European Commission

HELPING FIRMS GROW

EUROPEAN COMPETITIVENESS REPORT 2014

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EUROPEAN COMPETITIVENESS REPORT 2014

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This publication is prepared by Directorate-General for Enterprise and Industry, Unit A5 "Economic Analysis and Impact Assessment", under the overall supervision of Daniel Calleja Crespo, Director-General and Didier Herbert, Acting Director of the Directorate for Industrial Policy and Economic Analysis.

The report partly draws on background studies prepared by a consortium led by WIFO (see back of report for a full list of background studies). It was put together by a team consisting of Tomas Brännström (Chapter 1), Neil Kay (Chapter 2), Marshall Hsia (Chapter 3), Anastasios Saraidaris (Chapter 4), Smaranda Panthea (Chapter 5), Paolo Casini (Chapter 6), Luigi Cipriani (Statistical annex and support), Marieta Todorova, Elizabeth Catzel and Patricia Carbajosa-Dubourdieu (administrative support). The team was led by Tomas Brännström, Project Manager, and Konstantin Pashev, Head of Unit.

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The report and related materials can be downloaded at:
http://ec.europa.eu/enterprise/policies/industrial-competitiveness/competitiveness-analysis/index_en.htm

For further information contact us
By e-mail to: entr-econ-analysis-and-ia@ec.europa.eu
Or by mail to: Directorate-General for Enterprise and Industry
Unit A5 - Economic Analysis and Impact Assessment Unit
BREY 06/181
European Commission
B - 1049 Brussels (Belgium)

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FOREWORD

Daniel Calleja Crespo

Director General, DG Enterprise and Industry

Dear Reader

The 2014 edition of the European Competitiveness Report is seeking the empirical answer to an important policy question: how to help firms grow? As the EU emerges from the deepest and longest recession in the post-war history, firms need to be able to prosper and grow and the conditions must be right for new business ideas and start-ups to succeed. Growth of firms is not only a measure of the success of individual businesses but also a measure of the effectiveness of our industrial policy and the quality of the investment environment.

Firms can expand their operations and grow in terms of employees, assets, turnover, market share and profits. To shed light on the role of policy in enabling these different dimensions, this report looks at important factors and drivers of firms' growth such as the role of access to different forms of funding, the policies that help small and new firms expand their operations to new markets, the role of public administration, the role of innovation and, finally, the importance of energy costs for EU firms' export performance. These questions are now at the centre of the EU policy debate. The report uses new data and employs empirical methods to provide new evidence for policy-making. Some of the results confirm the relevance of current policy priorities, others reveal new opportunities.

The report reveals that while the fall in **private sector investment** is largely a consequence of weak demand, funding constraints play a major role. Since 2008 the proportion of bank-loan applications that are successful has dropped dramatically in the EU with large differences across countries. Firms are providing new evidence of the importance of access to external finance for investment. The report shows that a high level of firms' debt is a significant handicap while long-term credit is a strong enabler of investment and firm growth.

The report also examines what **helps firms expand their activities across national and EU borders**. It shows that policies targeting the business environment with respect to access to capital, skills support for innovation and actions to enhance productivity are important to help small firms expand exports. Targeted support measures, such as export credits and guarantees, may also have a positive effect when they address market imperfections.

The report also proves empirically the potentially positive impact of an efficient **public administration** and the quality of institutions on the growth and competitiveness of firms. It finds tax administration deficiencies, corruption and ineffective justice systems to be most detrimental to firms' growth.

The report sheds light on **the impact of innovation on jobs**. Increased demand for new products creates employment, but increasing productivity and phasing out old products may have the opposite effect. The report shows empirically that the overall impact of productivity-enhancing innovation on employment is positive and significant. Furthermore, product innovation has stronger job-creation effect than process innovation. A one percent increase in the sale of innovative products leads to a commensurate rise in employment.

The report also responds to the request of policymakers for further analysis on **the impact of rising energy prices on EU industrial competitiveness,** especially on energy-intensive industries. It finds that even though EU firms have scored highly in terms of energy efficiency it is not enough to fully offset the negative impact of energy price rises on industrial competitiveness. Energy costs have grown in proportion to output. Despite their relatively low share in average input costs, they may be a key impediment to competitiveness and growth for some energy-intensive sectors.

These are important factors in helping EU firms to grow and ensuring that they remain competitive internationally. EU industry has strengths in many sectors but it cannot solely rely on existing competences. Innovation is essential for job creation, productivity gains and new market opportunities. Similarly we need innovation in policy-making. I hope this publication, and your feedback, will contribute to the debate about new engines of sustainable and inclusive growth in Europe.

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List of abbreviations

BRIC	Brazil, Russia, India and China
CIS	Community Innovation Survey (CIS3, CIS4, CIS2006, CIS2008, CIS2010)
CPA	Classification of products by activity
EFIGE	European firms in a global economy
EC	European Commission
ECB	European Central Bank
EFTA	European Free Trade Agreement
EIB	European Investment Bank
ESSLait	ESSnet on Linking of Microdata to Analyse ICT Impact
EU	European Union
Eurofound	European Foundation for the Improvement of Living and Working Conditions
FDI	Foreign Direct Investment
FISIM	Financial Intermediation Services, Indirectly Measured
GDP	Gross domestic product
GERD	Gross domestic expenditure on R&D
GFCF	Gross Fixed Capital Formation
GVA	Gross value added at market prices
HGF	High growth firm
ICT	Information and communication technology
ISIC	International standard industrial classification
IEA	International Energy Agency
IID	Independent and identically distributed
IMF	International Monetary Fund
IOT	Input-Output table
LFS	Labour Force Survey
LNG	Liquefied natural gas
NACE	Nomenclature statistique des activités économiques dans la Communauté
OECD	Organisation for Economic Cooperation and Development
OLS	Ordinary Least Squares
PIAAC	Programme for the International Assessment of Adult Competences
PISA	Programme for International Student Assessment
PPI	Producer Price Index
RCA	Revealed Comparative Advantage
R&D	Research and development
RoW	Rest of the world
SBA	Small Business Act
SBS	Structural Business Statistics
SME	Small and medium-sized enterprise
SUT	Supply and use table
TFP	Total factor productivity
TJ	Terajoule
ULC	Unit labour cost
UN	United Nations
VA	Value added
VC	Venture capital
WGI	World Bank's Worldwide Governance Indicators
WIOD	World Input-Output database
WIOT	World Input-Output table
WTO	World Trade Organization

