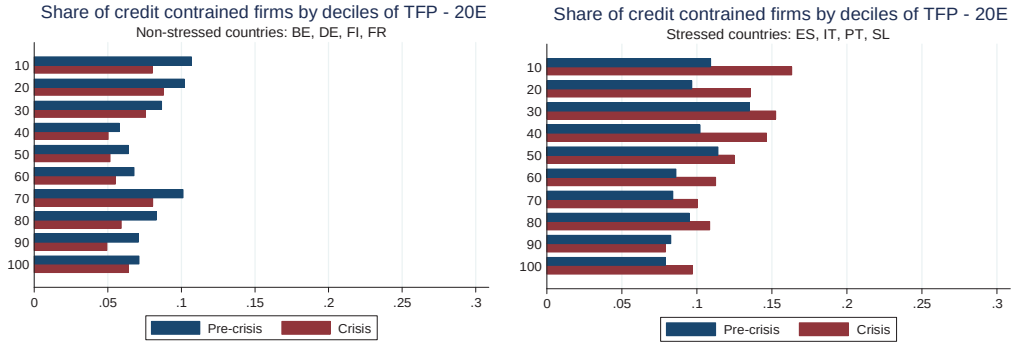
Although this is a well-known topic, from an empirical point of view only few papers have analysed the direct link between finance and productivity focusing on the firm level decision. Papers like Nunes et al (2007), Gatti and Love (2008), Moreno-Badia and Slootmaekers (2009), Chen and Guariglia (2013), using a single country framework, and A. Ferrando and A. Ruggieri (2015) using a multi-country analysis, found a negative association between financial constraints and firms' productivity across countries and sectors.

Figure 12 plots the ICC for the different TFP deciles comparing non-stressed and stressed countries for the 20-E sample and shows the diverse levels of the indicator in the periods before and after the crisis[16]. Not surprisingly, results across the two country groups are quite different. What is interesting is that they are not only different during the crisis, but also before. The share of credit-constrained firms, as predicted by the indicator, has been higher for firms in stressed countries not only during the crisis, but also already before.

When looking at the percentage of credit-constrained firms across the different deciles of the TFP distribution, one can see that in the stressed countries firms in the lower deciles (i.e. less productive firms) are more credit-constrained than firms in the upper deciles. This points at an efficient allocation of credit among firms. Looking at the results for the non-stressed countries, it is actually interesting to see that though firms in the lowest three deciles are clearly more often credit constrained than firms in the rest of the distribution, it is actually firms in the middle of the distribution that exhibit the lowest values. This might signal the presence of some non-linearities that need an additional investigation that goes beyond the scope of this paper.

[15] See Carrera and Silva (2010) for a survey of works related to financial constraints faced by firms.
[16] A similar descriptive analysis for the IFC index can be found in Appendix AA.4.3

Figure 12, *Share of credit constrained firms (ICC) in the different deciles of the distribution of TFP. 20E sample. Non-stressed countries (left) and stressed countries (right).*



4. Analysis of firms' financial characteristics using the CompNet database

The richness of the financial module in the CompNet database allows several levels of analysis from the simple descriptive analysis of the indicators along the various dimensions (country/size/sector/time) to more sophisticated empirical analysis using econometric tools. In this section we include both types of analysis. We will focus on the following topics: changes in the financial structure of European firms during the financial crisis; determinants of investment and in particular on the role played by leverage; cash management decisions of firms and determinants of firm profitability.

As the variables in the CompNet micro-based database are aggregated from firm-level sources with different dimensions (country, sector and size over time), we can run the econometric analyses at different levels of aggregation through cell-based regressions using mean (median) values as if we were handling panel data. In reality the CompNet database allows the creation of pseudo panels – hence in our analyses we overlook the questions of micro-heterogeneity within a cell and sample composition variations over time[17]. For the analysis of the determinants of investment we decided to use the lowest aggregation level available, where a "cell" is defined by a unique country/macro-sector/size class combination and observed over time. For the investment analysis we consider a more aggregated cell defined as country/macro-sector while for the cash holdings analysis we included both approaches.

[17] For a review of the pseudo-panel literature see Verbeek (2008).

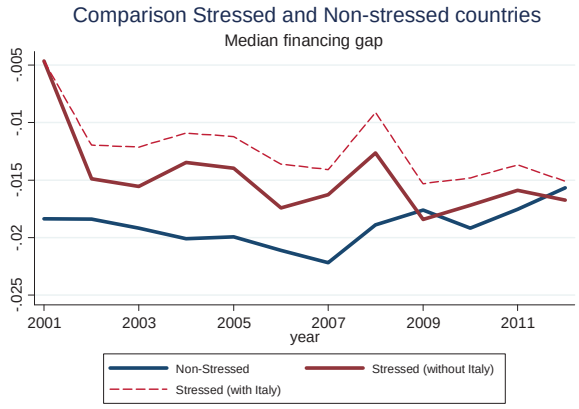
4.1. The financial structure of European firms during the crisis: an overview

In this section, we look at how the financial structure of firms has changed throughout the crisis and across different group of countries. In particular we compare the financial status of firms operating in eight European countries, some of which have undergone serious financial stress in the aftermath of the financial crisis (Italy, Portugal, Slovenia, Spain), while others have faced milder consequences in terms of credit availability and financial stability (Germany, Finland, France, Belgium). The analysis is performed by using the 20E sample.

Our aim is to understand 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. In what follows we present the median values for the most relevant indexes for stressed (red line) and non-stressed (in blue) countries over the period 2001-2012, trying to capture structural differences in the pre-crisis period (which might be responsible for a different response in financial stress after the crisis), as well as major changes in the dynamics of the same indexes after the economic downturn.

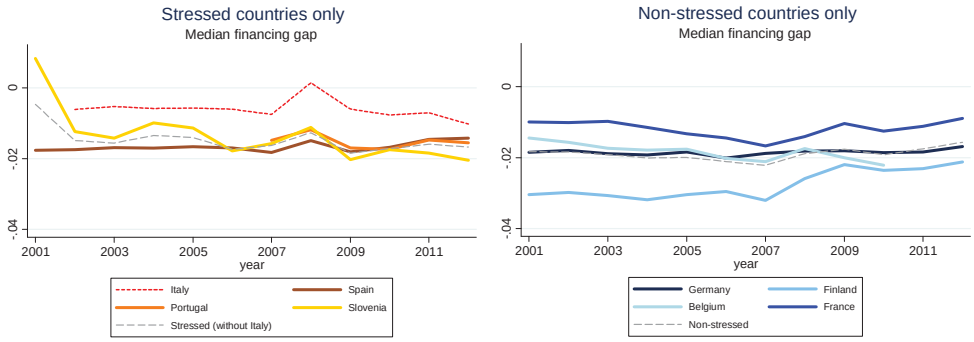
We start by analysing the financing gap (**Figure 13**), which is the difference between investment and cash flow over turnover. This is a measure of the extent of external resources needed to finance new investments: lower (often negative) values, driven by large cash flows, imply that firms mostly finance new investments through internal resources. Looking at the definition, we notice that low values of the indexes might also be driven by low new investments in a given year.

Figure 13, *Financing Gap, median values, stressed and non-stressed economies*



Over the considered period, we observe on average a higher level of financing gap for the stressed countries, implying a larger use of external resources for investment reasons[18]. The dynamics of the index, broadly declining over time, however change for the two groups of countries after the crisis. As it can be observed in **Figure 14**, where we report trends for the individual countries considered, the peak of the financing gap for stressed countries is mainly driven by Italy, although a similar pattern, albeit smaller, can be observed also for other countries. After the peak in 2008, we observe a sharp fall in the financing gap of the stressed countries, with aggregated values remaining close to -.015 after 2009; for the non-stressed countries, we observe a milder decline in the ratio before the crisis, and then a stable increase, with aggregate values converging to the level displayed by the stressed group.

Figure 14, *Financing Gap, median values, stressed and non-stressed economies, individual countries*



While looking at **Figure 13** it might seem that a beneficial convergence in financing gaps is in place in Europe, with firms aligning in their use of external resources for investment financing, these aggregate patterns might actually tell a different story. In fact, if we imagine a story of squeezing cash flows in all countries following the crisis, the result, at constant investment, would be an increase in the financing gap. If instead the increase in the use of external financial resources dictated by squeezing cash flows is not supported by the banking sector (which typically provides external resources in Europe), then investment would need to contract in order to keep the index constant after the shock.

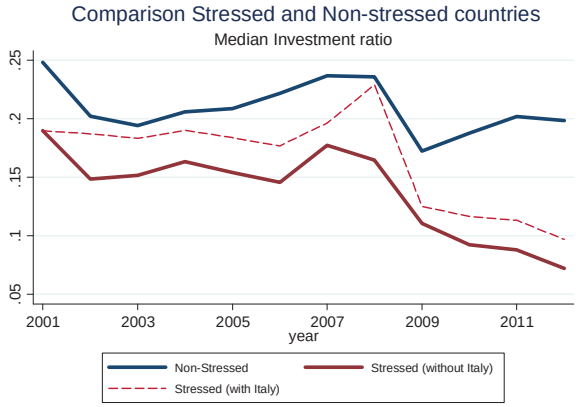
These actually seem to be the dynamics taking place in stressed versus non-stressed countries: once the crisis simultaneously squeezed cash flows during 2008, in all countries the index nudged forward, as investment decisions typically react with a delay to a financial shock. However, while external financial conditions in non-stressed countries supported the increase in the financing gap (i.e. investment remained constant with respect to squeezing cash flows), in the stressed countries the financing gap was already higher, while the banking sector was progressively cut out of international

[18] Italy is plotted in a separate line because of a break in the time series of investment ratio in 2008, due to a change in the accounting framework. Further information below, featured in the analysis of the investment ratio.

liquidity. Hence, after the shock and the upward spike, investment needed to contract, to maintain the financing gap sustainable over time.

This intuition is confirmed observing the investment ratio, showing the growth in investment net of depreciation. As it can be seen in **Figure 15**, prior to the crisis the gap in investment between the two groups of countries is gradually reducing. Not surprisingly, the economic downturn led to a sharp common decline in investments across stressed and non-stressed countries, due to the large reduction in demand and uncertainty in future revenues. Incidentally, note how the contraction of investment takes place in 2009, i.e. with a certain (expected) delay after the initial shock. After the shock, then, the two groups of countries start to diverge dramatically in terms of investment ratios, in line with the narrative on financing gaps previously reported. The peak in investment in stressed country is mainly due to Italy where the introduction of a new depreciation reform[19] produced a large increase in investment rates, especially in some service sectors (in particular small-medium sized computer companies).

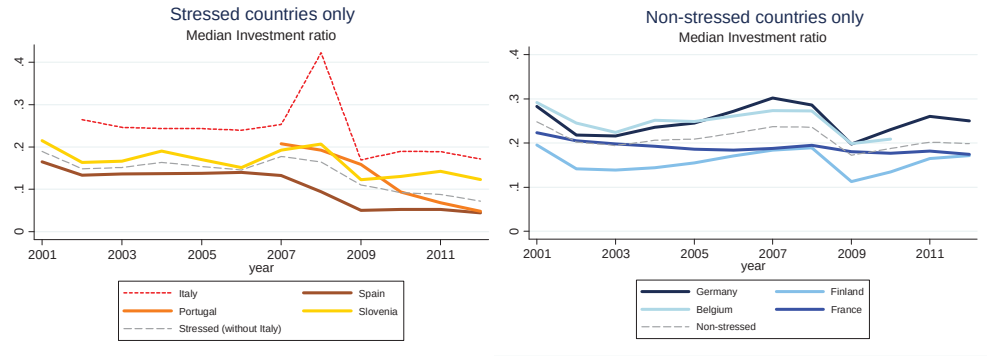
Figure 15, *Investment ratio, median values, stressed and non-stressed economies*



These dynamics also holds also when looking at the individual economies, as reported in **Figure 16**: while in non-stressed countries investment started to rise quickly after the 2009 shock, although not to the pre-crisis level, the ratio for stressed economies, which faced a much more dramatic fall in investment, never recovered in the subsequent years.

[19] Finance Law for 2008 n. 244 of 24th of Dec. 2007 - Chap. V - abolition of accelerated depreciation.

Figure 16, *Investment ratio, median values, stressed and non-stressed economies, individual countries*

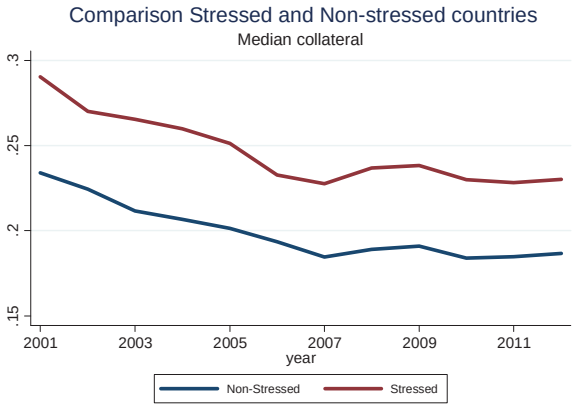


Insofar we have attributed the prolonged depression of investment in stressed countries to a lack of available external financing, i.e. essentially a credit-crunch and therefore supply-side argument. According to this argument, the fall in investment stems from financing institutions having difficulty to provide additional finance against a collateral that might be insufficient, and thus, since the necessary raise in the financing gap induced by the contraction in cash flows cannot take place, investment has to adjust on the downside.

However this is only one possible explanation. In fact, it might also be the case that investment in such countries is simply not considered profitable enough in the post-crisis context, and hence, on the demand side, firms are not interested in pursuing such an activity. Clearly, the lack of investment causes a reduction in productivity and profitability, and such a self-reinforcing mechanism leads to a protracted low investment – low profitability scenario.

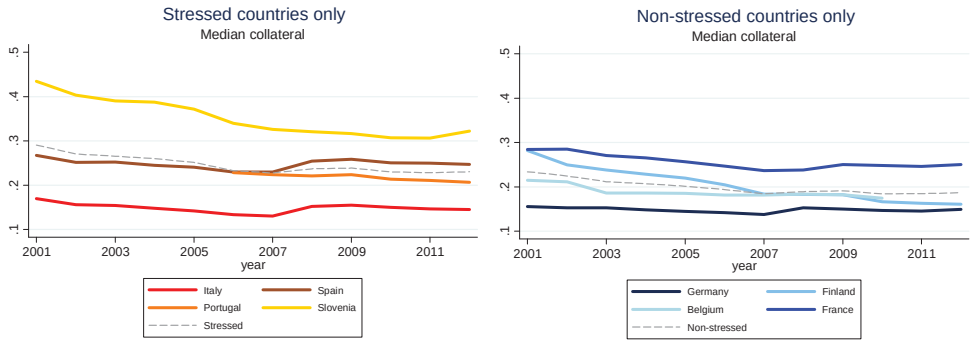
To check which explanation seems more plausible - collateral versus profitability - we first analyse the collateral for the two groups of countries.

Figure 17, *Collateral, median values, stressed and non-stressed economies*



High values signal the existence of a large portion of assets that can be used as collateral and hence higher probability of receiving a loan. **Figure 17** provides the median values of collateral for the period 2001-2012. Although collateral is consistently higher for stressed economies, showing that on average investors have always valued as riskier the investment in these countries, collateral dynamics are very similar across all economies. A steady decrease is observable before 2007, in line with eased monetary conditions in the pre-crisis world, with collateral not surprisingly increasing during the financial crisis, and then quickly returning to pre-crisis levels after 2010.

Figure 18, *Collateral, median values, stressed and non-stressed economies, individual countries*



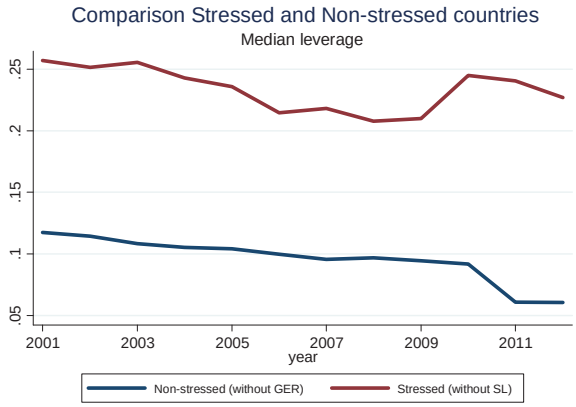
Looking at individual countries, it is interesting to notice in **Figure 18** that France and Slovenia present the highest levels of collateral, while Italy and Germany display the lowest values, entirely comparable in magnitude before and after the crisis. These similarities across countries very differently hit by the financial crisis suggest that the divergence in investment ratios observed after the crisis might not be entirely driven by a credit-crunch argument. Indeed, if that was entirely the case, we would have observed a surge in the collateral of the "stressed" countries, implying a much larger amount of fixed capital needed to ensure loans for firms perceived as very risky.

Figure 17 shows the developments of median leverage across stressed and non-stressed countries. Before starting any comments on the data, it should be recalled that Germany and Slovenia have used a different definition of leverage so the chart reports the aggregated values without these two countries. The debt ratio of these two countries is reported in **Figure 17** Some stylised facts appear. First of all, there are significant differences between stressed and non-stressed countries: the median firm in stressed countries is much more indebted than the one in non-stressed countries in the whole period. Second, looking at developments, the ratio of debt to total assets in stressed countries reveals periods when firms' leverage increased, and also periods of deleveraging. After a period of declining trend until 2005 and one of consolidation between 2006 and 2009, the ratio increased during the financial crisis, reaching a peak in 2010[20]. Since then some slight deleveraging has been observed, but the ratio has remained high. By contrast in non-stressed countries, leverage seems to be remaining at

[20] It should be taken into consideration that part of the increase is due to accounting changes in 2009 in Portugal.

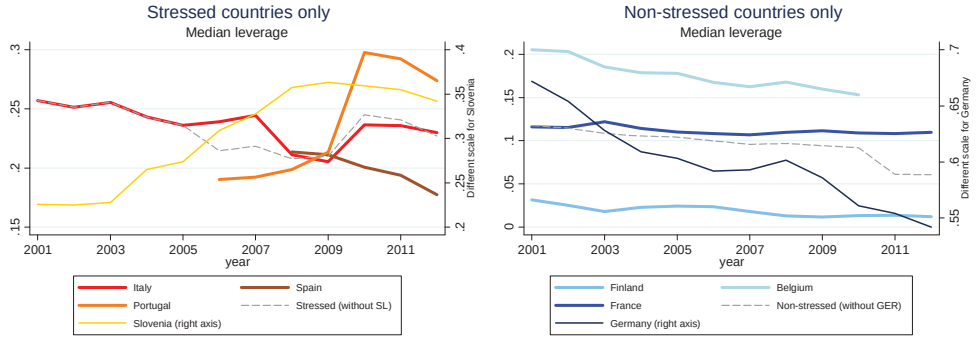
lower levels with no large changes over time (the drop in 2010 is due to a technical factor, namely no data available for Belgium).

Figure 19, *Leverage, median values, stressed and non-stressed economies*



Across euro area countries, a degree of heterogeneity was already evident before the financial crisis, although comparisons are a bit difficult. In the case of Portugal, for instance, the significant shift in the level of median leverage from 2009 to 2010 might be mostly influenced by the introduction of new accounting rules due to the adoption of the international accounting standards. Signs of deleveraging are visible from 2010 onwards in Portugal but also in Slovenia.. Spain shows a decline in leverage for the years for which data are available while Italy saw a return of leverage in the last period of the sample to the high level recorded before the crisis. Among non-stressed countries, Germany shows a continuous decline in the debt ratio while in the other countries the developments are more stable.

