EUROPEAN CENTRAL BANK
EUROSYSTEM

Working Paper Series

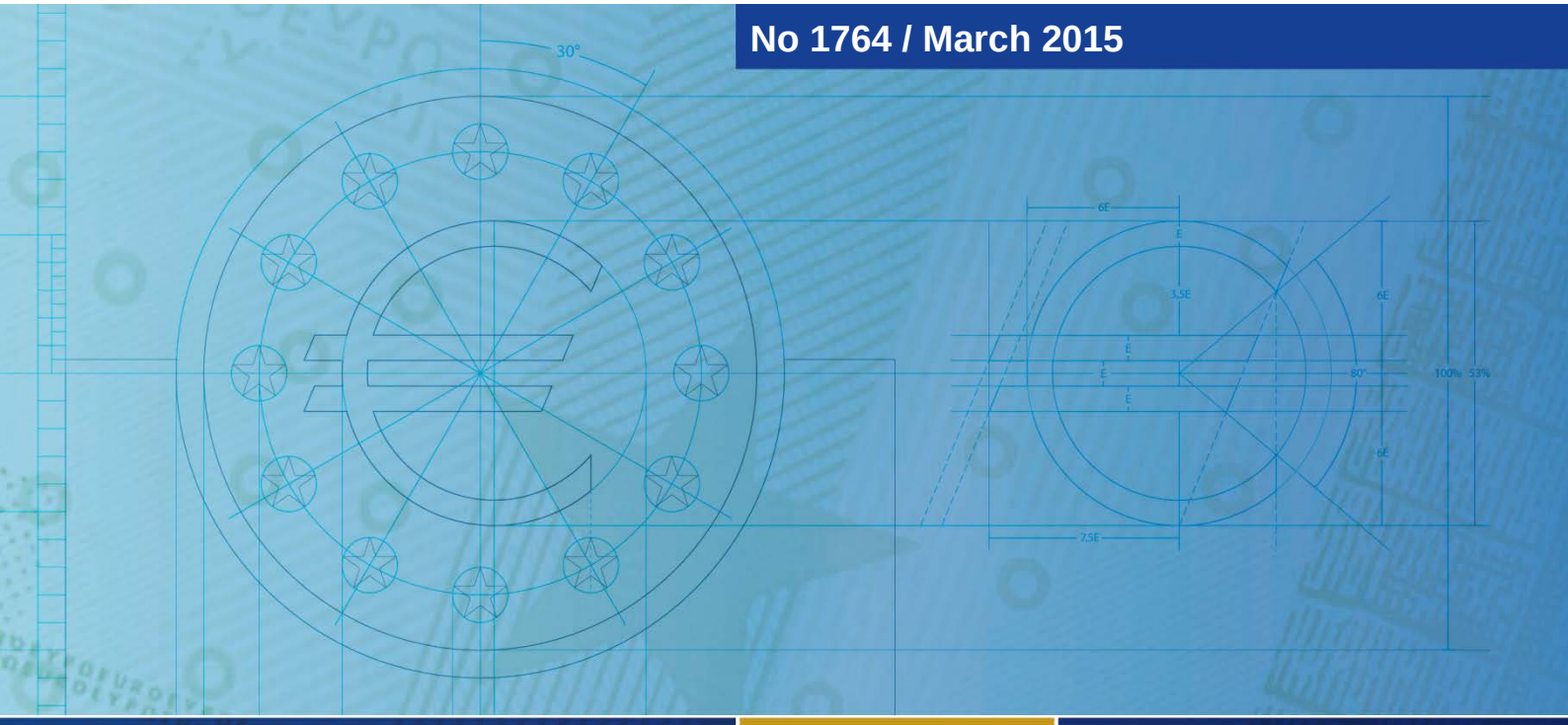
P. Lopez-Garcia, F. di Mauro
and the CompNet Task Force

Assessing European competitiveness:

the new CompNet micro-based database

CompNet The Competitiveness Research Network

No 1764 / March 2015



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The 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.

Acknowledgements
This paper includes inputs from all the participating teams. We would like to thank the teams of Belgium, Croatia, Estonia, France, Germany, Italy, Portugal, Romania Slovakia, Slovenia and Spain for extensive feedback on the paper. Professor Carlo Altomonte (Bocconi University) and Professor Eric Bartelsman (de Vries University) provided critical overall guidance and advice, particularly on the generation of indicators and interpretation of results. Matteo Bugamelli (Banca d'Italia) and Konstantins Benkovskis (Latvijas Banka) contributed with their comments to the drafting of this paper. Vlad Demian and Matteo Iudice provided the essential input for writing and checking the STATA codes. They also worked relentlessly with the country teams to coordinate and validate the results.

Paloma Lopez-Garcia
European Central bank; e-mail: paloma.lopez-garcia@ecb.europa.eu

Filippo di Mauro
European Central bank; e-mail: filippo.di_mauro@ecb.europa.eu

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Postal address	60640 Frankfurt am Main, Germany
Telephone	+49 69 1344 0
Internet	www.ecb.europa.eu

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ISSN	1725-2806 (online)
ISBN	978-92-899-1577-9
DOI	10.2866/390904
EU catalogue number	QB-AR-15-004-EN-N

CompNet Task Force

The following teams participated in the creation of the database presented in this paper:

European Central Bank	Filippo di Mauro (Chair), Paloma Lopez-Garcia, Vlad Demian, Matteo Iudice, Annalisa Ferrando, Roberta Serafini
Banca Națională a României	Ana-Maria Cazacu, Bogdan Chiriacescu
Banco de España	Cristina Fernández, Carmen Martínez, Jose Manuel Montero, Enrique Moral-Benito, Patrocinio Tello
Banco de Portugal	João Amador, Ana Cristina Soares
Lietuvos bankas	Ernestas Virbickas
Banka Slovenije	Urska Cede
Banque de France	Antoine Berthou, Vincent Vicard
Hrvatska Narodna Banka	Gorana Lukinic, Jurica Zrnc, Mljana Valdec
Central Bank of Malta	Karen Caruana, Alfred Demarco, Aaron Grech
Deutsche Bundesbank	Elena Biewen, Sven Blank, Philipp Meinen
Eesti Pank	Jaanika Meriküll
ISTAT	Davide Zurlo, Stefania Rossetti, Filippo Oropallo
Magyar Nemzeti Bank	Péter Harasztosi
Národná banka Slovenska	Tibor Lalinský
Narodowy Bank Polski	Jan Hagemejer
Statistics Finland	Satu Nurmi
Nationale Bank van België /Banque Nationale de Belgique	Emmanuel Dhyne, Catherine Fuss
Oesterreichische Nationalbank	Alfred Stiglbauer, Julia Wörz
Suomen Pankki	Juuso Vanhala

Abstract

Drawing from confidential firm-level balance sheets for 17 European countries (13 Euro-Area), the paper documents the newly expanded database of cross-country comparable competitiveness-related indicators built by the Competitiveness Research Network (CompNet). The new database provides information on the distribution of labour productivity, TFP, ULC or size of firms in detailed 2-digit industries but also within broad macro-sectors or considering the full economy. Most importantly, the expanded database includes detailed information on critical determinants of competitiveness such as the financial position of the firm, its exporting intensity, employment creation or price-cost margins. Both the distribution of all those variables, within each industry, but also their joint analysis with the productivity of the firm provides critical insights to both policy-makers and researchers regarding aggregate trends dynamics. The current database comprises 17 EU countries, with information for 56 industries, including both manufacturing and services, over the period 1995-2012. The paper aims at analysing the structure and characteristics of this novel database, pointing out a number of results that are relevant to study productivity developments and its drivers. For instance, by using covariances between productivity and employment the paper shows that the drop in employment which occurred during the recent crisis appears to have had "cleansing effects" on EU economies, as it seems to have accelerated resource reallocation towards the most productive firms, particularly in economies under stress. Lastly, this paper will be complemented by four forthcoming papers, each providing an in-depth description and methodological overview of each of the main groups of CompNet indicators (financial, trade-related, product and labour market).

JEL Classification: L11, L25, D24, O4, O57

Keywords: cross country analysis, firm-level data, competitiveness, productivity and size distribution, total factor productivity, allocative efficiency.

Non-technical summary:

The economic literature has long recognized that firm-level data delivers crucial information for understanding the drivers of competitiveness, as aggregate performance depends strongly on firm-level decisions and shocks have a different macroeconomic impact depending on the underlying distribution of firms. For these reasons, one of the pillars of the Competitiveness Research Network of the EU System of Central Banks (CompNet) since the start of its activity has been to exploit micro or firm-level based information to support and complement its analysis. However, cross-country firm-level analysis is hindered in practice by at least two major constraints. First, existing indicators based on firm-level data are often not comparable across-countries, given that they refer to non-homogenous periods, they are constructed using different methodologies or they use inconsistent variable definitions. Second, firm-level data are normally confidential. As a result, micro-based analysis of competitiveness remains mostly bounded at the national level, which thus hampers the scope for benchmarking analysis. This includes responding for instance to questions such as: what is the role of the regulatory environment and its impact on firm productivity?

One way to tackle the confidentiality and comparability issues associated to firm-level analysis is to have individual country teams handling the respective confidential firm-level data to produce homogenous indicators aggregated at the industry level. Those indicators are then collected by a central coordinating team, which re-circulates the whole set of aggregated information for the whole set of participating teams. This approach is known as "distributed micro-data analysis" and it has been followed by CompNet to set a new research infrastructure able to deliver cross-country firm-based indicators. The first output of this joint exercise was an industry-level database with comparable information on the distribution of productivity, Unit Labour Costs and Total Factor Productivity across 11 EU countries. The ECB WP 1634 documented in detail the exercise. The scope of the first version of the database was quite limited in terms of countries as well as of indicators analysed. Despite this preliminary nature, several relevant facts already stood out from the analysis: (1) adding information from firm-level data greatly enhances the ability to draw policy conclusions from aggregate patterns; (2) the process of reallocation of resources from low to high productive firms, which is vital for restoring growth, can only be tracked by using firm-level information; and (3) the aggregate impact of a shock might vary depending on the underlying distribution of firms, thus firm-level information is needed to assess the relevant elasticities.

The analysis of the first wave of firm-level data opened up novel evidence on the drivers of competitiveness across countries, but raised as well some important questions that could not be addressed with the available indicators. Those questions related to the different drivers of productivity across countries, as well as to their impact, among others, on exports and labour market dynamics. Given the promising results obtained, three needs emerged: (1) to expand the dataset in terms of country and sector coverage, in order to build a truly European database useful for the analysis of competitiveness; (2) to continue improving the cross-country comparability of the indicators; and (3) to collect new information from firm-level data, including indicators of the financial position of firms, exporting status, employment creation or price-cost margins. Hence, in February 2014, CompNet started a second, much more ambitious, data collection exercise. The new database now includes information on 17 EU countries (13 EA countries) and covers 70% of EU GDP (in 2013), and it is expected to be further expanded in the near future.

This paper documents the new CompNet firm-level database. It will be complemented by four forthcoming papers documenting and providing technical details on the construction and distribution of the new indicators included in this database (grouped around four broad topics: financial, trade, employment creation and mark-ups). It is also complemented by a technical analysis of data quality and cross-country comparability performed by the DG-Statistics of the ECB.

Although it is intended to provide a complete reference related to the novel micro database, the paper includes also a number of applications. For instance, by using covariances between productivity and employment, the paper shows that the drop in employment which occurred during the recent crisis appears to have had "cleansing effects" on EU economies. This can be seen by the fact that the employment share of the most productive firms has increased at the expense of that of the least productive ones, particularly in economies under stress.

1. Introduction

Micro-based data provide crucial information for understanding the drivers of competitiveness. Aggregate indicators alone, when interpreted as if they had been generated by the behaviour of a representative firm, often may be misinterpreted. In fact, widespread heterogeneity at the firm level (as documented in Caves 1998, Bartelsman and Doms 2000), opens up the possibility that aggregate performance depends jointly on firm-level decisions (on factor inputs, innovation and technological capacity or export strategy) as well as on market environment (macro wage and price dynamics, structural framework conditions and strategic interactions). Thus, cross-country information on the underlying distribution of firms is required in order to assess drivers of aggregate productivity, export performance, and competitiveness.

For this reason, the analysis of the micro (firm-level) dimension of competitiveness is one of the key areas of work of the Competitiveness Research Network (CompNet), set up by the EU System of Central Banks in March 2012 with the objective of analysing competitiveness from a comprehensive perspective, that is, encompassing the macro, firm-level and cross-country dimensions.

In order to preserve confidentiality of firm-level sources and to improve cross-country comparisons, CompNet has adopted the so-called "distributed micro-data approach" as developed by Bartelsman et al. (2004). In this approach a common protocol is used to extract relevant information, aggregated in such a way to preserve confidentiality, from existing firm-level datasets available within each National Central Bank (NCB) or National Statistical Institute (NSI). The common methodology harmonizes industry coverage, variable definitions, estimation methodologies and sampling procedures, as much as the underlying raw data allows it. The final outcome is the production of a number of indicators, based on micro-level data, which could be used systematically for analysis of competitiveness related issues.

The ECB WP 1634 documented the first results of such an exercise. Thirteen country teams participated actively in the first round of the data collection process.[1] The scope of the exercise was quite limited in terms of indicators collected. i.e. labour productivity, total factor productivity, firm size, unit labour costs, labour costs and capital intensity. The exercise however, included the full distribution of such individual indicators - computed within each of the 2-digit industries covered in the exercise – as well as the joint distribution (average of one variable for firms in a certain quartile of another variable's distribution) of several couples of those indicators. In addition, the database included information on the efficiency with which resources (labour and capital) are allocated across firms within a given sector.

Despite the preliminary nature of the database, several relevant facts already stood out from the analysis:

[1] Belgium, Italy, France, Spain, Germany, Portugal, Slovakia, Slovenia, Poland, Estonia, Hungary, Czech Republic and Romania.

(1) adding information from firm-level data greatly enhances the ability to draw policy conclusions from aggregate patterns;

(2) the process of reallocation of resources from low to high productive firms, which is vital for restoring growth, can only be tracked by using firm-level information; and

(3) the aggregate impact of a shock might vary depending on the underlying distribution of firms; thus firm-level information is needed to assess the relevant elasticities.[2]

The analysis of the first wave of firm-level data opened up novel evidence on the drivers of competitiveness across countries, but raised as well some important questions that could not be addressed with the available indicators. Those questions related to the drivers of productivity differences across countries, as well as to their impact, among others, on exports and labour market dynamics. Given the promising results obtained, three needs emerged: (1) to expand the dataset in terms of country and sector coverage, in order to build a truly European database useful for the analysis of competitiveness; (2) to continue improving the cross-country comparability of the indicators; and (3) to collect new information from firm-level data. Hence, in February 2014, CompNet started a second, much more ambitious, data collection exercise. The new database includes, for the moment, information on 17 EU countries.[3] All in all, the new expanded CompNet database will cover 13 Euro-Area countries and 70% of EU GDP.[4]

This paper aims at analyzing the structure and characteristics of this novel database, bringing about some of its initial results that are relevant for the analysis of Competitiveness issues. In doing so, the paper will also present further evidence on the importance of using micro-based indicators of competitiveness as an essential complement to traditional macroeconomic analysis. In addition, this paper includes sections explicitly devoted to issues of data limitations and comparability, including recommendations for the use of the database.

More in detail, Section 2 documents the available data as well as the technical methods applied to improve the comparability of samples across countries, which is a challenging task and still work in progress, given the different data sources and sampling procedures used by the national teams. It also includes important suggestions for researchers in exploiting the strengths of the cross-country micro-based indicators, and a detailed description of the remaining limitations of the data.

Section 3 provides an overview of the available indicators in the database. In this respect, this paper is complemented by four forthcoming papers, each providing an in-depth description and methodological

[2] All the above elements are summarised in the second ECB-CompNet Interim Report (April 2014), also taking a policy perspective http://www.ecb.europa.eu/home/pdf/research/compnet/CompNet_Interim_Report_II.pdf??85f4777862dc580902dae836a387be3a

[3] The additional countries are: Austria, Croatia, Finland, Lithuania and Malta, while Czech Republic is not included in the latest data set. Latvia, Ireland, Sweden, as well as Turkey and the Czech Republic, are expected to be included in the next version of the database.

[4] 2013 values

overview of each of the groups of CompNet indicators (financial, trade, market competition and firm growth). The interested reader should therefore refer to such module-specific papers.[5]

Finally, in Section 4, the paper provides an application of the database, in order to highlight the value added of this type of micro-based information. As it was mentioned earlier in the introduction, the existing heterogeneity in terms of firm performance opens the scope to reallocate resources from the low to the high productive firms in order to increase aggregate productivity. The question we explore in this final part of the paper is whether this reallocation has increased over the crisis. Or in other words, whether the crisis has had a "cleansing effect" of the economic structure.

2. The new database

The new CompNet database contains information about firms operating in all industries of the non-financial private sector. The basic set of productivity-related indicators has been complemented with others aimed at helping researchers and policy-makers understanding the drivers of competitiveness. Available indicators (see Table 6 for the exact list) can be grouped as follows: (1) Production and Allocation Indicators, e.g. productivity, TFP, firm size and OP gap among others; (2) Financial Indicators, e.g. the investment ratio, Return on Assets, cash holdings or a credit constraint index; (3) Trade Indicators, e.g. the share of exporters and value of exports, distinguishing between permanent and temporary exporters; (4) Product market indicators, e.g. a balance sheet weighted Price Cost Margin; and (5) Firm growth and determinants, e.g. transition matrices showing firm growth, in terms of size or productivity, between t and t+3.

2.1 Data sources, coverage and representativeness

This section is complemented by a report on the quality of the CompNet data published by DG-Statistics of the European Central Bank. We refer the user of the data to it for further technical details on the database, particularly on cross-country comparability issues. [6]

Table 1 below shows an overview of the different sources of the raw data across countries, which are quite heterogeneous.[7] The table shows as well the use of the data in regular publications. Annex 1 summarises, country by country, the main biases and breaks of the raw data.

Target populations are defined in the same way across countries, aiming at private sector, non-financial corporations consistent with the definition of category S11 in the European System of Accounts (that is, excluding sole proprietors). Note that in many countries entry and exit to and from

[5] The module-specific papers will be published shortly as WP. Additionally, they will be uploaded in CompNet's webpage.

