CompNet The Competitiveness Research Network

Firm Productivity Report

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Contents

Executive Summary

As we enter a second phase of the COVID-pandemic, in which we attempt to reopen economies and foster growth, investigating the efficiency and productivity of firms becomes essential if we wish to design the appropriate policies. The 2020 Flagship Firm Productivity report provides a comprehensive account of how productivity is changing – and what is driving those changes – in Europe, drawing from granular firm-level information. Although it was written before the crisis erupted, this report can therefore offer critical insights to current policy making and provides grounds for future research.

Chapter 2 gives an overview of the innovations in data collection for 2020. Subsequent chapters highlight how the different "modules" in the CompNet dataset – Productivity, Labour, Trade and Financial – that, by taking a firm-level perspective, help us to better understand productivity developments in Europe. The main results are as follows.

Chapter 3 – <u>Productivity developments –</u> shows that, across all the European countries in our dataset, productivity growth has been muted since the beginning of the financial crisis. Within-sector productivity dispersion between best- and worst-performing firms is not increasing but remains high at about 90% on average for Europe. In some countries (Italy, France, Croatia) however, the best-performing firms are twice as productive as the least-performing firms while in Finland, the dispersion is only 40%. Intangible inputs contribute to high dispersion, as they allow (the relatively few) intangible-rich firms to scale up at low marginal costs. There is a positive relationship between productivity and intangible inputs. Including intangible fixed assets in the production function reduces the unexplained productivity residual and explains some of the productivity dispersion across firms. This only deepens the mystery of the aggregate decline in productivity growth.

In <u>Allocative efficiency</u> (Chapter 4), we highlight that productivity-enhancing reallocation processes have weakened in Europe. The analysis exploits the between-firm component of aggregate productivity as measured by the covariance between firm-size and productivity in each sector, that is the change in sector-level productivity due to a reallocation of market shares towards more productive firms. Within sectors, the reduction in the covariance coincides with a fall-off in job dynamism, defined as the sum of job creation and destruction rates. Regressions analysis shows that job dynamism, allocative efficiency and aggregate productivity are all significantly positively related, suggesting that the slowdown in reallocation dynamics contributed to the slowdown in aggregate productivity growth.

Chapter 5 (<u>Productivity, labour markets and labour share</u>) analyses first, how worker skills interact with productivity across European regions. Both employee skills and firm productivity are highly differentiated across regions, and the smaller the regional high-skilled labour force is, the lower the regional productivity. Second, we look at the evolution of the share of wages in value added, showing that it has been constant or even increasing for the past 10 years in many European countries, and for the EU as a whole. But deeper analysis at the sector level shows that, in prospering sectors and in sectors characterised by higher firm product and labour market power levels, labour shares are lower.

Trade and productivity (Chapter 6) provides two applications showing how the CompNet dataset can help to understand macro aggregates by providing firm-level information. First, we focus on the buoyant export activity that we have seen post-crisis in countries in central and eastern Europe (CEE), and compare it with the sluggish growth in exports of a group of non-CEE EU countries, showing how the divergent performance was driven by both the intensive and the extensive margins. These patterns of performance match the divergent productivity trends in these country groups. Second, the chapter highlights that there are specific features that distinguish exporting from non-exporting firms, showing also that the positive average exporters' premium is a common feature for the entire productivity distribution, not just for the few most productive firms. For these firms, however, GVC participation is likely to be the main driver of their high productivity premium.

Chapter 7 (Financial constraints and productivity) studies the regional dimension of financially constrained firms. The share of financially constrained firms has declined in Europe following the sovereign debt crisis. Regional clusters of constrained firms have also become smaller. The interaction between firm productivity and financially constrained firms is negative at the sector level, but this relationship has also become weaker.

Finally, chapter 8 (Firm concentration and aggregate productivity), documents an increase in top firm concentration in recent years in Europe and investigates potential mechanisms behind this trend. We show that rising concentration is associated with a more efficient market environment, higher productivity levels, and more technologically advanced production methods. Our findings thus constitute support for the view that rising concentration in Europe is part of an efficient market outcome.

1. Introduction

As we enter in the "second phase" of the COVID-pandemic, reopening economies and fostering growth, investigating the efficiency and productivity of firms becomes essential if we are to design appropriate policies. Early this year, policymakers had to reduce economic activity in an attempt to save lives and provide a short-term safety net for their citizens. But now, issues such as how to make our firms more productive must again be the focus.[1] Slashed production, expectation shocks, disrupted demand for final and intermediate goods, constrains to export capacity, impairments in domestic and international supply chains, the collapse of travel and tourism, changes in workplace safety rules, and the emergence of solvency problems are not only severely affecting GDP and trade over a two-three year horizon, but will likely also depress productivity over the longer term. This may materialize as a result, for instance, of disruptions to highly productive firms involved in GVCs, as well as in global allocative efficiency and in the transmission of technology.

This year's Flagship Report of CompNet – in preparation well before the crisis erupted – can therefore be read as a way to think about the post-COVID recovery phase. Our dataset can provide critical insights on how the European economy may eventually weather the crisis, and the analysis in this report may offer advice on policy interventions.

1.1 Micro-founded policy has never been more valuable

Our dataset is a complement to the aggregate data on competitiveness and firm performance collated by, for example, the Joint Research Centre of the European Commission, National statistical institutes (NSI) agencies and the IMF.

Aggregation, by its nature, masks heterogeneity. For policymakers, this heterogeneity has never been more important, and we uncover that fully in this report.

Our critical starting point is that **aggregate** productivity growth can result from either a more efficient use of production factors *within* firms, or a more efficient **reallocation** of production factors *between* firms**.** Guided by this simple breakdown of productivity growth - and supported by our micro-founded dataset - we can shed light on changes in TFP that occur on the narrow sector levels. We focus mainly on the <u>**sector-level**</u> TFP growth because production factors have a large sector-specific component. The main benefit of the CompNet dataset is thus that it helps to improve macro-aggregate economic analysis based on high-quality firm-level data. Besides, in a cross-country context this is an understudied dimension of TFP growth.

As the economic contagion from Covid-19 spreads through Europe, disaggregated data can help show which firms and sectors are vulnerable. Transmission mechanisms will be

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[1] https://voxeu.org/article/covid-crisis-and-productivity-growth

influenced by structural characteristics such as firm size, financing constraints, and labour market conditions.

Policy responses that commit large amounts of public money must be accountable, both *ex ante* and *ex post*. Therefore, it is essential to know which types of firms and sectors are driving growth and productivity improvements, and which firms, sectors and regions need the particular attention of policy makers. With this report we extent our knowledge on these critical issues for Europe.

We do so by analysing the major drivers of productivity growth, after describing the just released CompNet dataset (chapter 2). Chapters 3 and 4 analyse productivity patterns in Europe. Chapter 5 deals with characteristics of labour markets such as education and connect them to productivity; moreover, it analyses the latest development of the labour share. Chapter 6 looks at the relation between trade and productivity, firstly by analysing the divergent trends between CEE and non-CEE countries and then by looking at the implication of GVC participation. Chapter 7 analyses the regional dimension of financial constraints and links it with productivity developments. Finally, the report includes a special chapter (8) analysing stylised facts on firms' concentration in Europe.

1.2 Acknowledgements

This report would have not been possible without the critical inputs of National Data Providers, the list of which you can find in the second page of the report, and the scientific team, composed by staff of IWH and ECB. Comments by Ettore Dorrucci and Eric Bartelsman are gratefully acknowledged.

2. CompNet Dataset 2020

(Marco Christophori)

The 2020 flagship report uses the seventh vintage of the CompNet dataset. It provides a set of micro-founded indicators on productivity developments and their possible drivers for a large set of European countries, covering channels such as trade, productivity, competition, labour and finance.

Distributed micro-aggregate approach help us to overcome existing issues in firm-level data availability. Cross-country firm-level analysis is difficult to do in practice for two reasons:

1. **Firm-level data are confidential.** Accessing official micro data for researchers is generally difficult (e.g.: in loco servers, special permissions, etc.) and normally limited to national data.
2. **Publicly available firm-level indicators are not accurately comparable across countries.** Commercial sources, such as Orbis[2], are available, but their actual use and cross-country comparability is severely affected by technical hurdles, such as differences across countries in underlying data sources, collection methodologies, or variable definitions.

Distributed micro-aggregate approach help us to overcome existing issues in firm-level data availability

We solve these problems by using the distributed micro-data approach introduced by Bartelsman et al. (2004) and explained in detail in the case of CompNet in Lopez-Garcia and di Mauro (2015). Individual country-based data providers process confidential firm-level data through a common protocol to produce homogenous indicators. The indicators are aggregated at several aggregation levels[3] and collected by a central coordinating team. This preserves confidentiality, while creating cross-country data that can be used for comparative research and policy work.

As a result, our data of statistical moments of firm-level distributions are available at the macro-sector level, but also at the two-digit NACE level (56 sectors, manufacturing and services) and, if the information is available, at the regional level.

But our data is much richer than this. The important feature of the resulting micro-aggregated indicators is the rich information from linked firm-level data, that we can implement in our dataset. For instance, take labour productivity indicators. We can provide the two-digit-sector average for each country, but also information on the distribution within the respective sector and country population of firms. Using our data, researchers can compare - for the same average sector labour productivity - whether a country contains a subset of high-productivity firms that masks the underperformance of the majority.[4] There are 19 countries in the

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[2] Bureau Van Dijk
[3] Country, Macro-Sector, Macro-sector size class, Sector and NUTS2.
[4] Chapter 5.2 in the appendix of the User Guide, which provides the technical background to this report, includes a complete list of all indicators. Section 5.3 gives more detail on how we estimated the more complex productivity measures.

CompNet 2020 dataset[5]. Figure 2.1. shows our geographical coverage, encompassing timespans ranging from 1999 until 2018.

Figure 2.1 - Geographical coverage in the CompNet dataset, 2020
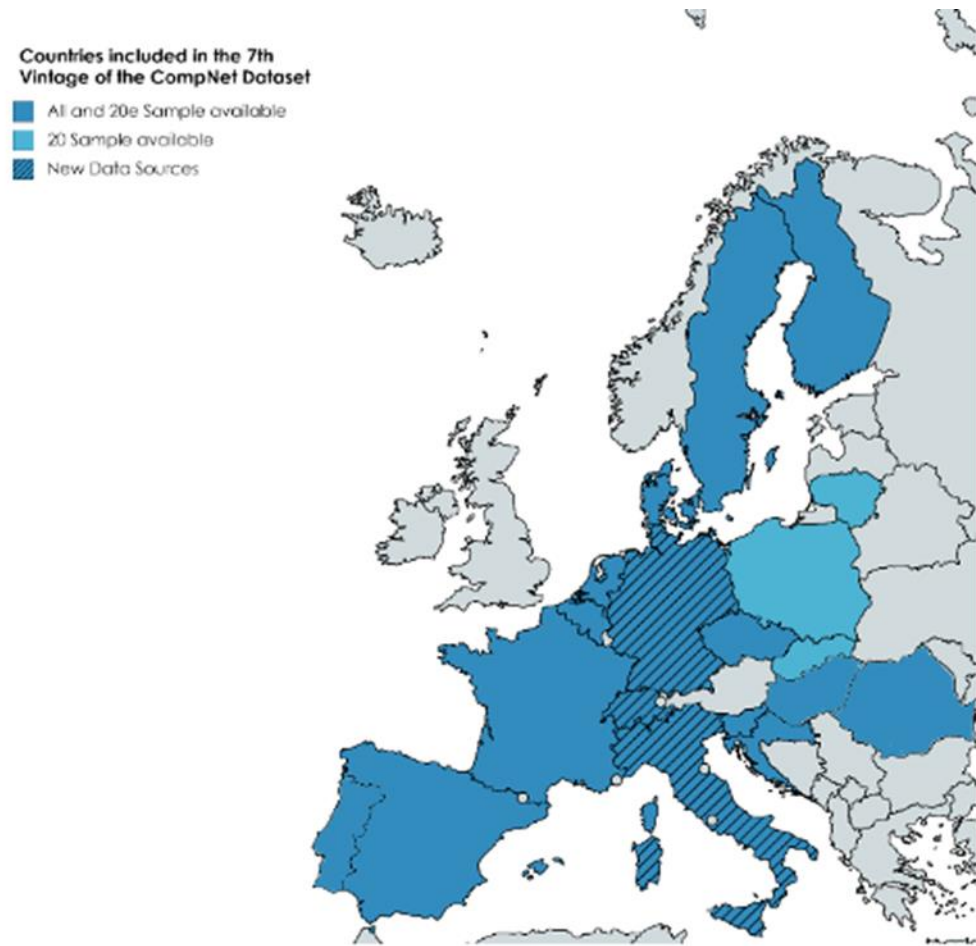
Source: CompNet User Guide.

Reporting standards in many European countries vary, depending on the size and kind of firms in the data. Minimum reporting requirements differ also widely across countries. Therefore, the dataset is available for two samples[6]:

- **All firms.** This includes all firms in the business economy with at least one employee.
- **20e sample**. This includes only firms with 20 or more employees. By omitting the smallest firms, the 20e sample improves cross-country comparability and coverage.

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[5] The complete list countries and time coverage can be found in the appendix (A.1), while the list of sectors is available in footnote 7. For the purpose of this report, Netherlands has not included since at the time of writing we did not have data available. Furthermore, the data used in this report for Germany are not the final ones by Destatis included in the dataset, but from IAB Establishment Panel (waves 2013-2018), as further re-elaborated by CompNet staff. For more information on the IAB panel please see https://www.iab.de/en/erhebungen/iab-betriebspanel.aspx.

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The data covers the business economy at the country, macro-sector, macro-sector-size-class, sectors[7] and NUTS2 – which divides the EU into 281 regions – level[8].

There are nearly 500 firm variables in the 2020 dataset. They can be clustered in six broad categories: finance, labour, productivity, competition, trade and others (Figure 2.2). More than 100 of these indicators directly relate to productivity, and range from basic indicators such as labour productivity to estimations of TFP or marginal factor products.

Figure 2.2 - Main indicators in the CompNet dataset in six categories, 2020

There are nearly 500 firm variables in the 2020 dataset

Productivity	Financial	Trade	Competition	Labour	Others
Labour productivity	Investment ratio	% established exporters	Price-cost margins	% of high growth firms	Energy costs
VA and revenue TFP, various estimation techniques	ROA, Cash-holdings, Leverage	% occasional exporters	Mark-Ups, various estimation techniques	% of firms that change employment b/w t and t+3 (t+1	Share of entry and exits from the market
ULC	Financing gap	Export intensity	Herfindal-Index	Job creation and job distruction rates	Public vs private ownership
Firm size	Collateral	Characteristics of top exporters	Concentration of sales in top 10 firms	Wage premium (proxy for human capital)	Legal form
Capital Intensity	Equity to Debt	Characteristics of 2-way traders			Foreign ownership
Marginal revenue productivity of inputs	Cash Flow	Exports by destination (intra- vs extra-EU)			
Static and dynamic allocative efficiency	Interest coverage ratio				
	Trade Credit/Debt				
	Debt Burden				
	Credit constraint index				
	Share of distressed firms				

Source: CompNet User Guide section.

New coverage in 2020:

- **Intangibles and energy cost.** We include information on these variables in form of levels and ratios relative to other inputs and outputs into the 7th vintage data.
- **More joint distributions.** There are now more than 250 joint distributions, including several ones based on productivity indicators as their condition.
- **Harmonization of input data.** This has been improved, making cross-country comparisons more meaningful. The 7th vintage introduces standardized 1st, 2nd and

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[7] The CompNet dataset includes several NACE 2 rev. two-digit sectors. Manufacturing (10-33), Construction (41-43), Wholesale and retail trade; repair of motor vehicles and motorcycles (45-47), Transportation and Storage (49-53), Accommodation and food service activities (55-56), Information and Communication (58-63), Real estate activities (68), Professional Scientific and technical activities (69-75), Administrative and Support service activities (77-82)

[8] An explanation of the NUTS regions can be found here. Nuts2 information is not available for few countries.

3rd best definitions for all input variables[9], further improving cross-country comparability.

- **Improved data interpretation.** New routines for the handling of outliers, missing observations and the weighting procedure in line with the suggestions made in the Cross-Country Comparability report (2018), written by a working group led by Professor Melitz. A description of these routines can be found in section 5.4 in the User Guide.

- **Aggregation of firm-level indicators.** New calculation methods of weighted averages for TFP, mark-ups, and other ratio-based indicators to provide a rich description of aggregate patterns while addressing micro-heterogeneity between firms.

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[9] The User Guide section 5.4.5 provides a list of all applied definitions, as well as country specifics details, to account for differences in the underlying definitions of the input data.

3. Productivity developments

(Johannes Amlung, Roman Blyzniuk, Jonathan Deist, Mirja Hälbig and Verena Plümpe)

An extensive literature[10] suggests that productivity growth, as measured by total factor productivity (TFP), has been slowing down for many years in Europe. Despite a large body of recent research, we still have no settled explanation -- but many candidates. In this chapter we use our data to analyse two possible reasons for low and decreasing productivity growth within sectors.

For the first time in 2020, our data includes information on firms' intangible assets. This allows us to examine the relationship between productivity and intangible assets and to investigate whether this relationship helps us to shed light on the mechanism behind the documented slowdown in aggregate productivity growth.

During the last decade, within-sector productivity growth has declined in almost all EU countries.

3.1 Productivity in Europe

During the last decade, within-sector productivity growth has declined in almost all EU countries.

The left-hand side of Figure 3.1 uses the CompNet dataset to show average within-sector TFP growth for our sample, and the right-hand side breaks this down by country.