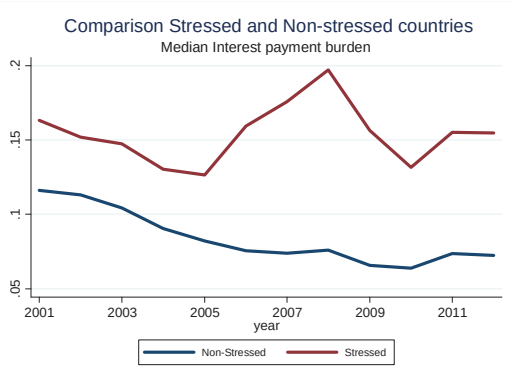
Figure 20, *Leverage, median values, stressed and non-stressed economies, individual countries*



Several studies on debt overhang during the recent crisis have shown that debt may have exerted a negative influence on firm investment, in particular when it reaches specific thresholds (see section 4.4 below). For these reasons, we turn to the analysis of the impact of leverage on the investments' profitability. First, we analyse the interest payments burden. The interest payments burden ratio

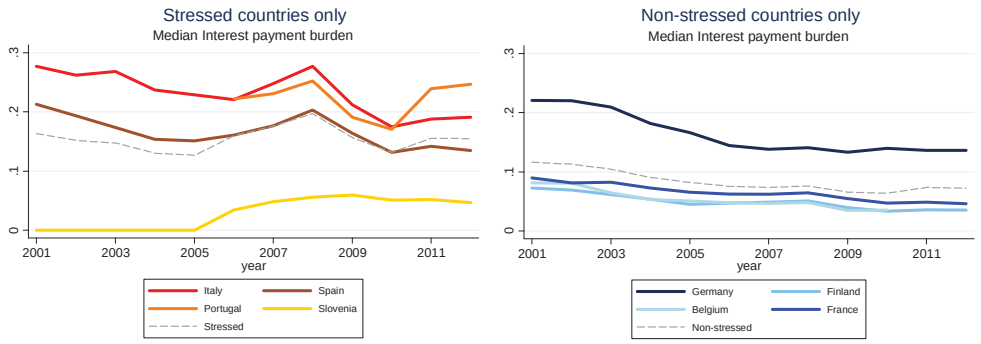
shows to which extent profits cover the interest paid by the firm, and it is indicative of the sustainability of the flow of interest payments: higher values imply that the interests paid, which are likely to be relative to loans undertaken to finance investments, are not covered by the profits generated by the firm. As such, the index might be interpreted as a symptom of low profitability of externally financed investments.

Figure 21, *Interest payment burden, median values, stressed and non-stressed economies*



To this extent, **Figure 21** shows very different dynamics in interest payments burden for stressed and non-stressed countries. Until 2005, both groups were characterized by a similar decrease in interest payments burden, followed by a sudden surge for the stressed economies, broadly corresponding to the sharp increase in investments observed in Figure 3. The interest payments burden of the stressed group decreases in the years of the crisis (following the fall in investment and credit granted by financing institutions), and then rises again to levels similar to those observed in the mid-2000. For non-stressed countries, we observe instead an overall decreasing trend during the entire period. The very high interest payments burden of stressed economies, with similar non-decreasing dynamics across countries (see **Figure 22**) even in a post-crisis context of reduced investments and progressively easing monetary conditions, might thus be symptomatic of a situation in which the undertaken investments are not profitable enough.

Figure 22, *Interest payments burden, median values, stressed and non-stressed economies, individual countries*



Clearly, it might still be the case that high interest payments burden levels derive by disproportionately high interest payments, in turn stemming from a dysfunctional monetary transmission channel. Hence, to better understand if the high interest payment burden observed is driven by low profitability or just high interest payments, we finally look at the Return on Assets (ROA).

Figure 23, *ROA, median values, stressed and non-stressed economies*

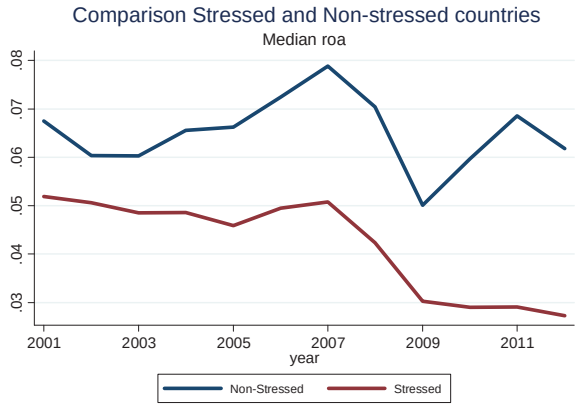
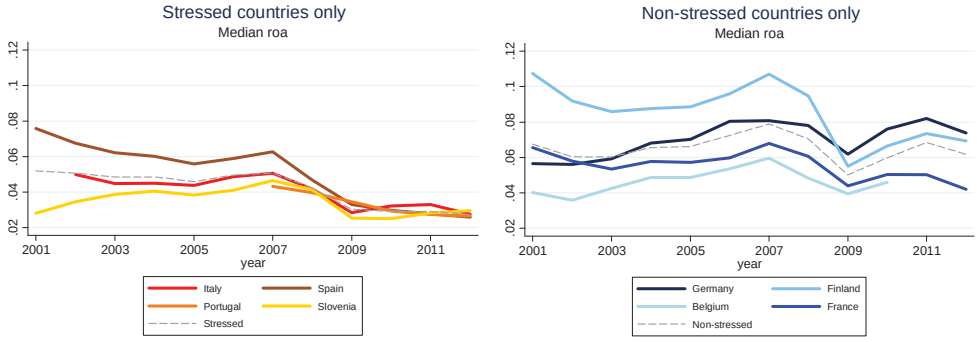


Figure 23 provides median levels for the considered economies. Again, we find very different levels between the two groups of countries, with considerably higher returns on investments for the non-stressed economies, both before and after the crisis. In fact, while the ROA is increasing for the non-stressed economies prior to the crisis, it is considerably flat for the stressed group. During the crisis the ROA predictably falls for both groups, due to profit contraction, but while the index recovers quickly for the non-stressed countries, for the stressed group it further decreases afterwards. This is also evident when looking at individual countries in **Figure 24**.

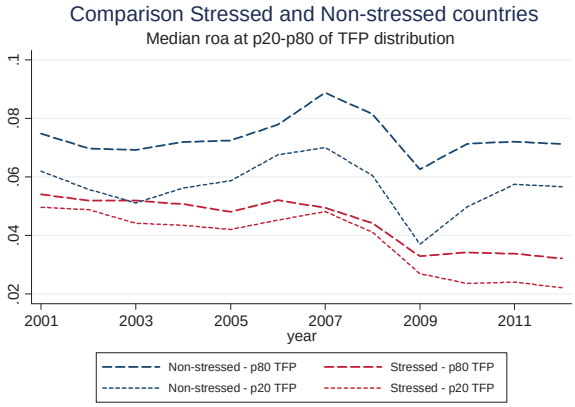
Figure 24, *ROA, median values, stressed and non-stressed economies, individual countries*



These findings thus seem to confirm the mechanism described above, with low investment and low profitability of investment generating a self-enforcing mechanism leading to reduced economic growth in stressed countries, on top and beyond any potential disruption in the monetary transmission channel.

A final caveat to consider in the interpretation of the dynamics of ROA is however the fact that it varies greatly across industries (typically based on how much an industry is capital intensive)[21]. Hence, some compositional effect might drive these results. Trying to correct for this heterogeneity, we have compared the ROA of the 20% most productive and 20% least productive firms in the considered country aggregates.

Figure 25, *ROA, median values, stressed and non-stressed economies, most and less productive firms*



As a matter of fact, the analysis of the average ROA of firms with different productivity levels confirms the hypothesis of a low profitability of investment in stressed countries: in particular, notice for example how the most productive firms in stressed economies display on average lower returns than the less productive firms in non-stressed countries.

Summing up, these very simple balance sheet indexes depict a scenario characterized by notable differences between stressed and non-stressed economies not entirely induced by a different reaction of their financial and credit markets to the crisis. Indeed, what has appeared to be characterizing stressed economies is the low profitability of investment, which might have exacerbated the negative effects of the crisis.

In the next section we start to empirically test some of the hints we collected from the descriptive analysis investigating first the determinants of investment, cash flow and leverage being the main ones. Then we will focus on cash holding and on the cash flow sensitivity of cash as an indication of financial constraints. Finally we turn on profitability and here we will consider once again the role played by leverage.

[21] See Appendix 2 for an analysis of the developments at sectoral level.

4.2. Determinants of cash holdings

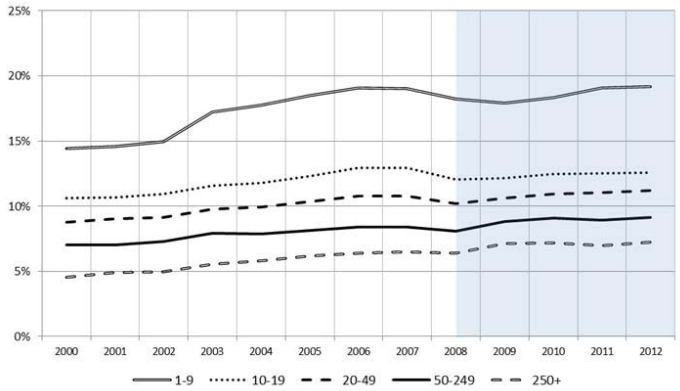
This section looks at the developments of firm's cash holdings[22]. In the literature there is no single theory that explains the cash holdings behaviour of firms. Cash holding behaviour is at least thought to be influenced by the following factors: 1) firms need cash to carry out transactions, i.e. to make payments without incurring the costs involved in converting non-cash assets into cash; 2) perhaps more importantly, firms hold cash as a precautionary measure, to cover against the risk of potential cash shortfalls; this ties in with the "pecking order" theory which explores firms' decision-making with regard to their sources of financing; 3) tax motives are also often mentioned: firms keep cash in their balances to avoid the tax consequences associated with repatriating foreign earnings; 4) agency motive: firms retain cash rather than distribute payments to shareholders in order to increase the manager's discretionary power over investment (it should be noted, however, that cash held on separate account in a verifiable way, e.g., margins or reserves, has positive incentive effects for prudent risk management); 5) investor horizon motive: firms with longer investment horizon hold more cash because the benefit of monitoring is higher.

Another interesting aspect is related to the link between cash holdings and the presence of financial constraints. Generally speaking, if a firm does not face financing constraints, it has no need to hold cash for future investment needs; hence, its cash holdings should not depend on either cash flow or cash flow volatility. However, if firms do face financing constraints, they can decide to hold more cash to hedge against the possibility of falling short of cash in the future and, hence, not being able to engage in valuable investment projects.[23]

As described in section 2 (and related Appendices), the financial module of the CompNet database includes a measure of cash holdings: it is a ratio of cash or cash equivalents over total assets. The following **Figure 26** shows the developments over time of the variable across firm size. The figure shows that firms in the CompNet database hold a non-negligible part of their assets in the form of liquid assets, in spite of the associated opportunity costs. Since 2000 the cash holding ratio for euro area firms has fluctuated somewhat, only to increase again in the late 2000s, in the context of high uncertainty and difficulties in accessing external financing. The developments have been different across firm sizes. Large firms' relative cash holdings are substantially lower, suggesting that these firms have easier access to external financing and use cash more efficiently. Micro and small firms have constantly kept higher levels of cash in their balance sheets.

[22] See for a similar analysis, ECB SIR Corporate finance and economic activity in the euro area (2013).
[23] See Almeida, H., M. Campello, and M. Weisbach, 2004, The cash flow sensitivity of cash, Journal of Finance 59, 1777-804.

Figure 26, *Cash holdings across size classes, simple averages, full sample*



In order to investigate the link between cash holdings and their determinants we estimate the following equation, in line with the available literature:[24]

$$\text{Cash}_{ct} = \beta_1 \text{CF}_{ct} + \beta_2 \text{spread}_{ct} + \beta_3 \text{CFV}_{ct-1} + \beta_4 \text{NWC}_{ct-1} + \beta_5 \text{Collateral}_{ct-1} + \beta_6 \text{Leverage}_{ct-1} + \beta_7 \text{Crisis dummy} + \beta_8 \text{ICC}_{ct} + \theta_t + \varepsilon_{ct} \quad (3)$$

where Cash is the ratio between a firm's holdings of cash and cash equivalents, and total assets; spread is the difference between the average lending rate to NFCs and the market interest rate, measuring, at the country level, a firm's opportunity cost of holding cash; CF is the ratio between a firm's cash flow and total assets; CFV is a firm's cash flow volatility, measured by dividing the standard deviation of cash flows by the average cash flow at sectoral level; NWC is the ratio between net working capital and total assets; Leverage is the ratio between a firm's financial debt and total assets; Collateral is the proportion of a firm's total assets accounted for by tangible fixed assets; ICC is the credit constraints index, θ_t are time dummies and ε_{it} is the error term; crisis is a dummy that takes the value 1 from the year 2008 onwards and 0 otherwise. The indexes c and t refers to the two dimensions of the panel: t is the time dimension while c is the cell defined by either by unique country/macro-sector or country/macro-sector/size class. As in the case of the analysis of investment, the empirical analysis is run through cell-based regressions using mean values as if it was panel data.

Table 7 presents the results of the econometric analysis run for the period 2001-2012 for the following countries: Belgium, Estonia, Finland, France, Germany, Italy and Slovenia. These results were obtained with a fixed effects generalised least squares (GLS) estimator that takes unobservable cell-level heterogeneity into account. Columns 1 and 2 report the estimated coefficients using the more aggregated cells, while columns 3 and 4 the most disaggregated ones.

[24] See, for instance, ECB SIR 2013 and the references thereby.

Table 7, *Cash holding determinants - estimation results*

Variables	***(1)***	***(2)***	***(3)***	***(4)***
Cash flow over total assets	0.201***	0.187***	0.099*	0.082
Cash flow SD	0.124***	0.117***	0.093***	0.09**
Spread	0. 002**	0.002**	0.002***	0.002***
NWC (t-1)	-0.003	-0.003	-0.014*	-0.013**
Leverage (t-1)	-0.104***	-0.073*	-0.090***	-0.087***
Collateral (t-1)	-0.083*	-0.097**	-0.057***	-0.058**
ICC		-0.045*		-0.028*
Crisis Dummy		0.007***		0.007***
Constant	0.129***	0.117***	0.101***	0.107***
Controls	Year and group	Year and group	Year and group	Year and group
Level of aggregation	Macrosector	Macrosector	Macrosector/ Size class	Macrosector/ Size class
N of cells	68	68	200	200
N observations	677	667	1948	1879
R^2	0.38	0.38	0.18	0.17

Starting from the first column, we see that most of the variables have the expected signs: cash flow and cash flow volatility positively affect cash holdings. The cash flow sensitive of cash may indicate that some firms have restricted access to external financing (Almeida et al., 2004). We find a positive and significant coefficient for the spread pointing to the fact that an increase in the relative cost of external finance makes cash more attractive for firms. However, firms with more leverage tend to reduce their cash holdings as the negative coefficient indicates. As expected, the estimated coefficient for the ratio of tangible assets to total assets is negatively related to cash holdings, suggesting that the access to external financing is strongly linked to the availability of collateral. Furthermore, firms holding a higher level of assets which can be considered as cash substitutes (i.e. those with a higher net working capital) hold less cash.

In the second column we include a dummy separating the period pre-crisis from the period thereafter, taking on a value of 1 in the crisis, and 0 otherwise. The dummy is positive and statistically significant, indicating that, all other things equal, firms tended to keep more cash in their balance sheets after the crisis. In addition, we included the ICC index. The negative coefficient is signalling that financially constrained firms have less cash at disposal, most probably due to their worse financial situation, in line with the results we found in section 3.

The results in columns 3 and 4 are based on the most disaggregated level in the CompNet database. Here the additional variability is given by size classes. The estimated coefficients are similar to those obtained in the first two columns; only the cash flow variable becomes less significant or even statistically insignificant when the ICC indicator is included in the specification.

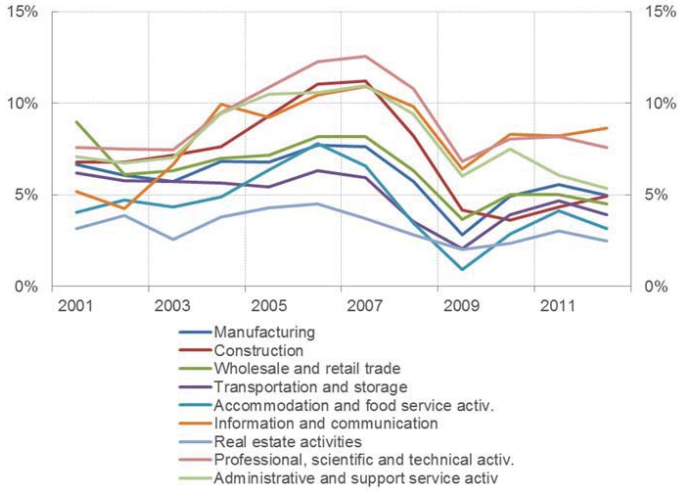
4.3. Determinants of profitability

Profitability is one important aspect of the performance of firms. Many strands of the literature have explored the variability of firm-level profitability (Nunes et al., 2009). They mostly emphasize the importance of micro-level variables as determinants of profitability while macro-level variables – such as economic conditions and the competitive environment - also play a significant role.

Figure 27 reports the developments of profitability of firms in the CompNet database across macro sectors. Some stylised facts emerge. First, there are structural differences across sectors on the level of profitability. This evidence is directly linked with the traditional structure-conduct-performance literature approach (Slater and Olson, 2002), which focuses on industry characteristics such as concentration and economies of scale and scope to explain differences in profitability. Second, our data confirms the procyclical nature of firm profitability as profits increase when the economy is growing but decline when the economy enters into a recession. Indeed, we can see that since the peak of 2007 there has been a strong erosion of profits across sectors, which continued until 2009. Some recovery can be seen after the trough but levels remain still below the sample averages for all sectors except for the information and communication sector.

An alternative strand of research – in particular the managerial one- focuses on the role of internal resources specific to firms – such as tangible or intangible factors reflecting the economic capabilities of a firm- to explain heterogeneity in profitability. In this respect the features of the CompNet database are well-suited to explore the importance of the various strands of the literature by combining the industry-level analysis of the Structure-Performance-Conduct paradigm with the firm-level approach using firm-level financial ratios.

Figure 27, *Profitability across macro sectors, simple averages 20E sample*



Following Pattitoni et al (2014) we consider the following dynamic model:

$$ROA_{ct} = \beta_1 ROA_{ct-1} + \beta_2 ROA_{ct-2} + \beta_3 \text{market share}_{ct} + \beta_4 \text{Leverage}_{ct} + \beta_5 \text{Leverage}\hat{}2_{ct} + \beta_6 \text{Cash holding}_{ct} + \beta_7 NWC_{ct} + \beta_8 \text{sales growth}_{ct} + \beta_9 \text{spread}_{ct} + \theta_t + \varepsilon_{ct} \quad (4)$$

where ROA is our dependent variable, market share is the share of sales of a specific sector in the whole economy, Leverage is the debt to total asset ratio and its quadratic term to allow for non-linearities, cash holding is the amount of cash over total assets, NWC is the ratio between net working capital and total assets, sales growth is the real rate of growth of sales and denotes the future investment and growth opportunities, spread is the opportunity cost of capital, proxied here by the cost of bank lending by companies. In a second specification we also include our indicator of financial constraints (ICC) and a dummy variable denoting the period of crisis.

The regression analysis considered in this section covers the period 2001-2012 and refers to the full 20E sample, which includes 13 countries and 9 macrosectors: the combination countries/macrosectors will be the level of disaggregation over time.

Table 8 reports the two different specifications. As for the analysis of investment, both specifications are estimated using the Arellano and Bond (1991) difference GMM estimator. All covariates (excluding time dummies) are assumed to be endogenous and instrumented with their own lags. Before interpreting the estimated coefficients, there are some observations on the results of the post-estimation tests. First, autocorrelation in the idiosyncratic disturbance term would render some lags invalid as instruments. We test second order correlation (AR2) of first differenced residuals using the Arellano-Bond test for autocorrelation. Second, the Hansen overidentification test (H-test) checks the validity of the identifying moment conditions

Table 8, *Profitability determinants, estimation results*

VARIABLES	(1)	(2)
ROA_{t-1}	0.56***	0.46***
ROA_{t-2}	-0.31***	-0.23**
Market share	0.22**	0.26**
Leverage	0.76***	0.94***
Leverage^2	-0.73**	-0.91**
Cash flow over total assets	0.73***	0.84***
Net Working Capital	-0.08**	-0.05
Sales growth	0.02	0.01
Spread	-0.01***	-0.00***
ICC		-0.11**
Crisis dummy		-0.01***
Controls	Year and group	Year and group
Observations	560	553
Number of cells	77	77
Number of instruments	46	46
AR2(p-value)	0.26	0.54
H-test(p-value)	0.03	0.09

Looking at the estimated coefficients of the second regression, we find a positive association between market share and profitability. As in Goddard et al. (2005) this might reflect a positive association between productive efficiency and firm size. The most efficient firms earn the highest rates of profit, and their success enables them to grow and achieve a relatively large market share. As for the case of the analysis of investment, we tested the presence of non-linearities between leverage and profitability.[25] For low levels of debt, leverage has a positive coefficient (in line with the "control hypothesis" of Jensen (1986)), while for higher levels the relation becomes negative. This could be explained by the fact that highly leveraged firms face cash constraints (as in our findings in the analysis of the determinants of cash holdings), which may force them to give up profitable investments. Moreover, firms that become more highly geared may tend to suffer, as the proportion of gross profits dedicated to servicing debt increases. We calculated the threshold at which debt begins to be negative in the CompNet sample which is about 50% based on our estimated coefficients[26]. The link between cash flow, sales growth and profitability is positive as firms that are successful are also more profitable. In our sample there is a negative relationship between net working capital and profitability, which is not in line with previous findings, but might signal some agency problems between managers and owners (Myers and Rajan, 1998). Furthermore, firms that are financially constrained are also less profitable and the significant and negative coefficient of the crisis dummy reinforces the descriptive analysis of a sharp drop of profitability across sectors since 2008 with few cases of recovery.