[6] The report can be found in CompNet's webpage: http://www.ecb.europa.eu/home/html/researcher_compnet.en.html It is based on a questionnaire conducted by the Statistical Development and Coordination division (DG-S/SDC) of the Directorate General Statistics of the ECB. The report investigates in some detail the nature of the firms' balance sheet information (including the sample composition) used to compute the CompNet indicators in each of the participating countries. This questionnaire was filled in by the data experts of each country, either from the statistical or the research departments of the National Central Banks or from the National Statistical Institutes.

[7] In terms of data source, out of the seventeen samples, 4 datasets are the result of surveys while 12 are coming directly from firm registers and 1 is pooled together from different sources (for country-specific details, refer to the above mentioned ECB DG-Statistics Quality report).

the market cannot be inferred from entry or exit to and from the sample (see Annex 1 for details). Moreover, the year of creation of the firm is an item provided in the balance sheet of only 6 of the countries. Hence, currently one cannot compute entry and exit rates, neither split firms according to their age,[8] features that may be added in the future.

Countries apply very different rules of exclusion to select the sample used for the CompNet indicators. Some of them use a size criterion to exclude some of the firms belonging to the small-size class and this criterion may vary across countries in terms of definition (turnover or number of employees) or in terms of export threshold.[9] Table 2 below summarises country coverage in terms of firms and employment as well as time and sectors. The two first columns of the table report the coverage of firms (average number per year) and employment vis-à-vis the population of firms with at least 1 employee (20 or more employees in France, Poland and Slovakia) operating in the sectors covered by CompNet. Columns 3 and 4 show the coverage of CompNet with respect to the overall economy, i.e. total value added and employment reported in the National Accounts (from Eurostat). The fifth column provides the time-span available for each country. Note that the indicators computed for the sample of larger firms (20 employees or more) are provided only from 2001 onwards. The last column of the table shows the specific sectors excluded in each country. The default is that countries cover all non-financial business industries, with the exception –for technical reasons- of mining and agriculture, manufacture of petroleum and coke and utilities. Annex 2 shows the list of 2-digit and 1-digit industries covered by CompNet.

[8] The mark-up methodology paper uses the 6 countries with available information on firm entry/year to study whether price-cost mark-ups are systematically different for young and mature firms.

[9] One example where such criteria may have had a significant impact on the coverage rate of the sample is France, where all firms with a turnover less than EUR 750,000 have been excluded. Similarly, Slovakia has only firms with more than 20 employees or with total assets higher than 5 M€ and Poland has only firms with more than 10 employees. Therefore, in all 3 cases we chose to include only firms with at least 20 employees in CompNet, in the so-called "20E sample". Finally, Malta has excluded from the dataset firms with less than 5 employees. For more information, see ECB DG-Statistics Quality Report and Annex 1.

Table 1: Data sources

Country	Data source	Name of the data source	Institution	Example of publication using the dataset
Austria	Multiple sources	Balance sheet data collection of the OeNB (includes data from business register)	Oesterreichische Nationalbank	Aggregate balance sheet data available on OeNB website
Belgium	Administrative data	Central Balance Sheet Office database, International transaction database, VAT declarations	National Bank of Belgium	Belgian National Accounts
Croatia	Administrative data	Annual Financial Statements Registry	Financial Agency (Financijska agencija, Fina)	Annual GDP and Structural business statistics (Croatian Bureau of Statistics); Financial Accounts Statistics (Croatian National Bank)
Estonia	Foreign trade statistics data	Foreign trade statistics data	Statistics Estonia	Foreign Trade Statistics of goods. Monthly news releases.
	Business Register	Business Register	Estonian Centre of Registers and Information Systems	Monthly statistics on the number of commercial entities
Finland	Administrative data	Structural Business Statistics	Statistics Finland	Documents available on Statistics Finland website, but only in Finnish
France	Administrative data	Fiscal Form (Fiben)	Banque de France	Aghion et al. (2012), "Credit Constraints and the cyclicality of R&D Investment: Evidence from France", Journal of the European Economic Association 10(5):1001-1024
Germany	Multiple sources	Financial Statements Data Pool	Deutsche Bundesbank	"German enterprises' profitability and financing in 2013, Deutsche Bundesbank, Monthly Report December 2014"
Hungary	Administrative data and trade data	NAV panel, Customs Data and Intrastat	Central Statistical Office	N/A
Italy	Multiple sources	1) Statistical Business Register (Asia), corporate events and company groups; 2) Financial statements; 3) Large enterprise survey (SCI); 4) Foreign Trade data.	Istat - National Statistical Institute of Italy	N/A
Lithuania	Structural Business Data	Structural Business Data	Statistics Lithuania	Publications available on Statistics Lithuania website
	External Trade Data	External Trade Data		
Malta	National Statistics Office	Structural Business Statistics	Central Bank of Malta	N/A
Poland	Administrative data	F-01 and F-02 forms	Central Statistical Office of Poland	Statistical Bulletin n 6/2014. Central Statistical office of Poland.
Portugal	Multiple sources	Informação Empresarial Simplificada	Ministry of Justice, Ministry of Finance and Public Administration, Instituto Nacional de Estatística - INE Portugal and Banco de Portugal.	*Statistical Bulletin (chapter A.19 and chapter G)* . Bank of Portugal.
Romania	Balance Sheet and Profit and Loss Account	Ministry of Public Finance	National Bank of Romania	N/A
	Export and import data	National Institute of Statistics		
Slovakia	Multiple sources	Report on production industries	Statistical Office of the Slovak Republic	Štatistická správa o základných vývojových tendenciách v hospodárstve SR (Statistical report on main development tendencies in the economy of the Slovak Republic) and other publications available in Slovak
		Foreign trade statistics		
		Business registry		
Slovenia	Administrative data	Slovenian companies' annual reports	Agency of the Republic of Slovenia for Public Legal Records and Related Services (AJPES)	AJPES, Aggregate data from annual reports; SORS, Annual enterprise statistics
Spain	Survey	Annual Central Balance Sheet Data Office (CBA)	Banco de España	Central Balance Sheet Data Office, Annual results of non-financial corporations. Bank of Spain. / Source of Financial Accounts of Spanish Economy
	Administrative data	Annual Accounts Deposited in Mercantile Registries Data Base (CBB-RM)		
	Exports/Imports	Balance of Payments	Banco de España	Balance of Payments Statistics computed following the 5th BPM

Table 2: Coverage[1]

	Coverage vs. similar population of firms (OECD)[1]		Coverage vs. National Accounts (Eurostat)[3]		Time and sector coverage of CompNet samples	
Country	**Average No. of firms per year**	**Total employment**	**Value added**	**Total employment**	**Time coverage**	**Sectors excluded (deviations from default)**
Austria	1%	29%	20%	NA	2000-2012	12, 50, 53, 60, 75, 80
Belgium	31%	76%	49%	39%	1996-2010	-
Croatia	32%	36%	NA	46%	2002-2012	12
Estonia	73%	95%	25%	56%	1995-2012	12
Finland	48%	96%	NA	45%	1999-2012	12, 68
France[2]	73%	88%	43%	36%	2001-2012	12
Germany	3%	41%	32%	20%	1997-2012	12, 55, 56, 68, 75, 77, 78, 79, 80, 81, 82
Hungary	44%	88%	20%	50%	2003-2012	12
Italy	10%	53%	27%	30%	2001-2012	-
Lithuania	27%	43%	20%	46%	2000-2011	12
Malta	NA	NA	7%	24%	2003-2011	12, 13, 15, 24, 29, 30, 45, 46, 47, 49, 50, 51, 52, 53, 63, 68, 75
Poland[2]	77%	80%	15%	24%	2005-2012	75
Portugal	30%	80%	40%	45%	2006-2012	-
Romania	70%	47%	29%	37%	2003-2012	53
Slovakia[2]	91%	95%	NA	29%	2001-2011	12, 50, 51, 53, 59, 60, 65
Slovenia	31%	85%	NA	46%	1995-2012	12
Spain	19%	47%	25%	32%	1995-2012	-

[1] Coverage is computed over the period 2004-2007, with the exception of Portugal (2006-2007).

Data of the population of firms with at least 1 employee come from the OECD Structural Business Statistics repository.

[2] France, Poland and Slovakia provide only information for firms with 20 employees or more. The coverage is computed over the population of fims with 20 employees or more.

[3] Coverage of the whole economy (not only private firm sector) is computed for 2005, with the exception of Portugal for which 2006 is used instead.
Eurostat data comes from National accounts: series nama_gdp_c and nama_aux_pem, respectively

Table 2 shows that firm coverage varies widely across countries. In order to address comparability issues derived from those differences, the CompNet team worked in two directions. First, across the paper we distinguish results related to the so-called "full sample" (with information on firms with at least one employee), and the "20E sample", which takes into account only the firms with 20 employees or more in the period after the year 2000; the representativeness of the latter sample is clearly much more homogeneous across countries. Second, in building the 20E sample, we use the technique of 'sample reweighting', which consists in applying population weights based on the total number of firms in each country, year, macro-sector and size class from Eurostat Structural Business Statistics (SBS), taken as the population. As shown in Box 1 population weights improves substantially the quality of the database. More specifically, the ex-post distribution of employment in terms of size (shown in Table 3) and sector (shown in Annex 3) mimics that of the underlying population of firms. However, there is still some discrepancy in some countries when we look at specific indicators within a macro-sector/size cell. In fact, as highlighted in the ECB DG-Statistics quality report, in terms of turnover and value added, the weighting system does not seem to be effective. Potential biases of the sample towards more productive firms are still present and lead to aggregated totals that are often higher than those of the population, especially, in cases where firms self-select into the sample. Also, one has to keep in mind that large firms are a small share of the overall population of firms and, therefore, the 20E sample will be unrepresentative of the full population of firms.

Table 3: Employment distribution by firm size class, CompNet and Eurostat. 20E sample.

	20-49		50-249		250 +	
Country	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet
BELGIUM	20.4%	20.3%	26.9%	26.9%	52.7%	52.8%
ESTONIA	23.1%	22.9%	42.4%	42.8%	34.5%	34.3%
FINLAND	17.2%	17.5%	25.1%	25.9%	57.7%	56.6%
FRANCE	18.0%	17.7%	24.6%	25.0%	57.4%	57.3%
GERMANY	14.9%	14.0%	29.1%	29.5%	56.0%	56.5%
ITALY	24.1%	24.3%	29.4%	28.9%	46.5%	46.8%
LITHUANIA	25.1%	25.4%	40.0%	39.5%	35.0%	35.1%
POLAND	14.9%	15.3%	33.7%	33.6%	51.4%	51.1%
PORTUGAL	24.7%	24.7%	32.6%	32.5%	42.7%	42.9%
SLOVAKIA	14.1%	15.5%	31.8%	32.0%	54.2%	52.5%
SLOVENIA	16.3%	18.3%	35.6%	36.2%	48.1%	45.5%
SPAIN	23.3%	19.0%	27.7%	22.8%	48.9%	58.3%

Averaged across years, Source: DG-Statistics Quality Report

BOX 1: Construction and impact of population weights

The main problem of sample comparability in the first round of CompNet was due to the under-representation of small firms in some countries. For that reason, in this version of the data, we have weighted each firm in the sample of firms with more than 20 employees according to its relative presence in the sample vis-à-vis the population of firms. The result is that the statistical probability of drawing a firm from a given sector and size class is the same in the CompNet sample as in the population.

In order to construct the population weights, we have retrieved data on the total number of firms in all size classes above 20 employees within each 1-digit or macro-sectors. These are obtained from several series in Eurostat's SBS. Given that the number of firms that are covered by Eurostat is subject to changes from one year to another due to external reasons (changes in classification, reporting standards etc.), we apply a minimal outlier treatment: we drop observations where the number of firms is 40% larger or smaller than in previous or posterior years and then linearly interpolate the dropped values, given that we need a balanced panel of population weights by country/1 digit sector/size class/year.

Table 1 illustrates the impact of the weights across countries. The table shows the share of firms in each size class (considering the sample of firms with 20 employees or more) before and after applying the weights.

Table 1: Impact of weights in different countries; average across years.

Share of firms out of total firms>20 employees						
	20-49 employees		50-249 employees		250 or more	
	Unweighted	Weighted	Unweighted	Weighted	Unweighted	Weighted
AUSTRIA	31%	65%	50%	29%	20%	6%
BELGIUM	65%	68%	28%	27%	6%	5%
CROATIA	61%	61%	32%	32%	7%	7%
ESTONIA	64%	63%	32%	33%	4%	4%
FINLAND	62%	63%	30%	30%	8%	7%
FRANCE	65%	66%	29%	28%	6%	6%
GERMANY	35%	61%	49%	32%	16%	7%
HUNGARY	63%	64%	31%	31%	6%	6%
ITALY	66%	69%	29%	26%	5%	4%
LITHUANIA	61%	63%	35%	33%	5%	4%
MALTA	55%	57%	38%	35%	7%	8%
PORTUGAL	67%	68%	28%	28%	4%	4%
ROMANIA	61%	61%	33%	33%	6%	6%
SLOVENIA	56%	58%	36%	34%	8%	8%
SPAIN	74%	71%	23%	25%	3%	4%

Note: Slovakia and Poland are not shown in the table because only aggregated weighted values of the indicators were collected for them.

The table shows that the largest impact of the weights can be found in Austrian and Germany, which feature the most biased samples. After applying the weights, however, the share of firms in each of the size classes in both countries is brought in line with the rest of countries.

2.2 Treatment of the data

Learning from the previous exercise, CompNet has introduced improvements in processing the micro-data in two important areas, namely the treatment of outliers and the harmonization of deflation methods across countries, bringing the resulting database to the highest standards among its kind. The next paragraphs summarize the actions taken in each of these areas.

2.2.1 Outlier treatment

Firm-level data is often distorted by outliers, especially in the case of non-normal distributions such as the ones analysed here; hence the importance given in CompNet to the cleaning of raw data. For that reason, the raw firm-level data are treated to eliminate outliers using a common procedure across all countries to improve cross-country comparability. The procedure, described briefly below, combines the cleaning of extreme growth rates and levels of the main indicators.

The outlier cleaning applied in CompNet is a multi-step procedure applied to the ratios, as well as to the respective numerator and denominator.[10] First, if a given ratio is found to have an abnormal growth rate, it is replaced by a missing.[11] Subsequently, the program identifies whether such abnormal behaviour is due to the numerator or the denominator and accordingly replaces it with a missing.

In a second step, we replace any variable with a missing if the ratio of such variables with respect to labour or capital is in the top or bottom 1% of observations in that sector and year. Hence, not only we eliminate the ratios which display aberrant growth rates (step 1 above), but also we eliminate any entry which displays extreme values as compared with those of other firms operating in the same sector (at the 2-digit level) and year.

The financial variables are also cleaned from outliers, following usual procedures in the financial literature. Although the process is detailed in the specific paper devoted to the financial indicators, in a nutshell it amounts to drop values within p1 and p99 in each sector, both in levels and in growth rates.[12] We also drop values which are more than 10 interquartile ranges from the median of that value in that sector. Finally, several financial indicators are ratios that logically should be bound between 0 and 1. We drop values which do not satisfy this condition. Box 2 gives some more details on the impact of the treatment of outliers implemented.

[10] We consider the ratios to labour and capital of the following variables: Real capital, real turnover, labour costs, materials and real value added. When the cleaning procedure is applied to ratios with respect to capital, we exclude "real capital" from the variables analysed.

[11] More precisely, this happens when the growth rate of any of these ratios in a given year is more than two interquartile ranges above or below the median growth rate in that sector and year.

[12] Investment ratio is a special variable whose values are not bounded upwards in any way and could and does take extremely high values, for which the above procedure may prove insufficient. This could be due to new capital inflows, mergers and acquisitions or other events we have no interest in capturing. Therefore for this variable we also replace with missing if the values are above 7.

BOX 2: Impact of the treatment of outliers

To get a sense of the impact of the treatment of outliers on the number of observations and averages, Table 1 below shows the percentage of observations dropped after applying the cleaning procedure to two real variables -number of employees and real value added per firm-, and two financial variables -return on assets (ROA) and the investment ratio. We show this information for each of the countries in CompNet. Table 2 shows the average value (pooling all sectors together) of those variables before and after running the treatment of outliers.

Table 1: Percentage of observations dropped by the outlier treatment; full sample; average across years

country	Number of employees	Real value added	ROA	Investment ratio
AUSTRIA	0.7%	8.7%	NA	NA
BELGIUM	0.9%	3.7%	2.0%	3.8%
CROATIA	1.0%	4.1%	NA	NA
ESTONIA	0.6%	6.2%	1.9%	5.1%
FINLAND	0.8%	3.6%	2.0%	4.8%
GERMANY	0.9%	3.6%	1.9%	2.8%
HUNGARY	0.8%	3.2%	NA	5.5%
ITALY	0.5%	3.6%	2.0%	4.4%
LITHUANIA	0.2%	4.8%	2.0%	6.9%
MALTA	0.4%	11.8%	NA	NA
PORTUGAL	1.3%	3.7%	2.3%	5.9%
ROMANIA	0.7%	3.5%	2.1%	6.2%
SLOVENIA	1.0%	5.0%	2.2%	4.3%
SPAIN	1.0%	3.8%	2.1%	4.8%

Note: France, Poland and Slovakia are not included, since the table refers to the full sample (firms with 1 or more employees)

Inspection of both tables included allows to draw two main conclusions: (1) there are very few outliers in the variable "number of employees", which is important given that it will be used to classify firms in different size classes; (2) Average value of investment ratio (defined as change in fixed assets over lagged stock of capital) is seriously distorted by outliers in all countries, above all in Finland, Lithuania and Portugal. The applied procedure is bringing the variable to more reasonable values in all countries. For further details on outliers at the sector level, please refer to the ECB DG-Statistics quality report, section 5.