COUNTRY ABBREVIATIONS

EU code	ISO code	Country name
AL	ALB	Albania
AT	AUT	Austria
BA	BIH	Bosnia and Herzegovina
BE	BEL	Belgium
BG	BGR	Bulgaria
CA	CAN	Canada
CN	CHN	People's Republic of China
CY	CYP	Cyprus
CZ	CZE	Czech Republic
DE	DEU	Germany
DK	DNK	Denmark
EE	EST	Estonia
EL	GRC	Greece
ES	ESP	Spain
FI	FIN	Finland
FR	FRA	France
–	MKD	FYROM (former Yugoslav Republic of Macedonia)
HR	HRV	Croatia
HU	HUN	Hungary
IE	IRL	Ireland
IS	ISL	Iceland
IT	ITA	Italy
JP	JPN	Japan
KR	KOR	South Korea
LT	LTU	Lithuania
LU	LUX	Luxembourg
LV	LVA	Latvia
ME	MNE	Montenegro
MT	MLT	Malta
NL	NLD	Netherlands
PL	POL	Poland
PT	PRT	Portugal
RO	ROU	Romania
RS	SRB	Serbia
SE	SWE	Sweden
SI	SVN	Slovenia
SK	SVK	Slovakia
TR	TUR	Turkey
UK	GBR	United Kingdom
US	USA	United States of America

MAIN FINDINGS OF THIS REPORT:

- As EU manufacturing emerges from the recession, its competitive strengths remain intact: highly skilled workers, high domestic content of export goods, and comparative advantages linked to complex and high-quality product segments.
- The fall in recent years in the value-added share of manufacturing is due mainly to falling relative prices of manufacturing in relation to services, which in turn stem from higher productivity growth. Discounting for the relative price effect, the actual fall has been much more gradual. On the other hand, the positive impact of reindustrialisation on the value-added share may not be strong enough to outweigh the opposite effect of falling relative prices.
- Otherwise viable projects appear to be held back by financial markets imperfections. Smaller and younger firms are especially affected and policy measures to improve their access to external financing may be justified.
- Smaller and younger firms are also less likely to enter foreign markets. Most internationalisation strategies by SMEs are focused primarily on exports and driven by factors in their home country and in the target country.
- The efficiency of public administration has an impact on the growth of firms, both in terms of employment and the share of high-growth firms. There are, however, only weak indications that public administration plays an important role as an input to different sectors of the economy.
- Product innovation has a positive and large effect on employment growth in all phases of the business cycle, in both manufacturing and service sectors. The effects of process and organisational innovations on employment growth are smaller and often statistically insignificant. The absolute effect of product innovation is largest in boom periods, which are characterised by high demand. However, in recessions, it plays a very important employment-preserving role.
- Electricity and gas prices are higher, and have recently risen more, in the EU than a number of other economies, mainly due to rising taxes, levies and network costs.
- Econometric analysis shows that, for several manufacturing industries, energy efficiency improvements have not fully offset the negative impact of increasing energy prices, even though European industries have achieved more than international competitors in reducing their energy intensity.
- Increasing electricity costs had a negative impact on export competitiveness. The impact can be particularly challenging for certain energy-intensive industries in the EU.

Post-recession fallout: manufacturing's strengths and challenges

Building on existing strengths…

As the economy emerges slowly from the longest and deepest recession in EU history, it is important to build on the existing strengths of EU manufacturing going forward. First, EU exporters have comparative advantages in a number of manufacturing sectors, including those characterised by high technology intensity, such as pharmaceutical products, and by medium-high technology intensity, such as chemical products, machinery and equipment, motor vehicles and other transport equipment. Similarly, in value added terms, the EU has great advantages in chemical products, machinery and transport equipment, but also in metal products, wood and wood products, paper, printing and recorded media.

Secondly, the domestic content of EU manufacturing exports is high — around 85% of value added — and comparable to the domestic content of Japanese or US manufacturing exports. The domestic content of Chinese and South Korean exports is much lower, as their export goods include much more foreign embedded value added, of which more than 5% is of EU origin.

Thirdly, EU manufacturing exports are characterised by a higher degree of sophistication and complexity than goods exported by many other economies, and from 1995 to 2010 all accession countries of 2004/2007 managed to raise the complexity of their exports.

Fourthly, EU manufacturing is characterised by growing share of high-skilled workers carrying out advanced and often specialised tasks.

…but challenges remain

At the same time, many challenges lie ahead and the EU economy is still far from reaching its targets for manufacturing value added, R&D expenditure, gross fixed capital formation and investment in machinery and equipment. This report shows that the increasing distance to the 20% reindustrialisation is primarily the result of higher productivity growth in manufacturing than in the rest of the economy, which in turn pushes the relative price of manufactured goods down in relation to services, and thereby the value-added share of manufacturing. Net of the relative price effect, the fall in the value-added share is much smaller.

Focus on firm growth

Structure of the report

With the recession now behind them in most Member States, EU firms can look forward and have a chance to prosper and grow — as will the many start-up firms not yet in existence. Because the growth of firms (in terms of employees, turnover, profitability, or market shares) is now of crucial importance, four chapters of this report are dedicated to various factors and drivers thereof such as access to finance (Chapter 2); SME internationalisation (Chapter 3); the efficiency of public administration (Chapter 4); growth of firms, innovation, and the business cycle (Chapter 5). Energy costs and energy efficiency — at least as crucial to EU competitiveness — are addressed in Chapter 6.

Financial market imperfections may hold back otherwise viable projects

External financing is crucial for firms to grow…

Europe's economic success depends on the competitiveness and growth of European enterprises. Access to external financing is essential for enterprises to invest, innovate and grow. As a consequence of financial market imperfections, for example caused by *information asymmetries*, 'financing gaps' may limit enterprises' investment and growth options if viable projects cannot be financed. Since 2008, the proportion of successful bank loan applications has fallen significantly, along with the level of enterprise investment. While the sharp fall in private sector investment is largely a consequence of weak demand, financial market imperfections may have also played a role.

The results of an econometric analysis of ECB survey data and EU firm accounts, from the Amadeus and EFIGE datasets, indicate that the difficulties that small and young firms have in obtaining external finance cannot be linked entirely to risk. Small and young firms have more difficulty than other firms in obtaining bank credit, even if their financial performance is the same. This indicates that the market for bank credit is not functioning efficiently. The financial market imperfections most likely stem primarily from information asymmetries. On the one hand, banks may not have sufficient financial information on firms who want to borrow, which discourages them from lending. On the other hand, firms may not have sufficient knowledge of potential lenders or may be discouraged from borrowing due to a belief that banks will not lend to them, and so may miss out on borrowing opportunities.

External finance has an effect on the growth of firms by providing resources to support investment, productivity, employment and expansion into international markets. The results of an econometric analysis of firm accounts from the Amadeus database indicate that lending is more important for small and young firms seeking to finance new investment than for other types of firm. However, as noted above, small and young firms find it more difficult to obtain loans. Also, they are more sensitive than other types of firm to the interest burden on loans. Because young firms, in particular, have difficulty obtaining long-term credit, they are being driven to accept shorter-term credit arrangements, which are unsuitable for funding long-term investment projects.

…and for job creation

Long-term credit is very important to all firms' moves to take on new staff, but most crucial for domestically-owned small and medium-sized enterprises (SMEs) and very small (micro) firms seeking to expand their workforce. In general, for young firms there is a strong positive relationship between increased cash flows and total factor productivity (TFP). In terms of enabling new employment, the high-tech knowledge-intensive services sector is more reliant on external finance than other sectors.

Firms that are less financially constrained are more likely to export, possibly because they have the available funds to overcome the sunk costs of entry into export markets. However, financial constraints do not affect the export sales (intensity) of firms that are already exporting. Access to external

finance is more important as a driver of new investment for manufacturing and construction sectors than for services.