The left panel shows that the average growth in productivity has been weak since 2002, and close to zero since 2010. This aligns with results based on macro-sector indicators[11]. The right panel implies that this decline occurred consistently, apart from Germany and Denmark (more positive) and Switzerland (more negative).

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[10] For a comprehensive review of the relevant literature on such productivity developments see Bauer et al. (2020).
[11] Gordon and Sayd (2019) find an average productivity growth rate, based on GDP per hours worked, of 0.8 for the EU-15 countries from 2005-2017.

Figure 3.1 - Within-sector productivity growth
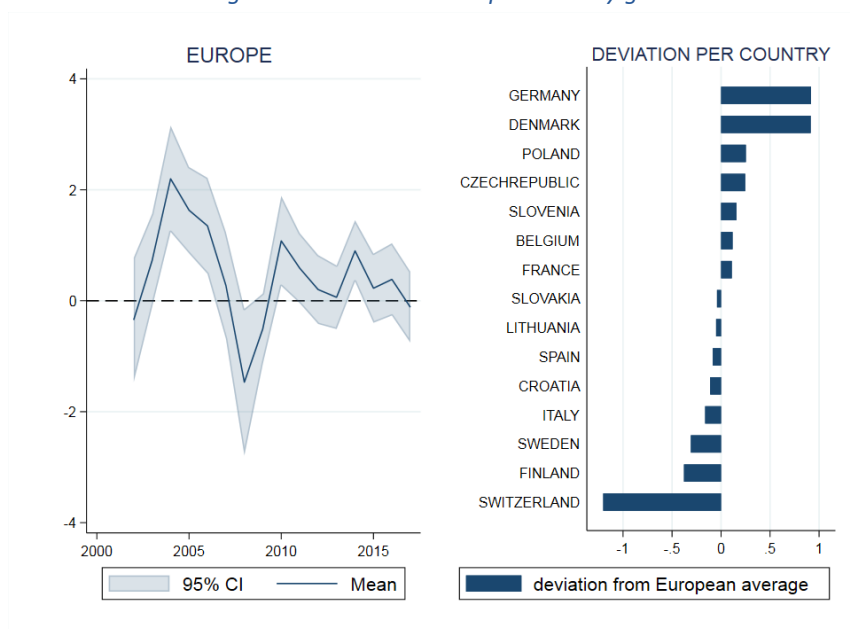
Source: CompNet

Notes: Based on 20e population weighted sample. Figure 3.1 plots the average predicted revenue based total factor productivity growth in Europe for each year, derived from OLS regressions of the TFP growth rate on a full set of time, two-digit sector, and country dummies with standard errors clustered on the sector level. All available sectors and countries are pooled. Please note that the coverage of countries and sectors changes over time: between 2009 and 2016, we have a balanced country sample of all available countries. On the right-hand side, the respective deviations per country from European average are depicted for the balanced sample.

Considering the rich information of our dataset, we can ask whether the productivity growth slowdown is associated with changes in productivity differences between the most and the least productive firms.

Productivity dispersion across firms varies by country, and is particularly large in Italy, France and Croatia.

Figure 3.2 plots the average log difference between the 90th and the 10th percentile of sector specific TFP distributions. As before, the right-hand side shows how each country deviates from this mean. A large positive deviation means that high-performing firms were relatively more productive than low-performing firms in that country.

After an early increase, the difference between high- and low-performing firms in each sector remained rather constant after 2005. Sector-level productivity dispersion is high: the figure of 0.65 implies that a firm in the 90th percentile of the productivity distribution is on average 90% more productive than one in the 10th percentile of the productivity distribution[12].

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[12] This can be derived from the log difference between the most and least productive ((exp(0.65)-1)*100).

Figure 3.2- Within-sector productivity dispersion across Europe
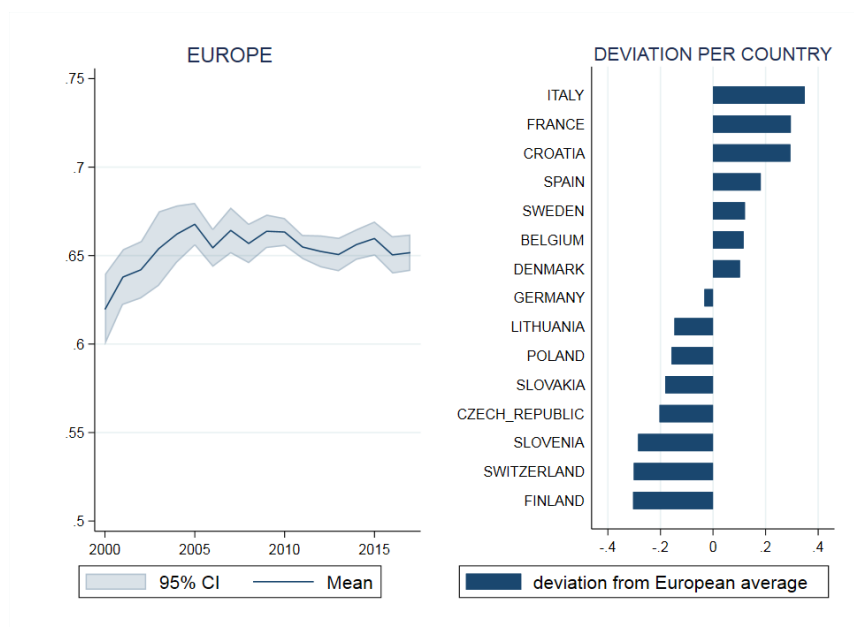
Source: CompNet

Notes: Based on 20e population weighted sample. On the left-hand side in figure 3.2 the average predicted 90th-10th percentile range of revenue based log total factor productivity for Europe for each year is plotted, derived from OLS regressions of the 90th-10th percentile range on a full set of time, two-digit sector, and country dummies, with standard errors clustered on the sector level. All available sectors and countries are pooled. Please note that the coverage of countries and sectors changes over time: between 2009 and 2016, we have a balanced country sample of all available countries. On the right-hand side the respective deviations per country are depicted for the balanced sample.

The magnitude of productivity dispersion also differs greatly across countries. In Croatia, France, Italy best performing firms in each 2-digit sector are roughly two-and-a-half times more productive than the least productive firms[13]. On the other hand, in Finland, Switzerland and Slovenia, the difference in productivity between top and bottom firms is only about 40%. Even if we use a sample limited only to manufacturing firms, or we analyse the differences between firms in the top and bottom quartiles, our data tells the same story.

3.2 Productivity in the Digital Age: the role of intangible investment

"You can see the computer age everywhere but in the productivity statistics."

Robert Solow[14]

Economy-wide, intangible assets are concentrated among few, leading firms. But sectorial specific patterns occur.

Intangible-rich firms can scale up at low marginal costs, widening the gap between leading and lagging firms, and so dispersion in productivity could increase if intangible assets are important (Bartelsman et al. 2016 for example). France and Italy, two of the countries in our

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[13] Bartelsman and Wolf (2018) find a lower dispersion rate for France and larger dispersion in Slovenia and Slovakia.
[14] Robert Solow, "We'd better watch out", New York Times Book Review, July 12, 1987, page 36.

sample with the largest difference in productivity between high- and low-performing firms, also rank among the highest intangible-intensive economies. Finland, Denmark and many Eastern European countries, in the bottom half of the dispersion ranking, also have less intangible-intensive economies (Bauer et al 2020).

> *Our measure of __Intangible Fixed Assets__ is derived from firm balance sheets. Examples for intangible assets are patented technology, computer software, databases, licenses, and trademarks.*

Economy-wide, intangible assets are concentrated among few, leading firms. But sectorial specific patterns occur.

As previously mentioned, intangibles might explain why productivity levels differ so much between firms. For instance, this dispersion might represent the difference in productivity between a firm at the technology frontier and a technology laggard (Autor et al. 2019), which relates to intangible assets endowment.

Our data suggests that the intensity of intangible capital use – measured as the ratio of intangible to tangible fixed assets – has increased over time. Furthermore, it is highly concentrated among sectors and firms[15].

- **Professional, Scientific, and Technical Activities has a high mean ratio.** On average in 2016, this was 0.94, compared to 0.55 in Manufacturing. The sector Information and Communication has a similarly high ratio of intangibles to tangibles.
- **Intangible asset intensity skews right.** The distribution of intangible intensity across countries and 2-digit sectors for the year 2016 has a mean of 0.58, but a median of 0.15.
- **They are at the top 1%.** At the very top of the distribution, the top 1% of firms in the real intangible fixed asset distribution hold at least 3.9% (Czech Republic) to 18% (Denmark) of all intangible assets in manufacturing in the year 2016.

The concentration of intangible assets among few firms is likely to result from a cumulative process of accumulation, depending on certain firm characteristics such as firm size, human capital, and historical intangible asset base (Arrighetti et al. 2014). Figure 3.3 shows that there is a positive correlation between sector-level intangible intensity and TFP for the pooled sample of country sectors in 2016.

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[15] Corrado et al. (2018) reports an increase of 0.8 for industry and 0.85 for services for 2000-2013.

Figure 3.3- Total factor productivity and intensity of intangible inputs use across sectors (2016)
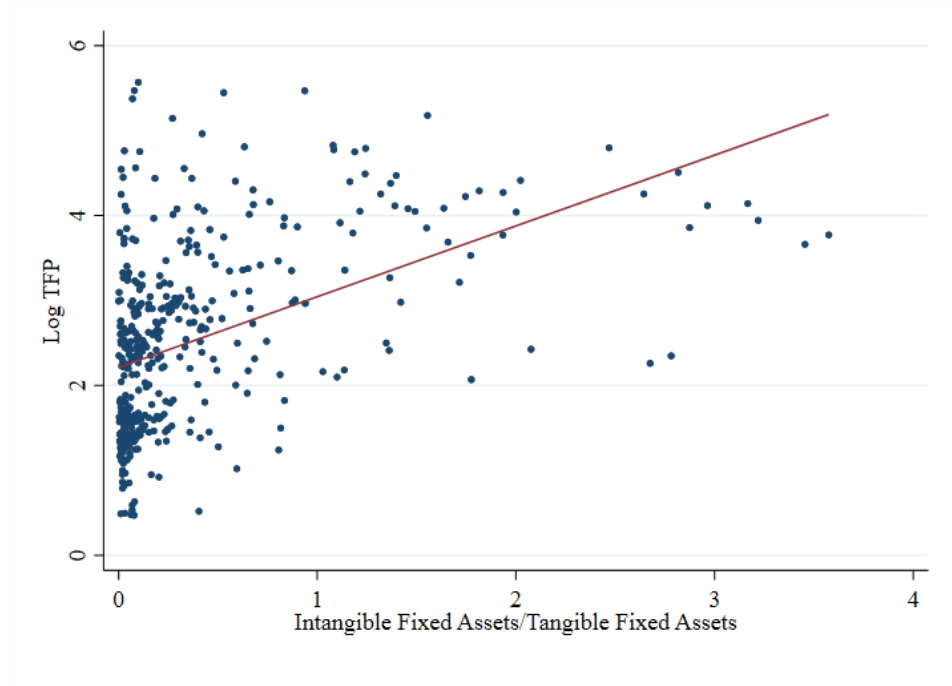
Notes: Based on 20e population weighted sample. Figure plots the relation between aggregate intangible fixed asset intensity and revenue-based log total factor productivity. All available sectors and countries are pooled.

Deepening the productivity puzzle: accounting for firm intangible inputs typically causes a reduction in the firm productivity residual

An OLS regression of productivity on intangible intensity for all years using country, industry and time fixed effects suggests that a 1% increase in intangible intensity is associated with an increase in productivity by 0.014%. This is in line with previous estimates from Corrado et al. (2018) and Bauer et al. (2020).

3.3 Are we measuring productivity correctly?

If productivity and intangible capital use are positively correlated, we are possibly measuring productivity incorrectly. This has implications both for what appear to be high-productivity firms, and for aggregate productivity growth.

If a firm relies heavily on intangibles, and those intangibles have not been included as inputs in the estimated production function, then the correlation in Figure 3.3 could imply that

'traditional' TFP has been overestimated as it does not account for all relevant input factors the firm paid for [16].

Figure 3.4 compares productivity estimates from a 'traditional' production function including labour, capital (tangible fixed assets) and intermediates ("without IFA") with productivity estimates from an 'augmented' production function for manufacturing firms in our data that use a lot of intangible capital[17]. The latter production function includes intangible fixed assets as an additional and separate input factor alongside labour, capital (tangible fixed assets) and intermediates ("with IFA").

Figure 3.4- Log TFP with and without intangible fixed assets for top 10% IFA intensity[18] (2016)
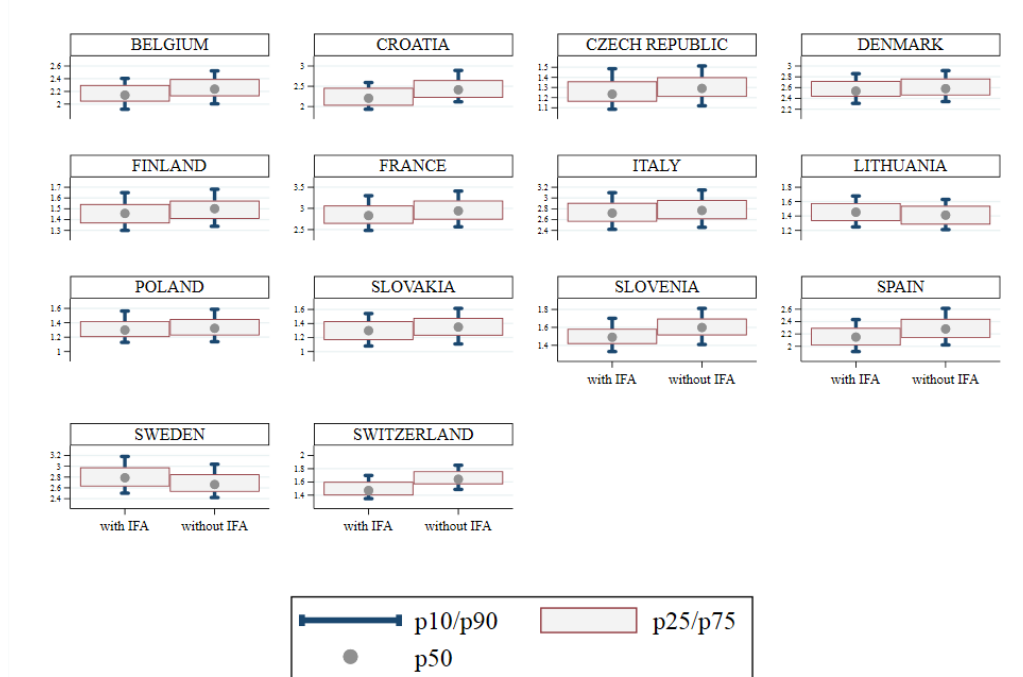
Source: CompNet

Notes: This figure plots the distribution of revenue-based log total factor productivity with and without accounting for intangibles for the firms belonging to the top 10% of the intangible fixed asset intensity (defined as Intangible fixed assets in terms of tangible fixed assets) distribution, manufacture sector only. 20e sample.

The figure shows that the distribution of productivity estimates for the high intangible intensive firms is shifted downwards upon the inclusion of intangible fixed assets as a separate input factor. Except for Sweden and Lithuania, TFP is smaller when we include intangible inputs in the production function. This implies that accounting for intangibles reduces the residual TFP measure for firms that use intangibles in the production process. The joint distribution of firm-level 'traditional' TFP and firm-level intangible intensity shows that the most productive firms also exhibit the highest use of intangibles in production, while

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[16]We are aware of the fact that this bias applies to all relevant production factors that are omitted from the production function. Particularly for intangible inputs, however, several datasets lack information on this part of the capital stock. Please be aware that also in CompNet the standard capital measure only includes tangible fixed assets, such as land, machinery and equipment, exactly because some countries do not include information on intangible assets for all years (e.g. Germany).
[17] We study the 10% firms with the highest intangible intensity for the manufacturing sector in 2016.

intangible use is low in the least productive firms. Therefore, including intangibles in the production function could lead to:

- **Smaller Dispersion Rates**. The difference in productivity between the most and least productive firms may be smaller than it seems.
- **Lower aggregate productivity growth.** The share of intangible fixed assets has grown over time. As this input factor is often not properly accounted for in the productivity estimation and including it typically causes a reduction in estimated TFP, aggregate productivity growth may be even lower than existing estimates suggest.

Including intangible assets in the production function seems to be important if we want to measure growth of productivity in a meaningful way. But this does not help us resolve the productivity puzzle, because it also implies that, if anything, our aggregate productivity trend measurements has been biased upwards.

4. Allocative Efficiency

(Roman Blyzniuk and Matthias Mertens)

Chapter 3 focused on aggregate sector-level TFP changes in Europe. We can also use the CompNet dataset to examine the between-firm component of sector-level TFP growth to investigate whether the current market environment in Europe supports or dampens productivity-enhancing reallocation processes.

We do this by focusing on allocative efficiency. If allocative efficiency is lower, then this will harm aggregate productivity.

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Allocative efficiency is the extent to which production factors are efficiently allocated across firms. The interpretation of allocative efficiency we adopt in this report is whether more productive firms are larger. Intuitively, aggregate productivity grows if resources are reallocated from relatively low to relatively high productive firms.