BOX 2, continued

Table 2: Average value of selected variables before and after outlier treatment; full sample; average across years

	Labour		Real value added		ROA		Investment ratio	
	Before	After	Before	After	Before	After	Before	After
AUSTRIA	226	227	23272	22669	NA	NA	NA	NA
BELGIUM	52	52	4822	4849	0.03	0.05	1.71	0.51
CROATIA	39	40	936	935	NA	NA	NA	NA
ESTONIA	25	25	477	427	0.07	0.08	11.3	0.5
FINLAND	37	37	3523	3527	0.25	0.13	305.84	0.31
GERMANY	385	379	41778	42209	0.1	0.1	1.2	0.49
HUNGARY	23	23	413	374	NA	NA	4.47	0.35
ITALY	58	58	4423	4169	0.03	0.03	3.52	0.56
LITHUANIA	38	38	472	445	-0.05	0	224.41	0.27
MALTA	46	47	620	560	NA	NA	NA	NA
PORTUGAL	31	31	1007	910	-0.03	0	140.78	0.31
ROMANIA	33	33	691	595	-0.02	0.08	4.98	0.36
SLOVENIA	46	46	798	822	-0.02	0.01	2.16	0.51
SPAIN	45	45	3089	2583	-0.01	0.02	1.12	0.24

Note: France, Poland and Slovakia are not shown in the table because it refers to the full sample (firms with 1 or more employees)

Further, we apply the following cleaning rules in all countries: (1) we replace with a missing value all observations with negative or zero labour costs, capital or value added; (2) we drop all firms with zero employees, considering therefore only the ones with at least one employee. This is due to two reasons. First, some countries, like Italy, report information on firms only when the firm has at least one employee, whereas other countries have no reporting thresholds in place. Second, some countries replace missing information with a zero and there is no way to disentangle "true" zero-employee firms from missing data.[13] Finally, we have also decided to implement stringent confidentiality rules – dropping industries/year with less than 10 firms- on top of the country-specific rules applied to the disclosure of firm-level data.[14]

[13] Besides, firms with zero employees are not considered when estimating total factor productivity and unit labour costs but were included in the computation of the different moments of the distribution of other variables.

[14] Besides, to compute the distribution of a given indicator we require any given cell, e.g. the 2-digit industry or the 1-digit industry and size class, to contain at least 100 observations.

2.2.2 Deflators and PPPs

In order to create variables in real terms we use sector-specific deflators. Deflators are created by downloading NACE Rev.2, 2-digit level series on National Accounts by 64 branches from Eurostat, both in volumes and in values[15]. From the volumes series we take gross value added measured in millions of euros, chain-linked, with 2005 as reference year; and for values we take gross value added in millions of euros. Since both series are already harmonized by Eurostat, all we need is to divide the two series in order to obtain a series of deflators[16]. The same procedure is performed in order to obtain GDP deflators. The value added in each sector is then deflated with its corresponding sector-deflator. Turnover, capital and intermediate inputs are deflated using the GDP deflator. [17]

One of the problems we faced in the previous round of data collection was the lack of comparability between nominal values in different countries. This was quite extreme when comparing the labour costs or value added per employee, for example, in mature and transition economies, within the EU. In order to improve on that score, in this version of the dataset the deflator series are adjusted by using country and sector-specific value added PPPs. PPPs are taken from the GGDC database for 1997.[18]

2.3 Remaining limitations in the use of data

The current version of the micro-distributed CompNet dataset analysed in this paper, provides a considerable improvement with respect to the first exercise, in a number of aspects. As such, it represents a powerful tool for the analysis of competitiveness. However, a number of limitations still exist in the data that call for some caveats in their analysis and interpretation, as well as further steps to tackle statistical issues emerging from the CompNet datasets.

In what follows we summarize some of the remaining limitations of the data and provide specific recommendations for their proper use and interpretation.

2.3.1 Coverage of different indicators

Table 2 of the paper shows the coverage of CompNet samples in terms of firms with at least 1 employee. That is, we provide the count of firms providing employment information (and with at

[15] Specifically, we download the series nama_nace64_c and nama_nace64_k

[16] There are some countries in which 1995 and 2012 are missing from Eurostat data. When these years are missing we assume that in that sector/year the growth rate of prices was the same as in the following/previous periods. That is, if 1995 is missing, we assume that the deflator between 1995 and 1996 is the same as between 1996 and 1997 and if 2012 is missing, we assume that the deflator between 2011 and 2012 is the same as between 2010 and 2011.

[17] One of the possible improvements in future versions of the database is the use of WIOD data to generate 2-digit specific intermediate inputs deflators.

[18] The data can be downloaded from the webpage: http://www.rug.nl/research/ggdc/data/ggdc-productivity-level-database. This data is in NACE Rev.1 2-digit sector classification and in national currency (or Euros for countries which had adopted it by 2008). We therefore have to convert the sectors into NACE Rev. 2 and then use average yearly exchange rates from Eurostat (Series 2Fert_bil_eur_a) to convert all countries to a common currency. The PPPs are defined as relative to the US. Note that if some sectors do not have data on PPPs or deflators, given that we require a balanced panel of deflators for all countries we impose that these sectors have the same deflator series as the sector preceding it in the NACE classification. The latest procedure is not the most appropriate in all cases, but it was the simplest to implement. We will apply a case-by-case procedure to substitute missing deflators or PPPs in the next version of the database.

least 1 employee) in our data and compare it with the number of firms in the population. But the coverage of firms varies if we consider other indicators, more demanding in terms of required variables.[19]

For example, whereas labour productivity can be computed, in average, for 87% of all firms in the sample, total factor productivity, much more demanding in terms of variables and lags of the variables, can only be estimated for about 60% of them; the same is the case for the credit constraint indicator, also the result of a parametric estimation. What is important is that the selection of firms for which each indicator can be computed might not be totally random: it will include firms with better reporting standards. For this reason, we consider cross-country comparability of the simple indicators based on employment or sales to be better than that of more complex indicators.

2.3.2 Analysis of time series

Another potential source of cross-country differences is related to differences in the compilation methods to produce time series, and variations over time of such methods. These methods directly depend on the degree of exhaustiveness and purpose of the data compilation at the country level. Those countries which have an exhaustive survey (Belgium, Estonia, Finland, Hungary, Poland, Portugal, Romania, Slovakia and Slovenia – please refer to Annex 1) are able to provide figures which are not affected by changes in the composition of the sample population over time and, therefore, can directly be compiled as time-series. For the rest of countries, yearly changes in the indicators over time could be the result of changes in the sample population, not related to firm dynamics but rather to statistical procedures. This could lead to the existence of outliers in the aggregates, as it is pointed out by the ECB DG-Statistics report. Furthermore, in some countries like Spain, data compilation procedures have improved over time – above all in the last half of the 90s- leading to an increasing trend in the number of firms sampled. For this reason we consider developments from the 2000s to be more reliable than those over the earlier years.

2.3.3 Comparison with National Accounts

Indicators aggregated from firm-level sources are fundamentally different from aggregate National Accounts statistics (NA) that consolidate and balance information from a variety of sources, from income, expenditure, and production sides to balance multiple sets of accounting rules. Furthermore, firm-level variables used by CompNet are collected based on national legislation on accounting rules (GAAP), while official aggregate statistics rely on National Accounts rules (ESA). Also, micro-based sources like CompNet rely on accounting figures that are mainly based on book value, although some assets are valued at market prices, following national accounting rules. National accounts, on the other

[19] The ECB DG-Statistics Quality Report has a detailed analysis of this issue, concluding that some of the variables are relatively less affected by this item non-response (such as labour or turnover) while others vary across countries, which could indicate heterogeneity with respect to the mechanism of response.

hand, tend to use market values. Furthermore, national accounts are beginning to include an estimate of the shadow economy, while firm registries only collect data on legal entities.

Although the trends detected within CompNet samples are correlated with those in National Accounts (not surprising, because NA incorporate information from business surveys and registers into their estimates), the correlation could be weaker if the dynamics of the public sector or the self-employed (not covered in the firm-level data) differ markedly from the non-financial corporate sector.

Investigating case-by-case the sources of such discrepancies can be a critical exercise to better assess in each country the underlying dynamics of competitiveness of private businesses and thus obtain a better signal of the state of the economy than either source alone.

2.4 Variable definitions

CompNet collects information on a rather large number of variables. Table 4 provides the harmonized definition of each of those variables. Given the different underlying data sources and accounting rules across countries, some country-specific deviations remain; these are presented in Annex 4.[20]

In order to clearly distinguish between firm-level variables and indicators aggregated to the industry or country level, the paper will follow the subsequent taxonomy convention. The entries in the balance sheet of firms, which is confidential information, will be referred to as "raw variables". Total fixed assets or intangible fixed assets are examples of raw variables. Those variables are then transformed by the code to compute ratios, or estimate firm-level variables. Those will be referred to as "derived variables" or "ratios". Some examples are labour productivity, which is the ratio of real value added to employees, or collateral which is the ratio of tangible fixed assets to total assets. These ratios are computed at the firm-level and, therefore, are also confidential. Finally, different moments of the distribution of those ratios or derived variables are computed, pooling together all firms in a given sector or at the country level. Those are, for example, the bottom and top 10% of the productivity distribution, of the median capital intensity. These will be referred as "indicators" and are the ones available in the CompNet database.

[20] For more detailed information on country-specific definitions of the variables, please refer to the ECB DG-Statistics Quality report as well as to the associated detailed questionnaire. Both of them can be found in the CompNet webpage.

Table 4: Raw variable definitions

Raw 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
Number of employees	Average number of employees calculated in full-time equivalents
Turnover	Total sales
Profits and losses before taxes	Earnings before taxes (EBT)
Raw materials	Consumption of raw materials + energy+ external services
Labour cost	Gross employee compensation
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
Value added	Turnover - raw material
Profit/loss	EBIT
Total exports	Total exports by the firm; may be adjusted for reporting threshold. For details, see the trade-specific paper
Total Imports	Total imports by the firm
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
Firm's birth year	Year of establishment of the firm (limited availability)

2.5 Levels of aggregation and statistics

The CompNet indicators are based on micro-level data on the above variables, which are then aggregated to the industry level. At any level of sector disaggregation, the CompNet database includes the various moments of the distribution of all indicators. The most detailed level of aggregation used in the CompNet database is the 2-digit industry level of the NACE rev.2 classification (i.e. about 60 sectors). The next level of aggregation is the macro-sector, roughly corresponding to the 1-digit industry aggregation of the NACE rev.2 classification (see Annex 2). Full distributions, and cross-moments, are also computed pooling all firms in the sample, that is, by considering all private non-financial sectors (this is what we call "country level"). For some indicators, mostly those related to the financial position of the firms, the distinction, within a given sector, of firms belonging to different size classes is also important. For this reason we have added in this version of the database two new levels of aggregations, namely: size classes within the macro-sector and size classes within the country.

Size classes are defined in terms of the number of employees of the firm. We consider five classes, following Eurostat standards: (1) firms with 1-9 employees; (2) firms with 10-19 employees; (3) firms with 20-49 employees; (4) firms with 50-249 employees; and (5) firms with 250 employees or more.

As mentioned, the database contains a rich set of statistics for each of the indicators beyond the traditional sector level average, hence capturing much of the firm-level richness. Table 5 lists and defines the computed statistics, although not all the statistics are computed for each indicator (see section 3 for details on the available statistics for each of the indicators in the database).

Table 5: Computed statistics

Count	Number of observations available for a given variable
Percentile	Percentiles of the distribution of the variable (10, 20, 30, 40, 50, 60, 70, 80, 90)
SD	Standard deviation of the distribution of the variable
Mean	Simple mean of the variable
IQR	Interquantile range of the variable, defined as the difference between the percentile 75 and the percentil 25 of the distribution
Median	Median of the distribution of the variable, defined as the percentile 50 of the distribution
Growth rate	Growth rates of the variable, computed at the firm level as difference in logarithms of the variable
Joint distribution	Median or average of a given variable considering firms in the decile of the distribution of another variable

2.6 Cross-country comparability

In general, cross-country comparability of the indicators has been at the core of the work in CompNet, and much has been achieved with respect to the first round of data collection and, more broadly, with respect to other databases. However, harmonization of indicators based on firm-level data to allow cross-country comparability remains a work in progress. For this reason, the following section provides a set of specific recommendations to the users of the data. Section 2.6.2 details the way ahead to continue improving cross-country comparability.

2.6.1 Recommendations for the use of existing data

We recommend the following procedures to the user of the current version of the micro-based database:

1. The data are perfectly fit and useful to compare within-country firm performance (of low and high productive firms, or of firms experiencing or not credit constraints, for example), as well as compare dynamics across sectors, or retrieve micro-based information to calibrate macroeconomic models. As it will be clear with some examples provided later in this paper, or in the companion papers where specific indicators on the different CompNet modules are presented, joint moments across variables now computable within the CompNet dataset can be highly informative of the competitiveness dynamics taking place within countries, or across similar groups of firms in different industries.
2. When performing the above-mentioned analysis, a number of precautionary practices should nevertheless be enforced. Since the coverage of the sample might vary across indicators, some robustness check with different indicators should be conducted (e.g. labour productivity vs. TFP); moreover, as time series could change in certain country/industries due to the variability of the sample, averages across years (e.g. before/after crisis) or cumulative growth rates rather than specific yearly figures, should be preferred.
3. Since cross-country comparisons have to play in any case a central role in the analysis, the use of the sample of firms with at least 20 employees is strongly recommended, given its better quality in terms of distribution of firms across size classes and sectors. However, as it was made apparent in the previous paragraphs, some within cell biases still persist. For this reason we discourage the use of these data to perform direct cross-country comparisons of aggregate levels (e.g. comparing simple averages of one indicator at a country level). Otherwise, we recommend restricting the analysis to the most comparable set of countries[21]. Moreover, it is not recommended, to compare the absolute magnitude of micro-based variables to macro aggregates retrieved from NA statistics, preferring when possible some sort of normalization.
4. Due to the lack of full comparability, the CompNet database has to be used for cross-country comparisons with a lot of caution, but this point is mostly relevant if one wants to produce descriptive, unconditional cross-country statistics. If instead one uses the data within a regression analysis, the researcher can control for country or sector differences via a rich set of dummies. The exact set of dummies depends, obviously, on the researcher's question, but they should be able to address the biases detailed in Annex 1.
5. Despite the fact that Germany and Austria provide information on firms with more than 1 employee, for such two countries we discourage the use of the full (unweighted) sample. According to Table 2, the sample in both countries includes 1-3% of firms in the population but covers 30-40% of the total employment, thus indicating a clear bias towards large firms in

[21] For example, if the research question requires the use of the full sample of firms, authors should restrict the analysis to countries with good coverage of small firms. For detailed information on sample coverage, refer to the ECB DG-Statistics Quality report.

both countries. The 20E sample (which is population weighted) is much more comparable, and therefore recommended for cross-country analysis.

2.6.2 The way ahead

Some of the causes of cross-country differences in terms, for example, of raw variable definitions or sampling procedures, are beyond our reach and are the subject of on-going statistical work to further harmonise data collection standards within the Eurosystem. Other sources of cross-country differences however can, and will be, dealt with in the next version of the CompNet micro-based database.[22] More specifically, and based on the recommendations laid out in the ECB DG-Statistics Quality Report, we envisage to implement the following procedures in the computer routines distributed to country teams, in later exercises:

1. Include population weights specific to each indicator, in order to mitigate the bias introduced by the various coverage rates across indicators.[23] We will also test the use of alternative weights not based on the number of firms but on turnover, or employees.
2. Harmonise further and within our possibilities, given the different sampling and accounting rules across countries, sample coverage and raw variable definitions.
3. Design ad-hoc estimation procedures for the imputation of missing data, in order to avoid that the number of firms for specific analyses gets significantly reduced in the absence of complete datasets.
4. Address the issue of outliers emerging at the indicator (country/industry/year) level, even after outliers at the firm level have been eliminated.
5. Compute indicators and measures (related especially to sample composition and other statistical checks) which can subsequently feed into future quality assessments of the CompNet database.

3. CompNet indicators

Table 6 provides an overview of the available indicators in the database, their definition, available statistics and levels of aggregation. As it was mentioned before, the CompNet indicators are grouped in topics or modules. The production and allocative efficiency indicators include all those indicators related to the measurement of the productivity and competitiveness of firms. This small group of indicators was already included in the previous version of the dataset and is core to the analysis of competitiveness. Hence they will be the main focus of discussion of the remaining of this paper.

[22] Although the micro-based database is expected to be updated regularly, details are yet to be decided.

[23] Using different weights for each indicator may introduce further problems, though given that they can affect the correlation between two indicators that have been aggregated using different weights. For this reason the way ahead in this respect is not straight forward and different alternatives will be careful pondered.