Measures to improve supply of and demand for external financing

On the side of lenders, information asymmetries could be addressed by standardising financial information on SMEs, for example through the establishment of centralised credit rating agencies at national or EU level. These could be used as a source of reference by all banks, similar in purpose to the credit ratings issued on government, municipal and corporate debt. On the side of borrowers, policy measures should be introduced that boost the market knowledge of small and young enterprises, as well as training in the preparation of loan proposals.

While current policy measures focus on supporting existing exporters, specific support measures may be needed to enable export participation of SMEs, possibly in the form of export credits and insurance, or other measures. To answer these questions the report dedicates a chapter on the link between internationalization and growth of firms

SMEs entering foreign markets

Exporting is most common way for SMEs to go international

Policymakers are increasingly focusing on the growth and employment potential of SMEs. Comprising over 99% of all firms and 60% of total output in the EU, SMEs are central to efforts to improve long-run competitiveness, particularly in international markets, where historically they have underperformed as compared with larger firms.

SMEs tend to enter foreign markets primarily as exporters because of the lower levels of capital investment and associated risk. Foreign direct investment is another form of internationalisation, although this is less common among SMEs than larger firms. Other forms, such as non-equity contractual modes, are relatively uncommon in manufacturing and business services. Franchising and licensing are important foreign entry modes in the retail, accommodation and restaurant sectors, where exports play a less significant role.

Strategies depend on firm and country characteristics

Not all SMEs have the same opportunities to internationalise their production activities. Internationalisation strategies differ according to inherent firm characteristics such as initial productivity, skill intensity, innovation performance and management characteristics. The factors influencing their internationalisation decisions can be divided into two categories: internal and firm-specific factors, or external factors. The former include firm size, labour productivity, skill intensity, innovation activities, and foreign ownership. The latter consist of home-country characteristics such as export promotion programmes, administrative and transport costs associated with exporting, and host-country characteristics such as tariffs, regulations, political risk factors, geographical distance and cultural factors.

Patterns and drivers of SME internationalisation

The report presents in chapter 3 SME internationalisation patterns, highlighting key trends and their impact on the growth of firms. It

distinguishes between SME size classes (small, medium and micro enterprises), internationalisation modes (exporting and outward FDI activity), types of exports (goods and/or services) and activity sectors (services and key manufacturing sectors). Some of the key findings include variations in SME export propensity, with higher participation rates in manufacturing and in software and business services, and the influence of home-country administrative burdens, such as heavier export and business regulations, leading to lower SME export participation rates. In broad terms, SME export participation increases with size and age of the firm, apart from some exceptions in technology-driven sectors, and is also positively linked to levels of innovation, R&D activity and skill intensity. Target country factors, including market size, language and geographical distance, also have a significant influence on SME internationalisation activity, particularly for the smallest firms, which are the most susceptible. In terms of technological considerations, skill-intensive SMEs have higher output and employment growth rates than those with a less skilled workforce, while overall there is a strong link between innovative SMEs and levels of export participation.

An efficient public administration is an important driver of competitiveness

It is becoming widely accepted in the EU that efficient public administration (PA) is a key driver of EU competitiveness. The demand for more efficient PA in the Member States has created a need for empirical evidence in addition to 'business perceptions', which are currently the only available form of feedback on the link between PA efficiency and business performance. While the need for more efficient PA can be supported empirically, assessing PA efficiency via microeconomic channels, with a view to providing 'hard evidence', is much more challenging. The report is identifying indicators of PA efficiency that can be related to the distribution of firms' growth, the share of high-growth firms and the turnover of firms in an economy?

An efficient public administration increases the share of high-growth firms and job creation

The results show that greater PA efficiency induces higher rates of fast-growing firms, in particular by increasing firm turnover and net entry. This holds especially for general indicators that measure the overall governance system, including the presence of an independent judiciary and freedom from corruption. From this perspective, PA efficiency is tied to the quality of a country's institutions and general (including political) governance.

Tax administration corruption and ineffective justice systems seem to impede most firms' growth

Employing input-output analysis the report finds in chapter four evidence that public service provision that relies more on fees than on taxes may be associated with higher efficiency.

Empirical results of a within-country analysis, presented in the chapter show that tax administration, corruption and ineffective justice systems are seen as the factors that most impede firms' growth in virtually all countries in the sample.

Impact of innovation on growth of employment

Innovation can have different, contrasting effects on employment: it can create jobs by creating additional demand for new products, but it can also destroy jobs because of productivity effects and lower demand for old products. It is likely that the extent to which innovation can stimulate demand and the extent to which process innovations are used to reduce costs vary over the course of the business cycle, with important implications for employment. Chapter 5 studies how the relationship between innovation and employment growth changes over various phases of the business cycle and how this relationship is affected by different firms' characteristics. It uses data from Community Innovation Survey, and it covers a large sample of firms in 26 European countries, in manufacturing and services sectors, for the period 1998-2010, which includes the recent economic crisis.

The chapter provides evidence that innovative firms have higher employment growth than non-innovative firms. This pattern can be observed in all sectors and in all phases of the business cycle, but is particularly pronounced in downturn and recession periods.

Impact of different types of innovation

The results of econometric estimations suggest that product innovation has a positive and large effect on employment growth in all phases of the business cycle, in both manufacturing and service sectors. In most cases, a 1% increase in successful product innovation leads to a 1% gross increase in employment. The effects of process and organisational innovation on employment growth are smaller and often statistically insignificant.

The contribution of product innovation to employment growth is largest during boom periods, when favourable economic conditions lead to higher sales of new products. However, in recessions, product innovation plays a very important employment-preserving role. Employment losses of product innovators are much smaller than those of firms that did not introduce product innovations.

Firm size, sector and ownership structure are important determinants of the strength of the effects of product innovation. Product innovation has a much more profound effect on employment growth in high-technology and knowledge-intensive sectors than in low-technology and less knowledge-intensive sectors. The results also suggest that product innovation tends to contribute more to employment growth in large and foreign-owned firms, compared to SMEs and domestic firms. However, large and foreign firms tend to lose more employment due to higher productivity effects than they gain from product innovation, thus leading to mostly jobless growth.

The findings of the report indicate that innovation, and especially product innovation, contributes to increasing and to preserving employment in all phases of the business cycle and in all sectors. They also suggest that innovation is particularly important during recessions, when it plays an important role in limiting job losses.

The findings underline the importance of innovation support as a policy priority during all phases of the business cycle, but particularly in times of

crisis when firms tend to decrease investment in innovation due to fears that demand will grow more slowly, or not at all. The finding that product innovation plays an important role in stabilising employment growth during recessions supports the view that investment in R&D could be a candidate for smart fiscal consolidation.

Energy cost has a significant impact on industrial competitiveness

Rising energy costs put pressure on energy-intensive industries

Electricity and gas prices have grown more in the EU than in many other economies. Although energy cost shares are slightly less than 5% of gross output in advanced economies such as the EU, Japan and the US, they have been generally increasing over time. For energy-intensive sectors energy cost shares are a fundamental determinant of competitiveness.