4.4. The role of indebtedness for firms' investment decisions

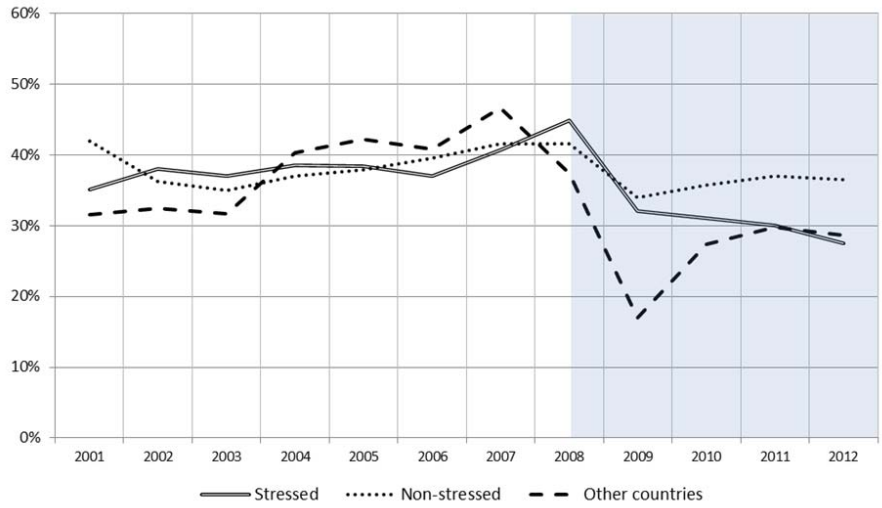
Since the seminal work of Fazzari, Hubbard and Peterson (1988), a large empirical literature has revealed an "excess sensitivity" of firms' investment decisions to financial factors such as cash flow, indebtedness or interest payment burden. The richness of the financial variables collected by the financial module of CompNet allows exploring the determinants of European firms' investment.

It is well known by now that the financial crisis in 2008 was characterised by a negative shock to the supply and demand of external finance for non-financial corporations. The bursting of the real estate bubble in some euro area countries led to a deterioration of the collateral value against which firms could borrow, and therefore, a reduction in the firm's net worth. This financial accelerator channel (Bernanke et al., 1999) created additional or exacerbated existing financing constraints. The impact of these factors on the investment decisions of firms has been different across countries, sectors and also across firm sizes. **Figure 28** depicts the development over time of the average investment in fixed tangible assets to total fixed assets ratio across countries. This is slightly different from the

[25] We tested the existence of non-linearities for the other regressors but we did not find significant results. The estimations are not reported.
[26] This is equal to: – coeff. Leverage / 2 * coefficient of squared leverage.

development shown in **Figure 15** that reported the median values of the same ratio. The average investment ratio declined across all countries in the CompNet database in 2009, although with different profiles. The drop was sharper for countries outside the euro area, but a strong decline has been recorded also for euro area stressed countries with a drop of almost 13 percentage points between 2007 and 2009. For those countries, no signals of recovery were detected until 2012.

Figure 28, *Mean investment ratio across countries, simple averages, 20E sample*



In this section we focus on the determinants of investment and in particular on the role played by leverage in the context of the financial crisis of 2008. We estimate a dynamic investment regression model where sales growth (SG_{it}) and cash flow (CFK_{it-1}) control for investment opportunities.[27] Leverage is lagged one period so as to represent the balance sheet position at the beginning of the investment period t. Consider the individual-level model

$$IK_{it} = \beta_1 IK_{it-1} + \beta_2 SG_{it} + \beta_3 CFK_{it-1} + \beta_4 Lev_{it-1} + \mu_i + v_{it} \qquad (1)$$

Where IK_{it} denotes investment of firm *i* at year t. μ_i is an individual-specific fixed effect and v_{it} is the idiosyncratic error term. As the variables in the CompNet micro-based database are aggregated from firm-level sources with different dimensions (country, sector and size over time), we decided to use the lowest aggregation level available, where a "cell" is defined by a unique country/macro-sector/size class combination and observed over time, and the empirical analysis is run through cell-based regressions using mean values. The corresponding cell-level model is then

$$\overline{IK}_{ct} = \beta_1 \overline{IK}_{ct-1} + \beta_2 \overline{SG}_{ct} + \beta_3 \overline{CFK}_{ct-1} + \beta_4 \overline{Lev}_{ct-1} + \bar{\mu}_c + \bar{v}_{ct} \qquad (2)$$

where $\overline{IK}_{ct}$ is the average value of all observed IK_{it}'s in cell c and year t.

[27] The interpretation of the cash flow parameter is controversial, see the discussion between Fazzari et al. (1988, 2000) and Kaplan and Zingales (1997, 2000).

With such a model both the pooled OLS and fixed effects estimators likely suffer from a dynamic panel bias (Nickell, 1981). We use the Arellano and Bond (1991) difference GMM estimator that first transforms the data to expunge the fixed effects and second instruments all potentially endogenous variables using lags of their own levels, so that all instruments are drawn from within the dataset.[28]

To investigate the impact of the financial crisis on investment determinants, we estimate a more flexible version of equation (2) where all the parameters – except for that of the lagged dependent variable – are allowed to change after 2008. For that purpose we use a dummy variable equal to 1 in the years 2009 to 2012 and zero otherwise.

$$\overline{IK}_{ct} = \beta_1 \overline{IK}_{ct-1} + \beta_{21} \overline{SG}_{ct} + \beta_{22} \overline{SG}_{ct} \text{x } 1\{t \geq 2009\} + \beta_{31} \overline{CFK}_{ct-1} + \beta_{32} \overline{CFK}_{ct-1} \text{x } 1\{t \geq 2009\} + \beta_{41} \overline{Lev}_{ct-1} + \beta_{42} \overline{Lev}_{ct-1} \text{x } 1\{t \geq 2009\} + \bar{\mu}_c + \bar{v}_{ct} \qquad (3)$$

Model (3) as well as an extension of this model is estimated on a sub-sample of the CompNet database. We consider 4 countries (Belgium, Germany, Spain and Italy) over the 2000-2012 period, disaggregated at the sectoral (9 macro-sectors) and firm size (5 size classes) levels. Our estimation results are summarized in **Table 9**. Tests are run to probe the validity of our results. First, autocorrelation in the idiosyncratic disturbance term would render some lags invalid as instruments. We test second order correlation (AR2) of first differenced residuals using the Arellano-Bond test for autocorrelation. Second, the Hansen overidentification test (H-test) checks the validity of the identifying moment conditions.

The first column presents estimates of model (3). The estimated impact of leverage is negative but not significant. There is however evidence of specification problems in that case. First, the coefficient on lagged investment of 0.0148 is not in the range between the OLS and FE estimates (not reported).[29] Second, the Hansen test of overidentifying restrictions is rejected. In column (B), model (3) was augmented with a squared leverage term. All the signals now hint at valid estimation results. The estimated impact of leverage on investment is now significant and non-linear: positive for small values of leverage and negative above a certain threshold. That means that higher borrowing and indebtedness represent a drag on investment as firms should direct funds to repay their debts. This result is similar to those found in ECB (2013) and at the macro level by Cecchetti et al. (2010): while debt can, in general, improve economic welfare and spur economic growth if it remains at moderate levels, when it reaches excessive levels it creates the conditions for financial instability and hampers investment and economic growth. The asymmetric effect has been also reported at the micro level, by

[28] Estimation is implemented in Stata using Roodman's *xtabond2* package. We use forward orthogonal deviations, two lags of instruments and "collapse" the instrument matrix, see Roodman (2009a) and Roodman (2009b).

[29] According to Bond (2002), given their respective biases, a consistent point estimate on the lagged dependent variable should not be significantly higher than the former or significantly lower than the latter.

Goretti and Souto (2013) using BACH data for a group of European countries in the period 2000-2010. The significant interaction terms with the time dummy also suggest that this threshold has moved (decreased) since the 2008 financial crisis. It is also in line with the findings by Ferrando, Marchica and Mura (2014) that firms' conservative debt policies aimed at maintaining financial flexibility allowed companies to reduce the negative impact of liquidity shocks on their investment decisions.

Table 9, *Leverage and investment - estimation results*

	(A)	(B)
IK_{it-1}	0.0148	0.148*
SG_{it}	0.211*	0.292**
SG_{it} x $1\{t \geq 2009\}$	-0.109	-0.134
CFK_{it-1}	1.354*	0.833
CFK_{it-1} x $1\{t \geq 2009\}$	0.0546	-1.691***
Lev_{it-1}	-0.236	2.394**
Lev_{it-1} x $1\{t \geq 2009\}$	-0.132	1.873***
Lev_{it-1}^2		-0.0482**
Lev_{it-1}^2 x $1\{t \geq 2009\}$		-0.0489***
Observations	1,049	1,049
Number of cells	157	157
Number of instruments	35	39
AR2(p-value)	0.878	0.579
H-test(p-value)	0.0182	0.953

The results point in direction of a non-linear impact of indebtedness on investment at the aggregate level, and a significant effect of the recent financial crisis on this relationship. The CompNet database could be further exploited to explore these questions. For example, heterogeneity across firm sizes could be further examined.[30]

4.5. Investment and productivity

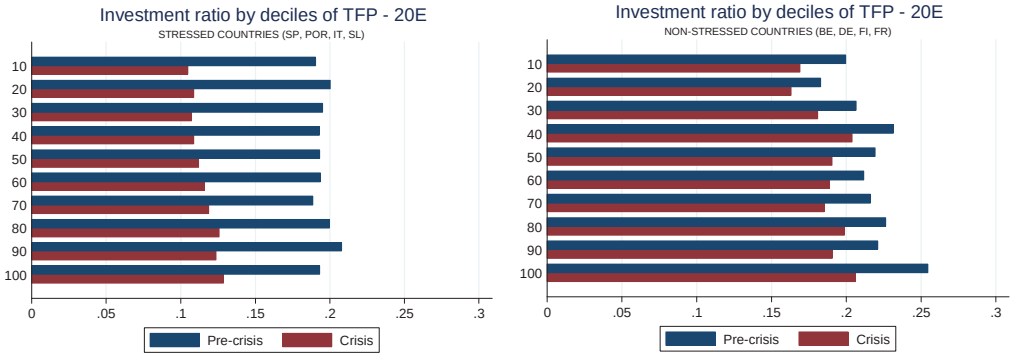
In this section we explore the link between investment and productivity. Understanding the implications and relationship of investment to productivity is an important task and it plays a crucial role for the evaluation (or initiation) of government policies, such as investment tax credits. However, there is limited empirical evidence of the link between investment, or the age of capital, and productivity. The descriptive statistics we present in this section indeed point to a positive relation

[30] Also nonlinearities in firm-level relationships can lead to discrepancies between aggregate-level relationships and firm-level relationships evaluated at the means of the variables. Higher moments might then be helpful to correctly estimate the former. See Chen, Felt and Ferrando (2015) forthcoming.

that might be explained with efficiency gains resulting from the acquisition of new fixed assets and the replacement of the old ones.[31]

Figure 29 presents the investment ratio for firms in the 20E sample by deciles of productivity, measured through TFP estimations. TFP is often regarded as a preferable productivity measure, though one has to keep in mind that TFP can be quite volatile in the short term and has strong data requirements in terms of variables needed for computation (resulting in fewer firms used for the calculation). For the stressed economies, the investment ratio was much lower during the crisis years and slightly higher for more productive firms, although the differences are not substantial. As the investment ratio quantifies the accumulation of fixed capital, it should not be surprising that higher values are correlated with higher productivity for firms. The levels of investment are higher for non-stressed countries, where the difference among less and more productive firms is less evident. This phenomenon is much more visible when using the labour productivity instead of the TFP estimates[32].

Figure 29, *Investment ratio by deciles of TFP for stressed (left) and non-stressed (right) economies, 20E sample*



4.6. Firms' financial characteristics and trade

The CompNet database allows a cross-country analysis of the link between firms' financial conditions and their international trading activities. The trade module paper[33] contains a detailed description of the different export and import indicators which have been constructed for the CompNet database. In this section we aim at indicating the potential of this joint information by highlighting some patterns on investment and leverage ratios of exporting and non-exporting firms that emerge from the data.

Greenaway et al. (2007) provide evidence that exporting firms on average dispose of a better financial situation than non-exporting firms. They explain this finding by arguing that exporting firms have access to internal and international financial markets which allow them to diversify the sources of financing and the associated risks. Moreover, the authors suggest that exporting is a signal of ability

[31] See Handjiski (2009) and Yu, Dosi, Grazzi and Lei (2014).
[32] See Appendix Investment and TFP Labour Productivity
[33] See Berthou, Dhyne et al. (2015).

and thus raises the probability of serving external debt. Given a better financial situation and access to external financing, we might expect that exporting firms on average have higher capital expenditures.[34] Indeed Campa and Shaver (2002) present some evidence of a positive relationship between capital investment and exporting which they link to lower liquidity constraints of exporting firms due to a diversification of risk by selling to different markets. Besides financing conditions, exporting firms may have greater investment incentives due to better growth perspectives on the international market and thus potentially higher benefits from investing.[35]

Figure 30, *Median Investment Ratio (20E)* shows the average median investment ratio of exporting and non-exporting firms for the periods 2005 to 2007, 2008 to 2009 and 2010 to 2012, respectively, and validates our conjecture above for almost all the countries, with the only exception being Finland. The observed differences in investment ratios between exporting and non-exporting firms vary across countries and appear to be less pronounced in the European core countries Belgium and France. Moreover, the figure reveals a clear negative impact of the global trade collapse following the financial crisis in 2008/2009, which affected both, exporting as well as only domestically active firms. This effect is observed in all countries except for France and Italy.[36] In the following years (2010-2012) investment ratios showed signs of recovery in some countries, while they further decreased in others in the face of the sovereign debt crisis that hit the Eurozone. Overall, the crisis impact was more pronounced in most Eastern European countries and Portugal, while Belgium, France and Finland were less affected.

[34] This expectation is also in line with some of the evidence presented by Bernard et al. (2007) who find that exporting firms on average have higher capital-labour ratios than non-exporting firms.
[35] For instance, Bustos (2011) shows that trade integration increases the incentives to invest in technology upgrading for exporting firms.
[36] Please refer to Section 4.1 where the investment ratio is analysed: Italian data suffer from a change in accounting rules in 2008.

Figure 30, *Median Investment Ratio (20E)*

Notes: Bars denote averages within countries over the years 2005 to 2007, 2008 to 2009, and 2009 to 2012, respectively (some countries do not cover all years). Blue bars and red bars denote exporting firms and non-exporting firms, respectively. Data are based on firms with at least 20 employees.

Consistent with previous results in the literature, data reveals that exporting firms indeed tend to invest more than non-exporting firms in most of the countries. There are several reasons why firms may have opted to invest less during the crisis. One reason might be that firms postpone investments in times of higher uncertainty since returns on investments are more risky (Bloom et al., 2007). Moreover, subdued demand and, hence, lower profitability implies limited growth prospects for firms which thus expand less. Additionally, tighter lending conditions in some countries may imply that firms rather focus on reducing external debt than on increasing capital expenditures. There certainly are other explanations for the drop in investments and it is difficult to disentangle the alternative explanations which also may be interrelated.

Here we present figures on firms' profitability and leverage to provide some insights about differences between exporting and non-exporting firms and their developments during the crisis, while stating that we do not intend to draw any causal conclusions.

Figure 31, *Median Return on Assets (ROA), 20E sample*

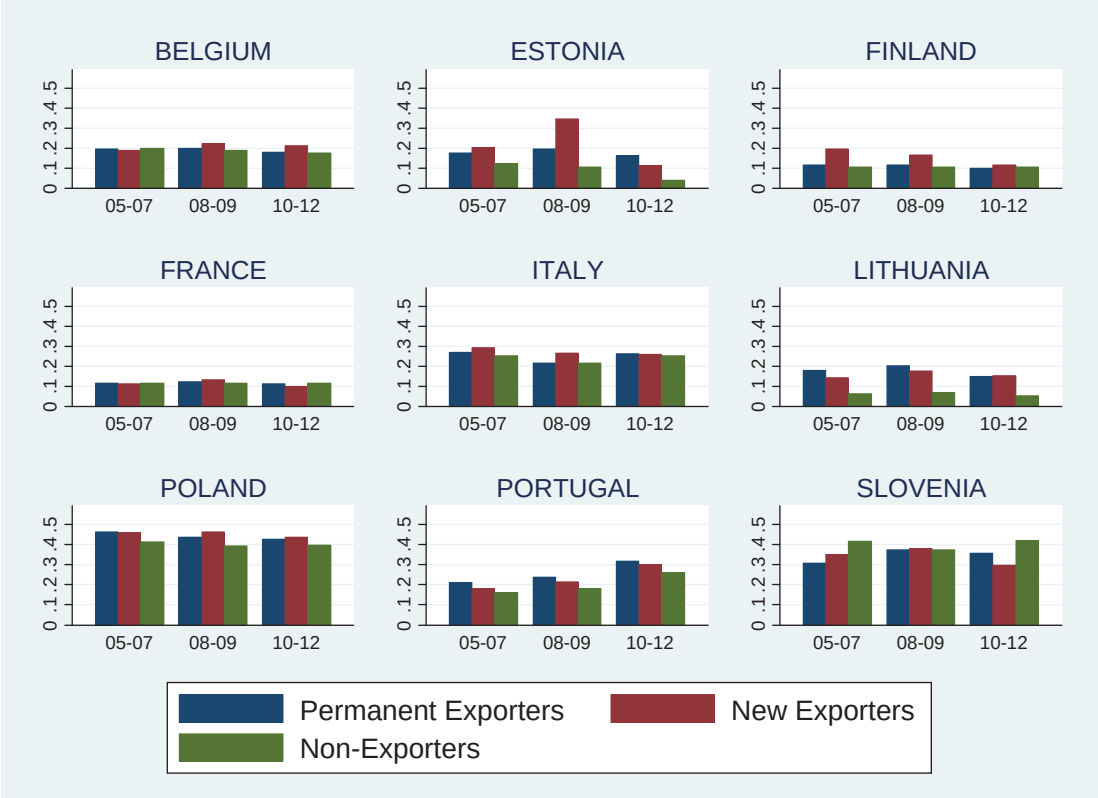
Notes: Bars denote averages within countries over the years 2005 to 2007, 2008 to 2009, and 2009 to 2012, respectively (some countries do not cover all years). Blue bars and red bars denote exporting firms and non-exporting firms, respectively. Data are based on firms with at least 20 employees. Germany and Spain did not provide information on exports.

Figure 31 provides some evidence regarding the profitability of investment by depicting the average median return on assets by exporters and non-exporters. First of all, the figure presents mixed evidence of profitability differentials between exporting and non-exporting firms. Returns on assets were higher for exporting firms in most countries from 2005 to 2007, the exceptions being Finland, France, Italy, and Poland. Second, the figure shows that during the trade collapse all countries experienced a deterioration of firms' profitability. Exporting firms were hit particularly hard in Belgium and Slovakia with now lower return on assets than non-exporting firms. However, during the course of recovery of world trade from 2010 onwards, exporting firms appeared to have caught up more quickly exhibiting a higher or almost equal profitability compared to non-exporters in all countries. Besides a better recovery of exporting firms related to an uptake of external demand in some non-Eurozone countries, reallocation effects related to the exit of least productive exporters and business restructuring of incumbent exporters during the crisis may explain this development.