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There is a European slowdown in productivity-enhancing reallocation processes within sectors

4.1 Allocative efficiency in Europe

More productive firms should employ relatively more inputs than less-productive firms, because their marginal products are larger. Hence, there should be a positive covariance between the market share of firms and their productivity. We measure allocative efficiency using the covariance between firms' market share and productivity for each two-digit sectors. To do this, we use the Olley-Pakes decomposition (Olley and Pakes 1996). This decomposition separates aggregate TFP into within- and between-firm productivity components; the latter component equals the covariance between firm size (market share) and productivity. Throughout this section, we refer to this covariance or between-firm component as 'the OP gap'.

The OP gap as a measure of allocative efficiency

There is a European slowdown in productivity-enhancing reallocation processes within sectors. Figure 4.1 highlights this fact by showing the average sector-level OP gap growth rate at the European level[19].

We focus on two-digit sectors as we view this to be the most direct way of studying the efficiency of input factor allocation across firms. This is because there is typically a large sector-specific component to production factors (e.g. due to skill-specific education).

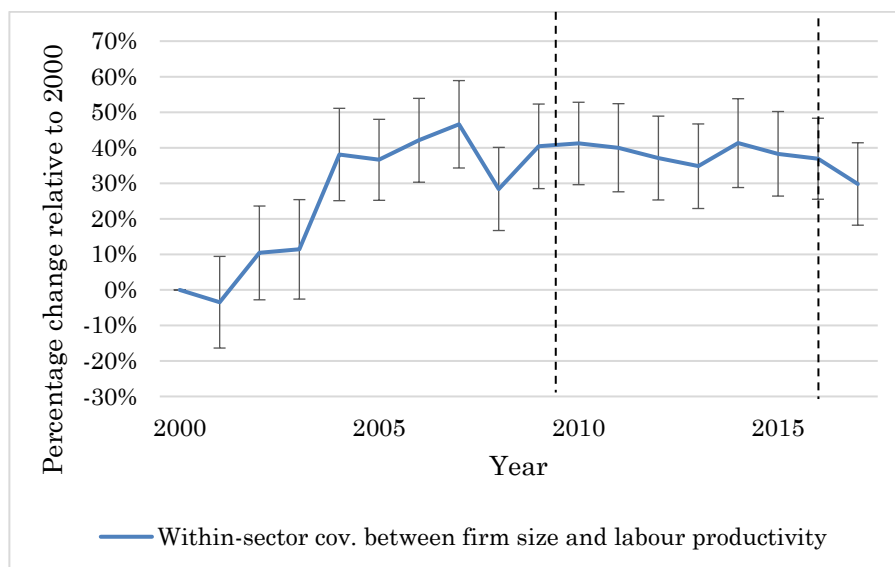[19] Formally, the chart plots the time dummies from a regression of logged (two-digit) sector-level covariance terms on a full set of year, sector and country dummies, allowing us to understand how allocative efficiency changed within European sectors

Figure 4.1 - Within-sector covariance between firm size and labour productivity

Source: CompNet

Notes: Based on 20e population weighted sample. Figure 4.1 reports coefficients on time dummies from OLS regressions of the logs of the covariance between firm size and productivity on time, two-digit sector, and country dummies. All available sectors and countries are pooled. Coverage of countries and sectors changes over time. The dashed vertical lines indicate that, between 2009 and 2016, we have a balanced country sample of all available countries. 20e sample.

4.2   Job dynamics, reallocation, and aggregate productivity

Within sectors, allocative efficiency in Europe as measured by the OP gap increased after 2000 but levelled off and declined following the Global Financial Crisis (GFC). Computing this for individual countries shows that this pattern holds across most countries, particularly the flattening after the GFC (see Appendix B). The key take-away from our analysis is therefore that - as a whole – Europe is experiencing a slowdown in productivity enhancing reallocation processes within sectors that even completely stopped in later years. In this section, we show that this slowdown of productivity-enhancing reallocation processes is associated with a decrease in Job dynamism within sectors.

Job dynamism is defined as the sum of the sector-level job creation and job destruction rate (Haltiwanger et al. 2013).

Figure 4.2 shows the evolution of the average within-sector job dynamism in Europe (blue line), compared to the change in within-sector aggregate TFP (red line)[20].

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[20] Both are computed in line with the methodology employed for Figure 4.1 above.

Job dynamism has experienced a sharp decline after the Great Financial Crisis.

Within-sector job dynamism in Europe — ▲— Within-sector total factor productivity

Source: CompNet

There is a significant positive relationship between job dynamism and allocative efficiency, and aggregate productivity, too.
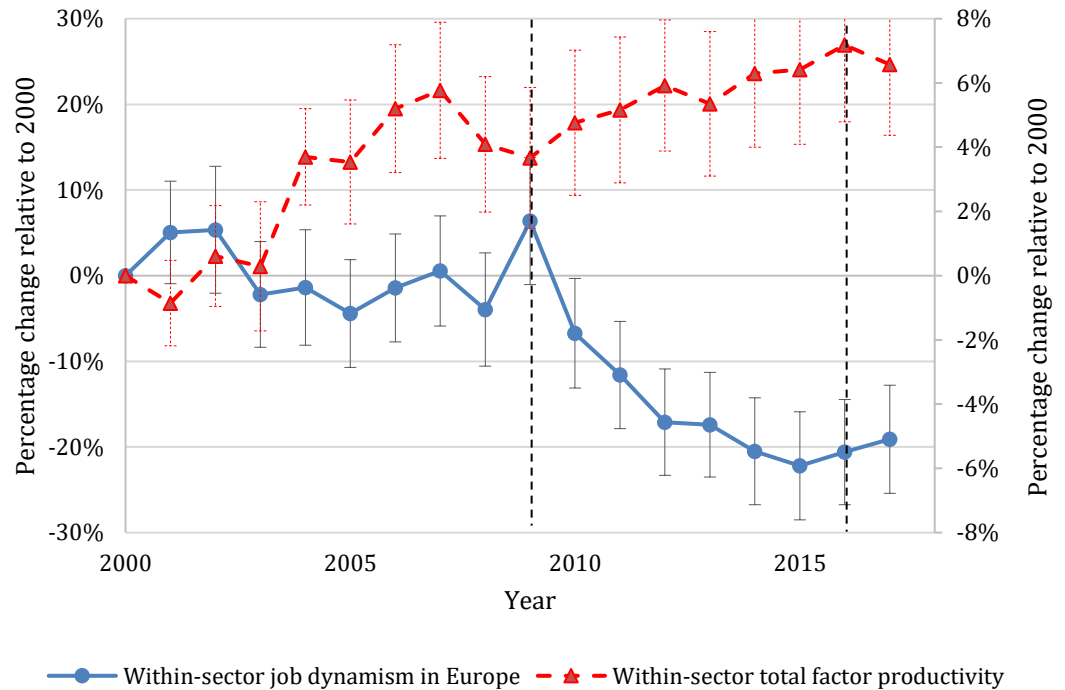
Notes: Based on 20e population weighted sample. Figure 4.2 reports coefficients on time dummies from OLS regressions of the logs of sector-level job dynamism (left vertical axis) and total factor productivity (right vertical axis) on a full set of year, two-digit sector, and country dummies. Coverage of countries and sectors changes over time. The dashed vertical lines indicate that, between 2009 and 2016, we have a balanced country sample of all available countries. We excluded the year 2016 for France due to an outlier cleaning routine. 20e sample.

The picture in Figure 4.2 is striking. Job dynamism fell dramatically, particularly after the crisis. At the same time, there is a slowdown in average sector-level TFP growth (see also Chapter 3). From above, we also know that this slowdown in within-sector job dynamism and productivity growth coincides with a slowdown of productivity enhancing reallocation processes at the sector level. If we analyse the job dynamics by country, we find that the slowdown in job dynamisms also exists for nearly each individual country in our dataset.[21]

To provide a statistical analysis of the relationship between job dynamism, aggregate productivity and allocative efficiency, we run several regressions. Results are presented in Table 4.1. In column 1 we find a positive association between allocative efficiency and job dynamism. This holds also after including various control variables which account for firm size and for possible changes in the firms' mode of production. In columns 3 and 4 we further document a positive correlation between job dynamism and sector-level aggregate TFP.

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[21] See the Appendix B.1.

Table 4.1 - Relationship between job dynamism vis a vis productivity and allocative efficiency

	(1) Covariance between TFP and firm size	(2) Covariance between TFP and firm size	(3) TFP	(4) TFP
Job dynamism	0.0366*** (0.0104)	0.0361*** (0.0101)	0.107*** (0.0400)	0.124*** (0.0417)
Average firm size		0.0171** (0.00687)		0.152*** (0.0577)
Ratio of Capital to Labour		-0.00204 (0.00666)		-0.0951** (0.0399)
Obs.	6,923	6,477	6,925	6,479
R-squared	0.354	0.414	0.834	0.839
Year FE	YES	YES	YES	YES
Country FE	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES

Source: CompNet

Notes: Based on 20e population weighted sample. Table 4.1 shows OLS-regression results from projecting i) the log of sector-level covariance terms capturing the covariance between firms' size and TFP (columns 1 and 2) and ii) the log of sector-level TFP (columns 3 and 4) on sector-level job dynamism. Standard errors are in parenthesis and clustered at the sector level. Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$. All the variables in the tables are in logarithmic form and refer to the pair "sector j and time t".

Less job dynamism and flat resource reallocation dynamics may be a threat to productivity growth. A high degree of employment and business dynamics reflects a high pace of reallocation and creative destruction (Decker et al. 2013, Bijnens and Konings 2018). Usually, this is assumed to be a contributing factor to aggregate productivity growth. But our data shows two alarming findings for European economies:

- **A severe and pervasive decrease in job dynamism.** This might be an important mechanism behind the recent slowdown of productivity growth.
- **Little growth of productivity-enhancing reallocation processes.** Reducing barriers to factor reallocation might be an important policy goal if we want to accelerate aggregate productivity growth.

Balancing these productivity-enhancing policies against other public interests like socially inclusive growth will clearly be one of the key challenges for policymakers.

5. Productivity, labour markets and labour share

(Tommaso Bighelli and Peter Haug)

Firm productivity is also driven by the characteristics of the labour force. The framework in which workers are embedded, either at the level of the firm or the region, matters when we attempt to explain their performance at work. Features of the labour force such as how many workers are in unions, their skill level and their education, can be critical in determining firm performance.

In this chapter we link firm performance with the education level of the labour force at the regional level. Firms with a more educated labour force are more productive, and firms that face a shortage of educated workers react by expanding the number of workers they employ.

The decline of labour share has been a stylised economic fact in the last few decades. We show that in Europe this decline has slowed down, or even stopped. Increasing market power of firms – both in the labour and product market – is negatively connected with changes in labour shares.

There is a high heterogeneity across European regions in both productivity and supply of high-skilled workers.

5.1 Productivity and the shortage of highly educated workers

There is a high heterogeneity across European regions in both productivity (Figure 5.2) and supply of high-skilled workers (Figure 5.1). We use comparable cross-country data on productivity at regional level (NUTS2) to study its relationship with regional heterogeneity in supply of tertiary-educated workers[22] by combining our data on firm performance[23] with EUROSTAT data. To this aim, we use simple OLS regressions and, since causality might work in both directions, instrumental variable regressions as well.

Figure 5.1. - Ratio of tertiary-educated workers to total workforce by quintile, across European regions, 2016
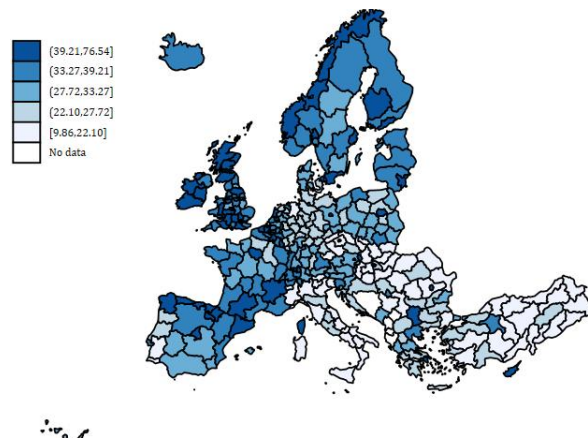
Source: CompNet, Eurostat and authors calculations. © EuroGeographics for the administrative boundaries.

Notes: Based on 20e population weighted sample.

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[22] Tertiary education is defined according ISCED 2011 classification: it includes short-cycle tertiary education, bachelor, masters or PhD programme.
[23] We used a pooled sample of regional data on 14 European Countries, for which we extract data for the labour productivity distribution.

Figure 5.2 - Labour productivity by quintile across European regions, 2016

Legend:
- [4.3592439,4.868863]
- [4.1979551,4.3592439]
- (3.858006,4.1979551]
- (3.586024,3.858006]
- [2.798,3.586024]
- No data
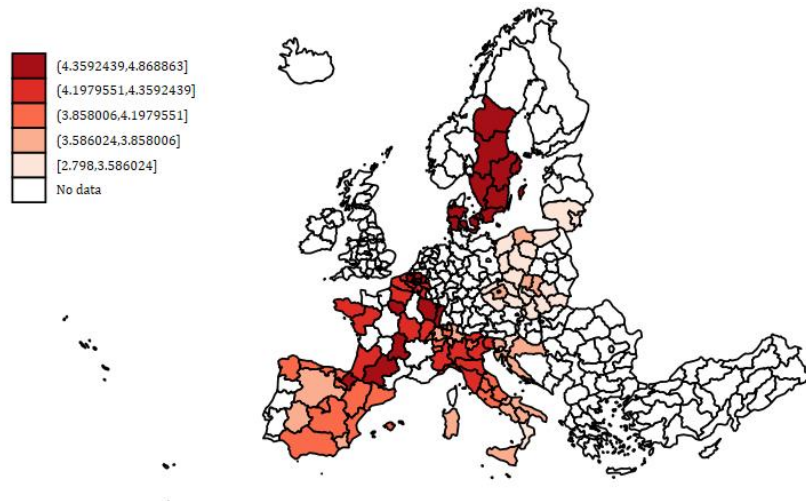
Source: CompNet © EuroGeographics for the administrative boundaries.

Notes: Based on 20e population weighted sample.: Mean labour productivity in NUTS2 regions. Countries Included: BE, HR, CZ, IT, LT, PL, SI, SK, ES, CH. Partly included due to confidentiality: DK, FR.

The analysis is based on a dummy variable for education shortage. This is equal 1 if in a region the share of workers with tertiary education belongs to the lowest decile of the distribution, i.e. where the fraction of high-educated workers is lower than 15%.

Firms in regions with fewer high-skilled workers have lower labour productivity

Table 5.1 (column 1) shows that the shortage in the supply of high-educated workers is negatively associated with labour productivity. In order to avoid endogeneity issues, we perform a 2SLS-IV regression using the fraction of Not in Education, Employment or Training (NEET) as instrument[24]. The reported F-test for the First stage regression is 10.63, yielding a relevant instrument. This result is consistent and robust to using 2SLS regression (column 2).

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[24] Since the fraction of NEET is easily correlated with the share of workers with tertiary education but not with the labour productivity, as the latter is computed as the ratio of real value added over total workers, it is a good instrument for providing more consistent results.

Table 5.1 - The impact of high-educated workers on labour productivity in Europe

	(1) OLS Log Labour Productivity	(2) 2SLS Log Labour Productivity	(3) OLS Number of Employees	(4) 2SLS Number of Employees	(5) OLS Log Solow Residual	(6) 2SLS Log Solow Residual
Shortage	-0.066*	-0.969***	0.751*	7.501***	-0.019*	-0.987***
	(0.032)	(0.1833)	(0.439)	(0.787)	(0.0191)	(0.263)
Year FE	YES		YES		YES	
Country FE	YES		YES		YES	
Region FE	YES		YES		YES	
Total Employees	-0.000***				-0.000***	
Constant	3.696***	4.055***	42.892***	37.120***	2.843***	3.085***
	(0.043)	(0.044)	(0.842)	(0.152)	(0.020)	(0.015)
Obs.	1150	1150	1152	1152	1150	1150
R-squared	0.963	0.042	0.905	0.025	0.986	0.028

Source: CompNet

Standard errors are in parenthesis and clustered at the NUTS 2 level. *** p<0.01, ** p<0.05, * p<0.1

Notes: Data include a set of years, regions and country dummies, and we control for the region total number of employees (bigger regions may be more productive). The analysis is based on a dummy variable for education shortage. This is equal to 1 if in a region the share of workers with tertiary education belongs to the lowest decile of the distribution (where the fraction of high-educated workers is lower than 15%).

Firms in regions with fewer high-skilled workers are larger

Columns 3 and 4 of Table 5.1 show how firms react to this lower productivity, as it uses size of firm – in our definition, employee headcount – as dependent variable.

- **A greater shortage of high-educated workers is associated with higher firm size**. This potentially suggest a specialization towards more labour-intensive production processes.
- **A greater shortage of high-skilled workers is associated with lower total factor productivity**. As a robustness check, we replicate the previous analysis using the Solow Residual as dependent variable. From columns 5 and 6 we can see that the effect is negative, robust and significant.

In conclusion, there seems to be a strong relation between the heterogeneity in the supply of high-educated workers and the heterogeneity in labour productivity between European regions. Firms in regions facing shortage of high-skilled workers have lower labour productivity (as well as lower TFP). The same kind of firms appear to be larger, to make up for the lower labour productivity and education endowment.

5.2 Is labour share declining?

The reported decline in the global labour share[25], and its relationship to the anaemic growth of firm productivity (Akcigit 2019, for example), is intensively debated.

We still don't know precisely what would cause a decline in labour shares, but researchers have identified many causes, including:

- the fall in relative prices for capital goods[26],
- the increase in the outsourcing of services and production processes,
- labour saving technological change and, most recently,
- increased product market power and labour market power[27].