In terms of energy intensity, a strong convergence process has taken place across major economies, particularly in Europe where Member States have been able to reduce their energy intensities. This has been driven mostly by technology, but a structural shift towards high-tech industries has also played a role, particularly in the EU-12 countries. By contrast, in the EU-15 a structural shift towards chemicals and chemical products has limited the reduction in energy intensity.

Higher gas and electricity prices in the EU

End-user gas and electricity prices for industry vary considerably across countries. In the case of natural gas, this reflects the regional fragmentation of wholesale markets, the differences in wholesale gas pricing formulas and varying degrees of end-user price regulation.

In the United States, gas prices are largely independent of the oil markets and tend to be much lower. The recent shale gas 'revolution' and the high degree of pass-through have also contributed to keeping industrial prices at around a quarter of the OECD-Europe average. Elsewhere, the cross-country differences in end-user gas prices can be largely attributed to varying degrees of price regulation. In Russia, low gas prices for industry are explained by end-user price regulation and cross-subsidisation of domestic customers at the expense of foreign shipments. Gas prices for industry in China vary widely by region, but on average they are broadly in line with the European level. In Japan, gas prices for industry are currently among the highest in the world, due not only to high upstream prices but also to cross-subsidisation of households by industry.

Due to taxation and exemptions, electricity prices in the EU differ not only between wholesale and retail but also between sectors and Member States. On average they are currently twice as high as those in the US. Network costs and electricity taxation and levies have contributed significantly to strong electricity price growth in Europe. At the same time, energy costs have decreased in some Member States thanks to the expansion of renewable energy production, since the variable costs of renewable electricity are negligibly low. There are also substantial differences across Member States, reflecting differences in the energy generation mix, in taxation and in the allocation of the cost of support for renewables, including the exemptions from such costs for many industrial sectors.

Energy efficiency cannot fully offset the impact of price rises

Unless they are offset by improvements in energy intensity, cross-country differences in energy prices may have important repercussions for production costs as well as industrial competitiveness. For this reason, the report estimates the price elasticity of energy intensity, i.e. how the energy intensities of individual industries responded to energy price shocks in the period from 1995 to 2009. The estimated elasticities are generally negative and not negligible, but their absolute value is smaller than one for most manufacturing sectors, implying that energy efficiency improvements in response to energy price shocks have generally not been sufficient to fully offset the adverse impact of rising energy prices, resulting in an overall increase of energy-related expenditure.

Growing electricity costs have negative impact on export competitiveness especially for some energy-intensive industries

The report investigates the link between energy prices, energy efficiency and industrial competitiveness (as measured by extra-EU exports). The findings shows that the increasing electricity costs had a negative impact on export competitiveness. Moreover, the high within sectors heterogeneity suggests that energy-intensive industries are most heavily affected.

The results show that, since energy savings in most cases were not large enough to fully compensate for energy price increases, energy represents a growing share of total production costs. Therefore caution is called for when adopting policies that determine a further increase of energy prices, since this creates a real burden that some European firms cannot fully compensate for.

Chapter 1.
FROM RECESSION TO REINDUSTRIALISATION?

This chapter assesses the competitive performance of EU manufacturing and other sectors, and compares it with the competitiveness of established and emerging economies outside the EU. The ability of EU industries to compete, on the single market or in third countries, is determined by a number of factors — some necessary to compete on price, others affecting their ability to develop products with characteristics and qualities that differentiate them from those of their competitors.[1] The following analysis of competitiveness performance is based on a number of traditional indicators (revealed comparative advantage, labour productivity, unit labour costs) as well some as less commonly used indicators.

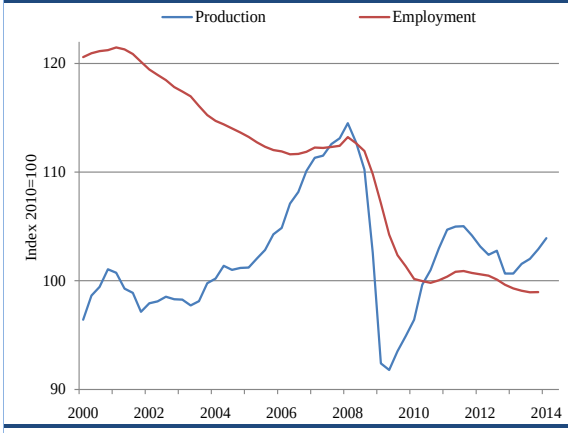
The first section of the chapter presents a brief overview of the state of recovery in EU manufacturing following the recession. The second section focuses on exports by EU industries to third-country markets, followed by four sections explaining their export performance by analysing the drivers of EU price and non-price competitiveness.

1.1. STATE OF EU REINDUSTRIALISATION

Employment in EU manufacturing has been declining steadily for several decades (Figure 1.1). With the onset of the deepest and longest recession in European post-war history, the decline accelerated temporarily but has since returned to its historical, more gradual rate.

EU manufacturing production followed a very different trajectory in the run-up to the financial crisis and the ensuing recession. After a lacklustre start to the century, output expanded for several years until reaching a peak in early 2008. It then fell rapidly by some 20% as the recession took hold. From its lowest point in 2009, it has since regained almost half the ground lost since 2008. It is important to emphasise that, though still far from its peak, EU manufacturing output is now higher than at any point prior to the 2005–2008 expansion depicted in Figure 1.1.

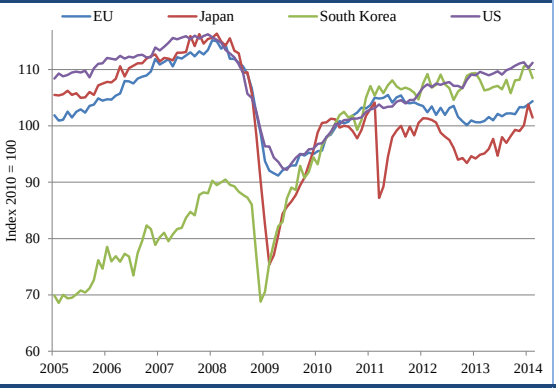
Figure 1.1: Production and employment in EU manufacturing, 2000–2014



Source: Eurostat

Recovery from the global economic crisis has been faster in other parts of the world. While manufacturing started to rebound in the EU before it did in the United States, EU recovery has since fallen behind. Asia, where manufacturing output plunged deeper than in the EU or the United States, is also recovering faster than the EU: South Korean manufacturing, for instance, surpassed its pre-crisis peak in less than 18 months after its trough.[2] Similarly, the rebound in Japan — the hardest hit of the economies in Figure 1.2 — was almost as fast as that in South Korea until it was brought to a halt in 2011 by the Fukushima earthquake and tsunami.