Table 6: CompNet indicators

Indicator	Definition	Statistics	Level of aggregation
Productivity indicators			
Real Value Added	Value Added Deflated With Sector Specific Deflators	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	Country, 2-Digit Industry, 1-Digit Industy, Size class, 1-Digit Indistry by Size class
Real Turnover	Turnover Deflated With GDP Deflator	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Labour Costs	Nominal Labour Costs, inlcuding wages and employers'social security contributions	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Labour Costs Per Employee	Nominal Labour Costs Divided By The Number Of Employees	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Real Capital	Capital Deflated With GDP Deflator	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Capital Intensity	Real Capital Divided By The Number Of Employees	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Labour Productivity	Real Value Added Divided By The Number Of Employees	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Labour Productivity Revenue	Real Turnover Divided By The Number Of Employees	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Unit Labour Costs	Nominal Labour Costs Divided By Real Value Added	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Capital Productivity	Real Value Added Divided By Capital	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
TFP	Total Factor Productivity. For Details, See Box 3 and ECB WP 1634	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Marginal Product Capital	For Details, See Box 3 and ECB WP 1634	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Marginal Product Labour	For Details, See Box 3 and ECB WP 1634	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Wageshare	Labour Costs Divided By Nominal Value Added	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Olley-Pakes gap	For details, see ECB WP 1634	Count, OP gap	Country, 2-Digit Industry, 1-Digit Industy
FKH dynamic allcoative efficiency	For details, see ECB WP 1634	Count, FKH indicator	Country, 2-Digit Industry, 1-Digit Industy
Financial indicators			
Investment Ratio	(Growth Rate Of Capital + Depreciation) Divided By Capital	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	Country, 2-Digit Industry, 1-Digit Industy, Size class, 1-Digit Indistry by Size class
Leverage	Debt Divided By Total Assets	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Return On Assets	Operating Profit-Loss Divided By Total Assets	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Cash Holding	Cash Divided By Total Assets	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Financing Gap	Approx Investment - Cash Flow	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Collateral	Capital Divided By Total Assets	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Equity over Debt	Equity Divided By Debt	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Cash Flow ratio	Cash Flow Divided By Total Assets	Counts, Mean, Median, SD, IQR, Skewness	"
Implicit Rate	Interest Paid Divided By Total Debt	Counts, Mean, Median, SD, IQR, Skewness	"
Trade Credit	Creditors Divided By Total Assets	Counts, Mean, Median, SD, IQR, Skewness	"
Trade Debit	Debtors Divided By Total Assets	Counts, Mean, Median, SD, IQR, Skewness	"
Inventories to Turnover	Inventories Divided By Turnover	Counts, Mean, Median, SD, IQR, Skewness	"
Capital Depreciation	Depreciation Divided By Total Assets	Counts, Mean, Median, SD, IQR, Skewness	"
Interest Payment Burden	Interest Paid Divided By Operating Profit-Loss	Counts, Mean, Median, SD, IQR, Skewness	"
Equity Ratio	Equity Divided By Total Assets	Counts, Mean, Median, SD, IQR, Skewness	"
Profit Margin	Operating Profit-Loss Divided By Turnover	Counts, Mean, Median, SD, IQR, Skewness	"
Credit Constraints Indicators	ICC (Estimation based on SAFE 2009-2011) and FR index. See Box 4 and the Financial paper	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	"
Trade			
Export Value	Firm's Total Exports	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	Manufacturing, 2-Digit Industies Within Manufacturing
Export Ratio	Export Value Divided By Turnover	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	Manufacturing, 2-Digit Industies Within Manufacturing
Export Value Added	The Share Of Value Added In Exports	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	Manufacturing, 2-Digit Industies Within Manufacturing
Export Markup	Lerner Index Of Market Power: (Turnover - Labour Costs - Materials)/Turnover	Counts, Mean, Median, IQR, SD, Skewness, Percentiles	Manufacturing, 2-Digit Industies Within Manufacturing
Markup			
Price-Cost Margin	Non Parametric Measure Of Market Power: (Turnover - Labour Costs - Nominal Materials)/Turnover	Mean, Median, IQR, SD, p1, p5, p10, p25, p75, p90, p95, p99	Country, 2-Digit Industry, 1-Digit Industy, Age And Size, Export Status
Pcm_K	Non Parametric Measure Of Market Power: (Turnover - Labour Costs - Nominal Materials -K_Pk)/Turnover	Mean, Median, IQR, SD, p1, p5, p10, p25, p75, p90, p95, p99	Country, 2-Digit Industry, 1-Digit Industy, Age And Size, Export Status
Input Shares	Shares Of Material, Capital And Labour Costs In Total Turnover	Mean, Median, IQR, SD, p1, p5, p10, p25, p75, p90, p95, p99	Country, 2-Digit Industry, 1-Digit Industy, Age And Size, Export Status
Market Share	Share Of Firm'S Turnover In Dimmension'S Total Turnover	Mean, Median, IQR, SD, p1, p5, p10, p25, p75, p90, p95, p99	Country, 2-Digit Industry, 1-Digit Industy, Age And Size, Export Status

The other indicators - namely those related to trade, financial characteristics, firm growth, and market competition - are documented in detail in forthcoming topic-specific methodology papers. Section 3.2 will nevertheless summarise briefly some of their main features and provide examples of how they can shed light on some of the most pressing current policy issues.

3.1 CompNet indicators of productivity

One of the core indicators compiled by CompNet is labour productivity, computed at the firm-level and then aggregated to each of the different levels of aggregation. Labour productivity is defined as real value added per employee. Further, the CompNet database contains information on the distribution of Total Factor Productivity (TFP). The computation of TFP, at the firm-level, is based on the procedure exposed with detail in the ECB WP 1634, although with substantial improvements (see BOX 3).

BOX 3: Total Factor Distribution estimation

While several productivity measures such as labour and capital productivity can readily be computed from the raw data, estimating firm-level total factor productivity (TFP) requires a more complicated estimation technique. The object of interest is A_{it} in the following equation

$$RVA_{it} = A_{it} K_{it}^{\alpha} L_{it}^{1-\alpha} \quad (1)$$

where *RVA* is real value added, *K* is the real book value of net capital and *L* is total employment. Building on the approach developed by Olley and Pakes (1996), Levinshon and Petrin (2003), Ackenberg et al (2006) and Wooldridge (2009) we estimate A_{it} by taking the natural logarithm of the above equation and then estimating firm-level TFP using an alteration of Wooldridge (2009) proposed by Galuscak and Lizal (2011) – see ECB WP 1634 for details.

Prior to the estimation a rough consistency check is performed. Because labour, and especially capital measures are often subject to measurement error this test is performed in order to get a sense of the magnitudes for TFP found in the data and whether these roughly correspond to pre-established priors. The check consists of assuming alpha = 1/3 and (1-alpha) = 2/3 in equation (1) above. The resulting Solow residual A_{it} is then purged of year and industry effects. If the units of all variables are consistent the resulting average Solow residual should be a small positive number.

The estimation of equation (1) is performed on a 2-digit industry level. However, in order to obtain consistent estimates with sufficient degrees of freedom, a cutoff of a minimum of 25 observations per sector and year is introduced. Sectors that do not meet the minimum cutoff are flagged and their TFP estimates are replaced by an estimated value obtained on the corresponding macro-sector level.

The regression used in order to obtain firm-level TFP is given by

$$\begin{aligned} rva_{it} = {} & \beta_0 + \beta_1 k_{it} + \beta_2 k_{i(t-1)} + \beta_3 m_{i(t-1)} + \beta_4 k_{i(t-1)}^2 + \beta_5 m_{i(t-1)}^2 + \beta_6 k_{i(t-1)}^3 \\ & + \beta_7 m_{i(t-1)}^3 + \beta_8 k_{i(t-1)} m_{i(t-1)} + \beta_9 k_{i(t-1)} m_{i(t-1)}^2 \\ & + \beta_{10} k_{i(t-1)}^2 m_{i(t-1)} + \gamma Year_t + \omega L_{i(t-1)} \end{aligned} \quad (2)$$

BOX 3, continued

All variables are expressed in logs. Material inputs are measured by M_{it}. Since labour and TFP are simultaneously determined, while capital takes time to build, labour is instrumented by its first lag. In addition to (1) equation (2) contains several higher order and interaction terms between capital and materials in order to control for non-linearities. A full set of year dummies is included to control for sector-specific trends. Equation (2) is estimated via GMM following Wooldridge (2009). Standard errors are clustered at the firm-level. Following the estimation, firm-level TFP is retrieved as the difference between (log) real value added and the fitted values for (log) real capital, (log) labour and a year trend:

$$TFP_{it} = rva_{it} - \left(\hat{\beta_0} + \hat{\beta_1} k_{it} + \hat{\gamma} Year_t + \hat{\omega} L_{i(t-1)}\right) \quad (3)$$

While removing year-specific means yields better (and less unrealistically high values) estimates for the distribution of TFP within a sector and country, it hampers the comparability of TFP-levels across countries. In order to facilitate cross-country comparability of the computed level of TFP, individual observations are rescaled by a country-specific mean or median TFP term coming from aggregate data such as the measure presented in (6) below (or alternatively an external data source such as the EU-KLEMS).

Using the estimated coefficients of capital and labour $\hat{\beta_1}$ and $\hat{\omega}$ the marginal products of both inputs can be computed:

$$MRPK_{it} = \frac{\hat{\beta_1} rva_{it}}{k_{it}} \quad (4)$$

$$MRPL_{it} = \frac{\hat{\omega} rva_{it}}{l_{it}} \quad (5)$$

Since the production function coefficients are reported, it is possible to adjust the hypothesis about the degree of decreasing returns to scale in the post estimation stage by directly manipulating equations (4) and (5). Note, however, that a common issue with using the book value of capital is that the capital share coefficient is estimated to be very low. Furthermore, the two equations can be used to construct an alternative measure of TFP following Hsieh and Klenow (2009) by defining

$$TFP_{HK} = mrpk_{st}^{\hat{\beta_{1s}}} * mrpl_{st}^{\hat{\omega_s}} \quad (6)$$

where s stands for a sector. This definition uses firm-level weighted marginal products (capital and labour), where the weights are the respective estimated production function coefficients.

The estimated firm-level TFP measures undergo a rough cleaning procedure before being reported. It consists of deleting the extreme outliers in the distribution, namely observations above the 99.5th percentile and below the 0.5% percentile.

Following the approach outlined in Kehrig (2011) the TFP and marginal product estimates are then used in order to calculate a more sophisticated measure of time-series dispersion. The reason is that when looking at aggregate dispersion measures, these can be driven by large volatilities in specific sectors and/or time trends. The measure proposed by Kehrig eliminates these two sources of bias. First, the raw measure is regressed on a time trend and the residuals are retrieved. Next, the residuals are divided by the sector-specific standard deviation. The dispersion measure at the industry level is then defined as the median standard deviation of the resulting series.

3.1.1 The distribution of labour productivity

Possibly, the most important message of the previous version of the database was related to the distribution of labour productivity. We showed that productivity was very heterogeneous across firms operating within narrowly defined sectors. Moreover, the distribution was found to be not only disperse, but also very asymmetric, featuring a large mass of low productive firms and very few high productive firms.

One of the novelties of the current database is the inclusion of sufficient moments of the productivity distribution so as to be able to depict productivity density kernels for each country/sector/year, which provide a more intuitive picture of the shape of the productivity distribution across sectors, and countries. Those kernels are shown in Figure 1. In order to limit sector composition effects, we focus on one macro-sector, i.e. manufacturing. Moreover, to improve cross-country comparability, we use the population weighted sample of firms with more than 20 employees, and average over 2006-2012. We group countries as follows: (1) non-stressed countries –Austria, Finland, France, Belgium and Germany; (2) Mature stressed countries –Portugal, Spain and Italy; (3) Transition economies –Croatia, Estonia, Hungary, Lithuania, Poland, Romania, Slovakia, Slovenia and Malta.[24]

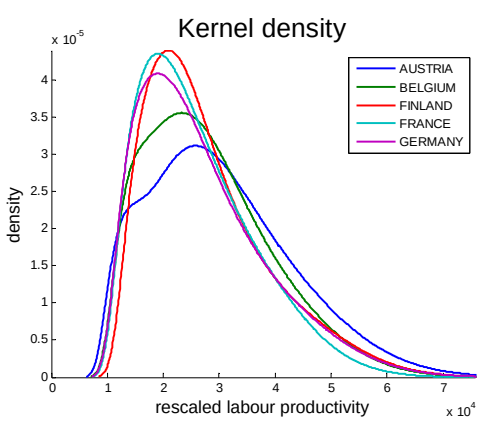
Given that the purpose of Figure 1 is not to compare average productivity level across countries –other sources of data might be better suited for that, as stated in the previous section- but rather the shape of the distributions, we have re-scaled the distributions so that the mean in each country is equal to its GDP per capita, provided by Eurostat.[25]

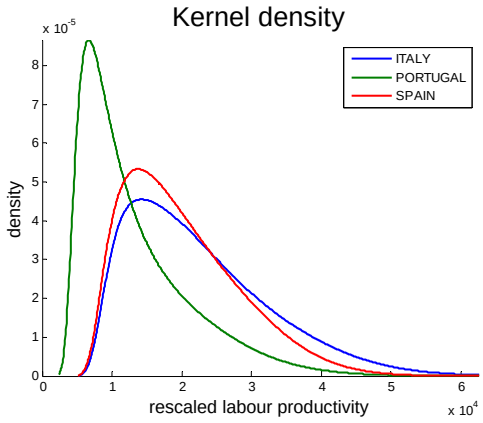
The first thing to notice is the accumulation of density around low productive levels and the long right-tail of the distribution in all countries, confirming previous findings by CompNet. Although this is a common feature across all countries, there are some interesting cross-country differences. In order to get a better sense of the differences in terms of the shape of the distribution across countries, Table 7 shows two moments of the productivity distribution, i.e. the ratio between the median and the mean of the distribution as well as the skewness. Given that labour productivity is bounded from below, the fact that the median of the distribution is, on average, 70% of the mean gives an idea of the extent of the asymmetry of the distribution.

[24] In the remaining of the paper, we will use the label "stressed countries" to refer to those countries in the database significantly stressed or in a program. Those are Portugal, Spain, Italy and Slovenia. Romania should also be included in this group but due to the fact that some of the joint distributions required for the graphs are missing for this country we decided against it. "Non-stressed countries" on the other hand group Germany, Belgium, Finland and France. The rest of countries have been stressed to some extent. Lastly, when scale matters, like in Figure 1, we will group together "old" EU countries and "new" EU countries. In these cases, Malta will be included in the latter group, even when it is clearly not a transition economy.

[25] That is, we divide each decile of the productivity distribution by the mean of the distribution and then multiply it by the GDP per capita. Note that the rescaling with GDP per capita might alter the ordering of countries for reasons not necessarily related to productivity, such as sector composition, the shadow economy or unusual demographic patterns.

Figure 1: Labour productivity kernels, normalised to country GDP per capita. 20E sample; Manufacturing sector; Average over 2006-2012





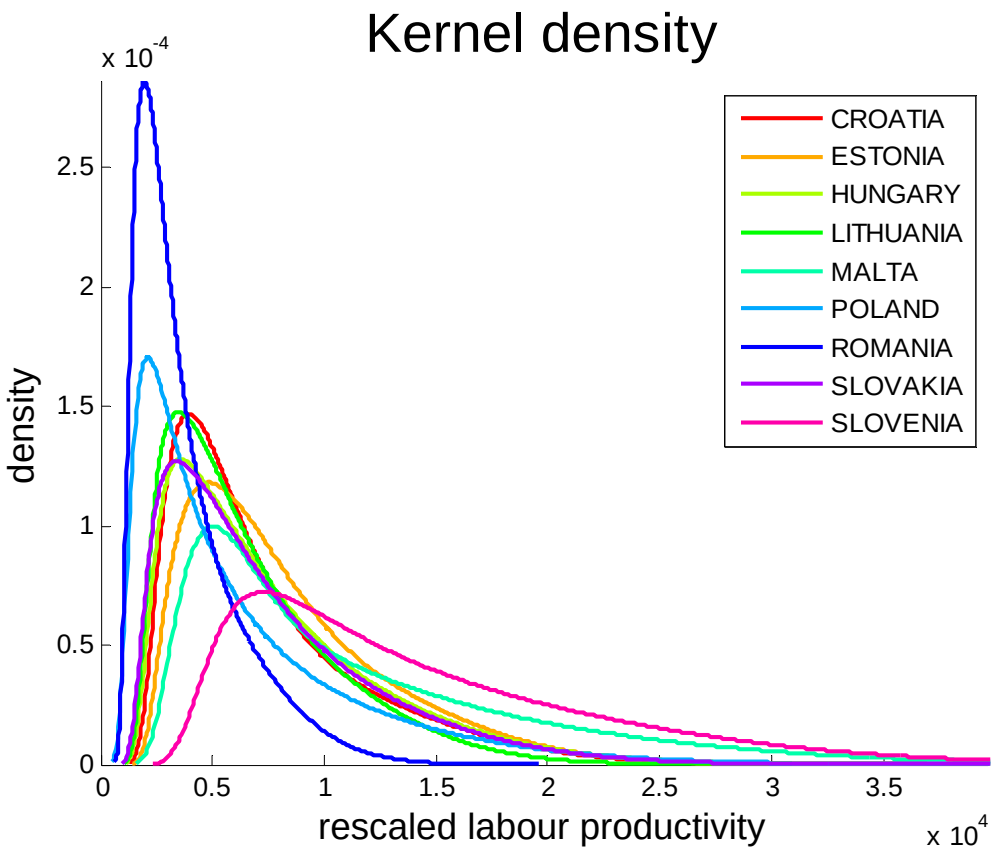


Table 7: Moments of the labour productivity distribution. 20E sample; Manufacturing sector. Average over 2006-2012.

country	median/mean	skewness
AUSTRIA	0.91	1.20
BELGIUM	0.89	1.51
CROATIA	0.69	2.73
ESTONIA	0.78	1.93
FINLAND	0.82	2.84
FRANCE	0.88	1.64
GERMANY	0.86	1.58
HUNGARY	0.71	3.19
ITALY	0.86	1.55
LITHUANIA	0.76	2.16
MALTA	0.68	1.89
POLAND	0.60	2.41
PORTUGAL	0.72	1.82
ROMANIA	0.68	2.93
SLOVAKIA	0.72	2.93
SLOVENIA	0.79	1.79
SPAIN	0.88	1.26

Furthermore, for some of the countries in CompNet we are able to compare the asymmetry of the distribution –as shown by the ratio of median to mean- with a second source. The comparisons are derived from a Eurostat-funded project on linking micro-data to analyse the ICT impact on the economy (ESSLait).[26] As one can observe, despite the selective coverage in some of the CompNet samples, the shape of the distribution we obtain comes quite close to that from alternate sources, which is very reassuring.

Table 8: Asymmetry of the labour productivity distribution, CompNet vs. Eurostat. Full sample; Manufacturing sector. Average 2004-2009.

Median/Mean		
Country	Eurostat	CompNet
AUSTRIA	0.73	0.91
GERMANY	0.87	0.89
FINLAND	0.8	0.76
FRANCE	0.86	0.86
ITALY	0.85	0.83
SLOVENIA	0.89	0.76

[26] For more information see http://ec.europa.eu/economy_finance/publications/economic_paper/2013/ecp486_en.htm and the references therein.

The importance of firm heterogeneity to shape the impact of trade shocks is highlighted by the pioneer work of Melitz (see for example Melitz and Redding 2013). Ongoing research using the CompNet database explores further this avenue by analysing the existing link between productivity dispersion and trade outcomes. In Barba Navaretti et al. (forthcoming), for example, the impact of exchange rates movements on exports is estimated for firms with different productivity levels or size within a given sector. Preliminary evidence shows that substantial heterogeneity can be observed across the different categories of firms, with large (and more productive firms) reacting differently as compared to the average firm. This heterogeneity in the response of exporters facing the same exchange rate shock has substantial influence on aggregate outcomes.