We know that labour-share patterns differ greatly across countries and sectors (Dao et al. 2017), and so our dataset is perfectly suited to provide new evidence on this debate, even when the timespan for investigating these secular changes is short.

In Europe, labour shares have been *increasing.* Figure 5.3 shows that European countries, with the exception of Belgium and Sweden, have increased labour shares in recent years.

> *In Europe, labour shares have been increasing*

Figure 5.3 Development of labour share in Europe, various periods 2000-2020, by country
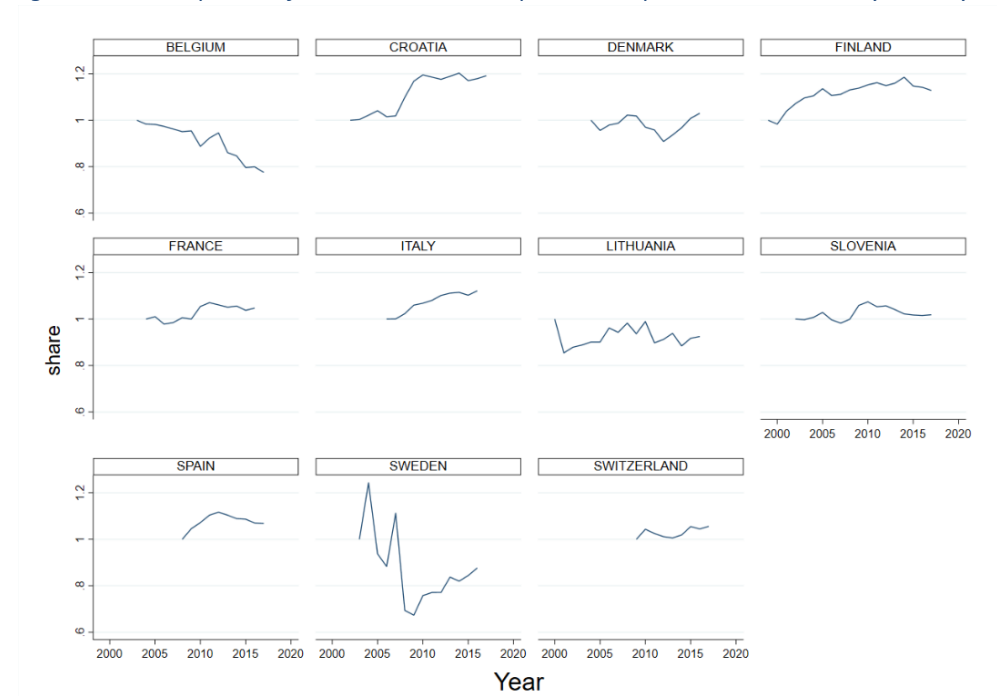
Source: CompNet

Notes: Based on all firm's population weighted sample. Notes: index=1 for the starting period; aggregate labour share= aggregate labour cost / aggregate value added

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[25] In this section, the labour share is defined as the share of labour costs in GDP, i.e. in the aggregate gross value added.
[26] This would lead to a fall in labour share if the elasticity of substitution between capital and labour is larger than one (Karabbarbounis and Neiman 2013).
[27] See De Loecker et al. (2020), Autor et al. (2020) and Mertens (2020a).

Figure 5.4 shows that this is particularly true at the European level since the early 2010.

Figure 5.4 Development of labour share over time – aggregate CompNet level

Labour share development is inversely correlated to output

This indicates that at least the secular redistribution from labour to capital for almost all the countries we include in our dataset has slowed down or even stopped, although our data does not include some important industrial countries – notably Germany.

Labour share development is inversely correlated to output growth. We split sectors with positive and negative revenue growth to show that revenue trajectories matter for changes in labour shares.

Figure 5.5 shows that sectors with positive output growth have constant or slightly negative labour share changes.

Figure 5.5 - Correlation between output growth rate and rate of growth of labour share rate in sectors with positive output growth in Europe, 2010-2016.
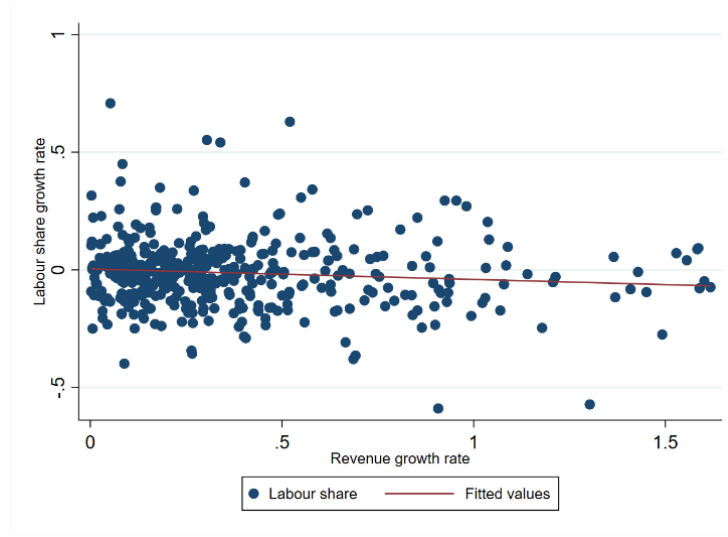
Source: CompNet

Notes: Based on 20e population weighted sample. 14 European countries included. Growth rate 2010-2016 (pooled regression at two-digit sector level over 14 countries, firms with at least 20 employees). Labour share = total sector labour cost/total sector value added.

By contrast, Figure 5.6 shows that sectors with negative output growth are associated with positive changes in labour shares.

Figure 5.6 - Correlation between output growth rate and rate of growth of labour share in sectors with negative output growth in Europe, 2009-2016.
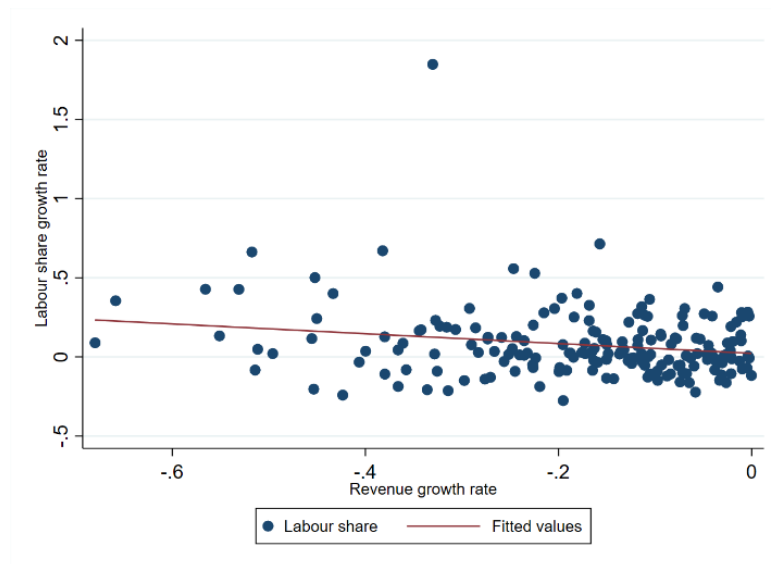
Source: CompNet

Notes: Based on all firms, population weighted sample. 14 European countries included. Growth rate 2010-2016. Labour share = total sector labour cost/total sector value added.

These findings suggest that – on average – the loss in labour share is concentrated in the sectors that are doing well. In shrinking industries, employers seem to have been unable to reduce the number of workers (or wages) to match the decline in output.

To shed further light on this issue, we test how product market power (following De Loecker and Warzynski 2012) and labour market power[28] (following Mertens 2020b) are related at sector-level to the changes in labour shares.[29]

From a policy perspective, understanding the above relationship is important, particularly the extent in which the reported labour and product market power results from potential market inefficiencies.

Table 5.2 shows the results of a sector-level OLS regression analysis for two versions of labour share.

Table 5.2 - Determinants of labour share growth in Europe, 2010-2016, OLS regression

Variables	Labour share (revenue based)	Labour share (value added based)
Growth rate nominal capital stock	0.0409**	0.0233
	(0.0201)	(0.0217)
Growth rate nominal revenue	-0.0412***	-0.0687***
	(0.0136)	(0.0147)
Log real capital per employee 2010	-0.00965	-0.0105
	(0.00832)	(0.00898)
Change rate labour market power	-0.153***	0.0427
	(0.0580)	(0.0627)
Change rate product market power	-0.678***	-0.583***
	(0.0987)	(0.107)
Constant	0.0287	0.0129
	(0.0422)	(0.0456)
Country fixed effects	YES	YES
Macro sector fixed effects	YES	YES
Observations	442	441
R-squared	0.365	0.278

Standard errors in parentheses
*** $p<0.01$, ** $p<0.05$, * $p<0.1$

Source: CompNet

Notes: Based on all firms, weighted sample, 14 European countries included. Dependent variable: growth rate labour share revenue growth 2010-2016. Dependent variable: I) growth rate labour share revenue growth II) growth rate labour share value added growth.

Labour share development is inversely correlated to product and labour market power

---

[28] Which is the ratio of the firm`s marginal revenue product of labour to the firm's wage rate (= total labour cost per employee).
[29] This addresses the recent wave of empirical and theoretical work connecting changes in labour's share to changes in market power through general equilibrium effects on labour demand (product market power) or rent-sharing processes and monopsonistic wage exploitation by firms (labour market power).

We conclude for this that:

- **Labour share development is inversely correlated to product and labour market power**.[30] Coefficients for the output growth rate, changes in labour market and output market power, are all negative.
- **Initial capital intensity of the sector has no effect.** This may explain the heterogeneous picture of sectors with rising and declining labour shares.
- **High investment implies higher labour share**. This contradicts the common belief that labour is being replaced by tangible or even intangible fixed assets.

In conclusion, although the labour share has continuously declined for half a century in most industrial countries[31], this trend seems to have slowed in the 21st century for our European sample. This implies that the secular trend of redistribution from labour to capital seemed to have slowed.

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[30] Changes in labour market power and product market power are positively correlated (Spearman's rho + 0.682), which might explain why labour market power is insignificant in the second version of the regression.
[31] See for example Autor et al. (2019), figure 1, page 44.

6. Trade and productivity

(by Tibor Lalinsky, Philipp Meinen, Ottavia Papagalli and Roberta Serafini)

The World Trade Organisation predicts that the volumes of world merchandise trade in 2020 will decline between 12.9% in its most optimistic scenario, and 31.9% in its pessimistic scenario. In Europe, exports are projected to fall by between 12.2% and 32.8%.[32] Europe's economies are very open, dependent on trade for their development. Our data offers an opportunity to study the relationship between trade and productivity for a large set of EU countries.

We know that after a fall in trade in 2009, aggregate EU exports quickly recovered almost to their long-term path. But this recovery was stronger in some nations than in others.

The first section of this chapter analyses the post-financial crisis export dynamics of Central and Eastern European (CEE) EU countries compared to other EU countries. It shows that buoyant export growth in CEE countries coincided with growth in average firm productivity, while in non-CEE countries both exports and productivity were mostly flat.

We decompose the export developments into intensive and extensive margins. The intensive margin examines average exports per manufacturing firm, and the extensive margin represents the number of exporting firms.

Stagnant average exports per manufacturing firm in non-CEE countries plus a decrease in the number of exporters, perhaps driven by weak productivity growth, tells the story of sluggish export growth. Our analysis also suggests that trade is positively related to sectoral productivity through higher allocative efficiency.

This shows the importance of ensuring an environment that allows productive firms to thrive, and that includes an expansion of sales beyond national borders.

The second section of this chapter highlights some distinguishing features of successful exporting firms and studies the global value chains (GVCs) of European firms. We show that a positive average exporters' premium is a common feature for entire productivity distribution, not just for a few very productive firms.

For those productive firms, however, GVC participation is likely to be the main driver of their high productivity premium. If the Covid-19 crisis disrupts these GVCs, this may be very bad news for firm productivity in Europe.

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[32] https://voxeu.org/article/trade-and-covid-19-wto-s-2020-and-2021-trade-forecast

6.1 Trade margins and productivity developments

Exports buoyant in CEE countries, not so for others. The solid line in Figure 6.1 shows that post-crisis exports from all EU countries in the CompNet dataset increased on average by more than 20% between 2010 and 2016.[33]

Figure 6.1 – Index of export dynamics in average CEE and non-CEE EU countries, 2008-2016, 2010 = 1
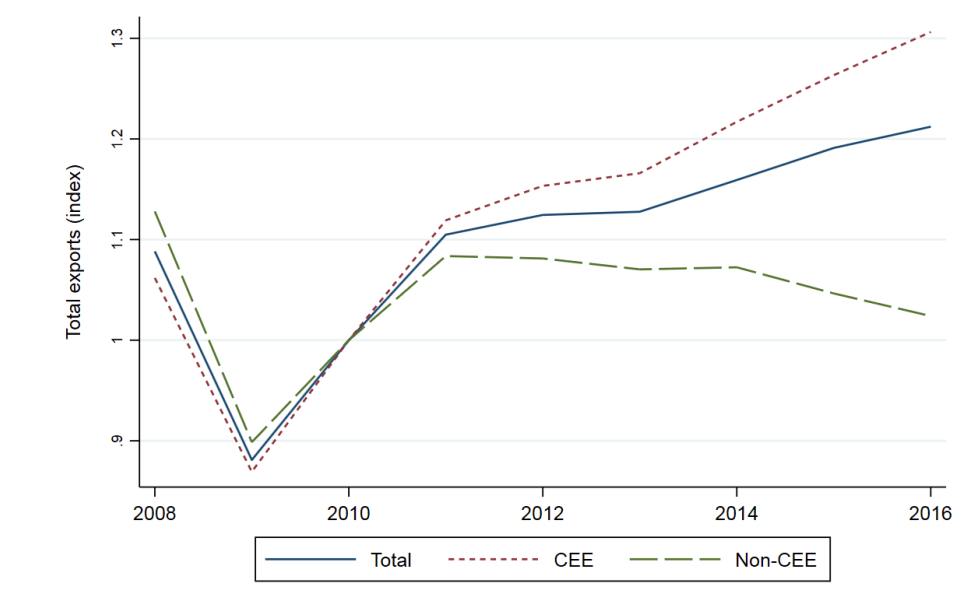
Source: CompNet, Eurostat

Note: Population-weighted 20e sample. CEE countries: CZ, LT, PL, SK, SI; Non-CEE countries: DK, FI, FR, SE. Country group aggregates are obtained by computing the simple average across country-specific indexes. DK up to 2014 only.

But note the dotted and dashed lines. We split the sample into CEE and non-CEE countries.

Exports from CEE countries grew by close to 30% in the post-crisis period, while those for non-CEE countries were almost unchanged.[34] We can use our data to decompose the exports into developments at the intensive and extensive margins: in other words, are exporters failing to grow their export trade, or is the number firms that are exporting failing to grow?

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[33] Not all countries in the CompNet dataset report trade-related indicators and, additionally, not all countries have submitted the data at the time of writing. As a result, the findings are not necessarily representative of the developments of the entire country groups presented in this chapter. For instance, CEE EU countries here include CZ, LT, PL, SK and SI, while non-CEE EU countries comprise (at most) DK, FI, FR and SE. In order to avoid that developments in one of these groups are driven by a single large country (e.g. France in the case of non-CEE countries), we calculate the group aggregate by computing the simple mean across country-specific index values. As a result, we refer to an average CEE or non-CEE country. Also note that this chapter is based on the more representative sample of firms with 20 and more employees due to data availability for a larger group of countries.

[34] As shown in the User Guide, the overall export dynamics presented in Figure 6.1 according to CompNet data are quite similar to the evolution of exports of the respective country group when considering Eurostat data. This is despite the fact in CompNet a firm is considered an exporter in a given year only if its export value (exceeding a given threshold) is positive and it operates in the manufacturing sector.

The left-hand panel of Figure 6.2 shows that the extensive margin of exports of CEE countries has increased significantly from 2010 until 2016, by around 25%. In contrast, average sales abroad per non-CEE firm have grown little in the same period.[35]

Figure 6.2 - Index of intensive and extensive margins of export dynamics in average CEE and non-CEE EU countries, 2008-2016, 2010 = 1.
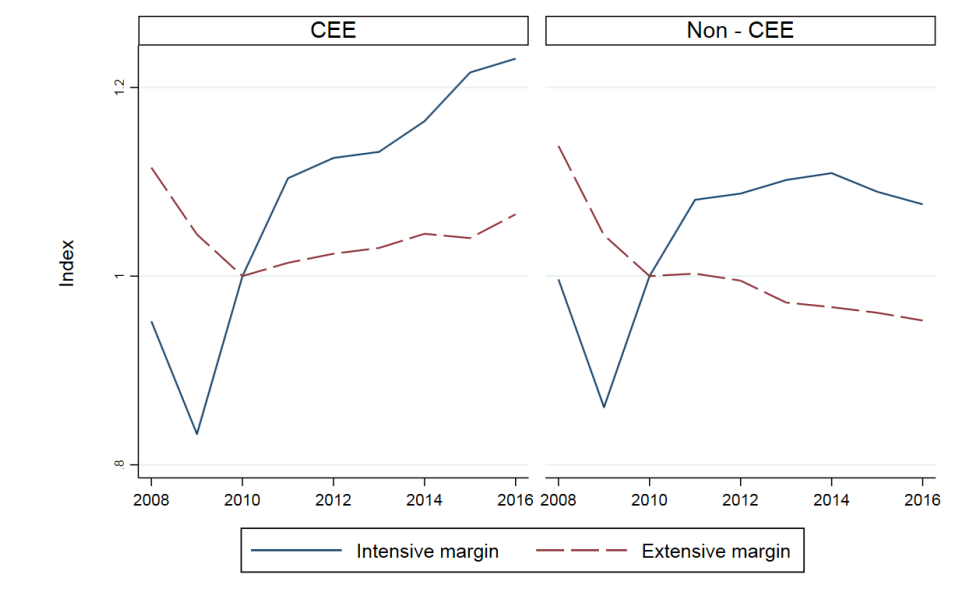
Source: CompNet

Notes: Population-weighted 20e sample. CEE countries: CZ, LT, PL, SK, SI; Non-CEE countries: DK, FI, FR, SE. Country group aggregates are obtained by computing the simple average across country-specific indexes. Export intensity measures the ratio of exports over total sales.