Berthou, Dhyne et al. (2015) provide some evidence that leverage ratios are often higher for exporting firms. This may reflect the fact that exporters have better access to external financing e.g. because being an exporter signals efficiency and the ability to compete in markets abroad. On the other hand,

this finding does not correspond with results from Greenaway et al. (2007), who showed that exporters on average have a lower leverage than non-exporters. Besides differences in variable definitions, the contrasting finding may be related to the groups that are compared. Indeed, while Greenaway et al. (2007) find that continuously exporting firms have a somewhat lower leverage than non-exporters, they also show that export starters usually have the highest leverage. The CompNet data allow us to investigate this possibility by depicting leverage ratios for different groups of exporters. **Figure 32** indeed reveals that in most countries export starters have particularly high leverage ratios. This can be explained by the fact that firms beginning to export usually need more financial resources since they have to front-load start-up costs of exporting (e.g. Das et al. 2007).

Figure 32, *Median Leverage by Type of Exporter, 20E sample*



Notes: See also **Figure 31**. In this figure, blue bars denote permanent exporters, i.e. firms that export in the years t-1, t, and t+1. Red bars denote firms that start exporting in year t and stay active in year t+1. Green bars denote non-exporting firms.

5. Conclusions

In this paper we described the new financial module of the CompNet database. The module is based on a set of indicators derived from balance sheet and profit and loss accounts. The methodology followed is the same applied to the other modules of the CompNet: 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 each National Central Bank (NCB) or National Statistical Institute (NSI). By using a common methodology the resulting set of indicators is harmonized across countries.

The set of financial indicators has been chosen to cover the different aspects of the financial and financing position of firms. We considered indicators related to firms' performance, the structure of external funding and to financial fragility and independence. In addition, we use two indicators of financial and financing constraints. The first one – which is a novel one – is based either on information derived from survey data and the second one uses an "a-priori classification" scheme based on information from the balance sheet and profit and loss accounts, to detect investment-constrained firms.

Going beyond the mere description of the dataset, we analysed how firms financing decisions become crucial in determining investment decisions and how they affect firms' performance in terms of profitability. We investigated 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. Leverage has also played an important role and we found signals that higher borrowing represented a drag on investment. We supplemented the descriptive evidence with econometric analyses using different levels of aggregation of the dataset and applying panel data techniques.

Another novelty of the financial module in the CompNet data is the possibility to link financial aspects to competitiveness issues. Admittedly, this paper has not exploited the richness of the constructed dataset which allows using the joint distributions of productivity indicators (or firm size) with the financial position, the exporting status and with firm growth.

We are also aware of a number of still existing statistical issues, which need to be tackled to improve cross-country comparability. The appendices accompanying this paper shed some lights on these additional issues.

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Appendix

A.1. *'Raw' financial variables*

The Financial Module of CompNet utilizes the variables available in the countries' firm-level datasets. They are simple balance sheet figures (or a combination of them), which are first cleaned from severe outliers and then used to compute ratios or 'derived' variables. Finally, these firm-level ratios are aggregated to obtain the indicators and the statistics which are part of the CompNet dataset. At the end of this process, all the firm-level information is dropped from the dataset and the user is provided with a full set of indicators.

The definition of these variables is not perfectly homogeneous: each country might have its own balance sheet template and a different legal framework. For this reason, a great effort consisted in harmonizing the definitions, in order to improve the comparability of the indicators which are derived from them.

Table A.1 lists the so-called 'raw' financial variables, and summarizes the adopted definition for each of those. For a more in-depth description of the differences in the definitions of the raw financial variables see Section 2.4 and Annex 4 of Lopez-Garcia, di Mauro and the CompNet Task Force, (2015)**.** This might be useful to understand when the discrepancies in the data are due to comparability issues across countries.

Table A.1, *Raw variables' definitions*

Variables	**Common definition**
Total fixed assets	Tangible, intangible and other fixed assets
Intangible fixed assets	Total intangible fixed assets
Other fixed assets	Total fixed assets - tangible fixed assets - intangible fixed assets
Other current assets	Current assets – Trade debtors – Total inventories
Cash and cash equivalents	Cash and balances at banks
Total assets	Total assets
Capital (Tangible fixed assets)	Tangible fixed assets
Non-current liabilities	Non-current liabilities
Long term debt	Loans due in more than 1 year
Other non-current liabilities	Provisions
Current liabilities	Current liabilities
Short-term debt	Loans due within 1 year
Other current liabilities	Other current liabilities
Shareholder funds (equity)	Equity
Current assets	Current assets

Turnover	Total sales
Profits and losses before taxes	Earnings before taxes (EBT)
Depreciation	Depreciation on intangible assets and tangible assets
Interest paid (or financial charges)	Interest on financial debts + other financial expenses
Cash flow (from profit/loss statement)	Net income + depreciation + extraordinary income
Profit/loss	EBIT
Total inventories	Inventories and consumable biological assets
Trade credit (accounts payable)	Trade credit or Accounts payable (Liabilities related to purchased goods and services)
Trade debt (accounts receivable)	Trade debt or Accounts receivable
Dividends	Dividends

The next two paragraphs are devoted to the Debt and Cash Flow variables, which might be computed with a different definition: the users of the dataset have to acknowledge this procedure to make proper comparison across countries.

A.1.1. Debt variable

The debt variable is an intermediate variable: it is constructed combining raw variables and it is used to calculate the leverage indicator (see section 3) but it is dropped from the final version of the dataset.

In order to collect the largest possible number of observations, two slightly different definitions are adopted:

1) the first one calculates debt as long-term debt plus short-term debt;

2) the alternative definition is the sum of current liabilities and non-current liabilities, net of trade credit.

If the debt variable, computed with the second definition, is available for at least 30% more firms than the debt computed with the first one, it is used as the definition of debt for that country. **Table A.2, *Debt variable definition*** provides the list of countries for which the variable is available and the definition used: (1) or (2).

Table A.2, *Debt variable definition*

Country	Adopted definition	Country	Adopted definition
Austria	N/A	Latvia	N/A
Belgium	(1)	Lithuania	(1)
Croatia	N/A	Malta	N/A
Estonia	(1)	Poland	(1)

Finland	(1)	Portugal	(1)
France	(1)	Romania	(1)
Germany	(2)	Slovakia	(1)
Hungary	(1)	Slovenia	(2)
Italy	(1)	Spain	(1)

Most countries are using the first definition of debt, reducing the risk of comparability issues; only Germany and Slovenia are adopting the second definition. Therefore, comparability across country on the levels of debt should be carried with caution. All countries use the same definition in their 20E or full samples.

A.1.2. Cash flow variable

Similarly to the case of the debt variable (paragraph above), the cash flow indicator is obtained in two different ways, in order to have the highest number of observation available: either it is directly coming as a raw variable from countries' datasets (1) or it is computed as a sum of the raw variables operating profits and losses (EBIT) and depreciation (2).

If the cash flow variable, computed with the second definition, is available for at least 30% more firms than the cash flow computed with the first one, it is used as the definition of cash flow for that country. **Table A.3, *Cash flow variable definition*** provides the list of countries for which the variable is available and the definition used: (1) or (2).

Table A.3, *Cash flow variable definition*

Country	**Adopted definition**	**Country**	**Adopted definition**
Austria	N/A	Latvia	N/A
Belgium	(1)	Lithuania	(1)
Croatia	N/A	Malta	N/A
Estonia	(1)	Poland	(2)
Finland	(1)	Portugal	(1)
France	(1)	Romania	(1)
Germany	(1)	Slovakia	(1)
Hungary	(1)	Slovenia	(1)
Italy	(1)	Spain	(1)

A.1.3. Treatment of the raw financial variables

Firm-level data is often distorted by outliers. The raw financial variables are cleaned from severe outliers, i.e. values without relevant economic meaning. To give an example, negative values of turnover or total assets are set to missing and excluded from the rest of the analysis.

Before checking the existence of outliers, some confidentiality rules have been applied. First, all the firms with less than 1 employee (self-employed) were dropped from the dataset; second, industries/year with less than 10 firms were also dropped- on top of the country-specific rules applied to the firm-level data.

Besides the simple cleaning applied to the raw financial variables, mentioned in the previous section, the outlier treatment is performed on the financial indicators. Given that several indicators are ratios, this procedure ensures that the extreme values that might be generated computing the indicators, are excluded. Technically speaking, the CompNet code contains multiple cleaning routines, applied one after the other in the following order.

The first one generates the 1st and the 99th percentiles of the distribution of each indicator, by sector. Then, it excludes every value which is smaller or bigger than the thresholds, setting it as missing.

The second one excludes all the values which are outside the interval:

$$median \pm 10 \cdot iqr$$

That is, the median of the distribution of each indicator (by sector) plus/minus ten times the interquartile range of the same distribution. The number 10 is the result of a trial and error process that led us to successfully eliminate outliers.

The third and last routine drops the observations of the ratios that should not exceed unity: this might happen, for example, due to some data entry errors at the credit registries or statistical offices.

For a detailed analysis of the impact of the outliers' treatment, please refer to Lopez-Garcia, di Mauro and the CompNet Task Force (2015).

A.2. *Definition of the indicators and availability tables*

A.2.1. Definition of the indicators

In this appendix we present an overview of the indicators' definition, their economic interpretation and a graphical representation of the trends over the period 1995-2012, across firms' size class and macro sector. For the latter, we decided to use the full sample in order to provide a wider overview of the general patterns. A drawback of this choice is that the incompleteness of the dataset related to the first years of the period considered (due to the temporal discrepancies of countries' availability of data) led, in several cases, to relevant fluctuations in the trends. Therefore, the reader should be aware that simple time comparison of the trends regarding the beginning of the sample could be misleading.

Cash flow over total assets. The indicator is computed as:

$$\frac{cash\ flow}{total\ assets}$$

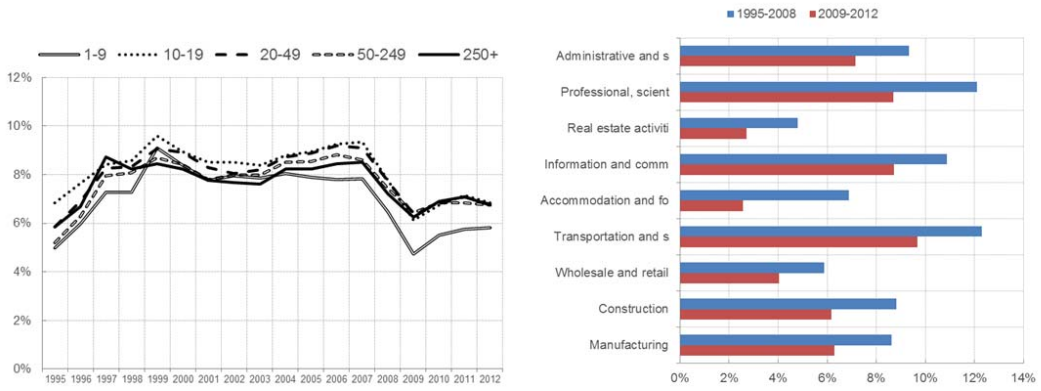
Where:

- $\boldsymbol{cash\ flow}$ stands for EBIT + depreciation.
- $\boldsymbol{total\ assets}$ stands for the sum of total fixed assets plus current assets.

This indicator is used to estimate the quality of a company's earnings as it shows how efficiently the company is using its assets to collect cash from sales and customers. The higher the ratio, the more efficient the company is. It should be noted, however, that the ratio of cash flow over total assets is not directly related to income or profitability. Therefore, a company with an extremely high ratio might still report a loss on the income statement for the year.

Figure 33 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. As it can be seen, micro firms have been displaying lower level of cash flow since 2004 compared to the other firms and, consequently, the gap with the other size classes increased. The after-crisis drop in 2008-09 is shared by firms of all size classes though the largest firms seem to suffer less. Shifting to a sectoral level analysis, we are able to see that the level of cash flow is largely heterogeneous among the different sectors, but the decreasing trend after 2007 is common to all of them.

Figure 33 , *Cash flow over TA median in the full sample, by size class (left) and macro sector (right)*



Investment ratio. The indicator is computed as:

$$\frac{K_t - K_{t-1} + depreciation}{K_{t-1}}$$

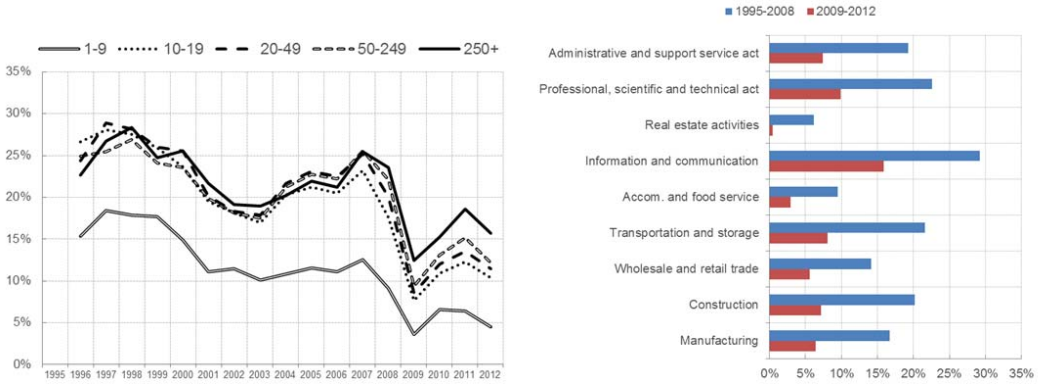
Where:

- K_t stands for fixed assets at time t.
- K_{t-1} stands for lagged fixed assets (fixed assets at time t-1)
- $depreciation$ stands for the amortization of fixed assets.

The investment ratio is defined as the increase in the capital stock, and thus quantifies the accumulation of fixed capital. The higher the ratio, the more the firm is investing and this should be reflected in its workers' labour productivity. Moreover, the level of fixed investment reveals some information about the level of confidence that both business owners and managers have about the ability to be profitable in the next few years: they would avoid accumulating additional capital in fixed assets, unless they have profitable plans ahead.

Figure 34 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. The first pattern that stands out is the considerable lower level of investment of micro firms. Over the whole period, they exhibit a far lower investment ratio than the other firms' level. The second one is the recovery among large companies after the crisis. Looking at the evolution across sectors, it appears that they all have been hit severely by the crisis. However, there are marked differences among sectors due to their different requirement of capital for their own businesses.

Figure 34, *Investment ratio median in the full sample, by size class (left) and macro sector (right)*



Profit Margin. The indicator is computed as:

$$\frac{profit/losses}{turnover}$$

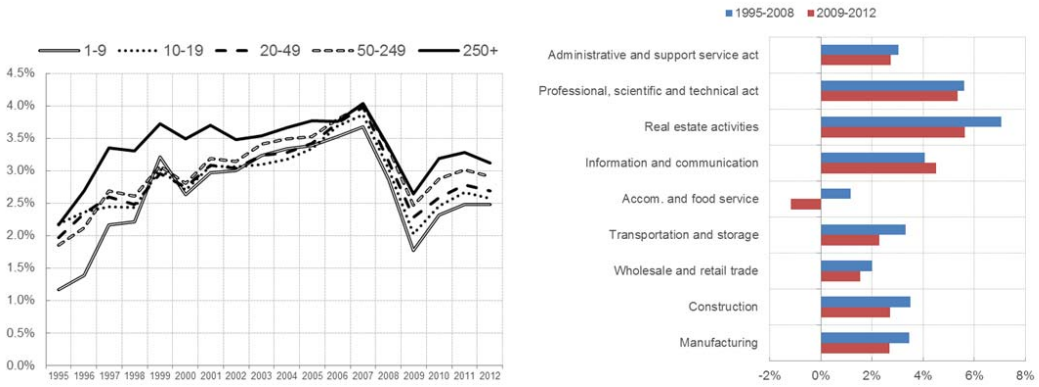
Where:

- $\boldsymbol{profits/losses}$ stands for operating profits or losses.
- $\boldsymbol{turnover}$ **or sales**

Profit margin is a measure of the amount of profit accruing to a firm from the sale of products and services. It also provides an indication of efficiency since it captures the amount of surplus generated per unit of the product or service sold. Profit margins vary greatly between sectors. Hence, across-time comparison of profit margin should be done carefully because of the cyclical trend of many industries.

Figure 35 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. We can see that the levels of the profit margin of the different size classes were converging to high values before the crisis. By contrast, after 2007 they started to diverge. The crisis had a negative impact on all the sectors except for "Information and Communication" that increased its level of profit margin. It has to be noted that the "Accommodation and Food Service" has reached a negative average value of the profit margin after the crisis.

Figure 35, *Profit margin median in the full sample, by size class (left) and macro sector (right)*



Return on Assets (RoA). The indicator is computed as:

$$\frac{profits/losses}{\frac{TA_t + TA_{t-1}}{2}}$$

Where:

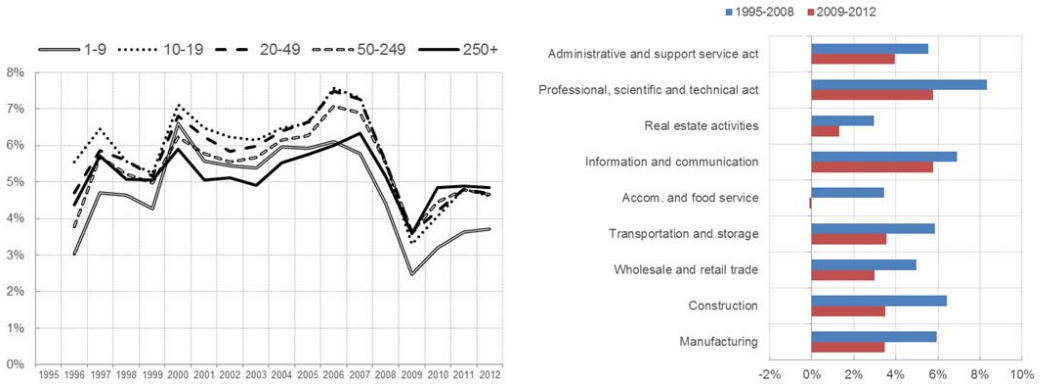
- $\boldsymbol{profits/losses}$ stands for operating profits or losses.
- $\boldsymbol{TA_t}$ stands for total assets, defined as total fixed assets plus current assets.

- $\boldsymbol{TA_{t-1}}$ stands for lagged total assets (i.e. total assets at time t-1).

Return on assets is one important way to measure the overall earning power or profitability of a firm. It explains how much earnings were generated from the invested capital. As for the profit margin, RoA can vary substantially between sectors.

From **Figure 36** we can see that the largest firms were not the most profitable before the crisis and that they suffered from the lowest impact from it. The level of RoA is also very different among the sectors but the crisis had a negative impact on all of them. Moreover, "Accommodation and Food Services" has reached a "zero profitability" level after the crisis.

Figure 36, *RoA median in the full sample, by size class (left) and macro sector (right)*



Equity over debt. This indicator is computed as:

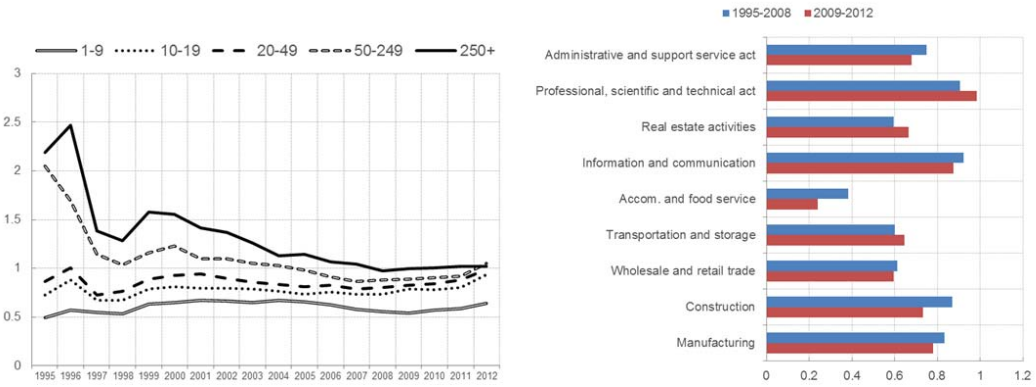
$$\frac{equity}{debt}$$

Where:

- $\boldsymbol{equity}$, or shareholders' funds, stands for a company's assets minus liabilities.
- $\boldsymbol{debt}$ stands for money or services owed to an outside party; for further details about its definition in CompNet see Appendix A.1.1.