Figure 1.2: Manufacturing output in the EU and selected other economies, 2005–2014



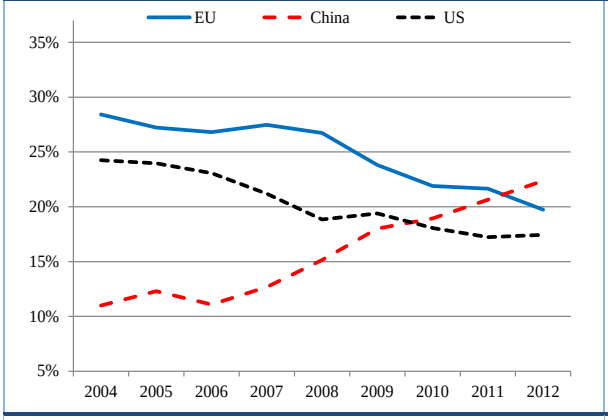
Source: Own calculations based on Eurostat and OECD manufacturing output data

[1] See European Commission (2010) for a thorough analysis and discussion of price and non-price factors; for an empirical analysis of the relative importance of price and non-price factors, see Benkovskis and Wörz (2014).

[2] Explanations for South Korea's recovery are put forward in OECD (2011).

As a result of the faster recovery in Asian manufacturing, China now accounts, according to national accounts, for a larger proportion of world manufacturing output value than the EU or the US, while EU manufacturing still accounts for the highest proportion in global value chains (Figure 1.3).

Figure 1.3a: EU, Chinese and US shares of world manufacturing production value, 2004–2012

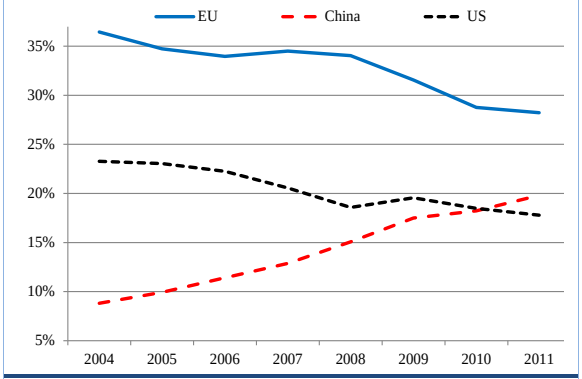


Source: Own calculations based on UN National Accounts Main Aggregates Database

In the EU, recovery has been much slower. While Poland, Slovakia, Romania, Estonia and other Member States have already surpassed their pre-recession peak levels of manufacturing output, most Member States are still producing less than before the crisis, with some (notably Cyprus and Greece) still at, or close to, their lowest point since the start of the recession (Figure 1.4).

A breakdown by sector shows that only a small number of manufacturing sectors (including pharmaceuticals, food, other transport equipment and other manufacturing) are producing at or above pre-crisis levels (Figure 1.5). However, even in sectors such as motor vehicles and beverages, output is close to pre-crisis levels of production following strong growth over the past 12 months.

Figure 1.3b: EU, Chinese and US shares of world manufacturing value added, 2004–2011

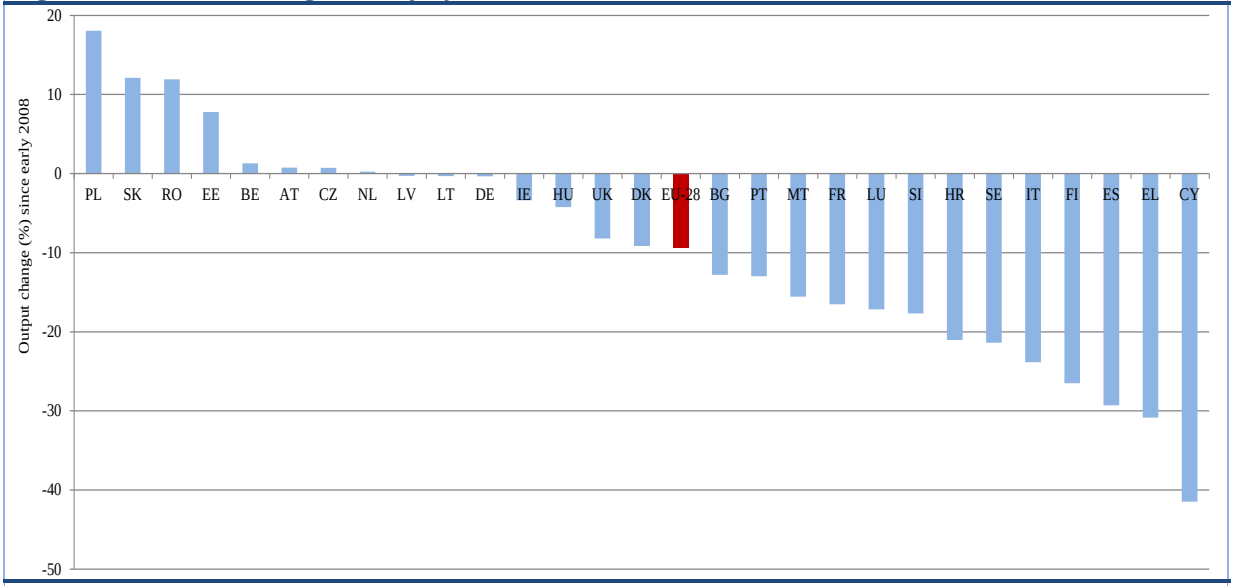


Source: Own calculations based on Timmer et al. (2013)

Capital goods and intermediate goods industries are more sensitive to business-cycle fluctuations than industries producing non-durable consumer goods and necessity goods such as food, beverages and pharmaceuticals, demand for which is less sensitive to variations in income (European Commission 2009, 2011, 2013b).

Outside manufacturing, the recession had an even greater impact on construction and extraction (mining and quarrying), but within extraction the impact was uneven: mining of metal ores quickly recovered after 2008-09 and production now