The number of exporting firms decreased in non-CEE EU countries

The right-hand panel of Figure 6.2 shows that differences between the two country groups are even larger at the extensive margin. In the average CEE country the number of firms that export increased by more than 5% between 2010 and 2016 even though the total number of manufacturing firms has decreased, implying that the share of exporting firms in all manufacturing firms has increased noticeably in these countries. In the average non-CEE EU country under investigation, this is a reduction of 5% between 2010 and 2016. This reduction is consistent with an overall decrease in the number of manufacturing firms, implying that the proportion of manufacturing firms that exports has hardly changed since 2010.

Diverging trade coincides with diverging productivity

Figure 6.3 shows that diverging trade developments run parallel to diverging productivity developments.

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[35] Export intensities (defined as the exports-to-sales ratio) suggest that exports on average developed more than total sales for all countries, though especially in the CEE.

6.3 - Index of labour productivity dynamics in CEE and non-CEE EU countries, 2008-2016, 2010 = 1.
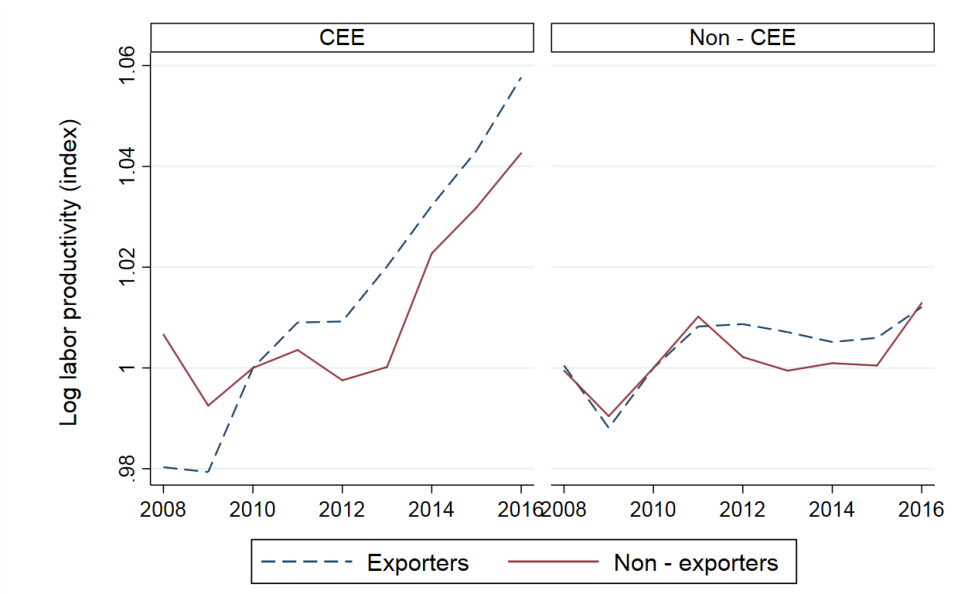

Source: CompNet

Notes: Population-weighted 20e sample. CEE countries: CZ, LT, PL, SK, SI; Non-CEE countries: DK, FI, FR, SE. Country group aggregates are obtained by computing the simple average across country-specific indexes. Labour productivity is measured as value added per employee.

Labour productivity has increased in CEE countries, especially in exporting firms[36]. By contrast, productivity growth was flatter in the average non-CEE EU country under investigation, both for exporting and non-exporting firms.

Diverging productivity development in non-CEE and CEE countries probably shows that CEE countries are catching up to their neighbours and becoming more integrated in the European production network. But it may also help to explain figure 6.1.

Indeed, productivity is considered to be a key factor which determines whether firms engage in exporting, since more productive firms are more able to pay the fixed costs of selling goods abroad (Bernard and Jensen 1999, Melitz, 2003)[37]. The left-hand panel of Figure 6.4 uses the sample of all available CEE and non-CEE EU countries to show the cumulative change in the number of exporting firms, and 95% error bands (derived from standard errors clustered at the size-class-sector-country level), in response to a one-standard-deviation productivity shock. The productivity shock is measured as the change in labour productivity, expressed as value added per employee. [38]

The productivity standstill helps explain why more non-CEE firms don't export

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[36] Indeed, the further analyses based on CompNet data reveals that in CEE countries average labour productivity has shifted up across the full distribution of export values (i.e., for small, medium, and large exporting firms).

[37] See Chiacchio et al. (2018) for another recent analysis on the link between trade and productivity in CEE countries.

[38] The impulse responses are derived using Jorda's (2005) local projection method applied to the joint distribution sample for number of employees (i.e., the observational unit is a year-country-sector-size-class combination). In particular, the impulse response function is obtained from regressing the cumulative change in the number of exporting firms between period h and t-1 on a productivity shock in period t, controlling for the lagged growth in the number of exporting firms, the lagged productivity shock as well as current and lagged sales growth, and country-sector-size-class and country-year fixed effects. Hence, the Chart

Figure 6.4 - Proportion of European firms that export after a simulated productivity shock
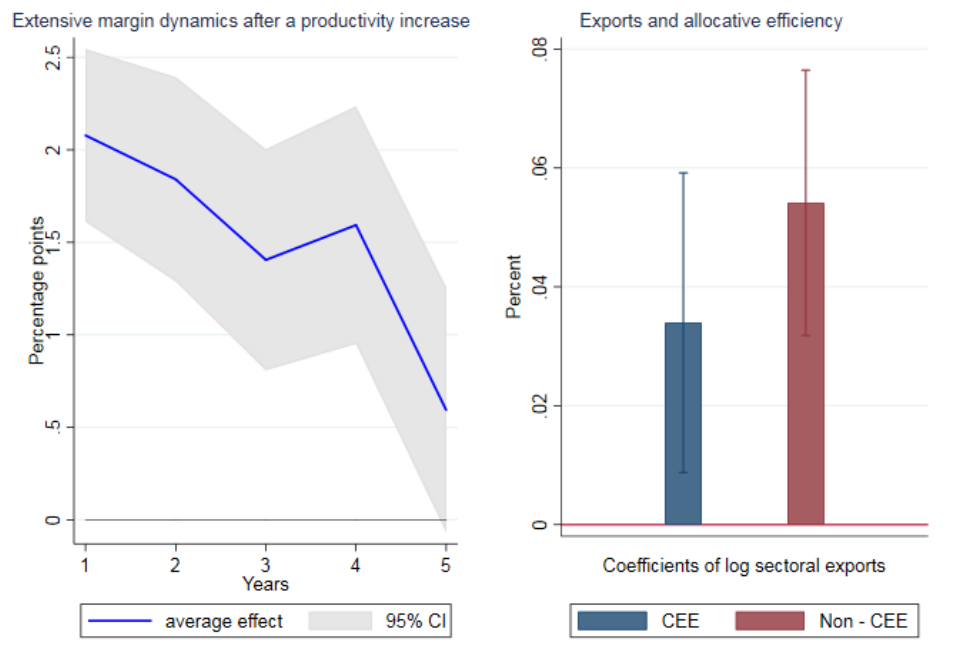
Source: CompNet

Notes: Population-weighted 20e sample (joint distribution with number of employees). Left-hand panel countries included: CZ, DK, LT, PL, SK, SI, FI, FR, SE. The right-hand panel CEE countries: CZ, LT, PL, SK, SI, Non-CEE countries: DK, FI, FR, SE.

The results suggest that a positive (generic) productivity shock would be associated with an increase in the number of exporting firms in subsequent years. These results are consistent with the idea that the change in the number of exporters in two groups of countries may be partly due to the diverging productivity trajectories.

This association is not causal. Indeed, the causal relationship between exports and productivity can go in both directions. For instance, there is empirical evidence suggesting that firms experience productivity gains after starting to export (De Loecker, 2013).[39] Moreover, Melitz (2003) showed that enhanced trade integration may positively affect aggregate (sectoral) productivity due to gains in allocative efficiency

The right-hand panel of Figure 6.4 shows consistent evidence since sectoral allocative efficiency, expressed by the OP gap (see Chapter 4 for a definition) is positively related to an industry's total exports[40]. This holds for both CEE and non-CEE EU countries.

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informs about the cumulative change in the number of exporting firms to a shock to the average productivity of the size class, sector, country, year combination. Note that we trim the first and the last percentiles of productivity shock variable, which is computed as the growth rate of productivity.

[39] Giordano and Lopez-Garcia (2019) review the two-way link between productivity and exporting

[40] These results are consistent with recent findings by Berthou et al. (2019). Our estimation approach is similar. Controlling for the number of firms present in the sector and country-year fixed effects. Hence, we exploit variation across sectors, but within country at a given point in time. These regression results do not present causal relationships.

If diverging trade developments in the two country groups coincide with diverging productivity developments, sluggish productivity dynamics in the average non-CEE country may be one reason that more firms in the region aren't exporting. Moreover, successful export activities matter for allocative efficiency. Hence, it's clearly important for policy to create the environment in which productive firms can thrive through exporting. This can for example be achieved by ensuring efficient product market regulations.

The destination and origin of firm sales and purchases

CompNet collects annual data on both exports and imports of goods. For the first time in 2020, the dataset provides partial information on trade by destination.

For several countries we can distinguish between the intra-EU and extra-EU exports and imports. We can investigate whether the low growth of exports from non-CEE countries are related to what is going on in destination markets.

Figure 6.5 shows that the difference in export growth between CEE and non-CEE EU countries is very similar for both intra- and extra EU exports. Sluggish export growth from non-CEE countries seems to be partly because they are exporting less to countries outside the EU.

Figure 6.5 Intra-EU and extra-EU export dynamics for European firms, 2006-2016 (2010=1)

Total exports value: CEE vs Non - CEE countries
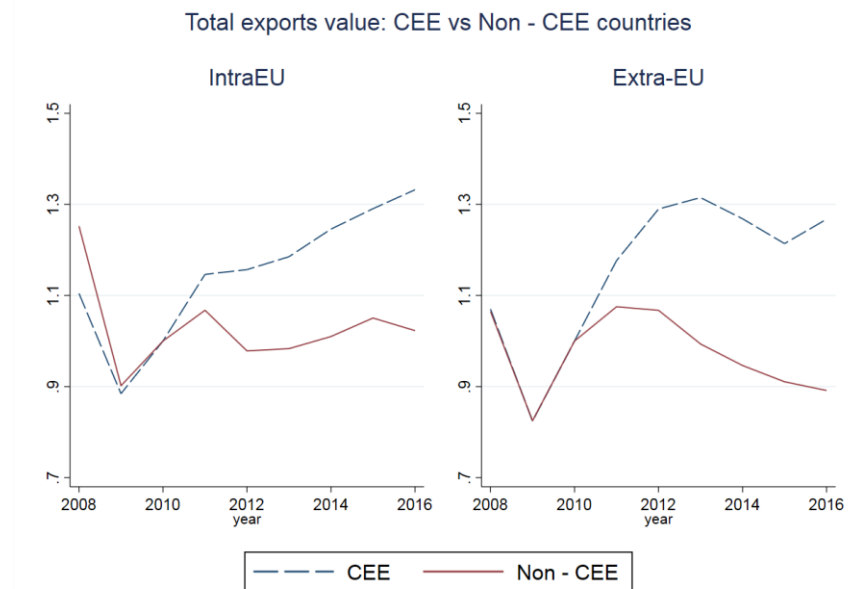
Source: CompNet

Note: Population-weighted 20e sample. CEE countries: CZ, LT, SK, SI; Non-CEE countries: FI, SE. Country group aggregates are obtained by computing the simple average across country-specific indexes.

6.2 Firm heterogeneity and exporter productivity performance

Trade theory asserts that, due to the presence of fixed trade costs, only firms above a certain productivity threshold will engage in exports (see Melitz 2003). In particular, exporting firms

are on average more productive than domestically oriented firms (ISGEP 2008 shows this empirically for a number of countries). But highly productive firms serving only the national market may also coexist with low productivity exporting firms, even within narrowly defined industries. Powell and Wagner (2014) used firm-level data on Germany to show this empirically.

Our dataset allows to investigate whether, for a given level of productivity, exporters are more productive than domestic firms. We can test the implications of the Melitz model by estimating the productivity premium – the percentage difference in labour productivity between exporting and non-exporting firms – for several productivity quantiles. Figure 6.6 suggests productivity of exporters is higher than domestically oriented firms along the entire productivity distribution.

Exporters are more productive than domestically oriented firms at all productivity levels

Figure 6.6 – Exporters' labour productivity premium by quantiles of the productivity distribution
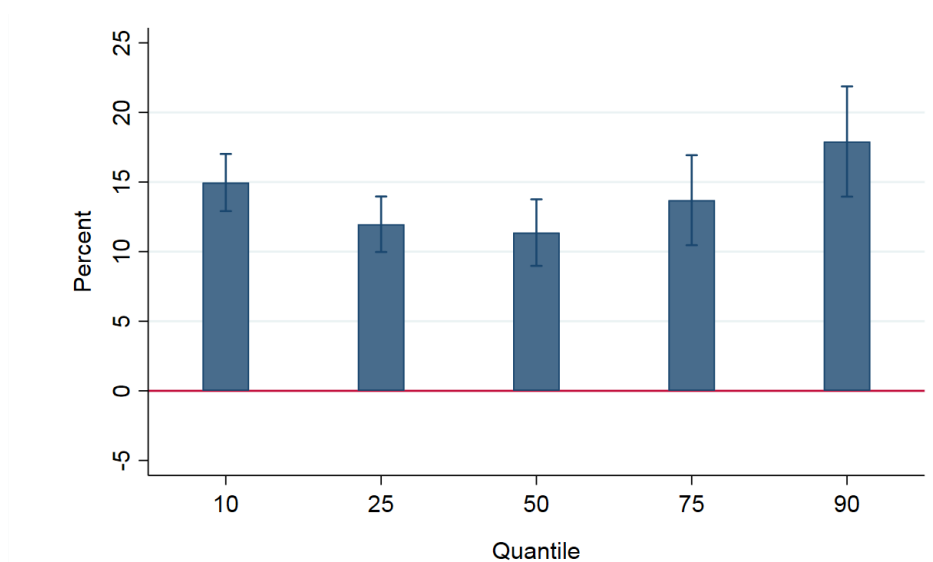
Source: CompNet

Notes: Population-weighted 20e sample. The productivity premium measures the percentage difference in labour productivity between exporting and non-exporting firms. At each productivity quantile, the coefficients and corresponding 95% confidence intervals obtained by regressing (log) labour productivity on a dummy variable which indicates observations related to exporters, controlling for firm size as well as country, sector and year fixed effects. Restricted to manufacture, all available sectors, countries and years are pooled.

Our dataset shows successful exporters differ significantly from domestically oriented firms. Table 6.2 shows that, on average, exporters invest relatively more in intangible capital and pay higher wages (consistently with the relatively higher skill level of the workforce employed). They also outperform in profitability and financial health.

Two-way traders are more productive

Table 6.2 – Estimated exporter premia for European firms, selected indicators

	(1) Number of employees	(2) Intangible capital intensity	(3) Profit margin	(4) Wages	(5) Degree of financial constraints
Exporter dummy	1.028***	0.625***	0.049***	1.235***	-0.439***
	(0.011)	(0.038)	(0.017)	(0.013)	(0.026)
Constant	3.978***	-3.271***	-3.198***	7.060***	-1.649***
	(0.008)	(0.027)	(0.012)	(0.009)	(0.019)
Obs.	3084	1380	1944	3122	786
R-squared	0.898	0.871	0.797	0.922	0.945
Year FE	YES	YES	YES	YES	YES
Country FE	YES	YES	YES	YES	YES
Sector FE	YES	YES	YES	YES	YES

Standard errors are in parenthesis. *** p<0.01, ** p<0.05, * p<0.1

Source: CompNet

Notes: Based on the 20e population weighted sample. Dependent variables in Log.

Exporters outperform non-exporters in many dimensions

Many relatively small, low-productivity exporters accounting for a negligible share of the overall exports, and they coexist with a handful of high-productivity, large firms that generating the bulk of export flows (Mayer and Ottaviano 2007). These large firms typically both export and import – they are "two-way traders" – and dominate GVC participation (World Bank 2020).

GVC participation is important for within-firm productivity gains. They create higher efficiency in the allocation of resources, wider variety and better quality (or cheaper) intermediate inputs, and enhanced technology transfer along the value chain.

The dataset confirms that two-way traders are accounting for about 94% of the total turnover of exporters in both value-added and employment.