The equity over debt ratio indicates which proportion of debt and equity a company is using to finance its assets. The lower the ratio, the more exposed the company. The indicator is positively related to size: larger firms tend to be either relatively more capitalized or less indebted (see **Figure 37**). The level of the ratio also depends on the sector in which the firm operates. After the crisis, in few sectors the equity over debt ratio has increased, like in "Professional, scientific and technical activities", "Real estate activities" and "Transportation and storage".

Figure 37, *Equity over debt median in the full sample, by size class (left) and macro sector (right)*



Equity ratio. The indicator is computed as:

$$\frac{equity}{total\ assets}$$

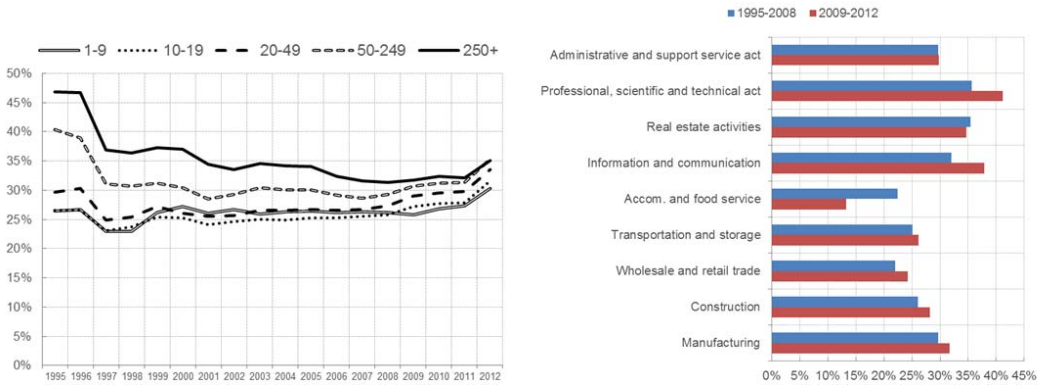
Where:

- ***equity***, or shareholders' funds, stands for company's assets minus liabilities.
- ***total assets*** stands for total fixed assets plus current assets.

The equity ratio should determine how much shareholders would receive in the event of a company-wide liquidation. The ratio represents the amount of assets on which shareholders have a residual claim. Care should be taken in interpreting time-trends because for countries such as Germany and Slovenia the dataset is built using a different definition of debt.

Figure 38 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. The ratio shows a quite stable trend before the crisis except for the largest firms whose median equity ratio decreased until 2011. As a consequence of the crisis, the ratio slightly increased for all the size classes and all the macro-sectors. "Real Estate Activities" and "Accommodation and Food Services" were the only sectors where the firms either increased their level of indebtedness or diminished their capitalization.

Figure 38, *Equity ratio median in the full sample, by size class (left) and macro sector (right)*



Leverage. The indicator is computed as:

$$\frac{debt}{total\ assets}$$

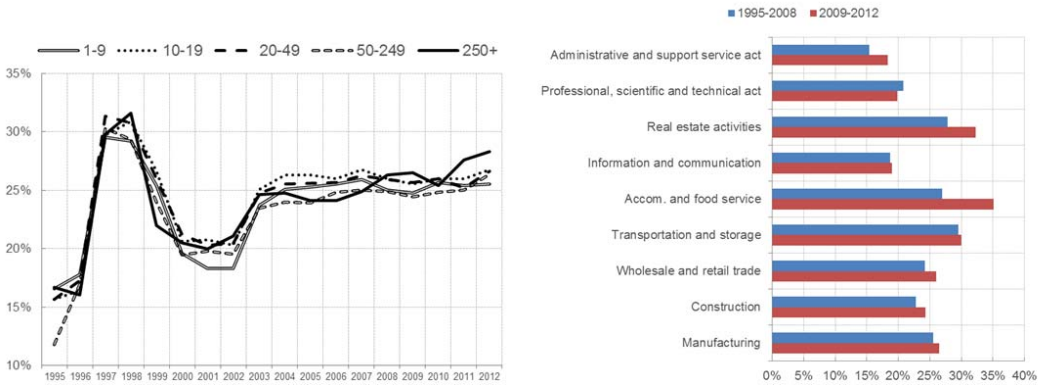
Where:

- $\boldsymbol{debt}$ stands for money owed to an outside party.
- $\boldsymbol{total\ assets}$ stands for total fixed assets plus current assets.

Leverage measures the relative proportion of external funds used to finance the firm's assets: it gives a good picture of the firm's level of indebtedness. The higher the leverage, the higher the value of the debt compared to the firm's assets.

Figure 39 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. The ratio seems to be not related to the firm's size and the level of all the sizes has been slightly increasing since 2003. The effect of the crisis was homogenously positive on the different sectors with the only exception of the "Professional, scientific and technical activities" that is the only sector that suffered from a negative impact of the crisis.

Figure 39, *Leverage median in the full sample, by size class (left) and macro sector (right)*



Trade credit. The indicator is computed as:

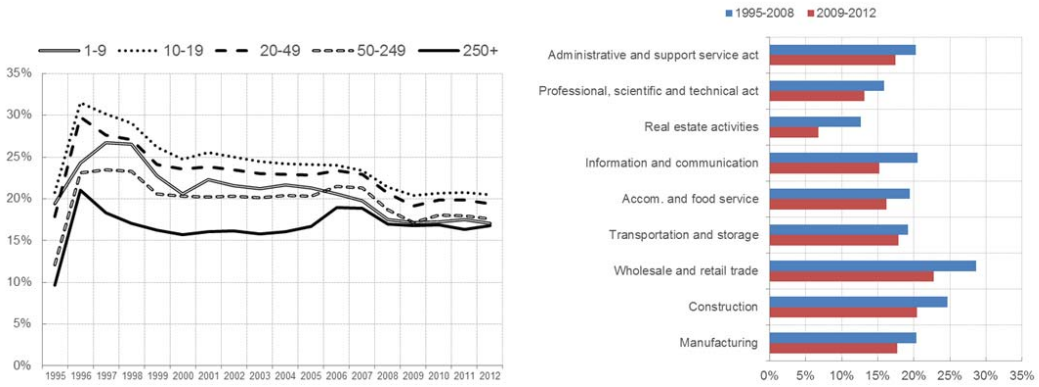
$$\frac{accounts\ payable}{total\ assets}$$

Where:

- $\boldsymbol{accounts\ payable}$ stands for the obligations to pay for goods or services that have been acquired from suppliers and yet have to be paid.
- $\boldsymbol{total\ assets}$ stands for total fixed assets plus current assets.

This indicator measures the credit received by a trader from another for the purchase of goods and services. Trade credit is an important source of finance for firms, especially for those which find it difficult to obtain external funding via credit institutions. **Figure 40** shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. The picture shows the procyclical pattern of trade credit as it is closely linked to the exchange of goods and services. The indicator is inversely related to the size of the firms with the only exception of the micro firms. At sectoral level, the crisis had a negative impact across all sectors.

Figure 40, *Trade credit median in the full sample, by size class (left) and macro sector (right)*



Interest payments burden. The indicator is computed as:

$$\frac{interests}{profits/losses}$$

Where:

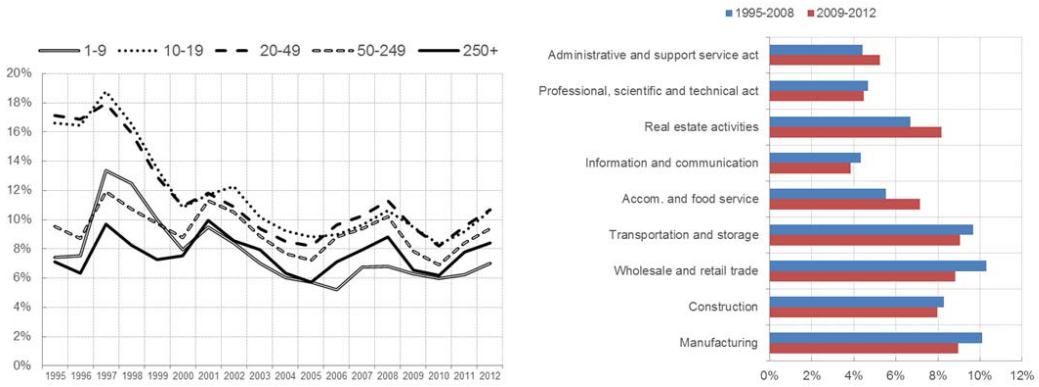
- $\boldsymbol{interests}$ stands for interest paid by the firm, inclusive of financial charges.
- $\boldsymbol{profits/losses}$ stands for operating profits or losses.

The indicator shows whether the firm is able to repay the interest with the profits of their business and how large the interest payment is. A very high value of this ratio means that the company might encounter serious difficulties in repaying its debt. It should be noted that the ratio has been computed only for firms with profits[37].

Figure 41 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. The indicator is inversely related to the size of the firms with the only exception of the micro firms. Overall, small firms tend to report higher levels of interest payment burden than large firms.

[37] This was made in order to preserve the 'interest rate' interpretation of the ratio, which would be meaningless for the firms with losses. For the calculation of the ICC, the IFP (Index of Financial Pressure) all negative values of the ratio have been replaced with the top 95th percentile of the distribution of the indicator (i.e. the most distressed firms).

Figure 41, *Interest payment burden median in the full sample, by size class (left) and macro sector (right)*



Implicit rate. The indicator is computed as:

$$\frac{interests}{\frac{debt_t + debt_{t-1}}{2}}$$

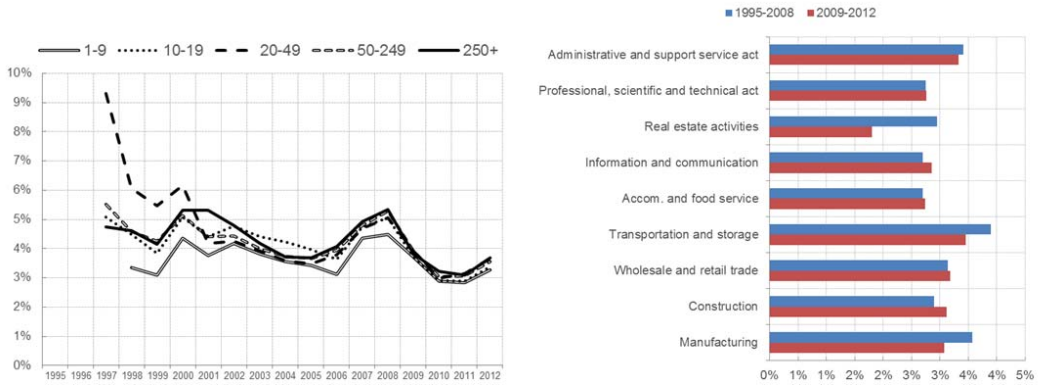
Where:

- $\boldsymbol{interests}$ stands for interest paid by the firm, inclusive of financial charges.
- $\boldsymbol{debt_t}$ stands for money or services owed to an outside party.
- $\boldsymbol{debt_{t-1}}$ is the debt of the firm at time t-1 (lagged debt).

This indicator represents an approximation of the interest rate on the outstanding debt, providing information on the cost of financing.

Looking at **Figure 42**, the differences across firm sizes have become smaller over time and the largest reduction in the implicit interest rate ratio is in the "Real estate activities".

Figure 42 *Implicit rate median in the full sample, by size class (left) and macro sector (right)*



Inventory turnover. The indicator is constructed as:

$$\frac{stock}{turnover}$$

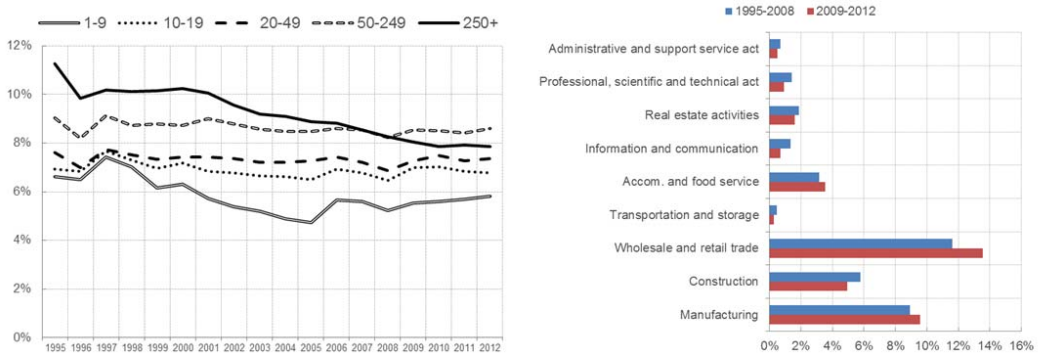
Where:

- $\boldsymbol{stock}$ stands for total inventories of the firm.
- $\boldsymbol{turnover}$ or sales

The inventory turnover ratio points out how large the inventory is compared to the turnover of the firm. When high, it implies poor sales and an excessively large inventory; when low, it signals strong sales. High inventory levels are usually not desirable, since they expose the company to troubles should prices begin to fall.

Figure 43 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. The indicator is positively related to firm size and does not change over the sample period. However, firms with more than 250 employees display a decreasing trend showing their higher flexibility in managing inventories in the business cycle. After the crisis, the ratio has increased in most sectors, signalling the increased difficulties of companies in reducing their inventories.[38]

Figure 43 *Inventory turnover median in the full sample, by size class (left) and macro sector (right)*



Financing gap. The indicator is computed as:

$$\frac{total\ investment - cash\ flow}{turnover}$$

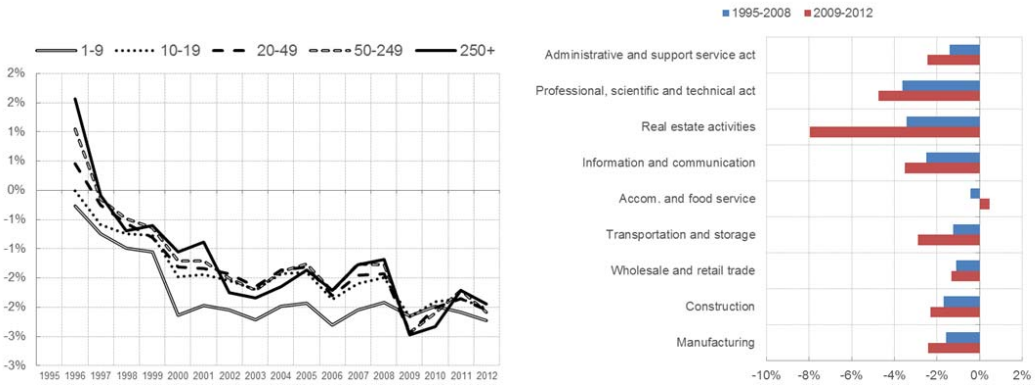
[38] Data referring to the real estate sector does not include Portugal, due to some inconsistencies in the definition of the ratio.

Where:

- ***total investment*** is defined as the increase with respect to the previous year in the stock of fixed assets, net of depreciation: it corresponds to the numerator of the investment ratio (see above): $K_t - K_{t-1} + depreciation$.
- ***cash flow*** stands for EBIT + depreciation.
- ***turnover*** or sales.

Under the pecking order hypothesis that the firms would invest first its cash flow, this indicator expresses how many external resources are needed by a firm for its investments. A large value of the ratio signals a need of external financing and, then, an increase in debt. The development over time of the financing gap is related to the business activity. Once investment is dropping, the financing gap is declining, as happened in 2009 (see **Figure 44**). The recent increase in the financing gap is more closely linked to low profitability of firms hit by the economic recession. In the CompNet sample the median financing gap is always negative and has increased after the crisis.

Figure 44 *Financing gap median in the full sample, by size class (left) and macro sector (right)*



Cash holdings. This indicator is computed as:

$$\frac{cash\ and\ cash\ equivalents}{total\ assets}$$

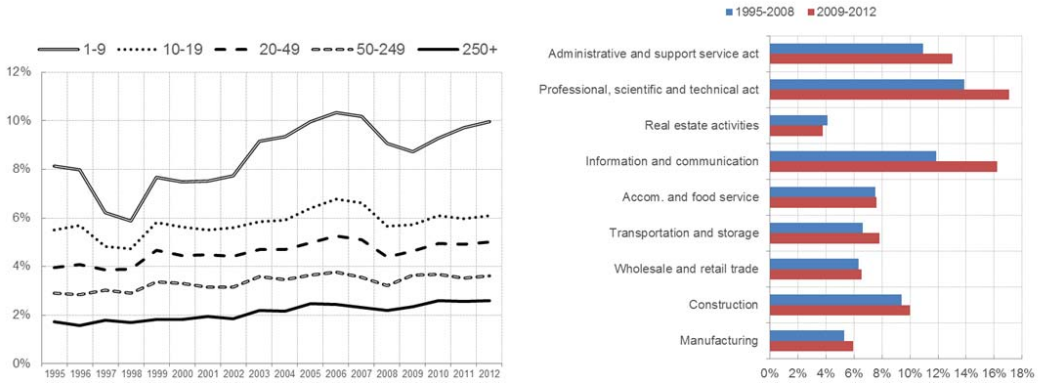
Where:

- ***cash and cash equivalents*** includes the available cash and all the liquid bonds/stocks (e.g., government debt) in the balance-sheet of a firm.
- ***total assets*** stands for total fixed assets plus current assets.

This simple ratio indicates the liquidity of a business. A high value for the ratio indicates a large availability of liquidity which is not negative per se but, when persistent, might signal a scarce ability of reinvesting the cash into other assets. The indicator varies largely by sector, since in some industries the firms need to maintain larger amounts of cash for their core business.

Figure 45 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. Cash holdings are inversely related to the size. Although the general pattern is shared by all industries, micro firms experience a steeper increase during this time period, widening the difference with the other firms. The effect of the crisis was negative across sectors probably reflecting the decrease either in investment[39] or in cash flows[40].

Figure 45, *Cash holdings median in the full sample, by size class (left) and macro sector (right)*



Collateral. The indicator is computed as:

$$\frac{K}{total\ assets}$$

Where:

- $\boldsymbol{K}$ stands for fixed assets.
- $\boldsymbol{total\ assets}$ stands for total fixed assets plus current assets.

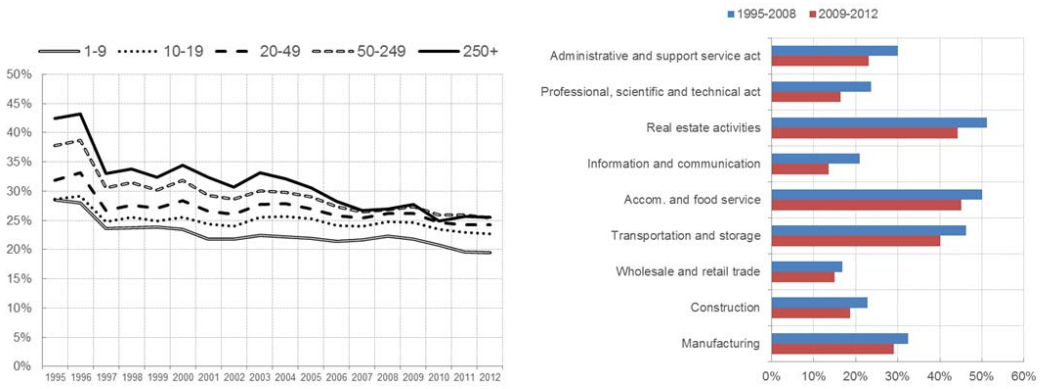
This indicator specifies the proportion of assets that might be potentially used as collateral over the total assets. This is because fixed assets are often used as a guarantee when debt is issued; a high level of the ratio should indicate a higher probability of receiving a loan.

Figure 46 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. Collateral is positively related to the size, probably reflecting that larger firms have

[39] See Investment ratio for further details.
[40] See Cash flow over total assets and financing gap for further details.

proportionally more fixed assets. All sectors were affected by the crisis in terms of a generalized reduction in the levels of collateral.