Another related venue of research in CompNet is the re-estimation of trade-exchange rate elasticities, when the underlying – and heterogeneous - productivity distribution across countries is taken into account. Some preliminary findings in this respect can be found in Demian and di Mauro (forthcoming), where the impact of exchange rate fluctuations on exports is estimated to be lower in sectors with a higher dispersion of TFP, signalling a concentration of exports in a few very productive firms. Moreover, controlling for sector productivity characteristics drastically changes the basic elasticity trade-exchange rate estimations. This confirms previous results in di Mauro and Pappadá (2014).

3.1.2 The joint moments of CompNet: Exploring the differences of firms at both ends of the productivity distribution

The large dispersion, and asymmetry, of the distribution of firm performance has other implications related, in the first place, to the importance of the reallocation of resources from low to high productive firms as a way to foster productivity growth (see Bartelsman et al. 2009). The issue will be examined in detail in section 4 as an illustration of the analysis made available by the new database. The second important implication of the existing heterogeneity relates to the very different economic behaviour of firms, depending on their relative position in the overall distribution. These differences are often overlooked by researchers and policy analysts, when only aggregate indicators are used; as it will be shown in this section, careful consideration of such differences can considerably improve the ability to draw policy conclusions.

As mentioned, in order to enhance the usability of firm-level information for policy analysis, besides the different moments of the distribution of each of the indicators listed in table 6, the CompNet database includes information on the bivariate or joint distribution of a selection of different couples 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, and alike. The complete list of computed joint distributions is provided in Table 9.

Table 9: Available joint distributions

Characteristics	Distribution
Firm size	Labour Productivity
Real Value Added	TFP
Capital	ULC
Labour Costs	Labour
Capital Intensity	Real Value Added
Labour Productivity	Capital
TFP	Labour Costs
ULC	Capital Intensity
Investment Ratio	Labour Growth
Leverage	Labour Productivity Growth
ROA	
Cash Holdings	
Financial Gap	
Collateral	
Debt Burden	
Equity Debt Ratio	
Share Of Credit Constrained	
Total Employment	

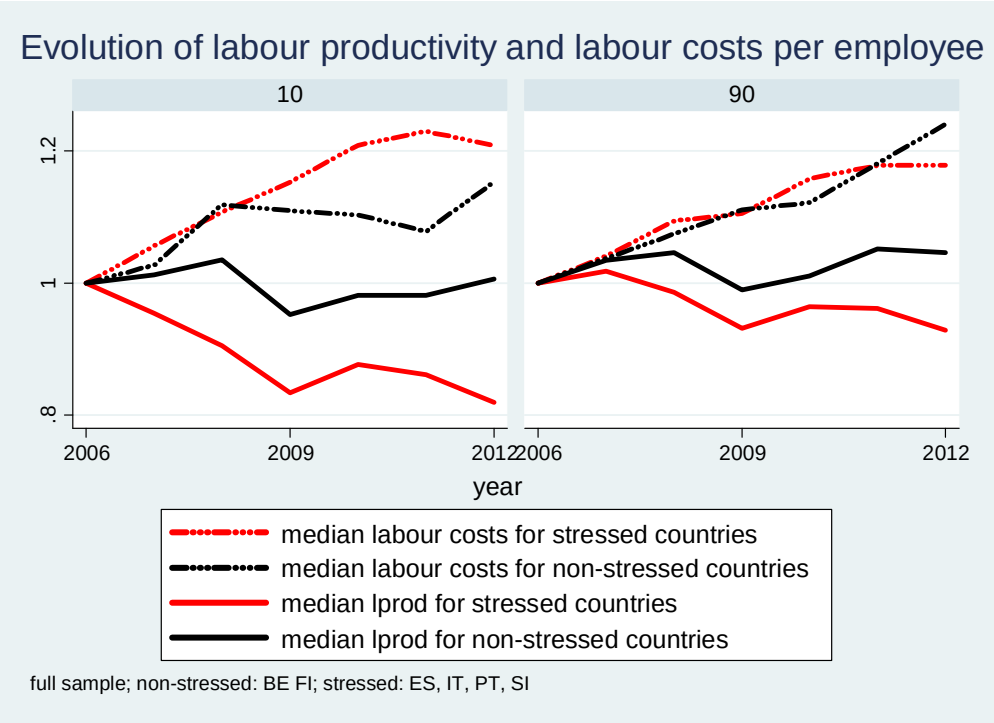
The way to read Table 9 is as follows: The median of each variable in the column "characteristics" –with the exception of the two last ones- is computed considering firms in different deciles of the distribution of each indicator listed in the column "distribution". For example, we have computed the median firm size, real value added or capital stock of firms in each decile of the labour productivity, TFP or ULC distribution within a given sector. These joint distributions are computed considering firms operating in a given 2-digit industry, macro-sector or country level. Lastly, we also compute the share of credit constrained firms and total employment, the two last variables in the "characteristics" column, considering firms in different deciles of the different distributions. In what follows we will analyse some of those joint distributions to provide additional information which could be relevant for the analysis of aggregate trends.

To start with, we reproduce here, using the new enlarged database, one of the most telling figures depicted in the ECB WP 1634 documenting the first wave of CompNet micro-based data. Figure 2 shows the development of both determinants of Unit Labour Costs (ULC), namely: labour cost per employee and productivity, in stressed and non-stressed countries, split by productivity of the firms.[27] The left panel depicts the developments of labour costs and productivity of firms in the bottom 10 pct of the productivity distribution in the country (10), whereas the right panel shows the evolution of the top 10% firms (90). The main observation is that the divergence between stressed and non-stressed countries originates at the

[27] Stressed countries are Spain, Italy, Portugal and Slovenia. Non-stressed countries are Belgium and Finland. Germany and Austria are not included in the non-stressed group because their full sample (i.e. non-weighted) is biased towards large firms. France only reports data for firms with at least 20 employees.

lower tail of the productivity distribution; it is there where nominal wage increases are obviously not in line with relative productivity performance. The most productive firms in stressed countries, on the other hand, appear to experience labour costs and, to a lesser extent, productivity growth, in line with those of non-stressed countries, leading to more similar developments of ULC.

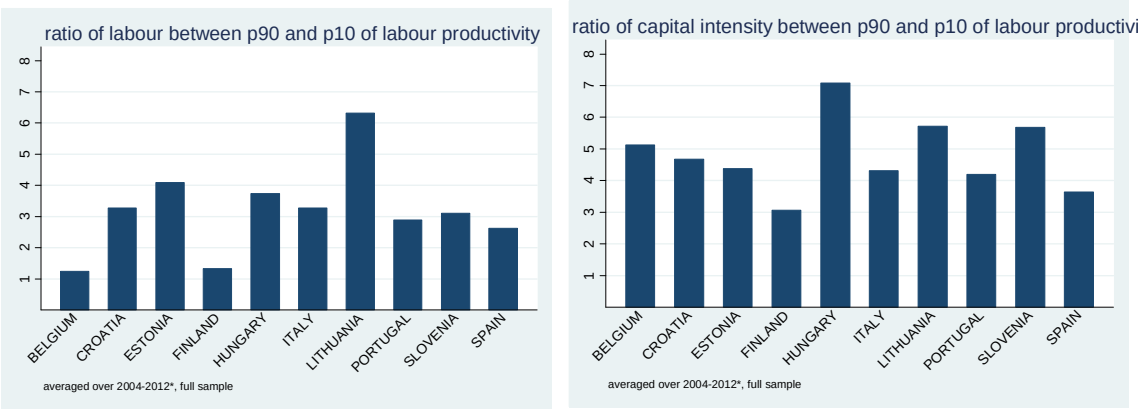
Figure 2: ULC dynamics for firms in different parts of the productivity distribution. Full sample; country level; evolution between 2006 and 2012[28]



The next two graphs compare firms at both tails of the productivity distribution in terms of capital intensity (left) and size (right). The figure compares the median capital intensity and size of the top 10% firms, in terms of productivity, vs. bottom 10% firms operating in the manufacturing sector. We show the average of 2004-2012.

[28] Belgium 2006-2010.

Figure 3: Capital intensity and size of firms of top 10% productive firms (P90) vs. bottom 10% (P10). Full sample; Manufacturing sector; Average 2004-2012.[29]



Capital intensity, defined as the stock of capital per employee, in top productive firms is on average four times larger than that of firms in the bottom part of the distribution of productivity within the same sector. Although this is a remarkable difference, given that we are examining firms operating in the same country and sector, the ratio is very similar across countries showing that productivity is highly related to capital deployment and exploitation of technology. Differences in terms of median size, measured as number of employees, between top and bottom productive firms are not so stunning but vary more across countries, ranging from little above one in Belgium and Finland to 6 times larger labour share in top Lithuanian firms.

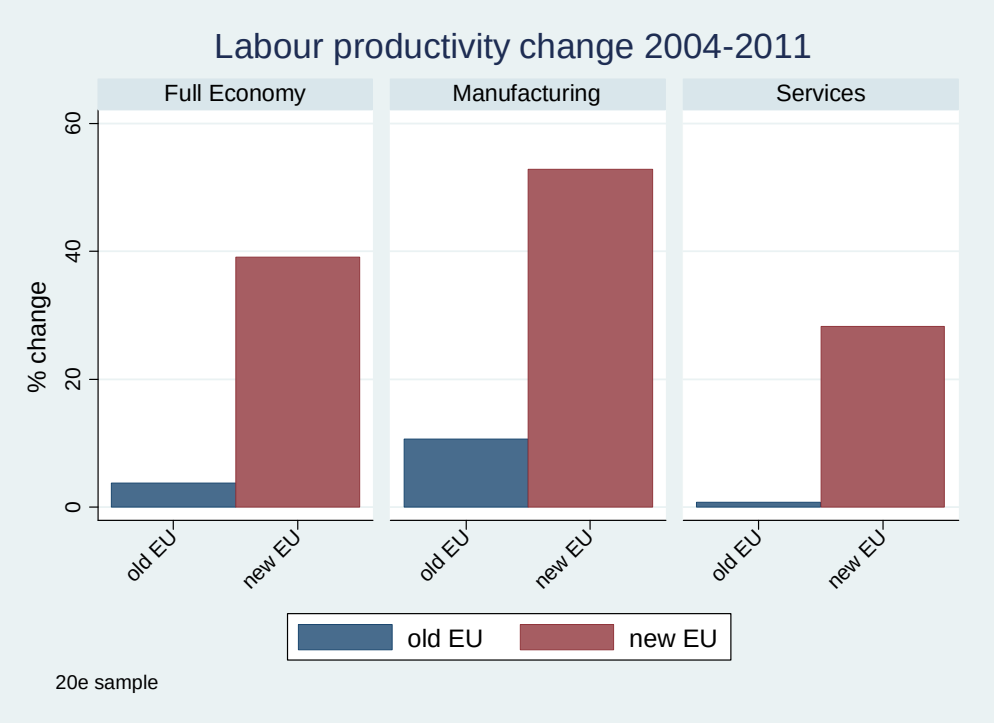
3.1.3 Plausibility of CompNet productivity indicators

In order to put at a test the results coming from our firm level database, we have conducted a number of checks with other micro results or relevant aggregate information; admittedly rather loosely we have defined such attempts as "plausibility tests". Two of such tests concerning labour productivity are shown here and consist in replicating two well-known and broadly accepted economic facts with our data. They are related, first, to the convergence process of productivity growth across countries, experienced in particular in Europe by the catch-up of the new EU member states vs. the rest of the Union; and, second, to within-country differences in terms of productivity growth in sectors "technologically progressive" and with "constant productivity" as Baumol (1967) named them in his seminal paper. Hence, the idea behind this exercise is to check whether the growth and within-country differences across sectors of labour productivity in the CompNet database are reasonable and reproduce well-known patterns.

Figure 4 depicts the cumulative growth rate of labour productivity between 2004 and 2011 for all countries in the dataset. The left panel pools all sectors together and compares "old" and "new" EU countries in terms of overall labour productivity growth rates. The other two panels look separately at manufacturing and services.

[29] Austria, France, Germany, Poland and Slovakia are not included as they either don't have full sample or their insrepresentativeness is especially poor for small firms

Figure 4: Cumulative productivity growth, 2004 to 2011. 20E sample[30]



The main result is that "new" EU countries (in red) show cumulative rates of productivity growth much larger than mature countries - an average of roughly 5,5% per year over the period, vis-à-vis 1% in mature economies if we look at the full economy. This is what one would expect given the catching –up process taking place in the new EU states, and in line with other sources of data. Further, we have quantitatively estimated the speed of (unconditional) convergence between new EU countries and old member states to assess whether it is reasonable. Borrowing from Barro and Sala-i-Martin (1992), we have ran a simple specification of year-on-year growth rate of productivity on initial productivity level finding a (highly significant) β coefficient of 1.7%, with a confidence interval including the value of 2% , which is the one commonly found in the literature.

The next well-established fact to be replicated with our data stems from the seminal work of Baumol (1967), "Macroeconomics of Unbalanced Growth: The Anatomy of Urban Crisis". Baumol claimed that there are two types of activities: technologically progressive industries (as he called them), in which innovation, capital accumulation and economies of scale lead to increases in productivity, normally in the production sector, and "constant productivity industries" where labour is not so much the mean but the end (normally in the service sector). Given the specific characteristics of each of these sectors, it is expected that productivity growth in the former will be larger than in the latter. The result of this

[30] Belgium 2004-2010; Poland 2005-2012; Portugal 2006-2012. Old EU: Austria, Belgium, Finland, France, Germany, Italy, Portugal, Spain. New EU: Estonia, Hungary, Lithuania, Poland, Romania, Slovakia, Slovenia

"unbalanced growth" is that, provided that demand for services does not decline, more and more labour will be needed to produce a given amount of services and, therefore, the share of services in total employment will increase over time. That is exactly what we observe across all countries. Figure 4, in its central and right panel respectively, shows the growth of productivity in manufacturing firms –operating in technology intensive sectors- and service firms. Although there are differences across countries (new versus old) it is a fact across the board that manufacturing productivity growth is larger than productivity growth in services, being the latter close to zero in mature economies.

3.2 The CompNet modules

As it was shown in Table 6 above, the new database includes a wealth of new indicators whose joint analysis with the productivity and competitiveness measures is at the core of the mandate of CompNet. In what follows we summarize briefly such new indicators, referring to the forthcoming module-specific methodology papers for more information.

3.2.1 The CompNet financial module

Financial variables in CompNet are extracted from the balance sheets and profit and loss accounts of firms. Besides detailing the construction of a number of standard indicators of the financial position of the firm and providing complete statistics of those indicators by sector or by sector and size-class, CompNet has estimated a firm-level indicator of credit constraints (ICC). This novel indicator uses the ECB Survey on Access to Finance of Enterprises (SAFE) matched with the balance sheets of the sampled firms. BOX 4 below details some of the most important methodology issues related to the new indicator. For more information, refer to the forthcoming financial methodology paper.

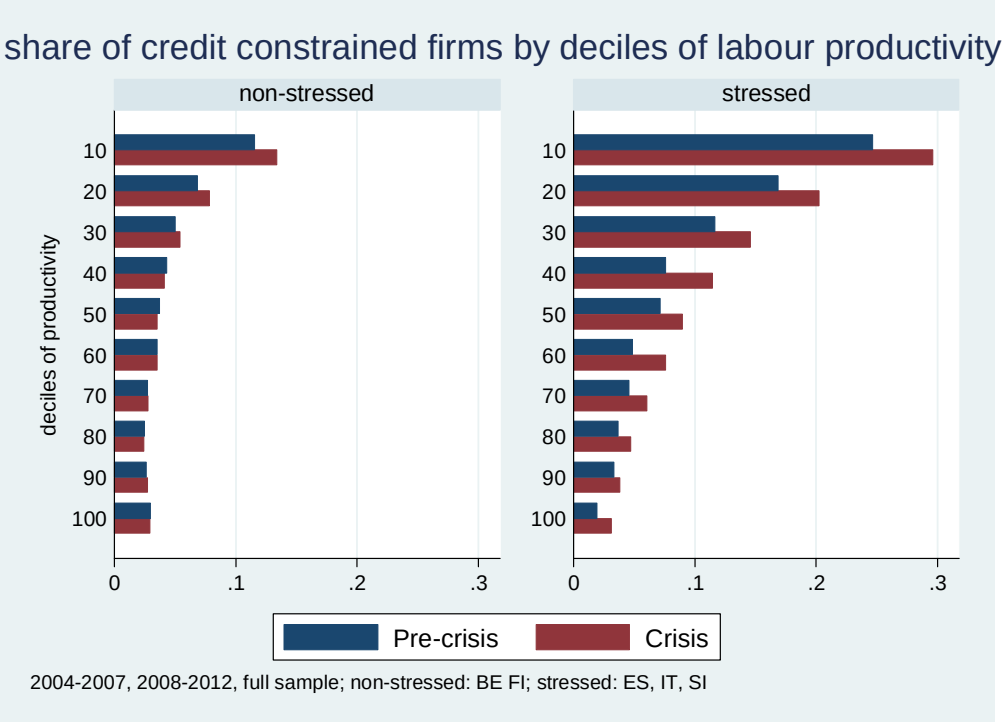
The joint analysis of labour productivity or TFP with this newly developed indicator of credit constraints allows researchers to analyse for instance credit allocation efficiency over time and across countries. In fact, because of agency problems, bank credit is often provided to firms based on availability of collateral rather than based on the quality of the investment. In times of uncertainty this inefficiency becomes larger, above all in countries with an immature banking sector.

To explore this issue, Figure 5 below shows the share of credit constrained firms in each decile of the productivity distribution, considering only the manufacturing sector. We show the figure for non-stressed and stressed countries. [31] Furthermore, we average the years before the crisis (2004-2007) in what we called the "pre-crisis period" and the years of the crisis (2008-2012)[32].

[31] Stressed countries are Spain, Italy and Slovenia. Portugal could not be included because it has data only from 2006 onwards. Non-stressed countries are Belgium and Finland. Austria, France and Germany are not included as they either don't have full sample or their representativeness is especially poor for small firms.