Figure 1.4: Manufacturing recovery by Member State, 2008–2014

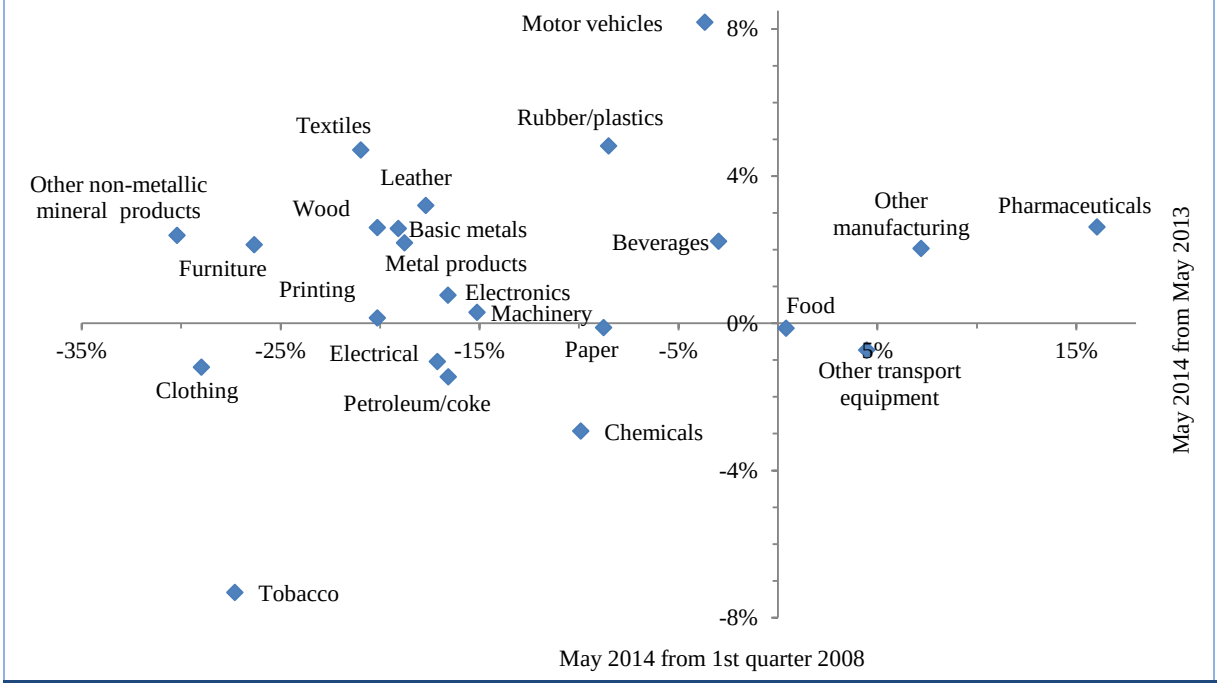


Source: Own calculations based on Eurostat manufacturing output data (as of March 2014)

exceeds the levels of early 2008 by almost 20%, to a large extent as a result of high global demand. On the other hand, industries such as coal and lignite mining and petroleum and gas extraction were already under pressure before 2008

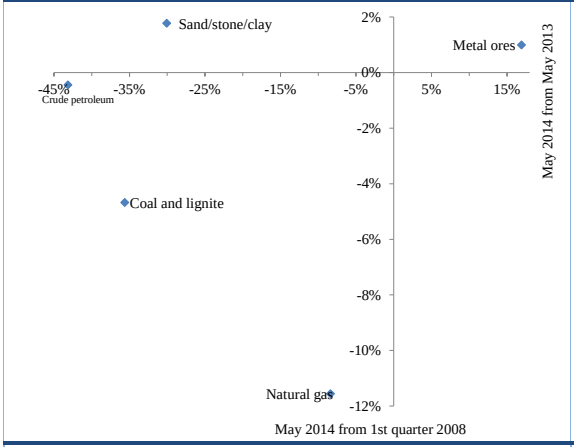
than before the recession, for the EU as a whole as well as in most Member States (Figure 1.7). As pointed out above, declining employment in manufacturing is a long-term trend; it goes hand in hand with a trend towards lower proportions of total

Figure 1.5: Manufacturing recovery by sector



Source: Own calculations based on Eurostat manufacturing output data

Figure 1.6: Extractive industries by sector



Source: Own calculations based on Eurostat industrial output data

and are currently producing 10% to 45% less than at the start of 2008.

The economic crisis and recession were more detrimental to manufacturing than to services: in the five years from the start of 2008 to 2013, services output declined by 9% in the EU, while manufacturing output fell by 12%. Because of this relative shift, manufacturing value added now represents a smaller proportion of total value added

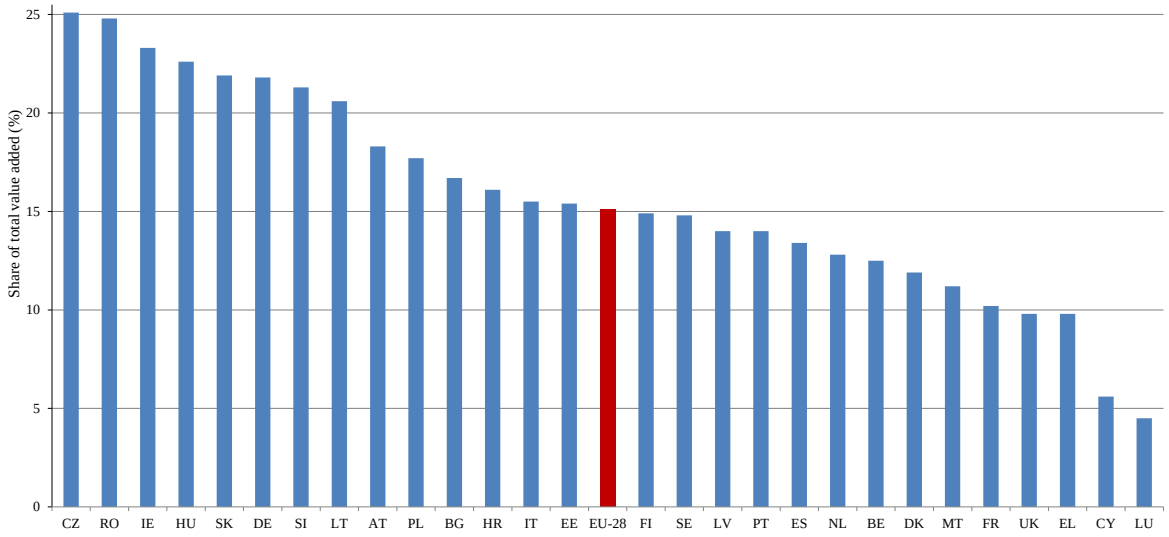
output and total value added accounted for by manufacturing. These long-term trends are driven by shifts in domestic demand due to a combination of factors: on the one hand substitution as a result of higher real incomes, on the other hand lower relative prices of manufactured output due to higher productivity growth in manufacturing than in the economy as a whole (Nickell et al. 2008). The trends can be mitigated by increasing external demand for EU manufactured goods, as long as EU manufacturers compete successfully on world markets.

Figure 1.7 also shows that the EU is still relatively far away from its reindustrialisation target: for manufacturing to approach a share of 20% of total EU gross value added. The aggregate proportion fell from 18.5% in 2000 to just over 15% in 2013.

On the other hand, in eight Member States (the Czech Republic, Romania, Ireland, Hungary, Slovakia, Germany, Slovenia and Lithuania) manufacturing sectors already account for more than 20 % of total value added, and in all Member States the proportion can be expected to rise as the EU economy returns to its historical growth rate in the coming years.

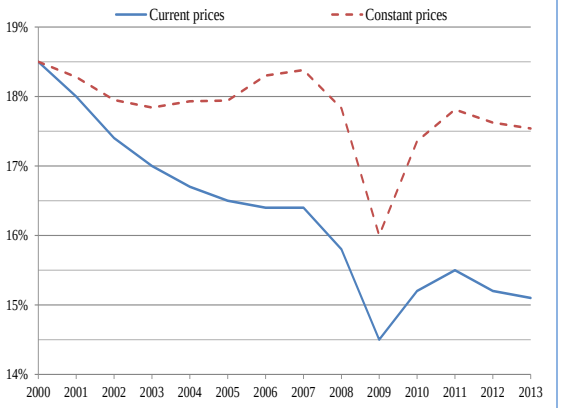
As pointed out above, the declining share of manufacturing value added in the EU — from 18.5% in 2000 to just over 15% in 2013 — is the result of several factors, not least the falling relative price of manufactured goods (in relation to services) as a consequence of productivity growing more in manufacturing than in services.