Figure 46 *Collateral median in the full sample, by size class (left) and macro sector (right)*



Depreciation. The indicator is computed as:

$$\frac{depreciation\ rate}{total\ assets}$$

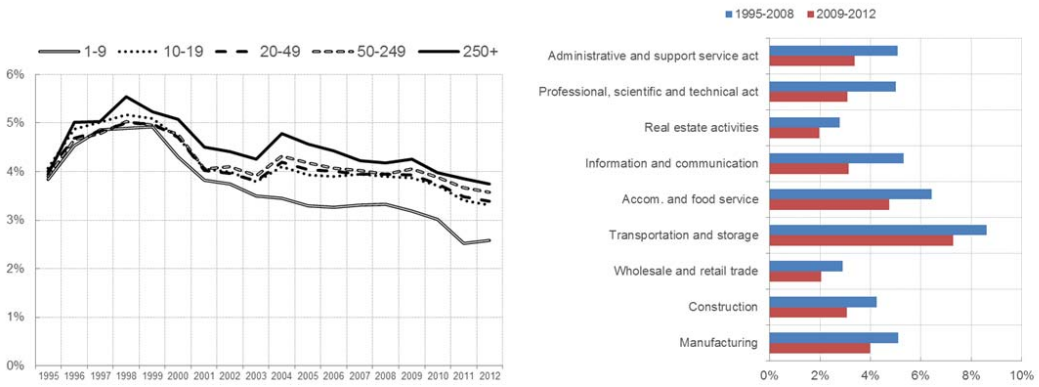
Where:

- $\boldsymbol{depreciation\ rate}$ stands for the depreciation on intangible assets and tangible assets.
- $\boldsymbol{total\ assets}$ stands for total fixed assets plus current assets.

This indicator points to the decline in the economic potential of firm's assets. It can be highly relevant for firms' investment decisions, given that a high value indicates great expenses for the replacement of firms' fixed assets.

Figure 47 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. The indicator is positively related to the size. Although the general trend is shared by all firms, the gap between micro firms and the other firms has been widening since 2003. This might indicate that larger firms need a faster turnover of their assets. The crisis had a negative impact on all sectors.

Figure 47 *Depreciation median in the full sample, by size class (left) and macro sector (right)*



Trade debt. The indicator is computed as:

$$\frac{accounts\ receivable}{total\ assets}$$

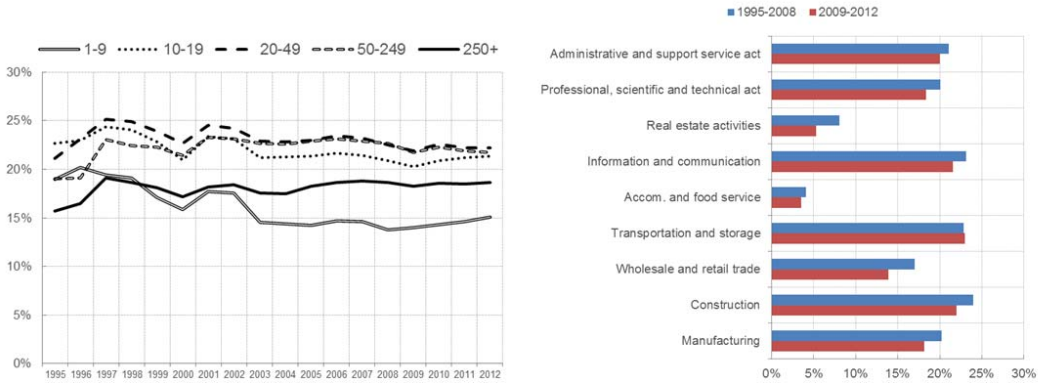
Where:

- ***accounts receivable*** stands for the amount due to the company on account for sold goods or services.
- ***total assets*** stands for total fixed assets plus current assets.

Trade debt measures the quantity of credit due to the sales management of a company. A high level of this indicator should indicate a future incoming cash flow.

Figure 48 shows the development of the indicator across firms' size classes and sectors for the period 1995-2012. Looking across size, our data show that middle-sized firms make more use of trade debt than micro and very large companies. Across sectors, accounts receivable are usually more diffused in sectors where there is a physical good involved, although in our case high ratios are recorded also for sectors providing services.

Figure 48 *Trade debit median in the full sample, by size class (left) and macro sector (right)*



A.2.2. Availability Table

Table 10, *Availability table of indicators for the 20E sample*

Type of indicator	Indicator	Short description	Austria	Belgium	Croatia	Estonia	Finland	France	Germany	Hungary
Performance indicators	*cash_flow_ta*	Cash flow over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
	invest_ratio	Investment ratio: change in the stock of fixed capital	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2004-2012
	profitmargin	EBIT over turNover	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	No
	roa	Return on Assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	No
Structure of external funding	*equity_debt*	Equity over debt	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
	equity_ratio	Equity over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
	leverage	Debt over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
	trade_credit	Trade credit: accounts payable over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	No
Financial fragility	*debt_burd*	Debt burden: interest paid over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	No
	implicit_rate	Implicit interest rate: interest paid over the stock of debt	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	No
	inv_turnover	Inventory turnover: inventories as a fraction of turnover	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
Financial independence	*financial_gap*	Financing gap: total investment minus cash flow, over turnover	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2004-2012
Other financial indicators	*cash_holdings*	Cash and cash equivalents over total assets	No	2001-2010	No	2001-2012	2001-2012	2002-2012	2001-2012	2003-2012
	collateral	Collateral: fixed assets over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
	depr_k	Depreciation rate over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
	trade_debt	Trade debt: accounts receivable over total assets	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2003-2012
Credit constraints indicators	*absconstrained*	Indicator of financial constraints (FR indicator)	No	2001-2010	No	2001-2012	2001-2012	2001-2012	2001-2012	2004-2012
	SAFE	Indicator of financial constraints (ICC indicator)	No	2001-2010	No	2001-2012	2001-2012	2002-2012	2001-2012	No

Type of indicator	Indicator	Short description	Italy	Lithuania	Malta	Poland	Portugal	Romania	Slovakia	Slovenia	Spain
Performance indicators	*cash_flow_ta*	Cash flow over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2001-2011	2001-2012	2001-2012
	invest_ratio	Investment ratio: change in the stock of fixed capital	2002-2012	2001-2011	No	2006-2012	2007-2012	2004-2012	2001-2011	2001-2012	2001-2012
	profitmargin	EBIT over turNover	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2001-2011	2001-2012	2001-2012
	roa	Return on Assets	2002-2012	2001-2011	No	2006-2012	2007-2012	2004-2012	2001-2011	2001-2012	2001-2012
Structure of external funding	*equity_debt*	Equity over debt	2001-2012	2001-2011	No	2005-2012	2006-2012	No	No	2001-2012	2008-2012
	equity_ratio	Equity over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2010-2011	2001-2012	2001-2012
	leverage	Debt over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	No	No	2001-2012	2008-2012
	trade_credit	Trade credit: accounts payable over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	No	2001-2011	2001-2012	2008-2012
Financial fragility	*debt_burd*	Debt burden: interest paid over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2001-2011	2001-2012	2001-2012
	implicit_rate	Implicit interest rate: interest paid over the stock of debt	2002-2012	2001-2011	No	2006-2012	2007-2012	No	No	2001-2012	2009-2012
	inv_turnover	Inventory turnover: inventories as a fraction of turnover	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2001-2011	2001-2012	2001-2012
Financial independence	*financial_gap*	Financing gap: total investment minus cash flow, over turnover	2002-2012	2001-2011	No	2006-2012	2007-2012	2004-2012	2001-2011	2001-2012	2001-2012
Other financial indicators	*cash_holdings*	Cash and cash equivalents over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	No	2001-2012	2001-2012
	collateral	Collateral: fixed assets over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2001-2011	2001-2012	2001-2012
	depr_k	Depreciation rate over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2001-2011	2001-2012	2001-2012
	trade_debt	Trade debt: accounts receivable over total assets	2001-2012	2001-2011	No	2005-2012	2006-2012	2003-2012	2001-2011	2001-2012	2008-2012
Credit constraints indicators	*absconstrained*	Indicator of financial constraints (FR indicator)	2002-2012	2001-2011	No	2006-2012	2007-2012	No	No	2001-2012	2009-2012
	SAFE	Indicator of financial constraints (ICC indicator)	2002-2012	2001-2011	No	2005-2012	2006-2012	No	No	2001-2012	2008-2012

Table 11, *Availability table of indicators for the full sample*

Type of indicator	Indicator	Short description	Austria	Belgium	Croatia	Estonia	Finland	France	Germany	Hungary
Performance indicators	*cash_flow_ta*	Cash flow over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
	invest_ratio	Investment ratio: change in the stock of fixed capital	No	1997-2010	No	1996-2012	2000-2012	No	1998-2012	2004-2012
	profitmargin	EBIT over turNover	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	No
	roa	Return on Assets	No	1998-2010	No	1996-2012	2000-2012	No	1998-2012	No
Structure of external funding	*equity_debt*	Equity over debt	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
	equity_ratio	Equity over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
	leverage	Debt over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
	trade_credit	Trade credit: accounts payable over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	No
Financial fragility	*debt_burd*	Debt burden: interest paid over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	No
	implicit_rate	Implicit interest rate: interest paid over the stock of debt	No	1998-2010	No	1996-2012	2000-2012	No	1998-2012	No
	inv_turnover	Inventory turnover: inventories as a fraction of turnover	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
Financial independence	*financial_gap*	Financing gap: total investment minus cash flow, over turnover	No	1997-2010	No	1996-2012	2000-2012	No	1998-2012	2004-2012
Other financial indicators	*cash_holdings*	Cash and cash equivalents over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
	collateral	Collateral: fixed assets over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
	depr_k	Depreciation rate over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
	trade_debt	Trade debt: accounts receivable over total assets	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	2003-2012
Credit constraints indicators	*absconstrained*	Indicator of financial constraints (FR indicator)	No	1998-2010	No	1996-2012	2000-2012	No	1998-2012	2004-2012
	SAFE	Indicator of financial constraints (ICC indicator)	No	1997-2010	No	1995-2012	1999-2012	No	1997-2012	No

Type of indicator	Indicator	Short description	Italy	Lithuania	Malta	Poland	Portugal	Romania	Slovakia	Slovenia	Spain
Performance indicators	*cash_flow_ta*	Cash flow over total assets	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	1995-2012
	invest_ratio	Investment ratio: change in the stock of fixed capital	2002-2012	2001-2011	No	No	2007-2012	2004-2012	No	1996-2012	1996-2012
	profitmargin	EBIT over turNover	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	1995-2012
	roa	Return on Assets	2002-2012	2001-2011	No	No	2007-2012	2004-2012	No	1996-2012	1996-2012
Structure of external funding	*equity_debt*	Equity over debt	2001-2012	2000-2011	No	No	2006-2012	No	No	1995-2012	2008-2012
	equity_ratio	Equity over total assets	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	1995-2012
	leverage	Debt over total assets	2001-2012	2000-2011	No	No	2006-2012	No	No	1995-2012	2008-2012
	trade_credit	Trade credit: accounts payable over total assets	2001-2012	2000-2011	No	No	2006-2012	No	No	1995-2012	2008-2012
Financial fragility	*debt_burd*	Debt burden: interest paid over total assets	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	2005-2012	1995-2012
	implicit_rate	Implicit interest rate: interest paid over the stock of debt	2002-2012	2001-2011	No	No	2007-2012	No	No	2005-2012	2009-2012
	inv_turnover	Inventory turnover: inventories as a fraction of turnover	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	1995-2012
Financial independence	*financial_gap*	Financing gap: total investment minus cash flow, over turnover	2002-2012	2001-2011	No	No	2007-2012	2004-2012	No	1996-2012	1996-2012
Other financial indicators	*cash_holdings*	Cash and cash equivalents over total assets	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	1995-2012
	collateral	Collateral: fixed assets over total assets	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	1995-2012
	depr_k	Depreciation rate over total assets	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	1995-2012
	trade_debt	Trade debt: accounts receivable over total assets	2001-2012	2000-2011	No	No	2006-2012	2003-2012	No	1995-2012	2008-2012
Credit constraints indicators	*absconstrained*	Indicator of financial constraints (FR indicator)	2002-2012	2001-2011	No	No	2007-2012	No	No	1996-2012	2009-2012
	SAFE	Indicator of financial constraints (ICC indicator)	2001-2012	2000-2011	No	No	2006-2012	No	No	2005-2012	2008-2012

A.3. *A comparison with samples derived from two different firm-level datasets*

The aim of this section is to compare the CompNet financial indicators with similar indicators based on other firm-level-based data sources. We consider two different samples used for two different 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.

A.3.1. Firm level dataset - SIR 2013 (BvD Amadeus)

The first sample is derived from the firm-level database used for the firm-level analysis in Chapter 3 of the SIR 2013 (ECB Structural Issues Report, "Corporate finance and economic activity in the euro area"). This was originally based on the Bureau van Dijk Amadeus database, which includes comparable financial information for public and private companies. The ECB database included firms located in all 17 euro area countries covering the period from 1993 to 2010. However, as suggested by the authors, owing to a widespread increase in the number of observations across all countries since 2000, in particular for smaller firms, the final published dataset includes data from 2001 to 2010. Moreover, as a final step, and in order to calculate certain variables that required lagged observations in the report and to increase the reliability of firms' data, companies were only considered if they had been monitored for at least three consecutive years. This condition represents a major difference from the CompNet approach where firms could enter and exit from the database every year. For this reason, we slightly revised the SIR sample to let firms be present also for less than 3 consecutive years and we updated this sample to get data until 2012. Moreover, we applied the same data cleaning procedure for the outliers.

Looking at the subsample useful for the comparison with the CompNet data, we could consider only the following euro area countries: Belgium, Finland, France, Germany, Italy, Slovenia and Portugal. The final sample comprises 1.894.801 observations for a total of 457.480 firms. As shown in **Table A.4, *Firm-level sample-SIR2013*** most observations are of companies located in France, Spain and Italy. Among the largest euro area countries, there are fewer firms observed in Germany than in Portugal. The number of observations is lowest for Slovenia and Finland.

Table A.4, *Firm-level sample-SIR2013*

Country	***N Observations***	***N Firms***
BE	86,051	14496
DE	158,664	68928
ES	544,277	115102
FI	55,886	11958
FR	464,300	102380
IT	462,287	114333
PT	100,463	25816
SI	22,873	4467
Total	1,894,801	457480

Source: Amadeus, BvD and ECB elaborations.

Please note that the comparison in this paragraph refers only to the 20E sample.

The first set of figures, **Figure 49** to **Figure 55**, show a comparison of the indicators in levels by country, averaged over the period 2001-2008 (pre-crisis) and 2009-2012 (post-crisis). It appears that most of them share similar dynamics among the two datasets, except for some minor discrepancies. More substantial differences are present in the trade credit and interest payment burden indicators.

Figure 49, *Investment ratio in Amadeus (left) and CompNet (right)*

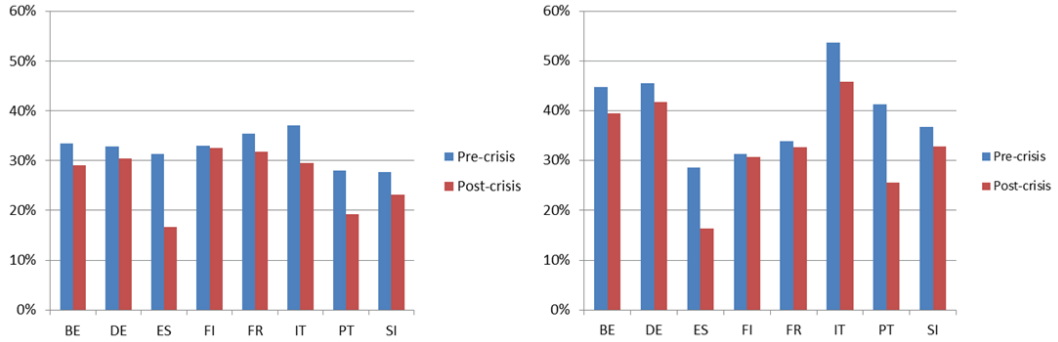


Figure 50, *ROA in Amadeus (left) and CompNet (right)*

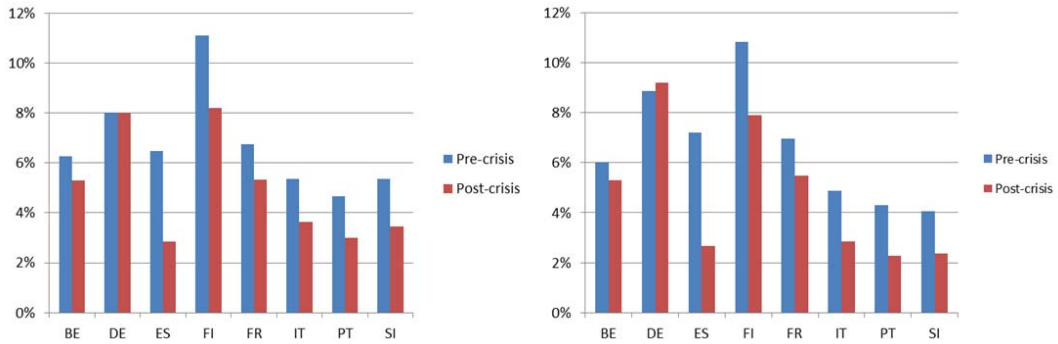


Figure 51, *Trade credit in Amadeus (left) and CompNet (right)*

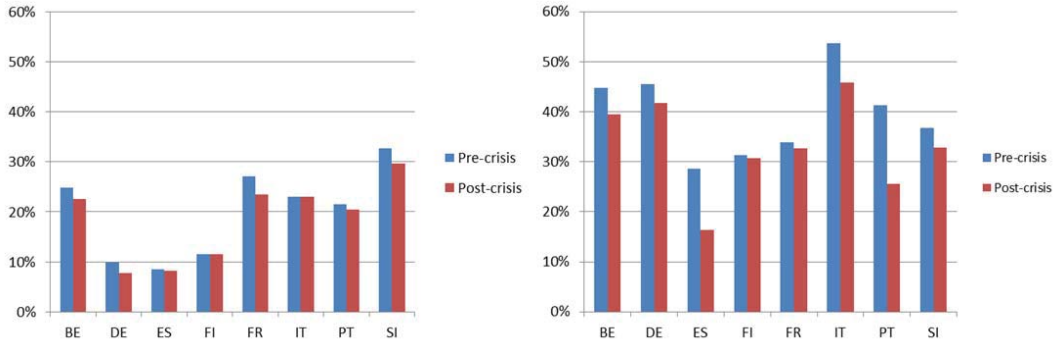


Figure 52, *Interest payment burden in Amadeus (left) and CompNet (right)*

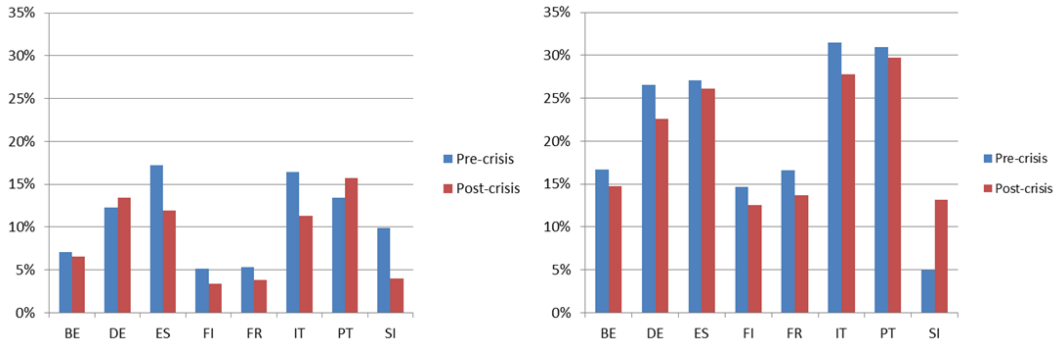


Figure 53, *Cash holdings in Amadeus (left) and CompNet (right)*

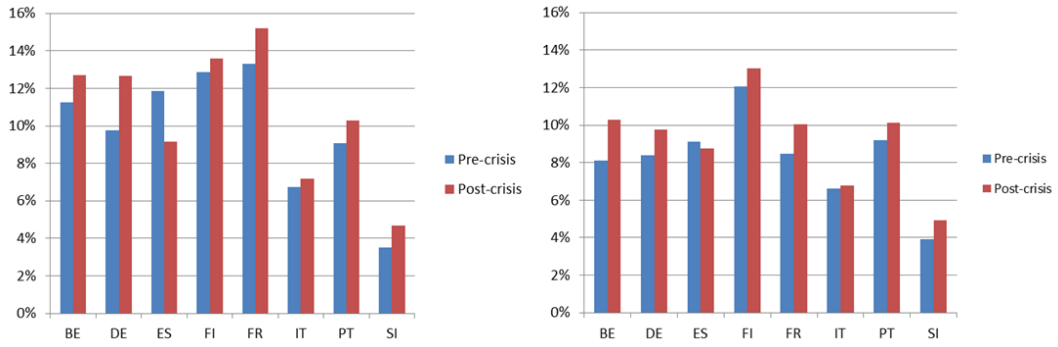


Figure 54, *Collateral in Amadeus (left) and CompNet (right)*

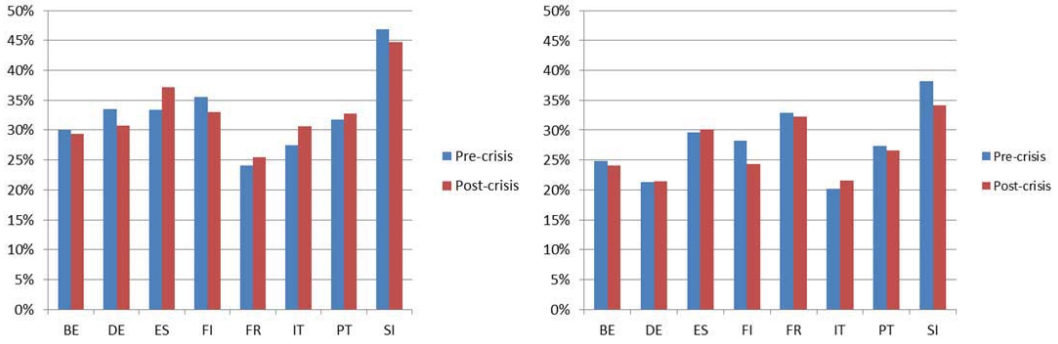
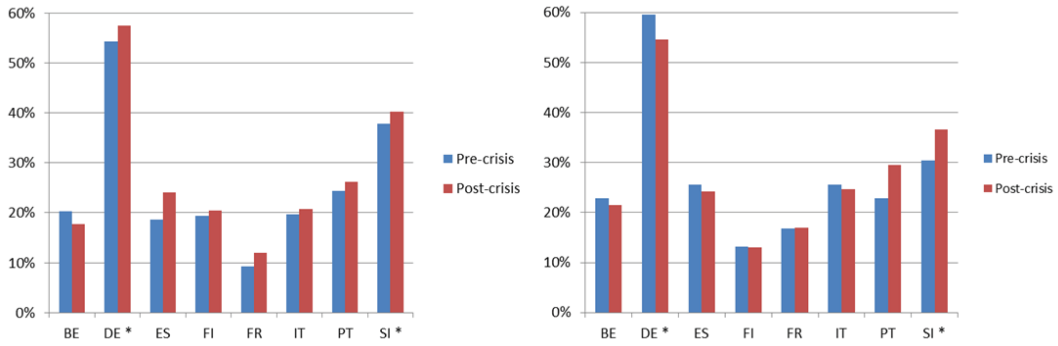