Figure 6.7 shows that two-way traders have been consistently more productive. If GVC participation causes higher productivity, a reversal of trade liberalization may reduce productivity for these firms and aggregate productivity too (see also Melitz and Redding 2014).
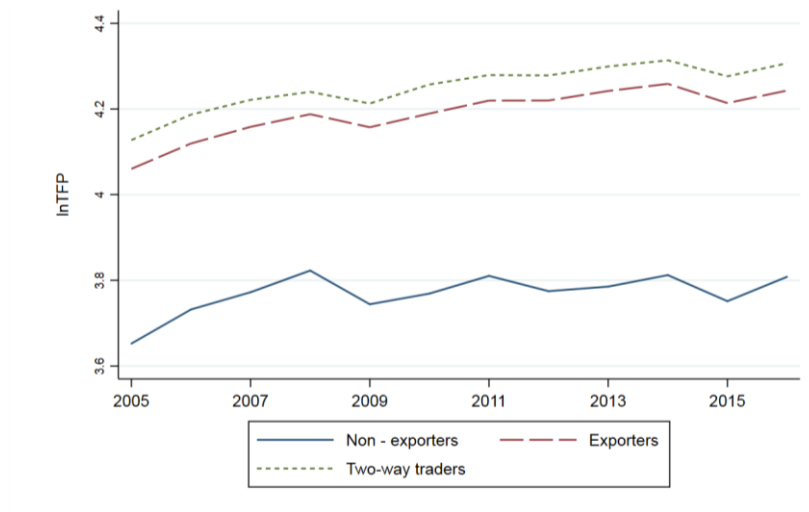
Source: CompNet

Notes: Population-weighted 20e sample. Countries included: HR, CZ, LT, PL, SK, SE, FI, DK up to 2014. TFP is based on sector level value added, estimated using a Cobb-Douglas function and Wooldridge methodology.

The CompNet dataset includes a rich set of trade related indicators

Imports and exports in the CompNet dataset

The CompNet dataset mirrors macro data by providing basic information on value of exports or imports, but also derived trade indicators, taking mostly form of either ratios or dummy variables. Two examples:

- **Types of exporters.** New or established, switchers, two-way exporters or firms that stop exporting.
- **Types of trading firms.** For example, firms relying more on the intra-EU or extra-EU markets, or net exporters representing firms with exports exceeding imports.

For the full list of trade variables, their definitions and detailed description please see CompNet (2020), section 5.2.4.

The trade module consists of a number of new trade-related joint distributions and, at the same time, new trade variables are part of descriptive variables available for other joint distributions based on productivity, labour, or financial indicators. With respect to the accessibility of various joint distributions, we may compare characteristics of different types of exporters or importers and thus, e.g., assess different forms of trade premia. As a case in point based on novel indicators present in the 7th vintage, we may analyse whether firms relying on intra-EU exports tend to be more frequently foreign owned than the firms that do not sell goods within EU countries.[41]

The above-mentioned trade related novelties of the 7th vintage of the CompNet dataset suggest only some of the possible avenues for its utilization. The main reason for not using the new information in this report is the limited number of countries for which we have the data at the time of writing the report.

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[41] Section 2.2.2 Joint Distribution.

7. Financial constraints and productivity

(Annalisa Ferrando and Sergio Inferrera)

If firms cannot access external funds, they cannot invest in improvements in productivity (Zingales and Rajan 1998, Albert and Caggese 2018, Eslava et al. 2010, Altomonte et al. 2017). Financial constraints may also cause fragility in the financial structure of companies, and hence changes in their production capabilities. And so, the financial position of firms – and their ability to access external sources of finance – help to explain their performance.

The CompNet dataset has a wide set of financial variables to describing firm financing conditions and capital structure.[42]

In particular, the CompNet dataset includes a unique indicator of financial constraints, constructed using the combined information from the replies that firms provided to the ECB/EC Survey of Access to Finance for Enterprises (SAFE) data[43], plus their financial statements (Ferrando et al. 2015). This indicator allows us to investigate directly the correlation between constraints in accessing external finance and firm productivity.

Figure 7.1 shows the development over time of the indicator of financial constraints across countries. Results vary, but the overall dynamics shows two major peaks around 2010 at the time of the global financial crisis and in 2013, after the EU sovereign debt crisis of 2012.

It shows that the presence of constrained firms at a regional level in one region is highly correlated with the presence of constrained firms in a neighbouring region.

Figure 7.1 Share of financially constrained firms in countries in Europe (left) and deviation from EU average (right), based on CompNet financial constraint indicator, 2001-2017
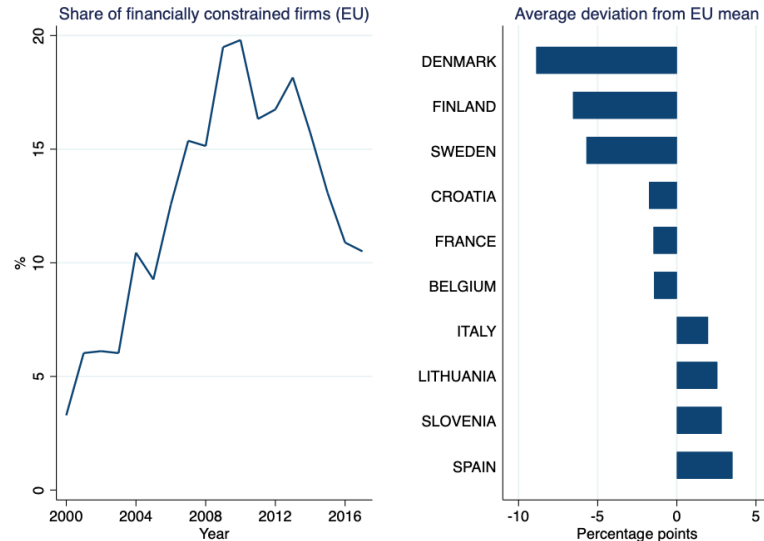
Source: CompNet

Notes: Population-weighted all sample. Left panel indicates the weighted average of the countries' share of financially constrained firms. Right panel indicates the average deviation across all years available of the single country's share of financially constrained firms from the European average.

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[42] For a detailed explanation of these indicators, refer to CompNet 2020.

[43] In the SAFE survey, the indicator of financing constraints is the sum of the percentages of firms reporting rejections of loan applications, loan applications for which only a limited amount was granted, and loan applications which resulted in an offer that was declined by them because the borrowing costs were too high. The indicator includes also the percentage of firms that did not apply for a loan for fear of rejection.

The 2013 peak coincides with important innovations in monetary policy and access to finance in Europe. In response to the weak economic conditions in the euro area, several monetary policy stimulus measures were introduced, starting from the announcement of the Outright Monetary Transaction (OMT) programme in summer 2012. This programme was specifically aimed at easing the financial market conditions of stressed debt countries, and, the singleness of monetary policy (Rostagno et al. 2019).

Aggregations at country level like this, masks some important differences across regions. We can exploit the new regional data in the CompNet dataset, which provides information on most variables at NUTS2 level, to show that the presence of constrained firms at a regional level in one region is highly correlated with the presence of constrained firms in a neighbouring region.

We also consider the impact of the OMT programme on productivity. The announcement represented a turning point for access to finance for euro area enterprises (Ferrando et al. 2020).

7.1 Financial constraints and regional clusters

Economic geographers have already explored the spatial distribution of production, examining factors like knowledge spill over, institutional factors, ease of buyer-supplier links to link the physical location of firms with productivity (Huang and Xiong 2018).

The OMT programme and spatial autocorrelation

A firm is involved in "relational" banking if the main reason to deal with its main bank is a personal relationship.

A firm is involved in "relational" banking if the main reason to deal with its principal bank is a personal relationship. Regional proximity to credit institutions is associated with relational banking, and this relation is systematically associated with a lower TFP (Ottaviano et al. 2016). Relational banking also alleviates credit constraints during a cyclical downturn. (Beck et al. 2018).

Thanks to the regional breakdown of the CompNet dataset, we are able to understand how location influences firms' performances along the financial structure dimension. To do this we use CompNet's indicator of financial constraints, compiled from SAFE's survey and from firms' financial indicators. Firms are considered to be financially constrained when their score is above a country and time threshold derived from the survey.

The regional dimension of this indicator is important, to understand that it is not only the financial health of the firm that matters but also the business environment in which it operates.

Figure 7.2 reports the percentages of financially constrained firms across regions in two years. Research shows that the OMT programme led to an improvement in credit access (Altavilla et al. 2016, and Ferrando et al. 2019), and Figure 7.2 reflects SAFE data that reports the percentage of SMEs reporting to be financially constrained dropped from about 18% between 2009 and 2012 to around 8% between 2016 and 2019. At a first glance, Figure 7.2 shows that

the percentages of financially constrained firms have declined with respect to 2013 (i.e. the colours are less dark everywhere) even though some heterogeneity remains across regions.

Figure 7.2 Proportion of financially constrained firms in NUTS2 regions in Europe by quintile, 2013 (left) and 2106 (right).
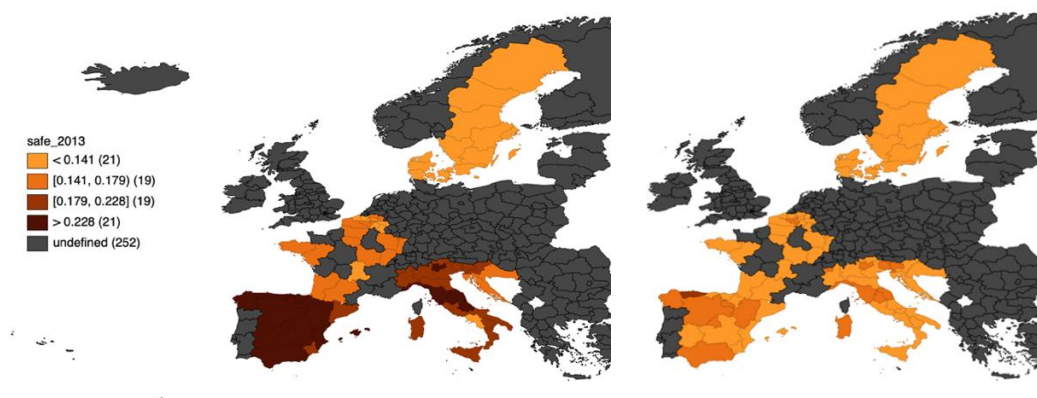
Source: CompNet. Eurostat. © EuroGeographics for the administrative boundaries.

Notes: Population-weighted all sample.

The left-hand panel shows the situation on 2013, which represented the peak during the euro area sovereign debt crisis as shown in Figure 7.1. As the indicator includes balance sheet information lagged by one year, any change in the economic and monetary policies is reflected with a time lag of one year at least. So, for countries in the euro area the indicator in 2013 summarises the prevailing financing conditions during the sovereign debt crisis.

This simple graphical evidence is in line the econometric analysis in Ferrando et al. (2017).

Credit-constrained firms are clustered

To further understand the correlation across regions, we measured the extent to which the presence of financially constrained firms in a region is positively or negatively associated with the presence of constrained firms in neighbouring ones.

First, we look at the spatial autocorrelation between given observations and the ones "close" to them using Moran's I index[44]. Figure 7.3 provides the scatter plot of this correlation among different regional units.

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[44] This coefficient ranges from -1 to 1. Positive values of the index signify positive association between close geographical observations. The weighting matrix used is the contiguity one. (Anselin, 2001)

Figure 7.3 Moran's I index of financial constraints for European firms in neighbouring NUTS2 regions

Source: CompNet. Eurostat. © EuroGeographics for the administrative boundaries.

Moran's I index is extremely positive (0.89), showing that a large presence of constrained firms in one region is correlated with a large presence of constrained firms in the neighbouring areas. Firms characterized by larger credit constraints tend to be somehow located in regional clusters.

This is not a complete surprise if we consider that most neighbouring NUTS2 areas are in the same country and share the same institutional and business frameworks. In a simple attempt to net out this effect we calculated the same index, considering regions in one country only, for the largest countries in our sample (Italy, Spain and France). The country-based spatial autocorrelation index is smaller than in the European sample as a whole[45].

Therefore, one can say that the business environments in neighbour regions interact with, and influence, each other across national borders. Policies aimed at loosening credit constraints in a given area might be influential to improve the business environment in the surrounding regions, too.

A positive "OMT effect" on financial constraints

In June 2012, the European Council agreed to create a European banking supervision mechanism and a resolution mechanism, a step towards building a banking union. In August 2012, the European Central Bank's Governing Council announced it would undertake OMTs,

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[45] The spatial correlation figures are 0.41, 0.10, 0.71, respectively.

a programme under which it would purchase sovereign bonds in secondary markets under strict conditions.

Did the autocorrelation among clusters of constrained firms decrease after these and other policy initiatives taken by the ECB, central banks and governments during the sovereign debt crisis? For simplicity, we call the effect of all these policies the "OMT effect". We find that:

- Moran's I index before the policy initiatives was 0.81.

- Moran's I Index in the period after the policy initiatives was 0.75.

We know already the level of financial constraints has declined, and so firms might have clustered slightly less in regions in which the business environment is more favourable.

The coefficient is still large. This signals that regions in which the business environment is more favourable (those regions with a smaller proportion of constrained firms), are more likely to experience a boost in their economic growth, while leaving behind those that are already lagging. But a decrease in this coefficient highlights a small convergence across regions, in line with the European Cohesion Policy.

7.2 Firm productivity and financial constraints

Previous research concludes that difficulty accessing external funding has a negative impact on firm productivity.

Unconstrained firms are more productive than constrained firms

Using joint distributions, we can illustrate these claims: Figure 7.4 shows that, as expected, unconstrained firms are on average more productive than constrained firms – even though productivity has declined over time.

Figure 7.4 - Labour productivity value added for constrained and unconstrained firms, EU aggregate
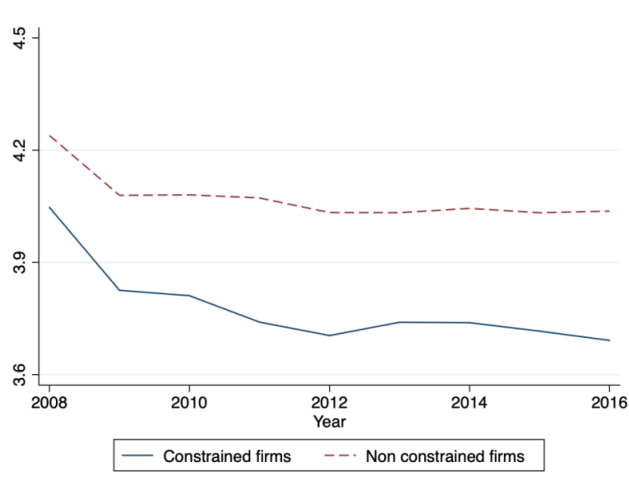
Source: CompNet

Notes: Population-weighted all sample.

Table 7.1 shows the estimated coefficients of the effect of financial constraints on labour productivity. Coefficients are negative and statistically significant, implying that there is a relationship between financial constraint and productivity.

Table 7.1 – Coefficients of the cross-sectional effect of financial constraints on labour productivity for European firms, by sector, 2009-2016.

	(1)	(2)	(3)
	Labour productivity	Labour productivity	Labour productivity (limited to EA countries)
Number of financially constrained firms	-0.075***	-0.075***	-0.153***
	(0.010)	(0.011)	(0.045)
Number of financially constrained firms after 2013		-0.001	0.030**
		(0.013)	(0.014)
Constant	3.861***	3.860***	5.100***
	(0.158)	(0.158)	(0.743)
Obs.	1862	1862	1249
R-squared	0.704	0.704	0.768
Year FE	Yes	Yes	Yes
Country FE	Yes	Yes	Yes
Additional Controls	Yes	Yes	Yes

Source: CompNet

Notes: All-firms weighted sample. Standard errors clustered at the sector level are in parenthesis. Column 3 is based on a model restricted to countries belonging to the Euro Area (BE, ES, FI, FR, IT, LT, SL, SK). Other countries included in the other models are HR, DK, SE. Time span is limited to create a balanced sample. All variables are included in logarithmic form. Each observation refers to the pair "sector j and time t".

Column 1 indicates that sectors with a 10% larger number of constrained firms than the average are less productive by 0.75%. All regressions include a full set of country and year dummies, as well as the average firm size, the average firms' age and the ratios of intermediate inputs and capital to number of employees to account for important determinants of productivity.

A positive "OMT effect" on productivity

To detect the "OMT effect" on productivity, we created a dummy variable equal to one if the reference year of each cell is after 2013. As expected, pooling all the countries in our sample, we do not detect any significant relation between being financially constrained and labour productivity after the OMT announcement[46].

However, if we restrict the sample to countries belonging to the euro area, we get two important results from the data:

- **The negative and significant effect of financial constraints is much higher during the financial crisis.** Either financial frictions hamper firm productivity by restraining investment in higher quality projects (Aghion et al. 2010) or they restrict firms' real and financial flexibilities to innovate and raise revenues and output per worker (Andersen 2016).

- **The "OMT effect" may have relaxed the negative link with productivity in the euro area.** The coefficient becomes positive and statistically significant after the OMT announcement. This is important: it signals that the decline in productivity in recent years might not be explained by problems in accessing finance.

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[46] We are aware that this simple interaction should capture many other policy elements related to the pickup of growth such as the positive effects in relation to the successful implementation of structural reforms in some program countries or a general recovery of the global economy, which both may have lowered the financial pressure of firms.

8 Firm concentration and aggregate productivity

(Tommaso Bighelli, Filippo di Mauro, Marc Melitz, Matthias Mertens)

The recent rise of "superstar" firms – extremely large firms that continue to build large market shares – has led to a concentration of economic activity in a few firms (for example, see Autor et al. 2020). Recently, economists and policymakers fret about the consequences of rising concentration: it was even the theme of the 2018 Annual Federal Reserve Symposium at Jackson Hole and of the latest annual meeting of CompNet at the EIB in Luxembourg in March 2019.[47]

The key concern is whether the rise in concentration is good or bad news about the structure of markets and the competitive environment. There are two arguments:

- **The positive interpretation: winner-takes-all.** The competitive environment is functioning smoothly by rewarding the most efficient and innovative producers, with increased market share representing "winner-takes-it all" competition (Van Reenen 2018).
- **The negative interpretation: market power**. Increasing concentration reflects a decrease in competition associated with increases in market power that are disconnected from technological advances at the top firms (De Loecker et al. 2020).