Figure 1.7: Manufacturing's share of total value added in the EU and in Member States



Note: Columns represent 2013 shares in all cases except Bulgaria, Romania, (2012 shares); current prices.
Source: Eurostat and the World Bank

Figure 1.8: Manufacturing share of total value added in the EU in constant and current prices

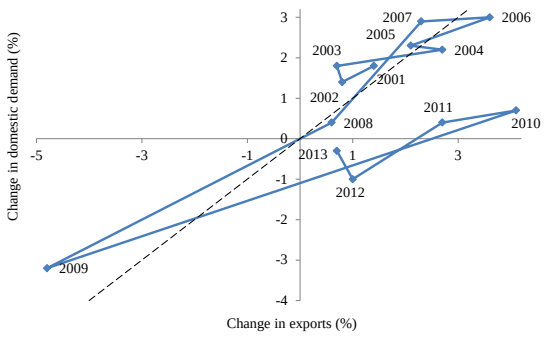


Source: Own calculations based on Eurostat data

Figure 1.8 illustrates the impact on the value-added share of manufacturing by contrasting it with the same share measured in constant (2000) prices. Instead of falling from 18.5% to just over 15% over 14 years, the share decreases by less than one percentage point, to just over 17.5%. The difference between the two lines represents the relative price effect; the negative impact on the value-added share of manufacturing of falling relative price of its output (in relation to services). The much smaller decrease resulting when constant prices are used is net of the relative price effect; this captures structural changes such as de-industrialisation, offshoring, outsourcing, falling EU market shares, and possibly even EU manufacturers falling behind on the quality ladder and in global value chains. Whatever the explanation for the modest decline over the 14-year period, Figure 1.8 suggests that the trend is not irreversible and that reindustrialisation is a realistic prospect. What appears to be unavoidable, though, are falling relative prices of manufactured goods in relation to services. In other words, reindustrialisation will lead to an increasing value-added share of manufacturing in constant prices but may not be strong enough to outweigh the effect of falling relative prices when measuring the value-added share in current prices.

Figure 1.9 shows how changes in exports and domestic demand contributed to GDP growth in the

Figure 1.9: Contribution of EU exports and domestic demand to GDP growth, 2001–2013



Note: Relative changes from previous year. Equal contributions of changes in exports and domestic demand along the 45-degree line
Source: AMECO database (Directorate General for Economic and Financial Affairs)

run-up to and during the recession.Before the start of the recession, GDP was growing at a steady pace in the EU. Growing exports and increased domestic demand made very similar contributions to GDP growth in 2001 and 2005, whereas in other pre-crisis years, growth in either exports or domestic demand tended to dominate. During the recession (from 2008 onwards), changing exports played a more prominent role than changes in domestic demand, except for 2012 when falling domestic demand caused real GDP to drop.

By 2013, the situation had deteriorated in many of the Member States still in recession at the time. While exports still made a positive contribution to growth, that contribution was much smaller than in 2010, 2011 and 2012. Domestic demand changed very little from 2012 to 2013, and real GDP increased only by a fraction.

1.2. EU INDUSTRIES ON WORLD MARKETS

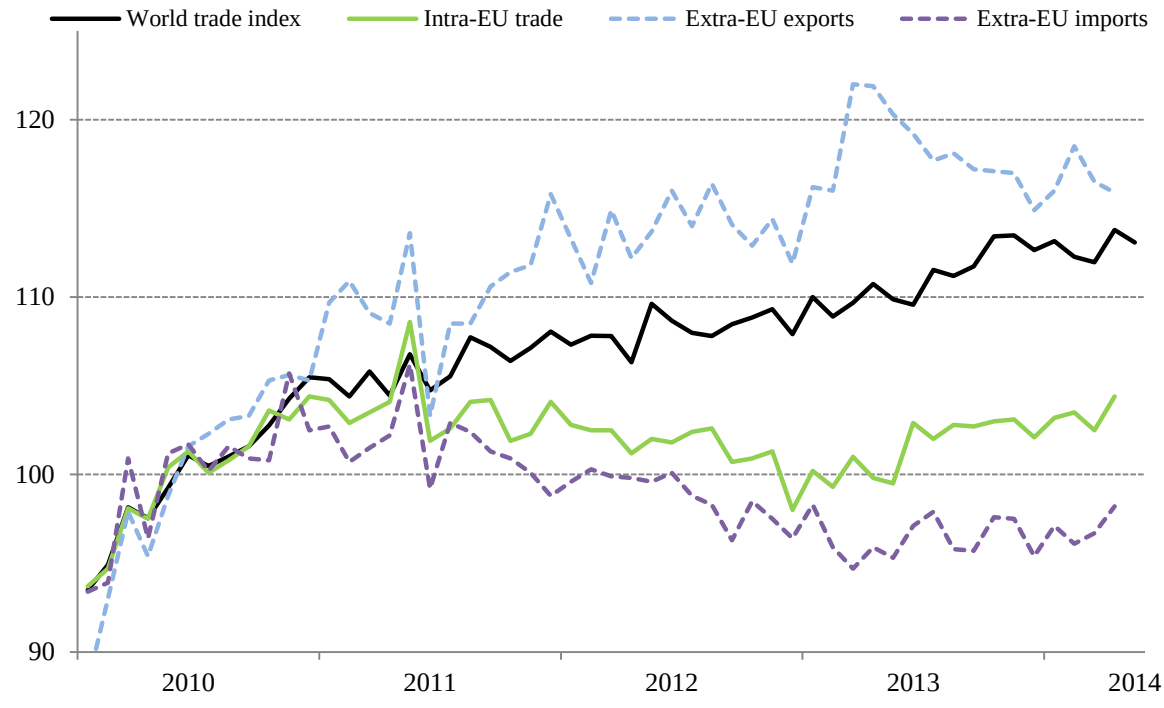
The severe global impact on manufacturing following the start of the recession in 2008 is evident in Figure 1.2. It affected demand for EU exports of finished products, intermediate goods and raw materials, between Member States as well as from the rest of the world. The combined effect was a sharp decrease in intra-EU trade and extra-EU exports.

However, as Figure 1.2 also shows, the impact of the crisis turned out to be more short-lived in parts of Asia and the Americas than in the EU. While many Member States have only recently come out of recession (two are still technically in recession), several economies in South-East Asia suffered only a brief drop in demand, mainly from Europe and North America, which was soon more than compensated for by growing demand from other parts of the world (chiefly from other Asian economies). As a consequence, economic activity in South-East Asia was relatively quickly back to pre-crisis growth rates, leading to growing demand for imports from the EU, North America and other parts of the world.

Meanwhile, high public and private debt continued to hold back domestic demand in many Member States, thereby delaying the EU recovery from the crisis and dampening intra-EU trade. Instead, strong demand from outside the EU kept the export economy going throughout the recession, partially compensating for weak domestic demand (Figure 1.9).