Figure 55, *Leverage in Amadeus (left) and CompNet (right)*[41]



The next set of figures is provided in **Figure 56** to **Figure 63** show a comparison of the indicators in level by macro sector, averaged over the period 2001-2008 (pre-crisis) and 2009-2012 (post-crisis). Again, except for trade credit and interest payment burden, which show a lower level in the Amadeus sample, the indicators are similar.

Figure 56, *Investment ratio by macro sector in Amadeus (left) and CompNet (right)*

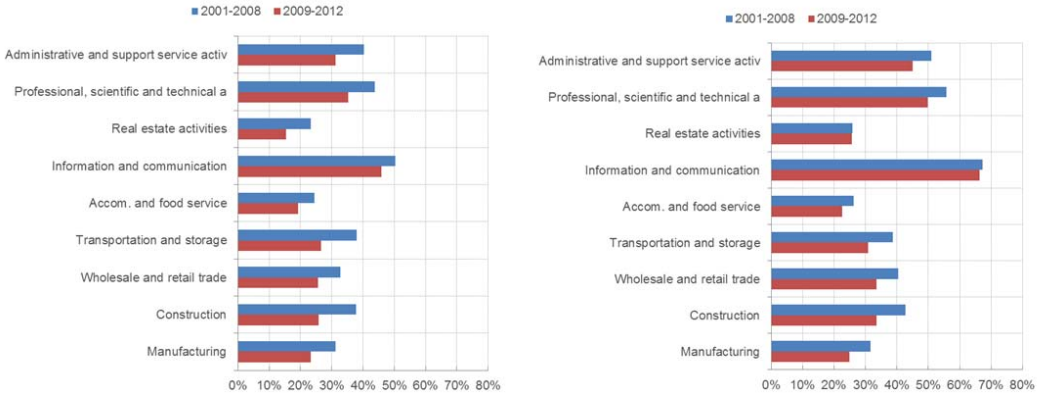
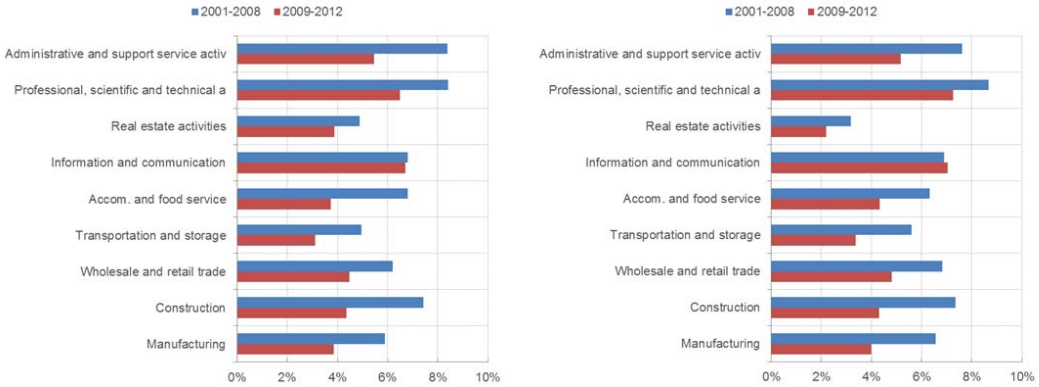


Figure 57, *ROA by macro sector in Amadeus (left) and CompNet (right)*



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

Figure 58, *Trade credit by macro sector in Amadeus (left) and CompNet (right)*

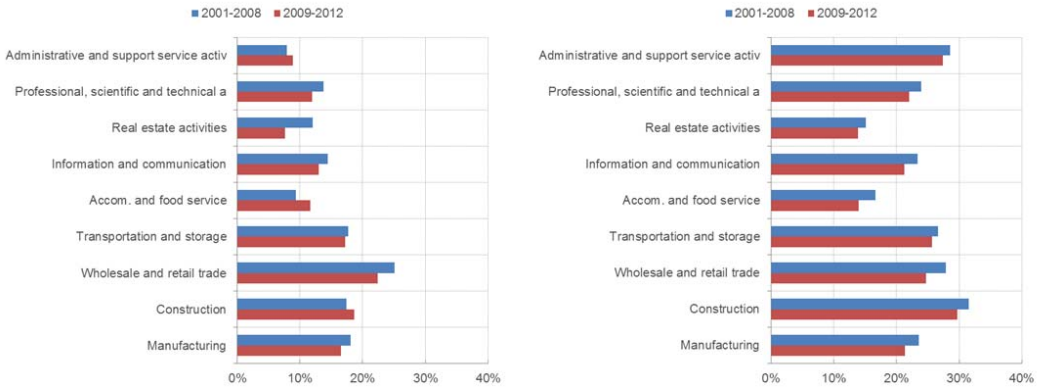


Figure 59, *Interest payment burden by macro sector in Amadeus (left) and CompNet (right)*

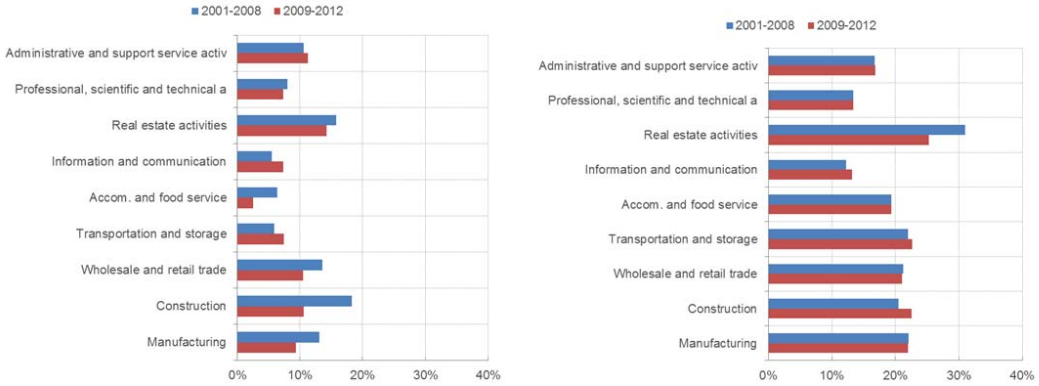


Figure 60, *Cash holdings by macro sector in Amadeus (left) and CompNet (right)*

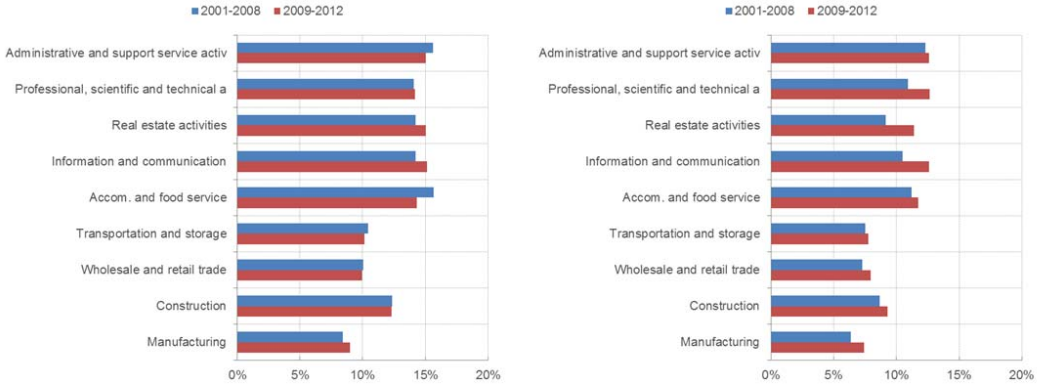


Figure 61, *Collateral by macro sector in Amadeus (left) and CompNet (right)*

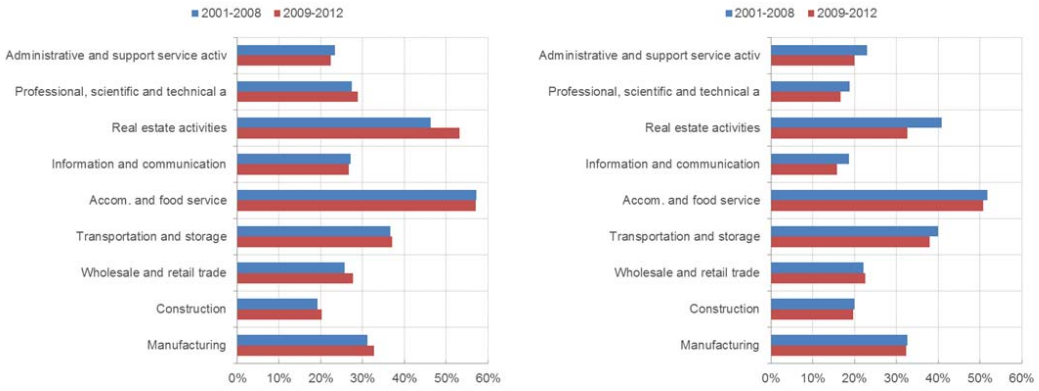


Figure 62, *Leverage by macro sector in Amadeus (left) and CompNet (right), DE and SI excluded*[42]

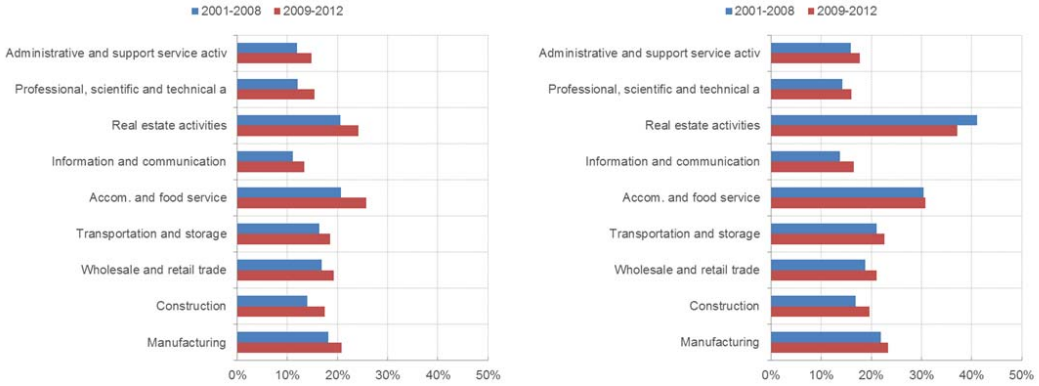
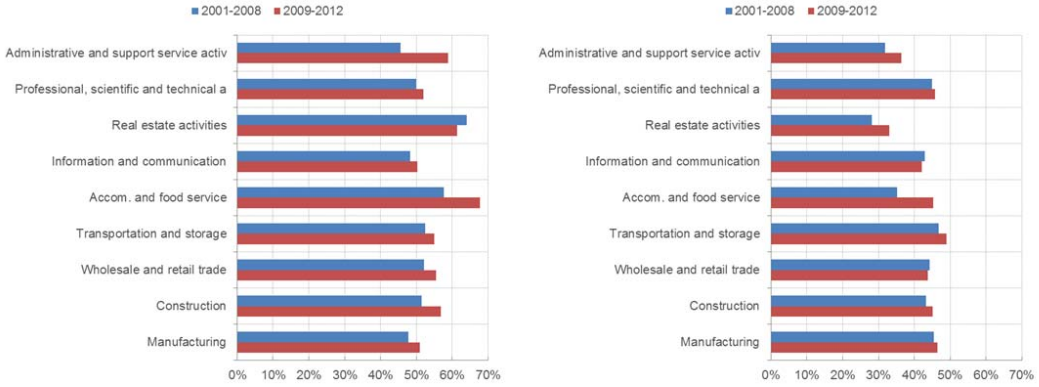


Figure 63, *Leverage by macro sector in Amadeus (left) and CompNet (right), DE and SI only*[42]



Finally, the last set of figures, from **Figure 64** to **Figure 71** shows the evolution of the indicator over time by size class. In line with results from the previous comparisons, some indicators are very similar both in levels and in dynamics (e.g. ROA). The differences in interest payment burden and trade credit persist also along this dimension, and in general the ranking of size classes is often different.

Figure 64, *Investment ratio by size class in Amadeus (left) and CompNet (right)*

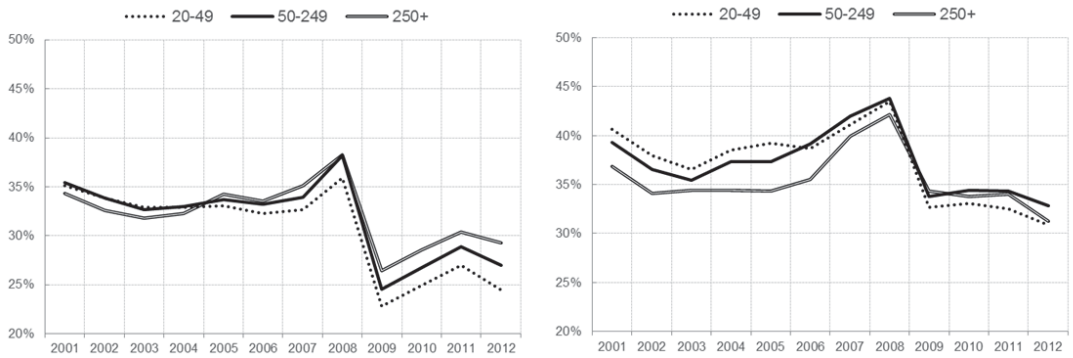


Figure 65, *ROA by size class in Amadeus (left) and CompNet (right)*

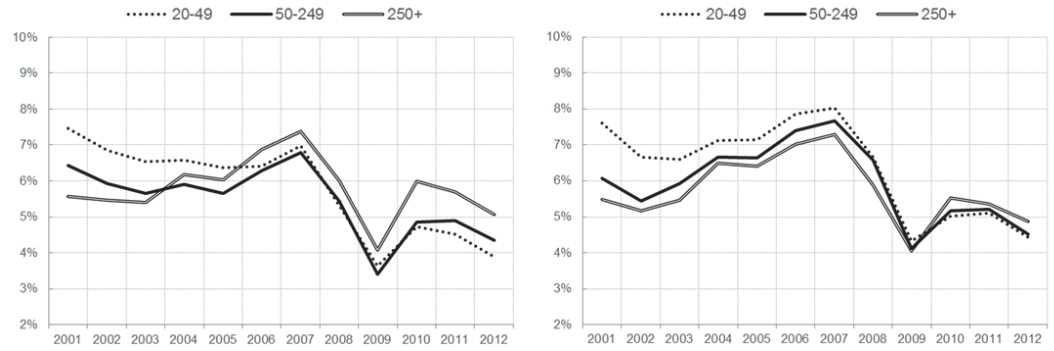


Figure 66, *Trade credit by size class in Amadeus (left) and CompNet (right)*

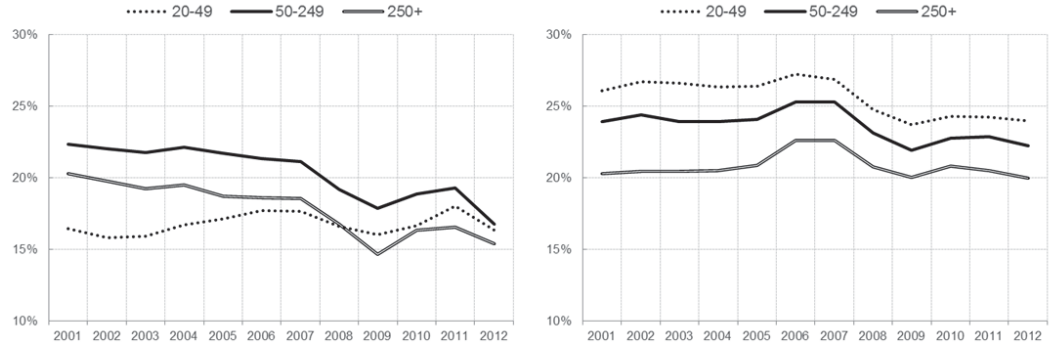


Figure 67, *Interest payments burden by size class in Amadeus (left) and CompNet (right)*