We can use our dataset to investigate how changes in firm concentration within narrowly defined sectors and countries are related to underlying technological changes in those sectors. This provides some key evidence on the mechanisms driving the changes in firm concentration we observe, and on which of these explanations is supported by our data.

Two measures of firm concentration

8.1 Measuring firm concentration in Europe

We do not have access to the individual firm data that would allow us to calculate the exact sales share of the top 1% and 5% of firms. But we know how the sales of the firms at the 99th and 95th percentile compares to the mean sales in each country and sector, and so we can use this ratio instead to construct a lower bound for the sales share of all firms above that 99th and 95th percentile: this would be the sales share if all firms above the 99th and 95th percentile had the same sales as the firm right from the 99th and 95th percentile. These shares equal 1% and 5%, respectively, if there is no variation in sales across firms[48] and vary between 0 and 1 where 1 means full concentration on the top percentile[49]. This concentration measure has an advantage over using individual firm data: it is less influenced by idiosyncratic fluctuations at the very top firms. If the sales of the single firm at the 99th or 95th percentile changes significantly, another firm takes its place at that percentile. We frequently refer to these two measures as "percentile ratios". We use the 20e sample, as this covers a broader set of countries.

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[47] For an extensive discussion on the topic, see also Philippon (2019).
[48] This concentration measure is also used by Cortes and Tschopp (2020).
[49] See appendix C for an overview of concentration levels among countries

Figure 8.1 shows the average change in firm concentration across European countries. The data are reported as country-level averages of first differences of the 99th percentile ratio, at the one-digit sector level. The circles represent this cross-sector average across all one-digit sectors, with a short-dashed line showing fitted values. The squares and long-dashed line represent the change just for the manufacturing sector.

Figure 8.1 The evolution of firm market concentration: Unweighted average of the first difference change across European countries, 2009-2016
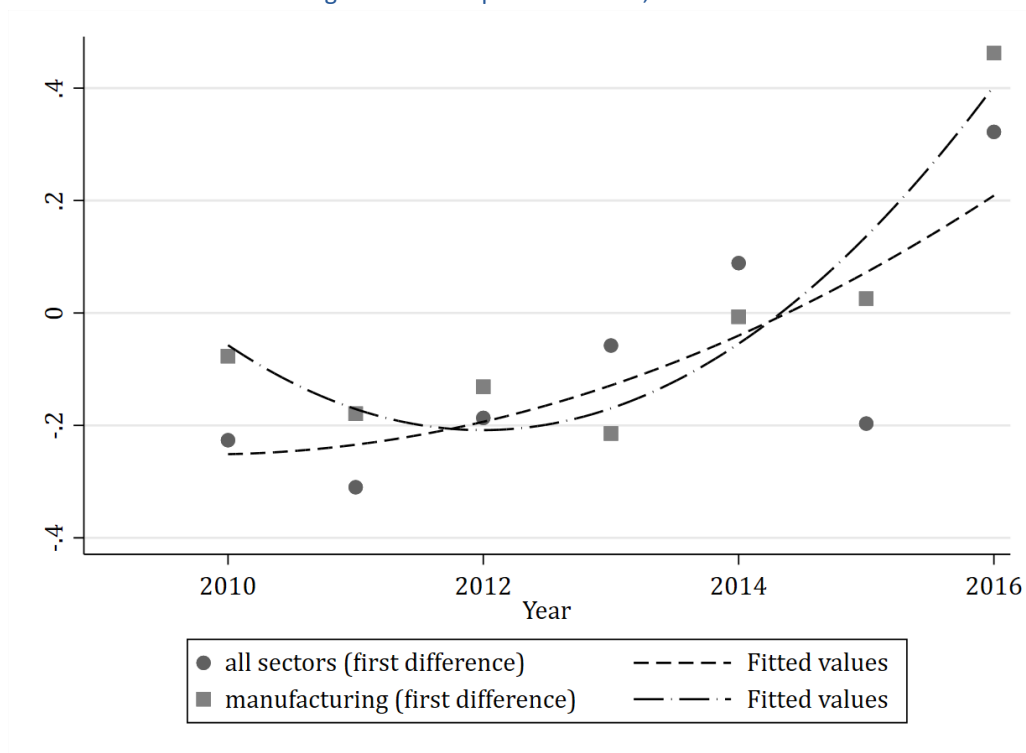
Source: CompNet 2020.

Notes: Population-weighted 20e sample. Country group aggregates are obtained by computing the unweighted average across country-specific indexes. Vertical axis is the percentage point difference with respect to the year before.

There are increases for both the all-sector measure of concentration, and also when we isolate the manufacturing sector. The trend is more linear for all sectors than for the manufacturing sector, but the increase in concentration for manufacturing is more evident in the past three years. If we measure concentration using the top 5% sales share, we find essentially the same picture. As the level of top firm concentration in manufacturing is higher than the average level of top firm concentration across all sectors, concentration in the European manufacturing sector is more strongly increasing than concentration in the entire economy.

Figure 8.2 shows large differences in concentration trends between European countries, particularly for the manufacturing sector. It reports the percentage-point difference in concentration growth of a country, compared to the European average.

Figure 8.2 Firm market concentration by country: Deviation from European average, 2009-2016
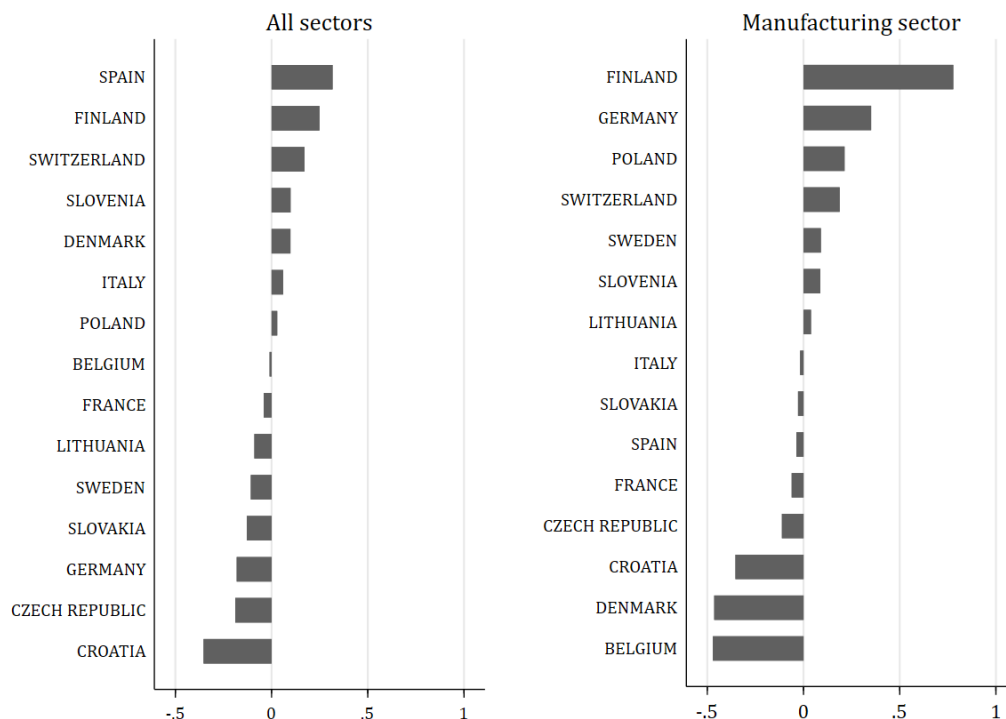
Source: CompNet 2020.

Notes: Population-weighted 20e sample. Country group aggregates are obtained by computing the unweighted average across country-specific indexes.

In some countries the path is strongly different between the two aggregations. For example, Spain faced a high increase in average concentration, but concentration in the manufacturing sector decreased. In these countries, the explanation is likely that concentration in manufacturing was already high (see Appendix C; Table 8.C.1) and that other macro sectors faced a strong increase in concentration (Spain, in particular, had a strong increase in concentration in real estate). In some other countries, changes in concentration are driven mainly by changes in the manufacturing sector.

8.2 The role of productivity, reallocation, and technology

Understanding the mechanisms behind this increase in concentration is key, particularly as rising market concentration is often seen as a threat to market competition and economic growth. The following analysis presents evidence in support of a very different story: changes in market concentration are positively associated with productivity growth, productivity-enhancing reallocation processes and changes in production processes towards modern technologies.

Table 8.1 presents regression results projecting the two-digit sector-level concentrations measures on the log of sector-level aggregate value-added-based labour productivity while controlling for a full set of year, sector and time dummies.

The coefficient on the productivity variable measures the extent to which *changes* in concentration are related to *changes* in productivity. For both, the 1% and 5% concentration measures, there is a highly significant positive relationship between concentration and aggregate productivity within European two-digit sectors. This holds even after controlling for the median firm size and median firm capital intensity of a sector. For manufacturing sectors, this association is even stronger than across all sectors.

Changes in market concentration are positively associated with productivity growth

Table 8.1 Relationship between concentration and aggregate productivity for European firms

	All sectors					Manufacturing			
	Top 1% (1)	Top 5% (2)	Top 1% (3)	Top 5% (4)		Top 1% (5)	Top 5% (6)	Top 1% (7)	Top 5% (8)
Sector-level aggregate productivity	0.0128**	0.021***	0.0154**	0.0225***		0.0305**	0.039***	0.0341**	0.0415***
	(0.0063)	(0.0071)	(0.0065)	(0.00745)		(0.0132)	(0.0118)	(0.0121)	(0.0101)
Median firm size			-0.00158	0.0166				-0.0296*	-0.0239*
			(0.0102)	(0.0115)				(0.0172)	(0.0133)
Median firm capital intensity			-0.008***	-0.00570				-0.00581	-0.00317
			(0.0023)	(0.00345)				(0.0103)	(0.0118)
Constant	0.0635**	0.165***	0.0787**	0.110**		-0.00381	0.101*	0.113*	0.193***
	(0.0258)	(0.0292)	(0.0380)	(0.0473)		(0.0551)	(0.0494)	(0.0600)	(0.0682)
Obs.	4,915	4,915	4,915	4,915		2,034	2,034	2,034	2,034
R-squared	0.289	0.396	0.296	0.400		0.294	0.437	0.306	0.443
Year FE	YES	YES	YES	YES		YES	YES	YES	YES
Country FE	YES	YES	YES	YES		YES	YES	YES	YES
Sector FE	YES	YES	YES	YES		YES	YES	YES	YES

Source: CompNet 2020.

Notes: OLS regression results from projecting the sector-level concentration on the log of aggregate productivity, which is a weighted average of firms' value-added-based labour productivity. All regressions include year, sector and country fixed effects. All available countries, years and sectors in the data. Standard errors are in parenthesis and clustered at the sector level. Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 8.2 and 8.3 show the role of specific percentiles of the productivity distribution in shaping this positive relationship using the same regression specification as above. Table 8.2 relates changes in concentration with changes at the top percentile, while Table 8.3 repeats this exercise, using the median of the productivity distribution.

We document that only changes at the top end of the productivity distribution are positively associated with changes in concentration. Even at the median, we find only statistically insignificant relationships with concentration. This strongly supports the key role of high-productivity (superstar) firms in shaping the relationship between concentration and aggregate productivity. The results are highly robust across all specifications.[50]

Table 8.2 Relationship between concentration and productivity of highly productive European firms

	All sectors					Manufacturing			
	Top 1%	Top 5%	Top 1%	Top 5%		Top 1%	Top 5%	Top 1%	Top 5%
	(1)	(2)	(3)	(4)		(5)	(6)	(7)	(8)
Firm productivity at 99th percentile	0.0508**	0.088***	0.0563**	0.0918***		0.102**	0.127***	0.108***	0.128***
	(0.0239)	(0.0251)	(0.0238)	(0.0254)		(0.0409)	(0.0324)	(0.0376)	(0.0263)
Median firm size			-0.00084	0.0168				-0.0263	-0.0202
			(0.0102)	(0.0115)				(0.0171)	(0.0137)
Median firm capital intensity			-0.007***	-0.00410				-0.00462	0.000232
			(0.0022)	(0.00321)				(0.0105)	(0.0120)
Constant	0.0335	0.107**	0.0450	0.0474		-0.0420	0.0583	0.0643	0.134*
	(0.0389)	(0.0410)	(0.0494)	(0.0614)		(0.0663)	(0.0525)	(0.0764)	(0.0740)
Obs.	4,843	4,843	4,843	4,843		2,010	2,010	2,010	2,010
R-squared	0.290	0.402	0.296	0.405		0.290	0.432	0.299	0.435
Year FE	YES	YES	YES	YES		YES	YES	YES	YES
Country FE	YES	YES	YES	YES		YES	YES	YES	YES
Sector FE	YES	YES	YES	YES		YES	YES	YES	YES

Source: CompNet 2020

Notes: OLS regression results from projecting the sector-level concentration on the log of the 99th percentile of the productivity distribution, which is a weighted average of firm productivity. All regressions include year, sector and country fixed effects. All available countries, years and sectors in the data. Standard errors are in parenthesis and clustered at the sector level. Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

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[50] Aggregate productivity for a sector is predominantly determined by the firms at the top of the distribution.

Table 8.3 Relationship between concentration and productivity of medium productive European firms

	All sectors					Manufacturing			
	Top 1% (1)	Top 5% (2)	Top 1% (3)	Top 5% (4)		Top 1% (5)	Top 5% (6)	Top 1% (7)	Top 5% (8)
Firm productivity at the median	-0.00786	0.00185	-0.0045	0.00362		-0.00182	0.0112	0.0001	0.012
	(0.0056)	(0.0065)	(0.0057)	(0.00678)		(0.016)	(0.0156)	(0.0139)	(0.0132)
Median firm size			-0.00108	0.0166				-0.0286	-0.0232
			(0.0104)	(0.0115)				(0.0183)	(0.0144)
Median firm capital intensity			-0.006***	-0.004				0.00244	0.00354
			(0.0021)	(0.0034)				(0.0091)	(0.0106)
Constant	0.146***	0.243***	0.152***	0.184***		0.130**	0.221***	0.227***	0.297***
	(0.0214)	(0.0251)	(0.0401)	(0.0461)		(0.0622)	(0.0607)	(0.0825)	(0.0785)
Obs.	4,915	4,915	4,915	4,915		2,034	2,034	2,034	2,034
R-squared	0.285	0.385	0.288	0.388		0.275	0.413	0.284	0.418
Year FE	YES	YES	YES	YES		YES	YES	YES	YES
Country FE	YES	YES	YES	YES		YES	YES	YES	YES
Sector FE	YES	YES	YES	YES		YES	YES	YES	YES

Source: CompNet 2020

Notes: Table X.3 shows OLS-regression results from projecting the sector-level on the log of the median of the productivity distribution. All regressions include year, sector and country fixed effects. All available countries, years and sectors in the data. Standard errors are in parenthesis and clustered at the sector level. Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Table 8.4 presents evidence on the role of productivity-enhancing reallocation processes in shaping concentration. Specifically, it shows the role of the covariance between firm productivity and size (firm's employment share). This covariance can be used as an index measure for allocative efficiency because it increases as factors of production (measured in this instance with labour) move from less to more productive firms (see section 4 for more details on this measure).

There is a strong and robust positive association between changes in concentration and changes in the covariance term. This provides strong evidence that increases in concentration reflect a more efficient allocation of labour in favour of more productive firms, reinforcing the argument that an efficient and competitive environment with "winner-takes-it-all-mechanisms" (for instance, through the increasing use of modern technologies such as digital platforming) contributes to increasing concentration in Europe.

Changes in market concentration are associated with productivity for only the most productive firms

Changes in market concentration are positively associated with productivity-enhancing reallocation processes

Table 8.4 Relationship between concentration and allocative efficiency for European firms

	All sectors					Manufacturing			
	Top 1% (1)	Top 5% (2)	Top 1% (3)	Top 5% (4)		Top 1% (5)	Top 5% (6)	Top 1% (7)	Top 5% (8)
Covariance between firm size and productivity	0.011***	0.012***	0.011***	0.012***		0.015***	0.015***	0.015***	0.015***
	(0.0021)	(0.0021)	(0.002)	(0.0021)		(0.004)	(0.0036)	(0.0037)	(0.0034)
Median firm size			-0.00185	0.0110				-0.0259	-0.0192
			(0.0115)	(0.0114)				(0.0160)	(0.0128)
Median firm capital intensity			-0.009***	-0.00292				0.00331	0.00725
			(0.0029)	(0.00406)				(0.001)	(0.0114)
Constant	0.101***	0.234***	0.132***	0.200***		0.095***	0.237***	0.185***	0.289***
	(0.0035)	(0.0036)	(0.0424)	(0.0420)		(0.0079)	(0.007)	(0.0624)	(0.0590)
Obs.	3,764	3,764	3,764	3,764		1,866	1,866	1,866	1,866
R-squared	0.341	0.458	0.348	0.459		0.333	0.456	0.340	0.460
Year FE	YES	YES	YES	YES		YES	YES	YES	YES
Country FE	YES	YES	YES	YES		YES	YES	YES	YES
Sector FE	YES	YES	YES	YES		YES	YES	YES	YES

Source: CompNet 2020

Notes: OLS regression results from projecting the sector-level concentration on the log of the covariance between size (employment share) and firm productivity of a sector. All regressions include year, sector and country fixed effects. All available countries, years and sectors in the data. Standard errors are in parenthesis and clustered at the sector level. Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

Changes in market concentration are positively associated with the adoption of modern technologies

Table 8.5 also suggests a role for intangible assets in understanding changes in concentration. It regresses our concentration measures on the log of the ratio of total intangible assets over labour at the sector level.[51] This specification captures the importance of modern production technologies in explaining changes in concentration. Again, there is a robust positive association between changes in a sector's intangible asset intensity and concentration. Notably, this association is stronger for manufacturing than for the entire economy, which combines a wider range of intangible intensive and non-intensive sectors. As our previous regression, this provides evidence for top firm concentration being a result of a competitive, efficient market environment that has emerged as an outcome of high-tech and intangible-asset-intensive production processes.