[32] In the remaining of the paper we will compare the pre-crisis with the crisis period. The former will be defined as the period between 2004 and 2007 whereas the later will be from 2008 to 2012. We are aware of the fact that there is cross-country variability in terms of the exact definition of these two periods. However, to simplify the exposition we decided to adopt this convention for all countries. Please note that Belgium is available only until 2010.

Figure 5: Credit allocation efficiency before and during the crisis, stressed and non-stressed countries. Full sample



According to the figure above, the percentage of credit constrained firms decreases with firm productivity (the bottom part of the chart), which is good news. Figure 5 shows also that the share of credit constrained firms in each of the splits of the productivity distribution in non-stressed countries has not changed significantly during the great recession (with the exception of the bottom tail of the distribution). The picture is different in stressed countries where the share of constrained firms has increased across the board, although particularly so among least productive firms. If we divide the distribution in stressed countries in two parts, bottom half and upper half, credit constraints increased by 3,9 percentage points (up by 35% with respect to the pre-crisis level) in firms at the bottom half of the distribution vs. 1,3 pp in firms at the top.

BOX 4: CompNet Indicator of Credit Constraints (ICC)

In a world with capital market imperfections, firm's liquidity and in general the strength of its balance sheet become relevant determinants of its access to external capital. CompNet has built a novel indicator of firm-level credit constraints based on both survey and balance sheet data, which can be analysed in conjunction with other competitiveness indicators.

The Indicator of Credit Constraints (ICC) is built with the support of a novel dataset from the European Central Bank, which matches the answers of firms sampled for the ECB Survey on Access to Finance of Enterprises (SAFE) with their financial statements between the second quarter of 2009 till the first quarter of 2011 (i.e. from wave 3 of SAFE till wave 8). Using the answers from the SAFE survey, 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,
- firms which did not apply for a loan for fear of rejection (i.e. discouraged borrowers).

Using the matched sample of firms, the probability of a given firm to encounter financing obstacles is estimated as a function of its financial situation, controlling for other possible determinants, like time, sector and country-specific effects, as well as its size. In particular, the balance sheet variables included in the regression are financial leverage, financial pressure (ratio between interest payments and the sum of profits, depreciation), profit margin, collateral, and cash holdings (all of them are commonly used in the literature); the dependent variable, on the other hand, is a binary variable taking the value 1 if the firm is credit constrained according to the answers provided to the SAFE survey.

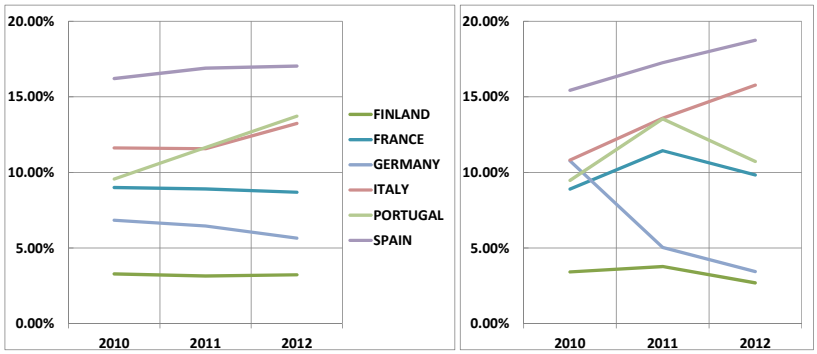
Based on the estimated coefficients of the probit analysis, a SAFE score is defined as[1]:

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

[1] Please note that the SAFE score might be computed with a different specification of the equation depending on the definition of debt variable for each country. Please refer to the forthcoming paper of the Financial module for further details.

BOX 4 (continued)

The ICC will be equal to 1 for a given firm if its score is above the country-specific threshold and zero otherwise. The graph below shows the share of credit constrained firms according to the ICC in CompNet (left) vs. the share of credit constrained firms from the SAFE survey data (right).



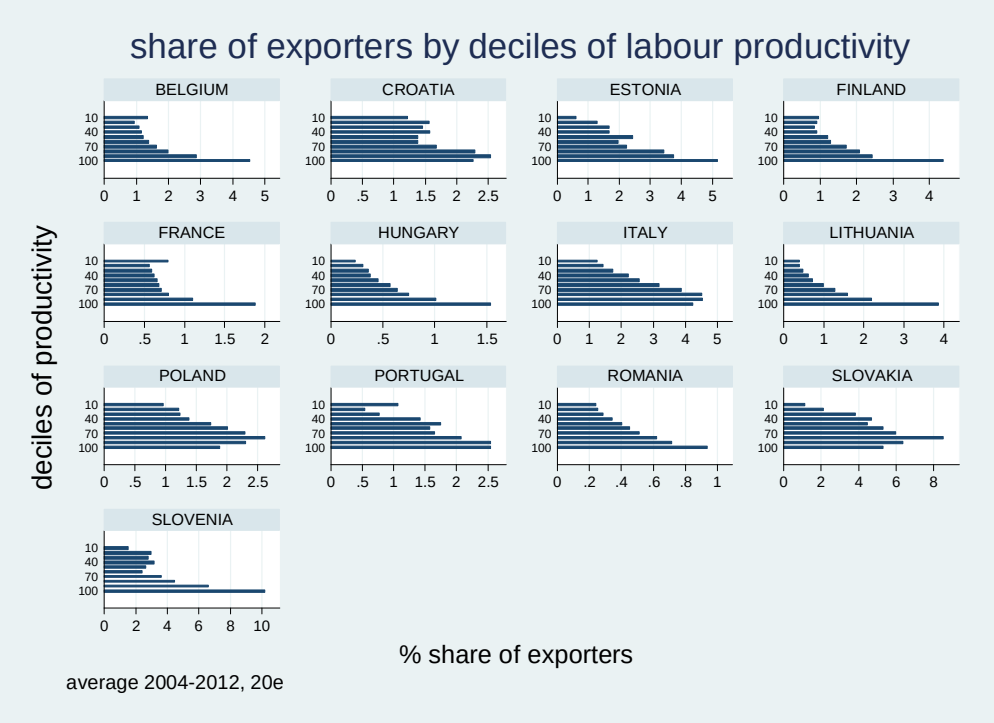
3.2.2 The CompNet trade module

The trade module exploits the information, provided originally at the firm-level, on the total value of exports and imports of manufacturing firms. The sources of this information vary: some countries have matched the balance sheets with custom data at the firm level whereas some other had access to information on the value of sales abroad (for details, refer to the trade-module methodology paper). It is worthwhile mentioning here that the coverage in terms of the value of exports is very high in all countries, given that CompNet samples contain most of the large, exporting firms. For an analysis on comparability in terms of types of exporters by sector and size, please refer to the trade-specific methodology paper.

The trade methodology paper will study jointly the financial and productivity characteristics of exporting (and non-exporting) firms to explore issues such as the characteristics of exporting firms in different countries, the degree of export concentration or the export premia considering different types of exporters. An example of the type of analysis that can be performed with the new CompNet database is shown in Figure 6 below. The figure depicts the share of exporters in different productivity deciles in all countries with available trade data (again the bottom of the figure concentrates the most productive firms) using the 20E sample.[33]

[33] Note that trade results from Spain for the 20E sample are not available, although they are available for the full sample of firms. The data of the figure come from the export reporting threshold adjusted version of trade statistics. For details on the export reporting threshold and how it was addressed, please consult the trade module paper.

Figure 6: Share of exporters across productivity deciles. 20E sample; manufacturing firms; average 2004-2012[34]



Even after restricting our attention to large firms (+20 employees), the results are consistent with the large body of literature on empirical international trade established with the seminal works of Bernard and Jensen (1995, 1999a, 1999b). First of all, while the relationship is not monotonic, it is clear that exporters are among the most productive firms of the economy. The share of exporters in the top decile of productivity is several times larger than the share in the bottom decile. Second, exporters are a minority of firms. Even when looking at the most productive decile, in no country are exporters more than 10% of firms, with most shares in the range of 2-4%. Third, there is a negative relationship between the size of a country and its degree of openness: smaller countries have an overall larger proportion of exporting firms as firms in small countries have more incentive to access foreign larger markets. The same pattern is observed in Arkolakis and Marc-Andreas Muendler (2013) where there is a negative correlation between the share of exporters among manufacturing firms and the size of the country, and this is consistent with the increasing returns to scale of advertising evidence cited in Arkolakis (2010).

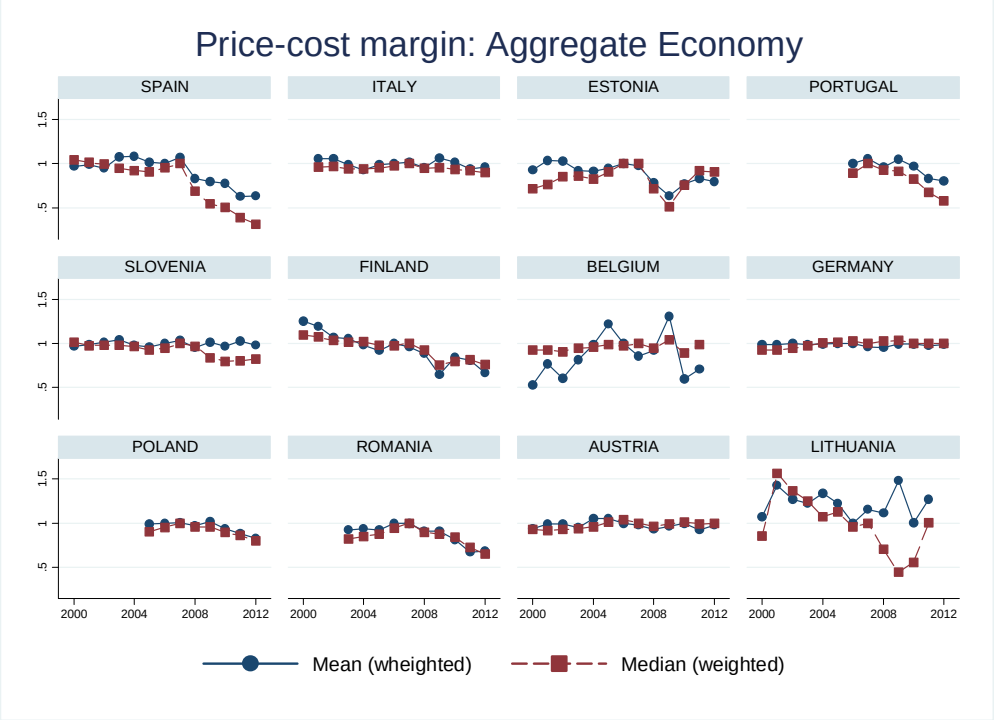
3.2.3 The CompNet mark-up module

The markup module is focused on one of the dimensions of aggregate competitiveness namely, product market imperfections. The forthcoming mark-up methodology paper focuses on the most popular indicator of competition: the price-cost margin computed from balance-sheet data. More specifically, it explores the evolution of the mean and median of price-cost margins, as well as their dispersion, for the

[34] Share of exporters defined as number of exporters over non-exporters. Belgium 2004-2010; Croatia 2008-2012; Lithuania 2004-2011; Poland 2005-2012; Portugal 2006-2012; Slovakia 2004-2011

total economy and at the sector level. In addition, patterns across sectors are highlighted. Box 5 details some of the issues explored in the module-specific paper as well as the proposed methodology to estimate mark-ups using firm-level data. Figure 7 below shows the dynamics of the mean and median price-cost margin for each country. Both indicators correspond to an index based on figures for 2007 obtained by weighting figures for each sector.

Figure 7: Dynamics of the mean and median price-cost margin; Country level; Full sample. 2000-2012



The figure shows that the price-cost margin has experienced different dynamics across countries. Portugal, Spain and Romania seem to have faced marked reductions, while Germany and Italy remained virtually unchanged. Upcoming research in CompNet is exploring the possible drivers of these, acute sometimes, cross-country differences.

BOX 5: Analysing price-cost margins

The price-cost margin is computed as the ratio difference between turnover and variable costs to turnover. Two distinct definitions of variable costs are considered. The first includes material costs, external supplies and labour costs. The second includes also the cost of capital. The module- specific paper discusses the evolution of the means and medians, but it also explores other dimensions of the distribution as the dispersion, while highlighting differences between sectors. Moreover, a score indicator for each sector is presented reflecting its ranking in terms of the level of the price-cost margin. Finally, the differences between exporters and non-exporters, as well as between new and old firms are discussed. Another type of indicators could potentially be introduced to measure the dynamics of concentration of market shares: the concentration ratio and the Herfindahl-Index.

Estimating mark-ups with firm-level data

One of the most classical approaches to measure market power within the relevant market is to test the distance between prices and marginal costs. Using the approach proposed by Roeger (1995), Crépon et. al. (2005), Dobblaere (2004) and Abraham (2004), the null hypothesis of perfect competition in the product is tested, relaxing the assumption of competitive labour markets. The reason is that market power is underestimated if workers hold positive bargaining power. By receiving wages above productivity, employees are in fact capturing some of the market power held by the firm. If these rents are disregarded, product market imperfection is perceived to be lower than what it is in reality.

Boone (2000, 2008) proposed a new measure of competition among firms: the profit elasticity which captures the drop in profits due to a one percent increase in marginal costs. The profit elasticity complements classical competition measures like the Herfindahl–Hirschman Index or the price-cost margin. The underlying intuition is that the stronger the market competition, the harsher is the punishment of relatively less efficient firms and the bigger is the reward of relatively more efficient ones, i.e., more competitive markets are those where marginal cost reductions translate into larger profit increases (higher elasticity of profits to marginal costs, in absolute terms). The main advantage of profit elasticities is that they are robust to the impact of reallocation effects, which may induce an incorrect signalling of competition changes under the classical measures.

The parametric analysis of mark-ups is at the core of the future research agenda of CompNet.

3.2.4 The CompNet labour module

The labour module aims at investigating the role of labour market structure and dynamics in driving firms' growth, defined in terms of number of employees or productivity. The new database has allowed to construct a powerful analytical tool, the so-called "transition matrices", also used in other studies like the Dynemp of the OECD.[35] Such matrices reflect firms' movements along the distribution of size, productivity or ULC in three year windows. The database includes the number of firms in each cell of the transition matrix, i.e. the share of firms of a given size class at time t growing or shrinking over a 3 year period and, differently from other projects like the abovementioned Dynemp, collects as well the characteristics of those different types of firms (growing or shrinking).

The labour methodology paper will explore the information contained in the transition matrices across countries, sectors and over time and then analyse the existing patterns in terms of the characteristics of each type of firms. This analysis will set the ground for the forthcoming research project, also co-signed by all labour module participants, aimed at exploring the determinants of firm growth as well as the impact of the great recession on firms operating in different sectors and countries.

The figure below shows an example of the type of information available in the labour module. The figure shows the initial median productivity and investment ratio, i.e. at time t, of firms downsizing, not changing their size or growing between t and t+3.

Figure 8: Distinct characteristics of firms downsizing and growing. Full sample; average across countries, sectors and rolling windows.[36]

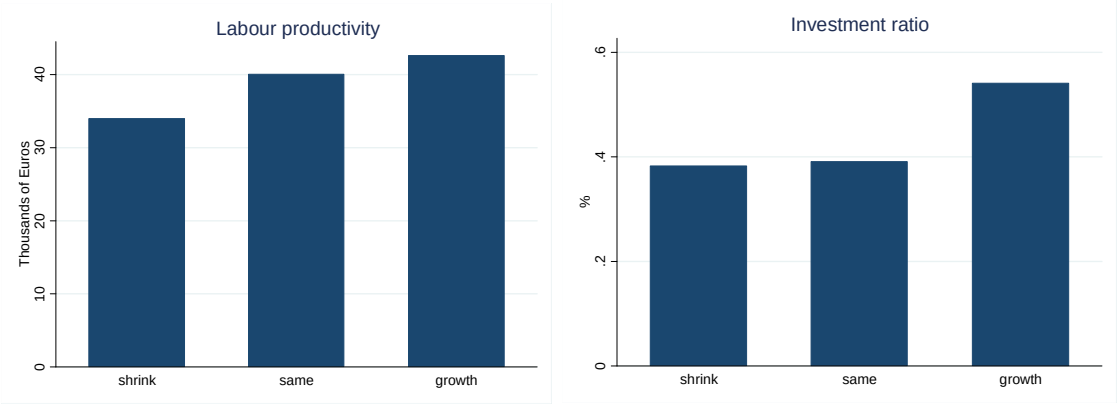


Figure 8 shows that the initial conditions of firms downsizing are distinct from those of firms expanding. For example, the median productivity of firms that will shrink over the subsequent 3 years (this is an average across countries, sectors and rolling windows) is about 30% lower than the productivity of firms

[35] Dynemp is an OECD project aimed at providing new empirical evidence on the role of creative destruction, start-ups and young firms using the same micro-distributed approach as in CompNet. For more information refer to http://www.oecd.org/sti/dynemp.htm

[36] Austria, France, Germany, Poland and Slovakia are not included as they either don't have full sample or their representativeness is especially poor for small firms. The maximum time-period considered is 1995-2012 (last 3-year rolling window is 2009-2012) although it varies across countries. Please refer to Table 2 for information on the country-specific time span.

that will expand. This is an interesting feature resulting from the interplay between firm heterogeneity and institutional factors that can now be tested using comparable data across countries.

4. Putting the indicators to work: Is the recession cleansing?

A recent strand of literature, analysing cross-country indicators built up from firm-level data shows that cross-country productivity differences can be partially accounted for by differences in allocative efficiency. That is, aggregate productivity in a country may be lagging partly because available inputs are not allocated efficiently across firms within an industry. This finding provides a potentially new channel for boosting aggregate productivity, namely through reallocation of resources away from poorly performing firms towards the most productive firms.

Although we are still far from fully understanding why allocative efficiency varies across sectors, and countries, the fact is that in well-functioning markets resources should flow to more productive plants or firms. Or in other words, there should be a positive correlation between productivity and size at the firm level. Accordingly, the literature has developed a measure of allocative efficiency by means of the industry-level covariance between productivity and size, a very simple-to-compute and robust indicator first introduced by Olley and Pakes (1996) and then popularized by Bartelsman et al. (2009) as the OP gap index. The CompNet database includes also such an indicator and is using it extensively to explore whether observed country and sector differences can be related to sector specific regulations of the labour, the product or even the credit market (see Restuccia and Rogerson 2008, Arnold et al. 2011, Andrews and Cingano 2012, Aghion et al. 2007 and Martin and Scarpetta 2011).