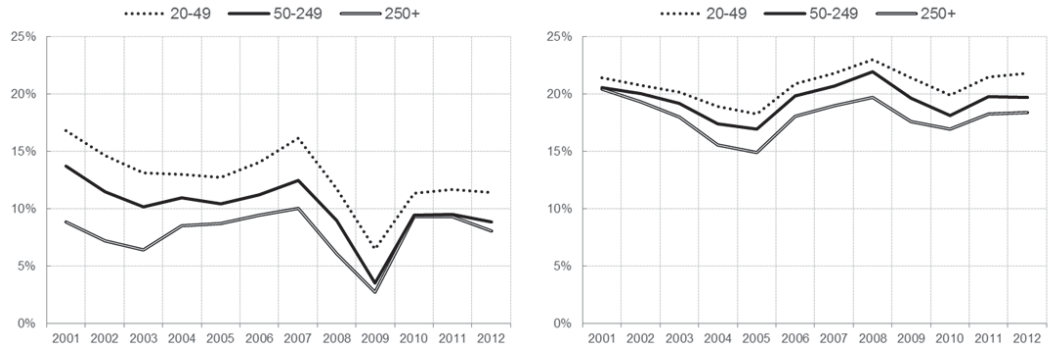


Figure 68, *Cash holdings by size class in Amadeus (left) and CompNet (right)*

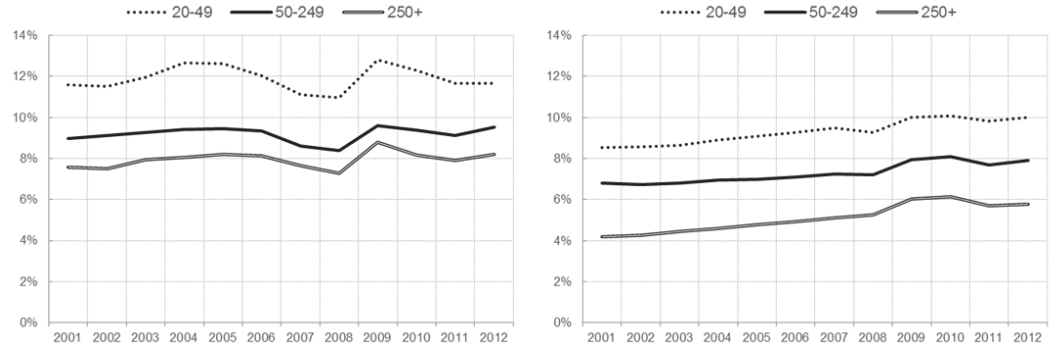


Figure 69, *Collateral by size class in Amadeus (left) and CompNet (right)*

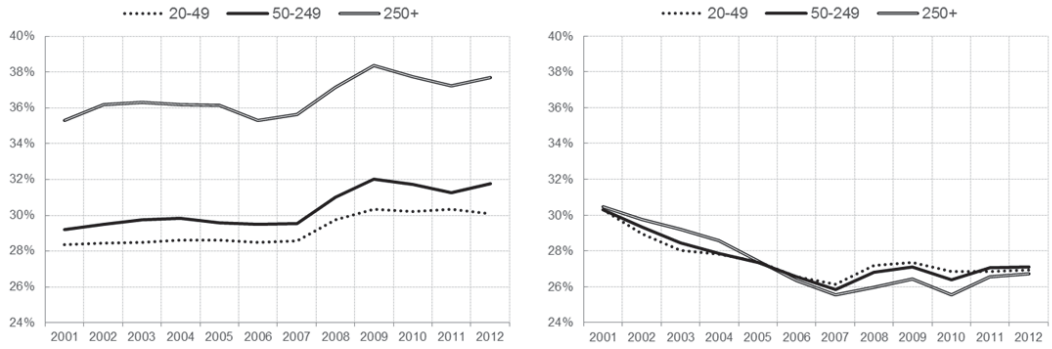


Figure 70, *Leverage by size class in Amadeus (left) and CompNet (right), DE and SI excluded*[42]

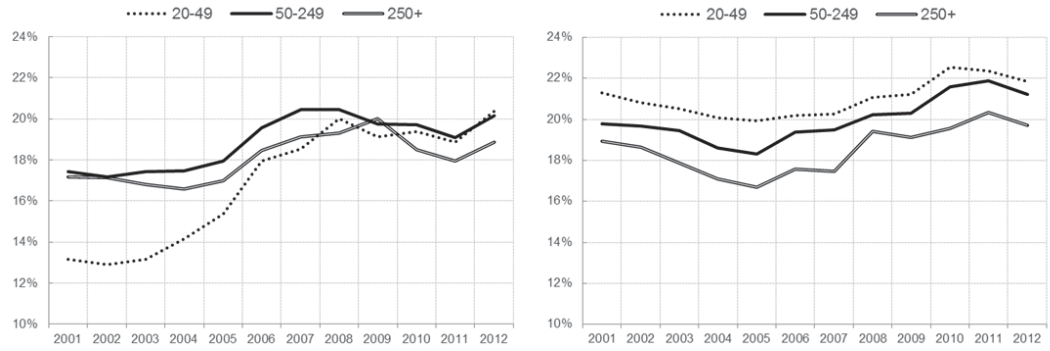
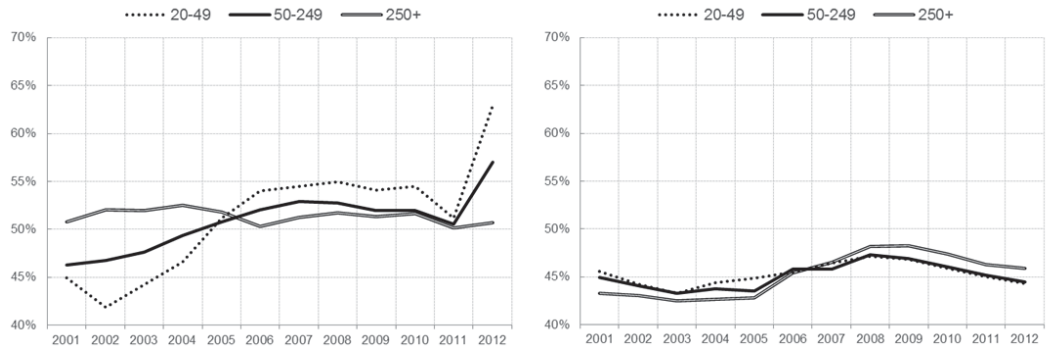


Figure 71, *Leverage by size class in Amadeus (left) and CompNet (right), DE and SI only*[42]



A.3.2. Micro-based dataset - SIR 2015 (BACH database)

For an alternative comparison of the financial module indicators we consider a sample based on the BACH dataset, which was used in Chapter 3.2 of the SIR 2015 Savings and investment in the euro area. This is a database managed by the European Committee of Central Balance-Sheet Data Offices[43]. BACH provides aggregated and harmonized accounting data of non-financial enterprises of several European countries over the 2000-2012 period, based on national accounting standards (individual annual accounts). The aggregation of firm-level data is made at the country – sector – firm size level. The dataset contains 22 indicators from the income statement (expressed in terms of net turnover) and 44 indicators of the balance sheet (expressed in terms of balance sheet total). Moreover, BACH includes 29 financial and profitability ratios. For each indicator in a given country – sector – firm size combination, the weighted mean, the median as well as the first and third quartile of the underlying distribution are given. Firm size is defined in terms of net turnover in the following way: small firms (<10 million EUR), medium firms (10-50 million EUR), large firms (>50million EUR)). Regarding the sectoral disaggregation, information is available for each of the 17 NACE sections and

[42] Germany and Slovenia adopt a different definition of debt and, consequently, leverage.
[43] Data downloaded from https://www.bach.banque-france.fr/?lang=en on September 26, 2014.

for each of the 81 NACE divisions. For reasons of data availability, we limit our comparison to four euro area countries: Belgium, Germany, Spain and Italy.

The first set of figures shows a comparison by country as in the previous section. The number of countries is quite limited due to data availability.[44] If for some indicators there is a difference in the levels but the evolution is similar (as in the case of investment ratio), for others the difference is substantial: e.g. Spain, in its post-crisis levels of cash flow over total assets. Leverage shows similar levels but a different behaviour pre-post crisis. It should be recalled that Germany has a different definition of leverage in the two datasets.

Figure 72, *Investment ratio by country in BACH (left) and CompNet full sample (right)*

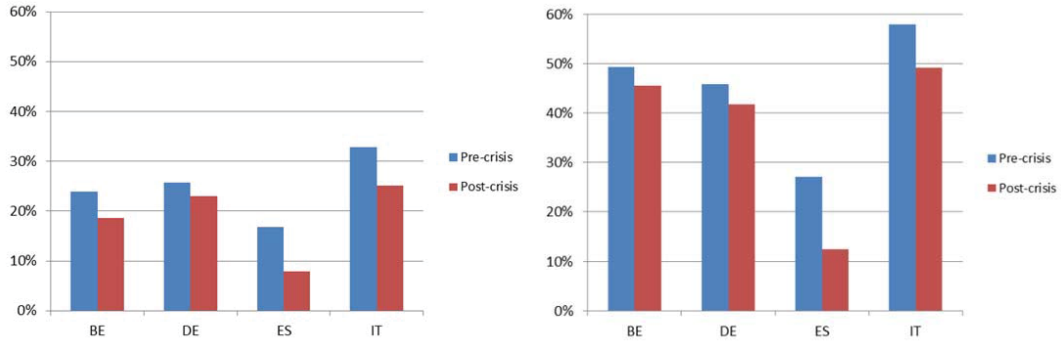
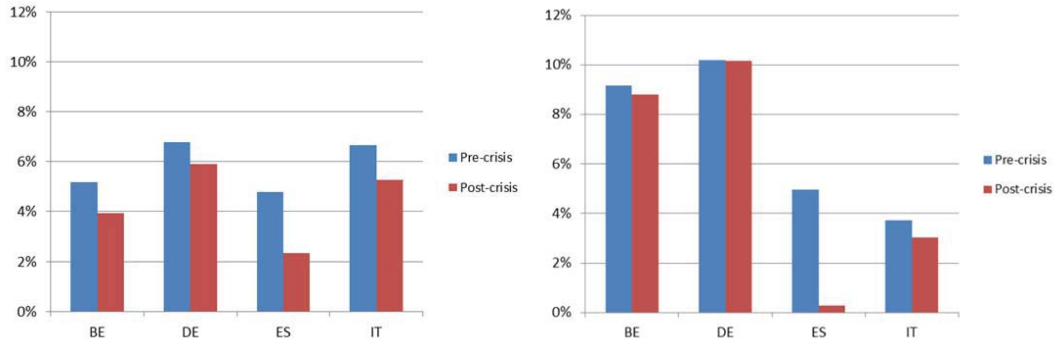
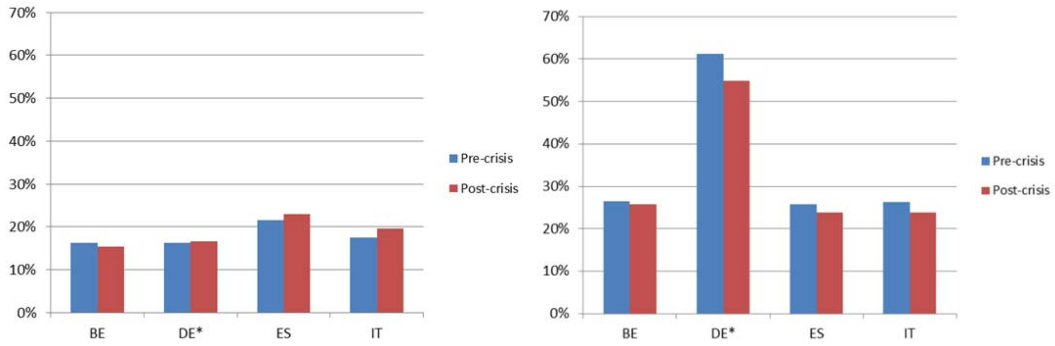


Figure 73, *Cash flow over total assets by country in BACH (left) and CompNet full sample (right)*



[44] We used the CompNet full sample for the comparison due to a different definition of size , as explained below. Hence France is not included.

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)*

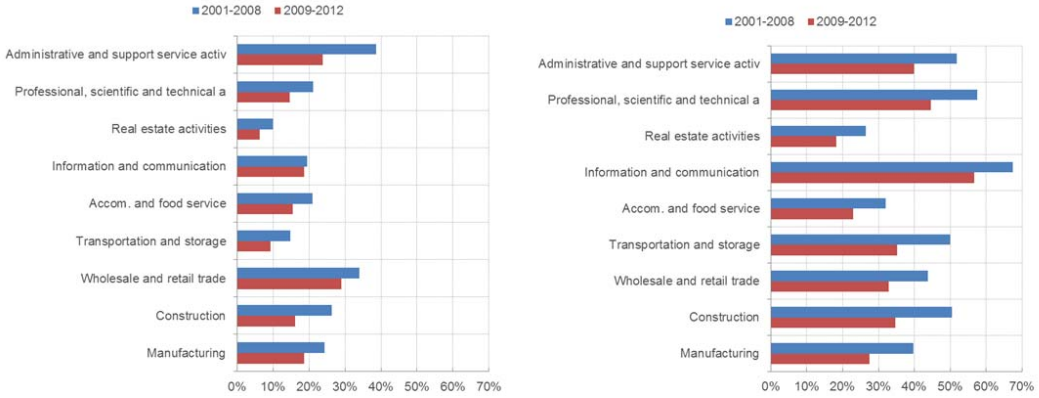
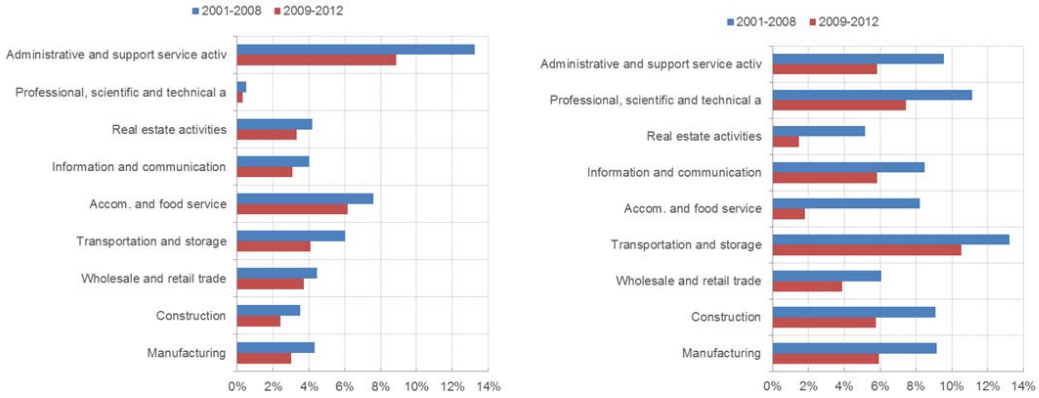
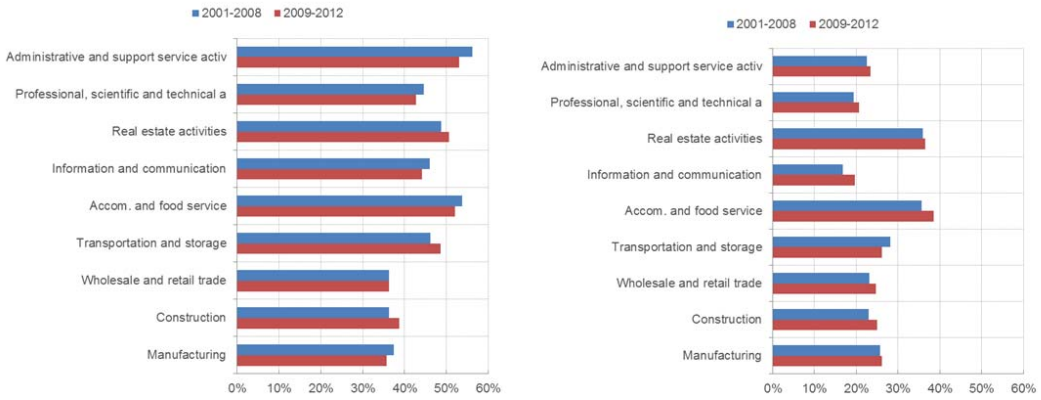


Figure 76, *Cash flow over TA by macro sectors in BACH (left) and CompNet full sample (right)*



[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

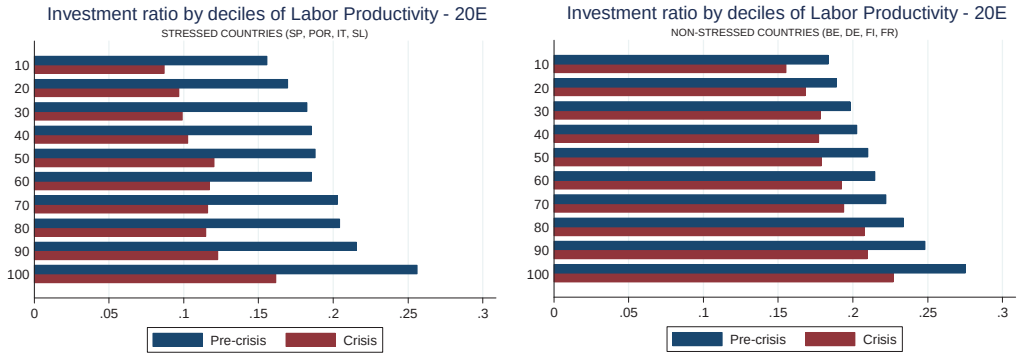
independence	turnover
Other financial indicators	Cash holdings: Cash and cash equivalents over total assets
	Collateral: fixed assets over total assets
Credit constraints indicators	Indicator of financial constraints (FR indicator)
	Indicator of credit constraints (ICC indicator)

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.

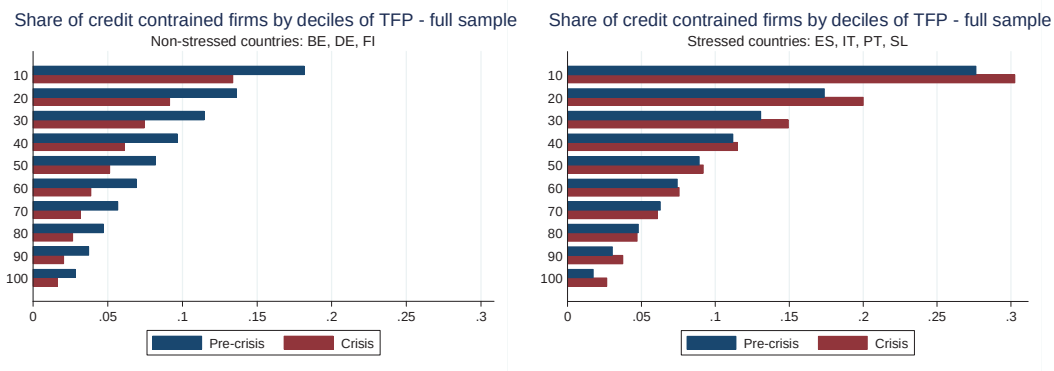
Figure 78, *Investment ratio by deciles of TFP for stressed (left) and non-stressed (right) economies, 20E sample*



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).*

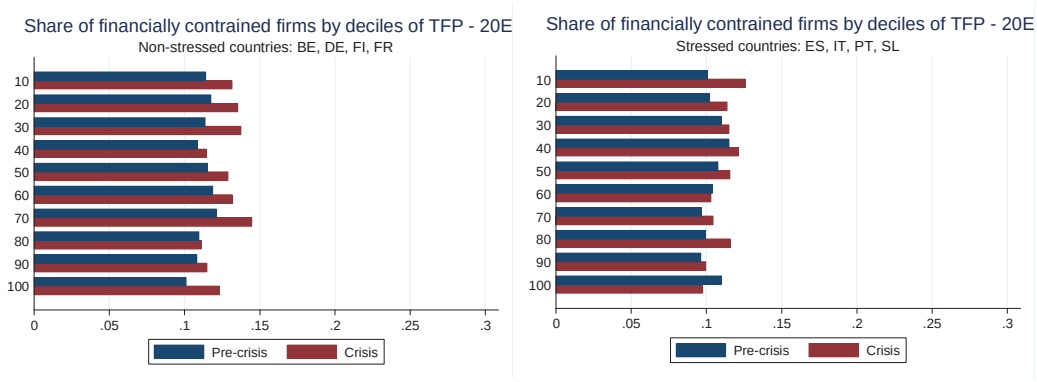
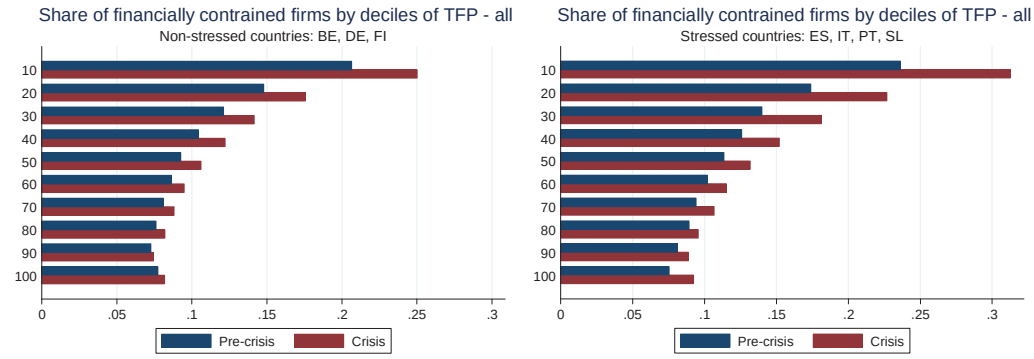


Figure 81, *Share of financially constrained firms (IFC Index) in the different deciles of the distribution of TFP. Full sample. Non-stressed countries (left) and stressed countries (right).*



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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