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[51] We take logs and therefore focus on the intensive margin of intangible asset usage. We do so because there are many zeros in the intangible asset intensity variable.

Table 8.5 Relationship between concentration and intangible asset intensity for European firms

	All sectors					Manufacturing			
	Top 1% (1)	Top 5% (2)	Top 1% (3)	Top 5% (4)		Top 1% (5)	Top 5% (6)	Top 1% (7)	Top 5% (8)
Sector-level Intangible input intensity	0.00420**	0.0054**	0.00435**	0.0057**		0.0128**	0.013***	0.0125**	0.0124***
	(0.0025)	(0.0026)	(0.0024)	(0.00254)		(0.0048)	(0.0034)	(0.0045)	(0.0032)
Median firm size			-0.00059	0.0179				-0.0349*	-0.0285
			(0.0129)	(0.0137)				(0.0194)	(0.0170)
Median firm capital intensity			-0.006**	-0.00258				0.00304	0.00656
			(0.0026)	(0.00366)				(0.0099)	(0.0118)
Constant	0.110***	0.243***	0.127**	0.182***		0.107***	0.247***	0.233***	0.337***
	(0.0025)	(0.0027)	(0.0478)	(0.0508)		(0.0052)	(0.0037)	(0.0762)	(0.0738)
Obs.	3,580	3,580	3,580	3,580		1,541	1,541	1,541	1,541
R-squared	0.299	0.407	0.303	0.410		0.328	0.448	0.342	0.455
Year FE	YES	YES	YES	YES		YES	YES	YES	YES
Country FE	YES	YES	YES	YES		YES	YES	YES	YES
Sector FE	YES	YES	YES	YES		YES	YES	YES	YES

Source: CompNet 2020

Notes: Table X.5 shows OLS-regression results from projecting the sector-level concentration on the log of the sector-level ratio of intangible capital over labour. All regressions include year, sector and country fixed effects. All available countries, years and sectors in the data. Standard errors are in parenthesis and clustered at the sector level. Significance: *** $p<0.01$, ** $p<0.05$, * $p<0.1$.

In sum, our main findings are:

- Top firm concentration is increasing within European sectors since 2014.
- This trend is strongly and positively associated with changes in sector-level productivity. This relationship is driven by the most productive firms.
- Productivity-enhancing reallocation processes and the usage of modern production technologies are associated with increases in concentration.

We therefore conclude that rising concentration should not be viewed as conclusive evidence for a weak competitive environment with rising market power. Therefore, rising concentration need not be, *prima facie*, a cause of concern. Instead, we find strong support for the assessment that rising concentration is in part a reflection of more efficient market processes with more technologically advanced production methods that benefit large and

highly productive firms. This has important consequences for industrial and antitrust policy, which must carefully evaluate the costs and benefits of increasing concentration. In particular, assessments regarding the detrimental consequences of excessive market power must be based on more direct measures of that market power and its associated rents rather than relying on the observed increases in concentration.

Conclusions

We cannot fully explain the stagnant aggregate productivity growth displayed by the EU over the last decade. But micro-founded evidence reveals some of the mechanisms underpinning it and the policy levers to enhance productivity growth.

We need these insights. If we want to continue to improve European living standards, we can't do it without improving productivity. But the Covid-19 pandemic has restricted economic activity, increased the costs of compliance, and created behavioural responses among consumers that will challenge productivity growth for years to come.

Our living standards will improve when we can ensure that markets are functioning healthily through an efficient allocation of resources. Our report has shown inefficiencies in labour force dispersal among firms. Reducing this wastefulness, for instance by promoting competitive market environments and removing frictions in the reallocation process, would help.

Regional shortages of highly educated workers are associated with lower productivity growth. We have also discovered that returns to scale and localised externalities play a major role in enhancing productivity for European firms.

Technology, an intangible fixed asset, is highly concentrated both within and between sectors. It is associated with higher productivity levels, contributing to the high dispersion between leading and lagging firms. It is now urgent that policy encourages better technology diffusion with appropriate incentives, aiming at optimising processes and provide employees with appropriate tools for remote working.

We also found the fall in labour share not to be a generalized pattern, although diminishing labour share is associated with positive firms' output growth. This is not necessary the result of a substitution effect, as capital endowment could increase output.

Financial constraints – covering cash holdings, collateral and credit conditions – are hurdles for productivity growth. The challenge for both firms and policymakers is clear.

Finally, the assertion of national borders has become a major threat to productivity. The trade collapse experienced since the onset of containment measures has been even greater than that of 2008. Openness gives firms the chance to grow overcoming domestic demand and input supply limitations, and the most productive firms are engaged in GVCs and account for a large share of GDP. If our nations turn in on themselves, it will have severe impacts on these firms, national economies, and the economy of the EU. This is particularly true for smaller countries, especially those in central and Easter Europe, whose growth and living standards, have thrived on the back of trade liberalisation.

The unprecedented economic scenario we are facing today demands prompt, targeted and evidence-based policy action. The report has shown that the CompNet project can provide unique data and analysis to support these initiatives.

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APPENDIX A: Countries and time coverage in the CompNet dataset

Table A1 Country and Time Coverage in the 7th Vintage of the CompNet Dataset

| Country	Full Sample	20E	Time Span
Belgium	X	X	2003-2017
Croatia	X	X	2002-2017
Czech Republic	X	X	2005-2017
Denmark	X	X	2000-2016
Finland	X	X	1999-2017
France	X	X	2004-2016
Germany		X	2001-2016
Hungary	X		2004-2017
Italy	X	X	2006-2016
Lithuania		X	2000-2017
Netherlands		X	2005-2016
Poland		X	2005-2017
Portugal	X	X	2004-2017
Romania	X	X	2005-2017
Slovakia		X	2000-2017
Slovenia	X	X	2002-2017
Spain	X	X	2008-2017
Sweden	X	X	2003-2016
Switzerland	X	X	2009-2017

APPENDIX B: Allocative Efficiency

Figure B.1: Within-sector job dynamism for selected countries (2)
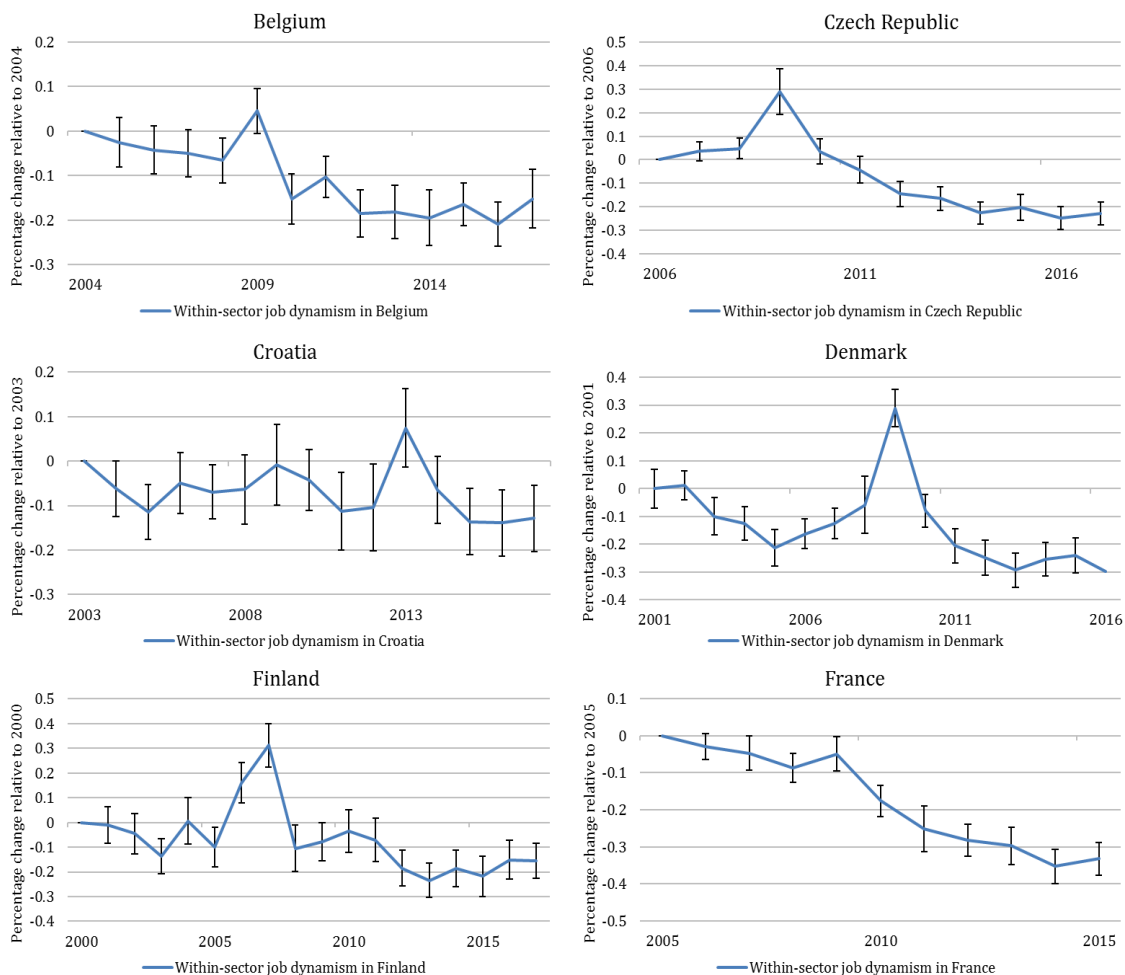
Notes: Figure B.1 reports coefficients on time dummies from OLS regressions of the logs of sector-level job dynamism on a full set of year and two-digit sector dummies for Belgium, the Czech Republic, Croatia, Denmark, Finland, and France. We excluded the year 2016 for France due to an outlier cleaning routine. 20e sample.
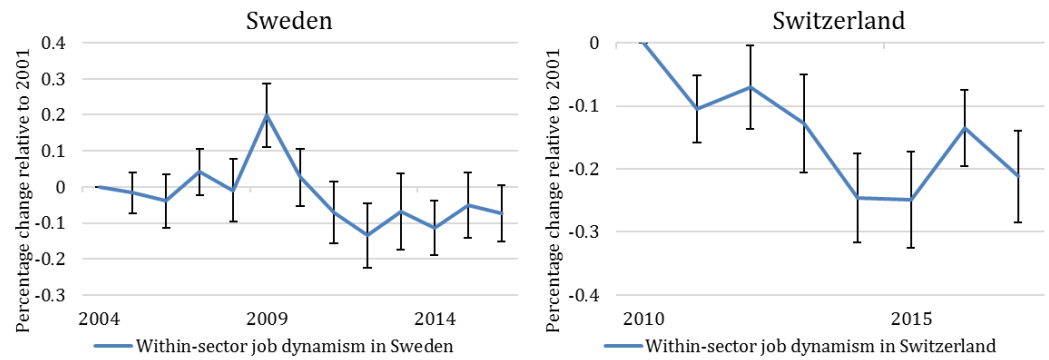
Figure B.2: Within-sector job dynamism for selected countries (3)
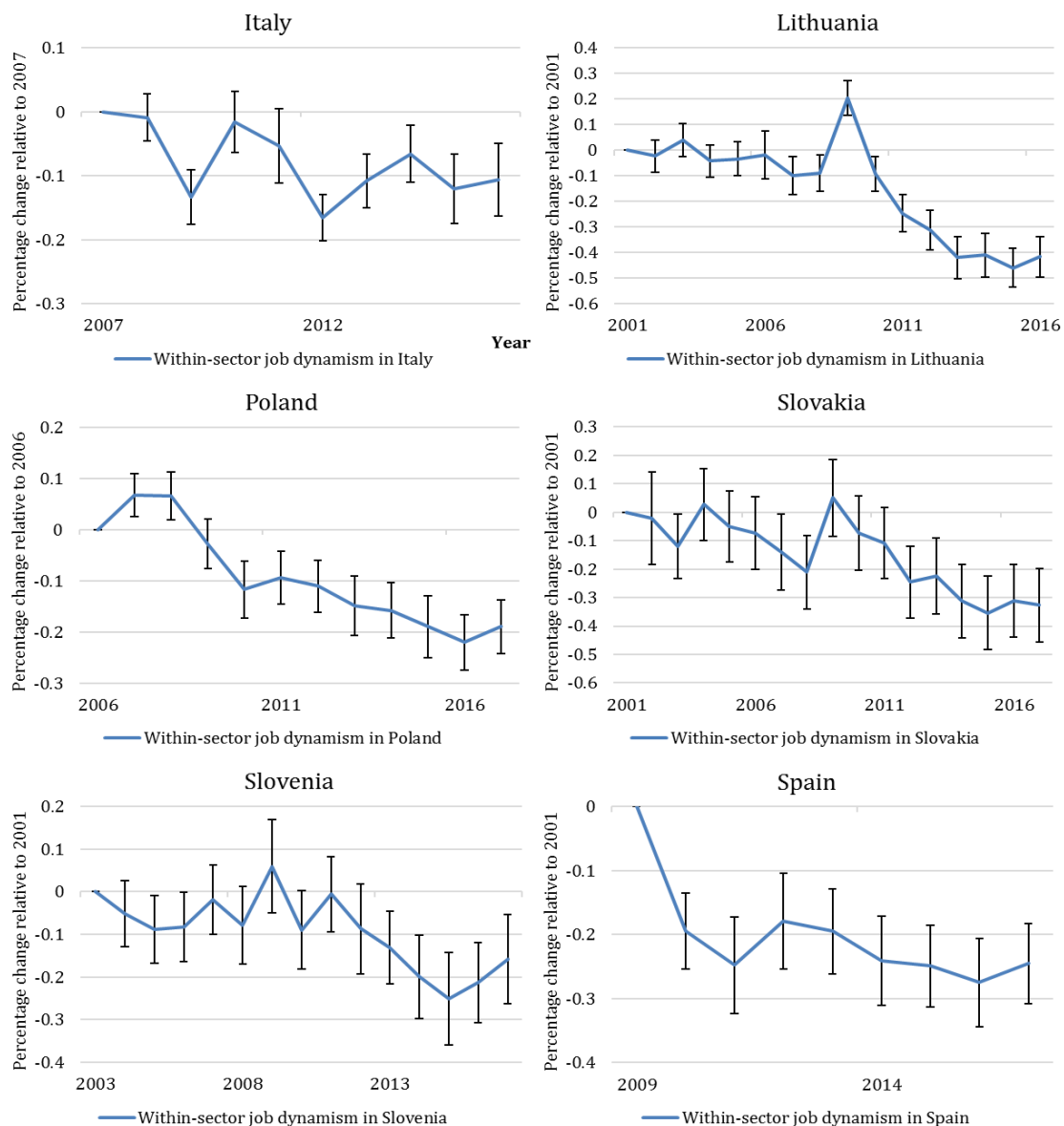
Notes: Figure B.2 reports coefficients on time dummies from OLS regressions of the logs of sector-level job dynamism on a full set of year and two-digit sector dummies for Italy, Lithuania, Poland, Slovakia, Slovenia, and Spain. 20e sample.

Sweden

Switzerland

Notes: Figure B.3 reports coefficients on time dummies from OLS regressions of the logs of sector-level job dynamism on a full set of year and two-digit sector dummies for Sweden and Switzerland. 20e sample.

APPENDIX C: Firm Concentration Levels in Europe

Table 8.C.1: Percentage of revenue of top 1% Firms. Values in percentage

COUNTRY	Concentration				Most concentrated sector	
	2009		2016		2009	2016
	All sectors	Manu-facturing	All sectors	Manu-facturing		
Belgium	10.6	11.4	10.3	10.6	Information and communication	Information and communication
Croatia	16.5	15.4	12.5	14.1	Information and communication	Information and communication
Czech R.	12.4	12.3	10.5	11.9	Real Estate	Administrative and supports
Denmark	12.7	10.1	12.2	7.6	Information and communication	Professional, scientific and tech activities
Finland	15.3	12.7	16.1	17.6	Administrative and support	Manufacturing
France	10.7	13.6	10.4	14.2	Manufacturing	Manufacturing
Italy	11.4	11.1	11.7	10.9	Real Estate	Real Estate
Lithuania	13.8	14.0	12.9	13.5	Information and communication	Information and communication
Poland	10.4	12.6	10.3	13.5	Transportation and storage	Information and communication
Slovakia	13.5	11.4	10.7	10.7	Transportation and storage	Professional, scientific and tech activities
Slovenia	12.1	10.5	11.9	10.7	Information and communication	Transportation and storage
Spain	12.5	17.4	13.8	15.1	Manufacturing	Real Estate
Sweden	10.6	14.2	9.6	12.4	Manufacturing	Information and communication
Switzerland	9.9	9.9	10.5	11.2	Professional, scientific and tech activities	Wholesale and retail trade