Thanks to the wealth of data available in the second version of the micro-distributed dataset, CompNet includes other indicators of allocative efficiency, which can be used to complement the more traditional ones. The new indicators available are the joint moments of employment and productivity. More concretely, we can retrieve from the firm-level data employment changes of firms split by productivity level as well as their employment share in the sector. Inspection of these joint distributions enables researchers to explore whether those employment flows in a given sector have improved the allocation of labour across firms in the sector. That is, whether more (less) productive firms have increased (decreased) their employment share. By measuring the change in employment over time and across productivity deciles, one can also check for the first time whether the effect of the great recession across EU countries and industries has been cleansing the least efficient firms or not. This allows drawing a comparison with similar exercises undertaken for the US economy, like Foster et al. (2014).

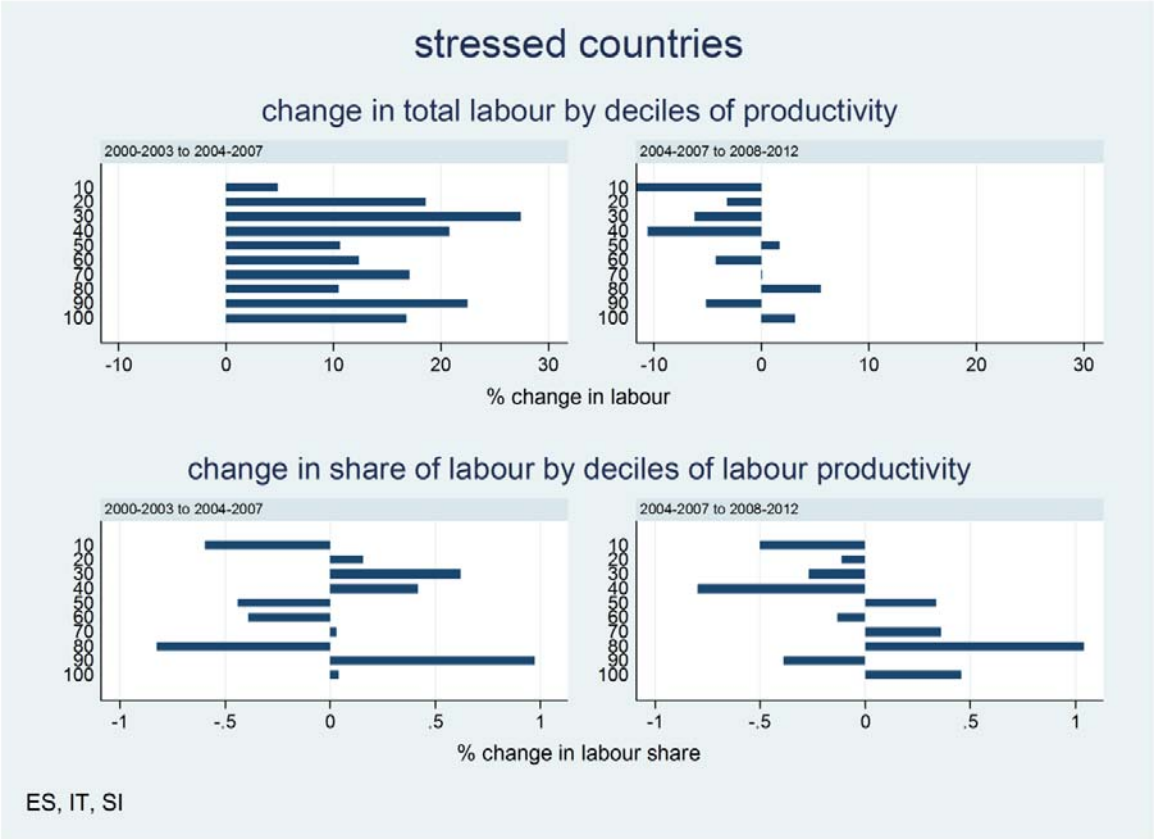
We start exploring whether the crisis triggered changes in the distribution of labour over and above what happens in "normal" times. We use for this exercise the data from the full sample (firms with at least 1 employee), which excludes countries with only larger firms in their sample, like France, Poland and Slovakia.[37] Given these constraints, we group countries in stressed –Spain, Italy and Slovenia- and non-stressed countries –Belgium and Finland.

[37] Apart from France, Poland and Slovakia, we also exclude Germany and Austria given the existing bias in their full samples.

Figure 9 pools together all sectors and shows, for the stressed countries, the employment growth (top row) and the resulting change in employment share (bottom raw) of firms split by productivity decile in two different periods. The left charts show the employment growth and resulting change in employment share of firms in different deciles between 2000-2003 and 2004-2007, that is, the change over a "normal" period, and the right ones show the same information between 2004-2007 and 2008-2012 which reflects the changes triggered by the crisis. [38]

Labour allocation will become more efficient if, as a result of the employment flows, the employment share of more productive firms increases at the expense of the employment share of low productive firms.

Figure 9: Employment growth and change in employment share of firms split by productivity, normal times vs. crisis. Stressed countries (ES, IT, SI). Full sample; country level

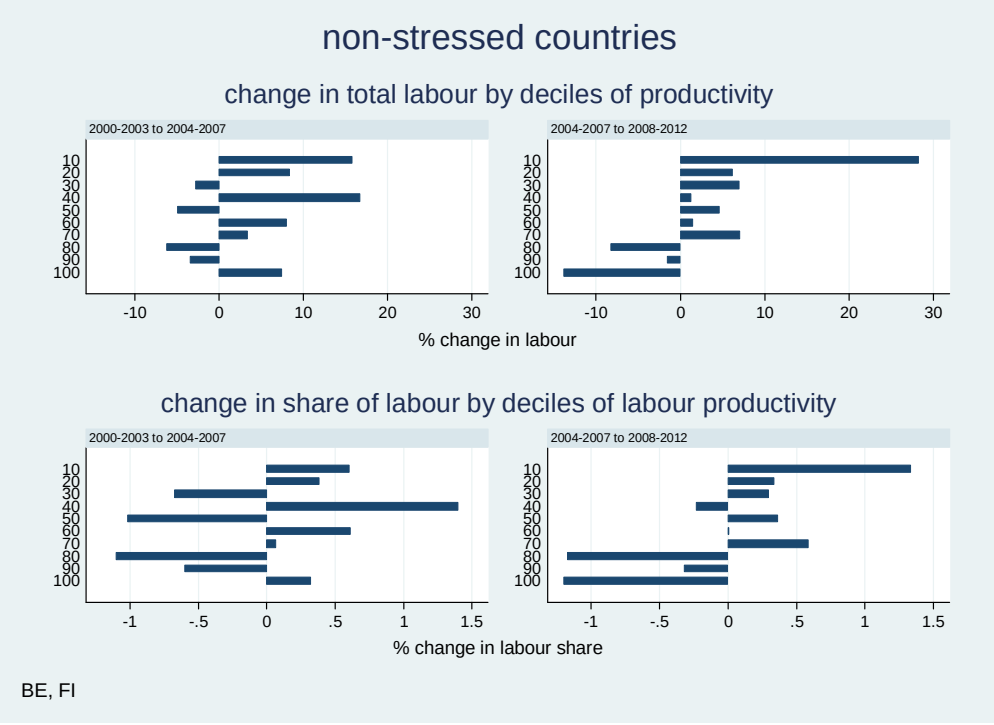


[38] That is, we compute the average employment over the period 2000 and 2003 and over 2004 and 2007 of firms in a given decile and then calculate the relative change between both periods. With respect to the employment share, we compute the average employment share of firms in a given decile over the period 2000-2003 and also over the period 2004-2007 and then calculate the relative change. The same procedure is applied for the period 2004-2007 and 2008-2012.

Focusing on the top row, employment dynamics changed rather sharply from the period pre-crisis, which is what we expect. Yet, the largest increase in employment during the boom was not concentrated in the most productive firms but rather in the low part of the productivity distribution, likely driven by the developments in the construction sector. During the crisis, on the other hand, firms across virtually all segments of the productivity distribution lost employment. But what matters here is that low productive firms lost proportionally more jobs than high productive firms. Hence, the crisis seems to have a cleansing effect in these countries. This is clearly seen in the bottom row, depicting the change in employment share of firms in different productive deciles. As a result of the cleansing of low productive firms, the employment share of the bottom part of the productivity distribution decreased whereas the employment share of the top productive firms increased. Hence labour allocation became more efficient.

Figure 10 shows the same type of graphs for non-stressed countries. The only difference between the "normal" and crisis period here is the loss of employment and share of the top productive firms. This is directly related to the impact of the 2009 trade collapse, which affected mostly exporting, more productive firms, as we will see in the next figure. [39]

Figure 10: Employment growth and change in employment share of firms split by productivity, normal times vs. crisis. Non-stressed countries (BE, FI). Full sample; country level[40]



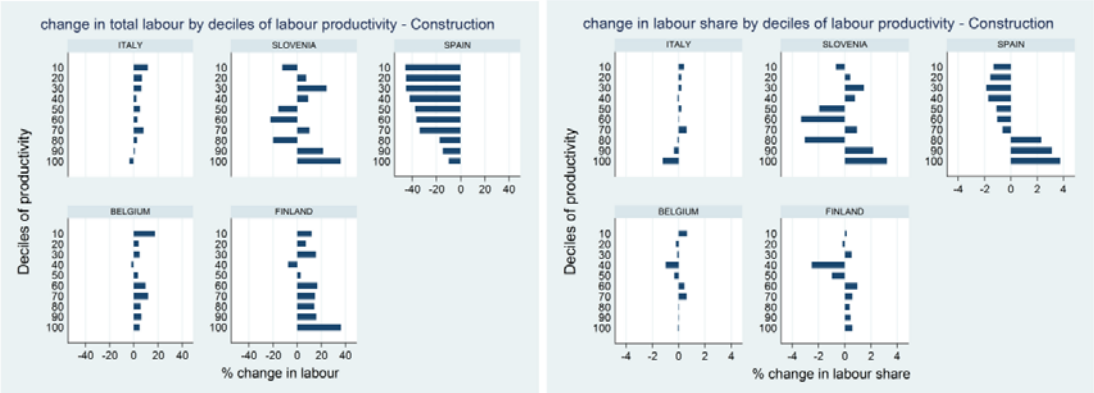
Indeed, the impact of the crisis has been different across industries depending, among other things, on whether they built up inefficiencies in the preceding years. Figure 11 shows in its left panel the

[39] Of course, non-exporters may also have been affected through input-output linkages with exporters.

[40] Belgium: 2000-2010

employment change in the construction sector between the period 2004-2007 (pre-crisis) and 2008-2012 (crisis) in each of the 5 countries considered. The right panel shows the impact of the employment flows on the efficiency of labour allocation, that is, the change of employment share of firms in different segments of the productivity distribution for the same set of countries.

Figure 11: Employment growth and change in employment share of firms. Full sample; IT, SI, ES, BE, FI; construction sector; crisis versus pre-crisis period



From Figure 11 it is evident that the crisis had an enormous impact on the construction sector of Spain among the stressed countries. Most importantly, the impact was not equal across firms, but was rather concentrated in the bottom part of the productivity distribution. Hence the gains in efficiency, in terms of labour allocation are remarkable, as one can see (right-hand panel) in the large increase in employment share of the top firms in the sector. Figure 12 shows the same information but considering only firms in the manufacturing sector.

Figure 12: Employment growth and change in employment share of firms. Full sample; IT, SI, ES, BE, FI; manufacturing sector; crisis versus pre-crisis period

The figure shows that non-stressed countries concentrated the largest employment loss in the top 20% of the productivity distribution of the manufacturing sector, which includes most of the exporting firms. On the other hand, in stressed countries the loss of employment was widely spread over the distribution and, therefore, was most likely related to a drop in demand or difficulties to access credit.

The next question is whether observed country/industry differences in terms of labour allocation efficiency are related to institutional factors, sector regulations or credit market conditions, once we take into account the different magnitude of the shock across countries. These are extremely important questions. Several research projects in the CompNet research pipeline are explicitly devoted to shed some light on them and are expected to produce results in the next few months.[41]

5. Conclusions

That firm heterogeneity matters enormously in order to appropriately assess aggregate performance, and most notably competitiveness, has been known in the literature for a while. Severe data limitations, however, have constrained the research attempts, particularly since adequate and consistent cross country coverage is currently not available in existing databases. In order to manage such constraints, empirical analysis has taken three main directions. First, it has used commercial databases – such as Amadeus – which simply collects firm level information (at times very rich) available at the country level, but without an express attempt of ensuring that data are comparable across countries. Second, it has used calibration of theoretical models relying on rather aggregated firm level information (see Ottaviano et al., 2009). Third – as in the case of the EFIGE database - it has promoted dedicated surveys of firms across countries, explicitly designed to ensure sampling coherence; unfortunately, the cost of the exercise has discouraged its repetition, thus allowing only one year observation point.

Against this background, the CompNet firm-level database aims expressly at filling an evident gap in the firm data collection in the EU. The strength of the exercise is that it leverages on rich firm-level databases available at National Central Banks and/or National Statistical Institutes, as well as on the high professional competence of the staff dealing in such institutions with that type of data. Having established a network among national teams with the common purpose of establishing a state of the art European database represents, therefore, the most relevant contribution of the project. The results and the potential of the exercise can be seen just by comparing the quality of the database developed in early 2014 with the one just produced and analysed in this paper, in terms of coverage and progress in data processing.

Among the most impressive and promising results of the CompNet database – unavailable so far to this extent and coverage in similar database for the EU – is the possibility of matching productivity distributions at the firm level with a number of covariates and drivers, such as export performance, financial characteristics, as well as firm growth and product market structure. This would allow researchers to establish deeper links between competitiveness drivers and policy outcomes.

[41] The research pipeline of CompNet is uploaded and regularly updated in the webpage. For more information on concrete projects visit: http://www.ecb.europa.eu/home/pdf/research/compnet/updated_research_pipeline-ws2.pdf

Admittedly, the work is still in progress, particularly as there are a number of statistical issues, which need to be tackled to improve cross-country comparability, thus allowing a more systematic use of the results for policy analysis as well as for research. However, as shown in this paper, the potential for policy relevant research is so rich that further improvement efforts are hard not to be urgently called for.

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7. Annex 1: Country-specific breaks and biases in sample time span

Austria:

- The Austrian dataset is very biased towards large firms: It covers about 3% of the population of firms and one-third of total employment. This is the result of the groups of firms reporting data to the Bank of Austria:
    1. Firms receiving passive direct investment from abroad are legally obliged to report their balance sheet data to the OeNB. These firms constitute the most important group in the data.
    2. All firms from the commercial register for which balance sheet data are available (i. e. corporations)
    3. Firms receiving a loan from the ERP (European Recovery Programme)
    4. Austrian "Top-500" firms
    5. Firms receiving larger loans (above EUR 5 million)
- No information on financial statements or exporting activities of the firms.

Belgium:

- Change in reporting thresholds for EU intra trade: Reporting of intra-EU and extra-EU trade activities of Belgian firms are conditional on reporting thresholds. Exports to non-EU countries of at least 1,000 EUR per year have to be reported. Concerning intra-EU trade flows, firms only have to report their intra-EU exports if the total of their exports to EU countries over the last 12 months are above the intra-EU threshold. This threshold is varying over time and has been set to fulfill Eurostat requirements in terms of the coverage of total export activities. That intra-EU threshold was 104.115 EUR from 1995 to 1997, 250.000 EUR from 1998 to 2005 and 1.000.000 EUR from 2006 onwards.
- The Belgian dataset covers the universe of firms that have to provide complete or abbreviate standardized annual accounts

Croatia:

- Relevant methodological changes were adopted in 2008 and 2010: These changes affected the construction of the intermediate input variable which is not directly comparable between methodologies. There is some uncertainty about tracking energy costs in different profit and loss statement items because there is no explicit item for energy costs in the 2007-2008 and 2010-2012 methodologies. Specifically, before 2008 energy costs are reported separately, and afterwards it is assumed that they are included in costs of raw materials or costs of sold goods.
- From 2002 onwards (the Croatian dataset goes from 2002 to 2012), non-reporting to the firm registries is subject to penalties for all legal firms.
- Although this database is widely used for statistical purposes, there are still some issues regarding non-reporting of firms which suggest taking results with some caution. More concretely, some firms drop from the database and then reappear but it is not known this caused by statistical or economic reasons.

Estonia:

- With the accession to the EU in 2004 there was a change in the methodology for foreign trade statistics. More concretely:
    - 1995-2003
        - Special trade system, i.e. commodities to free circulation or goods where some value is added after importing and before exporting
        - Full population of exporters/importers is covered, based on declarations to tax and customs board
    - 2004-onwards
        - Extra EU, same as before, i.e. special trade system and whole population is covered (Extrastat)
        - Intra EU, important change (Intrastat): Includes commodities re-exported through customs warehouses without free circulation; includes import/export only above a certain threshold. The threshold is time-varying , 100 000 EUR for yearly export and 140 000 EUR for yearly import in 2012
- Switch from print-out paper reports to the electronic reports in 2009. This change concerned mostly one item - employment. It was not compulsory to report employment before the switch, although the majority of firms did report it; since 2009 it has become compulsory. As a result the smallest firms started reporting employment and the median size of a firm decreased from 3 to 2 and the average from 11 to 8 between 2009 and 2010.

Finland:

- There was a change in taxation records data in 2005-2006: The financial statements statistics data had to be constructed from a new database and detailed information on all items was no longer available. The perspective changed from accounting to taxation. Although these changes do not seem to result in any break of the series, they should be kept in mind when using the data.
- The Finish data covers the full universe of firms during the entire time period covered in CompNet

France:

- Only firms with more than 750.000 euros of turnover report data to the Bank of France

Germany:

- There is a severe bias towards large firms. For this reason the use of the 20E sample is strongly recommended.
- There is a bias towards manufacturing firms. Some service sectors feature a rather poor coverage
- Selection bias is present for multiple reasons (firms report to get a rating, for example).

Hungary:

- Data starts in 2004 because the accession to the EU resulted in a break in trade data.
- Change in NACE from rev.2.1 to rev.2.2 in 2008
- Otherwise, no reported breaks or biases.
- The Hungarian dataset covers the universe of firms subject to corporate income tax

Italy:

- New NACE classification was adopted in 2008 (from NACE rev. 1 to NACE rev.2)
- The Italian dataset all Limited Liability Companies with employees, that is, excluding (differently from the figures provided from the Italian Business Register), all self-employed, sole proprietorships and partnerships (not Limited Liability Companies).

Lithuania:

- In 2004 the new national business accounting standards were implemented (new financial asset value assessment and some new accounting rules were introduced).
- Until 1 May 2004 the main source of information for external trade data was customs declarations. As of 1 May 2004 foreign trade data is based on the data from two statistical surveys – Intrastat and Extrastat.
- The dataset covers all the surveyed firms excluding a few (just a few) very large companies dropped for confidentiality causes.

Malta: Only firms with more than 5 employees.

Poland:

- New NACE classification was adopted in 2008 (although firm-level statistics had double NACE codes from 2005)
- The Polish dataset covers the universe of firms with more than 10 employees, although CompNet indicators are only computed for firms with at least 20 employees (in the 20E sample)

Portugal:

- New accounting standards were introduced in 2010: This introduction led to a break in the Survey, which can have implications on some variables, namely financial variables related to debt and interest expenses.

Romania:

- There were changes in accounting standards (2005) related to a better harmonization of the national framework with the European standards although it did not result in any structural break in the number of companies or the values of the indicators used in the CompNet.
- Changes in national classification in 2008 (from NACE rev 1 to NACE rev 2) but again, with no reported breaks in the series
- The Romanian dataset cover the universe of firms TO BE COMPLETED

Slovakia:

- Euro adoption in 2009;
- Total imports are retrieved from customs data (change in reporting threshold for EU intra trade), but total exports' source is balance sheet data (no reporting threshold)
- Slovak dataset covers the universe of firms with more than 20 employees

Slovenia:

- There is no trade (custom-based) data prior 2000
- There is no separate data on "financial expenses attributable to operating liabilities" prior 2006
- Prior 2006, there are breaks and biases present in many sub-items of the financial statements due to changes in accounting regulations
- The Slovenian dataset covers the universe (more than 90%) of registered firms.

Spain:

- It has to be taken into account that there is a positive trend in the number of firms until around 2002/03 due to improvements in data compilation capacity, not to genuine firm dynamics. The Spanish sample is thus less representative of the firm population in the period 1995-2002.
- We have identified problems when computing aggregates for productivity, labour share, profit share and unit labour costs from 2007 on. The previous problems are partially related to a change in general accounting rules that took place in 2007 (effective in 2008), which somehow produced a break in the series of some of the variables used to compute productivity, profits and labour costs. This change might affect both the level and the trend of these variables, but heterogeneity of those variables between sectors appears to be more resilient to the change.
- The abovementioned change in accounting rules was accompanied by a somewhat more detailed information on liabilities, allowing the incorporation of the leverage ratio (and the subsequent indicators based on this ratio) to the list of financial indicators that can be provided for Spain (before 2007, data on costly debt is not available).
- The change in accounting rules affected the way machinery acquired through leasing was recorded (formerly as an intangible asset and currently as a tangible asset). This issue only affects firms from the CBB sample (i.e. the one coming from Mercantile Registries). As a solution, the Spanish measure of the stock of capital is the sum of both tangible and intangible assets. This should be taken into account when computing variables in levels that use the stock of capital.
- Finally, concerning trade data, the Balance of payments Statistics (BoP) is used to identify whether a Spanish firm has exported goods between 1995 and 2011. There is a simplification reporting threshold, below which any exporting firms do not have to report about the nature of the external transaction. This reporting threshold has change over time: 3.000 € from 1995 to 2000; 12.500 € from 2001 to 2007; and, finally, 50.000 € from 2008 onwards. Any increase in the threshold automatically reduces the sample of exporting firms and introduces a break in the time series. In Spain, this break was relevant in 2008, when there was a significant decrease in the number of goods exporting firms that had the obligation to report to the Banco de España to

compile the BoP. Despite this reduction in the sample of exporting firms, the exported value reported by these firms still accounted for around 95% of total Spanish exports of goods according to the official figures since 2008 (around 20% in terms of total goods exporting firms, 55% before 2008). Nevertheless, this percentage decreases when the BoP data are combined with other statistics to obtain firm level information, such as, the number of employees or the labour cost, that it required to compute ULCs or productivity at firm level.

8. Annex 2: Sector classification

Code	Description	Code	Description
C	Manufacturing	10	Manufacture of food products
		11	Manufacture of beverages
		12	Manufacture of tobacco products
		13	Manufacture of textiles
		14	Manufacture of wearing apparel
		15	Manufacture of leather and related products
		16	Manufacture of wood and of products of wood and cork, except furniture
		17	Manufacture of paper and paper products
		18	Printing and reproduction of recorded media
		20	Manufacture of chemicals and chemical products
		21	Manufacture of basic pharmaceutical products and pharmaceutical preparations
		22	Manufacture of rubber and plastic products
		23	Manufacture of other nonmetallic mineral products
		24	Manufacture of basic metals
		25	Manufacture of fabricated metal products, except machinery and equipment
		26	Manufacture of computer, electronic and optical products
		27	Manufacture of electrical equipment
		28	Manufacture of machinery and equipment n
		29	Manufacture of motor vehicles, trailers and semitrailers
		30	Manufacture of other transport equipment
		31	Manufacture of furniture
		32	Other manufacturing
		33	Repair and installation of machinery and equipment
F	Construction	41	Construction of buildings
		42	Civil engineering
		43	Specialised construction activities
G	Wholesale and retail trade; repair of motor vehicles and motorcycles	45	Wholesale and retail trade and repair of motor vehicles and motorcycles
		46	Wholesale trade, except of motor vehicles and motorcycles
		47	Retail trade, except of motor vehicles and motorcycles
H	Transportation and storage	49	Land transport and transport via pipelines
		50	Water transport
		51	Air transport
		52	Warehousing and support activities for transportation
		53	Postal and courier activities
I	Accommodation and food service activities	55	Accommodation
		56	Food and beverage service activities
J	Information and communication	58	Publishing activities
		59	Motion picture, video and television programme production, sound recording and music publishing
		60	Programming and broadcasting activities
		61	Telecommunications
		62	Computer programming, consultancy and related activities
		63	Information service activities
L	Real estate activities	68	Real estate activities
		69	Legal and accounting activities
M	Professional, scientific and technical activities	70	Activities of head offices; management consultancy activities
		71	Architectural and engineering activities; technical testing and analysis
		72	Scientific research and development
		73	Advertising and market research
		74	Other professional, scientific and technical activities
		75	Veterinary activities
N	Administrative and support service activities	77	Rental and leasing activities
		78	Employment activities
		79	Travel agency, tour operator and other reservation service and related activities
		80	Security and investigation activities
		81	Services to buildings and landscape activities
		82	Office administrative, office support and other business support activities

9. Annex 3: Sector distribution of employment in the 20E sample after applying population weights

	Manufacturing		Construction		Wholesale and retail trade		Transportation and storage		Accommodation and food		Information and communication		Real Estate		Professionals		Administratives	
Country	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet	Eurostat	CompNet
BELGIUM	21%	28%	12%	8%	24%	20%	8%	12%	7%	3%	5%	5%	2%	0%	9%	5%	13%	20%
ESTONIA	27%	35%	11%	8%	23%	20%	11%	10%	5%	4%	5%	5%	3%	5%	6%	3%	8%	10%
FINLAND	27%	34%	13%	9%	22%	20%	11%	10%	5%	3%	6%	8%	n.a.	n.a.	8%	5%	9%	10%
FRANCE	21%	27%	12%	8%	23%	21%	9%	13%	7%	4%	5%	5%	2%	1%	9%	7%	12%	13%
GERMANY	36%	42%	8%	5%	31%	26%	10%	14%	n.a.	n.a.	5%	5%	n.a.	n.a.	10%	8%	n.a.	n.a.
ITALY	27%	39%	12%	6%	23%	16%	7%	13%	8%	5%	4%	6%	2%	0%	8%	3%	7%	13%
LATVIA	21%	27%	10%	10%	29%	25%	13%	16%	5%	4%	4%	4%	6%	5%	6%	3%	5%	7%
POLAND	31%	42%	11%	9%	29%	22%	9%	10%	3%	2%	3%	3%	2%	2%	6%	3%	6%	7%
PORTUGAL	22%	30%	14%	12%	26%	20%	5%	7%	9%	6%	2%	3%	2%	0%	7%	3%	13%	17%
SLOVAKIA	32%	48%	12%	7%	26%	19%	8%	11%	4%	1%	3%	4%	2%	0%	7%	3%	5%	7%
SLOVENIA	34%	44%	13%	10%	20%	19%	9%	7%	6%	4%	4%	4%	1%	0%	8%	6%	5%	6%
SPAIN	17%	22%	14%	9%	26%	24%	8%	9%	10%	7%	4%	6%	2%	0%	8%	5%	10%	19%

Averaged over all available years. Source: DG-Statistics Quality report

9. Annex 4: Country deviations from harmonised variable definitions[41]

Variables	Austria	Belgium	Croatia	Estonia
Total fixed assets				
Intangible fixed assets	NA			
Other fixed assets	NA			Fixed assets - tangible fixed assets - intangible fixed assets. Consists of long-term investments into financial assets and real estate, and biological assets.
Other current assets	NA			Current assets - cash and cash equivalents - inventories - trade debt. Consists of biological assets and fixed assets waiting to be sold.
Cash and cash equivalents	NA			
Total assets	NA			
Capital (Tangible fixed assets)				
Non-current liabilities	NA			
Long term debt	NA			
Other non-current liabilities	NA			Non-current liabilities - long-term debt. Consists of other long-term debt, long-term target financing and long-term allocations.
Current liabilities	NA			
Short-term debt	NA			
Other current liabilities	NA			Current liabilities - short-term debt - trade credit. Consists of target financing and short-term allocations.
Shareholder funds (equity)	NA			
Current assets	NA			
Number of employees				
Turnover				
Profits and losses before taxes	NA			
Raw materials			Before 2008 energy costs are reported separately, and afterwards it is assumed that they are included in costs of raw materials or costs of sold goods.	
Labour cost				
Depreciation	NA			
Interest paid (or financial charges)	NA			Interest expenses consists of expenses from loans, finance lease and bonds, and other interest expenses.
Cash flow (from profit/loss statement)	NA			Net profit + depreciation. Definition from Amadeus.
Value added	Turnover - intermediate inputs			
Profit/loss	NA			
Total inventories				
Trade credit (accounts payable)	NA			
Trade debt (accounts receivable)	NA			
Dividends	NA			From cash-flow statements
Firm's birth year	NA		-	Date of registration

[41] NA means that the variable is not available in the specified country. A black cell means that there are no differences with respect to the common definition of Table 4

Variables	Finland	France	Germany
Total fixed assets			
Intangible fixed assets	Not included	Net figure. Research expenses are now intermediates consumption and are not registered in assets, contrary to patents	
Other fixed assets			Financial assets
Other current assets		NA	Current asset securities + Cash, Bundesbank balances, balances at credit institutions and cheques + Prepaid expenses + Deferred tax assets + Deficit not covered by equity + Other adjustments
Cash and cash equivalents	Cash and cash holdings		
Total assets			
Capital (Tangible fixed assets)	Includes intagible assets		
Non-current liabilities	Long term debt + other non-current liabilities + compulsory provisions	NA	All liabilities due in more than 1 year
Long term debt	Total debt	Total debt	
Other non-current liabilities	Not included	NA	
Current liabilities	Short term debt + accounts payable + other current liabilities	Total Dettes + produits constatés d'avance	All liabilities due within 1 year
Short-term debt		Not available	
Other current liabilities	Not included	NA	Payments received on account due within 1 year + Liabilities arising from the acceptance of drafts and issue of own bills due within 1 year + Liabilities to partners due within 1 year + Liabilities to affiliates due within 1 year + Liabilities to enterprises in which the company has participating interests due within 1 year + Other liabilities due within 1 year + Deferred income
Shareholder funds (equity)	Includes other reserves and accumulated closing entries		Includes also special items with equity portion; other special items - unclaimed outstanding contributions - Deficit not covered by equity.
Current assets		Total de l'actif circulant + charges constatées d'avance (net figure)	Current assets + Prepaid expenses + Deferred tax assets + Deficit not covered by equity + Other adjustments
Number of employees			
Turnover			
Profits and losses before taxes	Ebit + financial profit/loss		EBIT + Financial result
Raw materials	Turnover - value added	Just materials	Cost of materials: expenses for raw, auxiliary and process materials, for purchased goods + external services
Labour cost			
Depreciation			Includes depreciation on capitalized start-up and business expansion expenses.
Interest paid (or financial charges)			
Cash flow (from profit/loss statement)			
Value added	Value added at factor cost		
Profit/loss			
Total inventories			
Trade credit (accounts payable)			
Trade debt (accounts receivable)			
Dividends	Not included		NA
Firm's birth year	Not included		NA

Variables	Hungary	Italy	Lithuania	Malta
Total fixed assets				
Intangible fixed assets				NA
Other fixed assets	NA	Financial assets		NA
Other current assets	NA			NA
Cash and cash equivalents				NA
Total assets				NA
Capital (Tangible fixed assets)				NA
Non-current liabilities	Long term liabilities			NA
Long term debt				NA
Other non-current liabilities	NA			NA
Current liabilities	Short term liabilities + Deferred income			NA
Short-term debt	Short term liabilities			NA
Other current liabilities	NA			NA
Shareholder funds (equity)	Share Capital + unpaid subscribed capital +Capital surplus + accumulated profit reserve + fixed reserve+ Revaluation reserve+General reserves			NA
Current assets	Inventories+ Accounts receivable+Accrued assets+Cash equivalents (liquid assets)+securities			NA
Number of employees				
Turnover				
Profits and losses before taxes	Operating surplus			NA
Raw materials	total cost of materials: raw, including energy and services			Turnover-Value Added
Labour cost				
Depreciation				NA
Interest paid (or financial charges)	NA			NA
Cash flow (from profit/loss statement)				NA
Value added	Sales+ Capitalized value of self-manufactured assets-matarials and material services			
Profit/loss				NA
Total inventories				NA
Trade credit (accounts payable)	NA			NA
Trade debt (accounts receivable)				NA
Dividends		Profits/loss of the year	NA	NA
Firm's birth year				

Variables	Poland	Portugal	Romania
Total fixed assets			
Intangible fixed assets	Direct translation: Non-material and legal assets – wartosci niematerialne i prawne	Net of depreciations	Material costs= Raw materials and consumables expenses + other material and consumables expenses + Electricity, heating and water expenses (utilities expenses) + cost of goods for resale
Other fixed assets	NA	Other tangible and intangible fixed assets net of depreciations	
Other current assets	NA	Cash and Bank deposits	turnover+net changes in inventories + capitalized production – raw materials and consumables expenses – other material expenses – utilities expenses – costs of goods for resale
Cash and cash equivalents			
Total assets			
Capital (Tangible fixed assets)			
Non-current liabilities	Long-term liabilities	Other accounts payable + Obtained funding	
Long term debt			CF Total = CF Operational + CF Financing + CF Investment
Other non-current liabilities	NA	Other accounts payable	
Current liabilities	Short-term liabilities	Suppliers + State and other public entities + Obtained funding + Deferred income + Other current liabilities	
Short-term debt			Not available
Other current liabilities	Current liabilities	Financial instruments + Salaries payable + Attributable net income + Investments suppliers + Creditors for accrued expenses + other operations (liabilities) + other debtors and creditors (liabilities)	Not available
Shareholder funds (equity)			
Current assets		Cash and bank deposits + Inventories and consumable biological assets + Customers	
Number of employees			Not available
Turnover			
Profits and losses before taxes			
Raw materials			Not available
Labour cost			
Depreciation		Depreciation on intangibles not included	
Interest paid (or financial charges)			
Cash flow (from profit/loss statement)			Not available
Value added			
Profit/loss	Net profits		
Total inventories			
Trade credit (accounts payable)			Not available
Trade debt (accounts receivable)			
Dividends	NA	NA	
Firm's birth year	NA		

Variables	Slovakia	Slovenia	Spain
Total fixed assets			Total assets – Current assets
Intangible fixed assets			Includes brands, patents, copyrights, licenses, research and development expenses capitalized etc.,. This item also includes the Goodwill recognized separately
Other fixed assets	Not available		Net of investment property
Other current assets	Not available		
Cash and cash equivalents	Not available		
Total assets			Fixed assets + Current assets
Capital (Tangible fixed assets)			Includes investment properties and assets under leasing
Non-current liabilities	Not available		Special debts+ Long-term funds from financial institutions+ Other long-term external funds
Long term debt	Not available		
Other non-current liabilities	Not available		Non-current liabilities – Long-term debt
Current liabilities	Not available		Liabilities linked to non-current assets held for sale+ Short-term interest-bearing external funds+ Short-term non interest-bearing external funds
Short-term debt	Total Bank Loans		
Other current liabilities	Not available		Current liabilities – Loans – Suppliers
Shareholder funds (equity)			Includes also valuation adjustments, grants, donations and legacies received
Current assets	Not available		Inventories + Trade and other receivables + Short-term financial investments + Cash and cash equivalents + Prepayments + Non-current assets held for sale
Number of employees			
Turnover			
Profits and losses before taxes	Gross Profit/Loss		Profit and losses (including extraordinary items) + corporate income tax
Raw materials		Total costs of merchandise, material (including energy), and services	
Labour cost	Gross Wages + Employers' Social Contributions		
Depreciation			Net of capital subsidies transferred to results of the exercise
Interest paid (or financial charges)			
Cash flow (from profit/loss statement)	Gross Profit-Depreciation		
Value added	Total Sales - Intermediate Consumption		
Profit/loss	Gross Profit/Loss - Taxes		Total Incomes – Total Expenses
Total inventories			
Trade credit (accounts payable)			
Trade debt (accounts receivable)			
Dividends	Not available	NA	Not available
Firm's birth year		the first year of reporting if the registration data not available	