Outside the EU, world demand picked up after 2009 and global trade recovered relatively quickly. A particularly strong rise in Chinese imports spurred the recovery in other Asian countries.[3] EU exports to

Figure 1.10: World trade, EU exports and imports, 2010–2014



Source: CPB World Trade Monitor and Eurostat (seasonally adjusted monthly volumes)

[3] European Commission (2012).

the rest of the world also benefited from the increase in global demand from 2010 onwards (Figure 1.10), whereas extra-EU imports and intra-EU trade were largely unaffected. Intra-EU trade remains slightly above, and extra-EU imports slightly below, their 2010 levels. The growing gap between expanding exports and stagnant imports helped create large trade surpluses in many Member States, with exports (until recently) acting as the main engine of economic recovery.

Table 1.1: EU manufacturing: revealed comparative advantages and disadvantages (2012)

	Manufacturing sectors with the highest RCA	Manufacturing sectors with the lowest RCA
EU	Beverages (2.25) Basic pharmaceutical products and pharmaceutical preparations (1.96)	Clothing (0.52) Textiles (0.54)
Brazil	Food products (5.17) Paper and paper products (2.99)	Clothing (0.04) Computer, electronic and optical products (0.10)
China	Clothing (2.72) Textiles (2.54)	Beverages (0.09) Tobacco products (0.15)
India	Other manufacturing (5.37) Coke and refined petroleum products (3.07)	Beverages (0.10) Wood and wood products (0.11)
Japan	Machinery and equipment (2.09) Motor vehicles (2.01)	Clothing (0.02) Leather and related products (0.02) Wood and wood products (0.02)
Russia	Coke and refined petroleum products (7.83) Wood and wood products (3.45)	Clothing (0.02) Other manufacturing (0.03)
US	Other manufacturing (1.52) Chemicals (1.41)	Clothing (0.15) Leather and related products (0.20)

Colours reflect technology intensity:
High / Medium-high / Medium-low / Low
Source: Statistical annex

Looking specifically at EU exports of manufactured goods in 2011, indices of revealed comparative advantage (RCA) can give an indication of the manufacturing sectors in which the EU has an advantage or disadvantage in relation to its competitors.

For the purposes of this section, the RCA index is calculated by manufacturing sector and compares EU exports in that sector (as a proportion of total EU manufacturing exports) with the same sector's share of total exports from a group of reference countries. RCA values higher than 1 mean that a given industry performs better than the reference group and has a comparative advantage; values below 1 are indicative of comparative disadvantages.[4] As Table 1.1 demonstrates, the EU has advantages in beverages (low technology intensity) and pharmaceuticals (high technology intensity), while it has comparative disadvantages in clothing and textiles.

Despite the EU's revealed comparative advantage in pharmaceuticals, its high-technology exports represent a smaller proportion of its total manufacturing exports than that of high-technology exports in world trade. In other words, the EU has a revealed comparative disadvantage (RCA=0.85) in high-technology goods at their highest level of aggregation. On the other hand, the proportion of high-technology EU exports was stable from 2009 to 2012, whereas in Japan, the US and China it diminished over the same period (Figure 1.12).

In sectors characterised by medium-high technology intensity, EU manufacturing has comparative advantages in four aggregated sectors (chemicals, machinery and equipment, motor vehicles, and other transport equipment), while it has a slight disadvantage in one (electrical equipment). On aggregate across all five sectors characterised by medium-high technology intensity, the RCA index of EU manufacturing is higher than in high-technology, medium-low or low-technology industries.

Of the five manufacturing sectors characterised by medium-low technology intensity (coke and refined petroleum products, rubber and plastic products, non-metallic mineral products, basic metals, fabricated metal products), EU manufacturing has comparative advantages in two — non-metallic mineral products, fabricated metal products — and disadvantages in the remaining three. On aggregate across all five sectors, the revealed comparative disadvantage of EU manufacturing is similar to that in high-technology sectors.

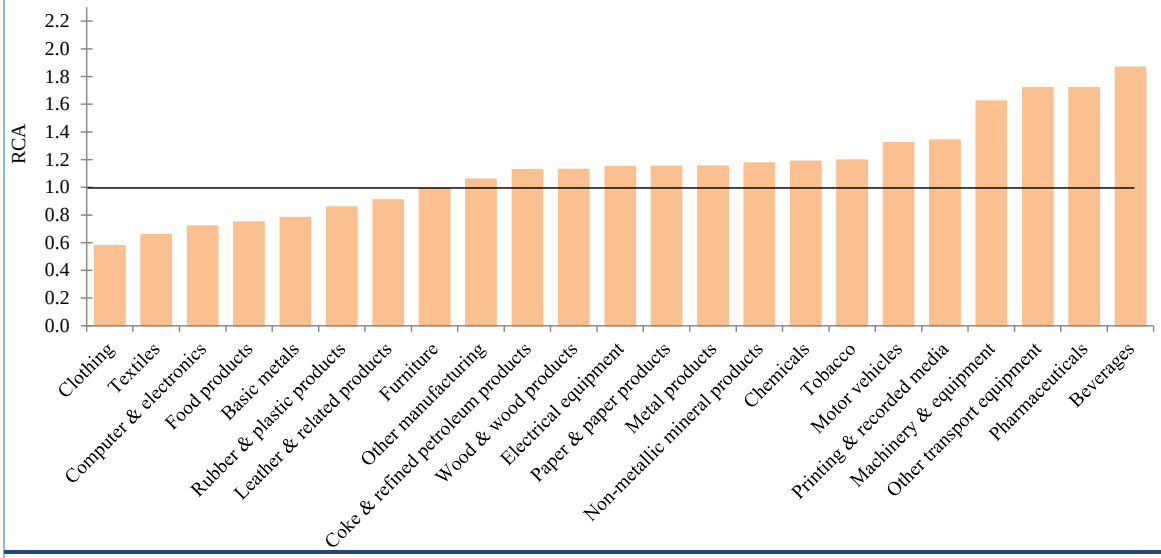
The remaining eleven sectors in Figure 1.11 are characterised by low technology intensity. EU manufacturers have comparative disadvantages in most of these; only in beverages, printing and

[4] Alternatives to the specification proposed by Balassa (1965) include European Commission (2010) and Leromain and Orefice (2013).

recorded media, and tobacco products do they have revealed comparative advantages.[5]

disadvantages of EU manufacturers vis-à-vis their competitors, and also allows for a more precise discussion of sectors with high, medium-high,

Figure 1.11: EU manufacturing: revealed comparative advantages, 2012



Source: Statistical annex

In all, the EU had comparative advantages in ten aggregated manufacturing sectors in 2012 and comparative disadvantages in twelve.[6] However, half of the sectors in which the EU had comparative advantages are characterised high or medium-high technology intensity.

Calculations of revealed comparative advantages for Brazil, China, India, Japan, Russia and the US show that the Brazil and China are the only major economies in which the sectors with the highest RCAs are characterised by low technology intensity. In Japan and the US, on the other hand, some of the highest RCAs are in sectors characterised by medium-high technology intensity, while the lowest RCAs are in low-tech sectors. Similar results were obtained by Leromain and Orefice (2013) on the basis of 2010 data and an alternative approach to calculating RCA indices.

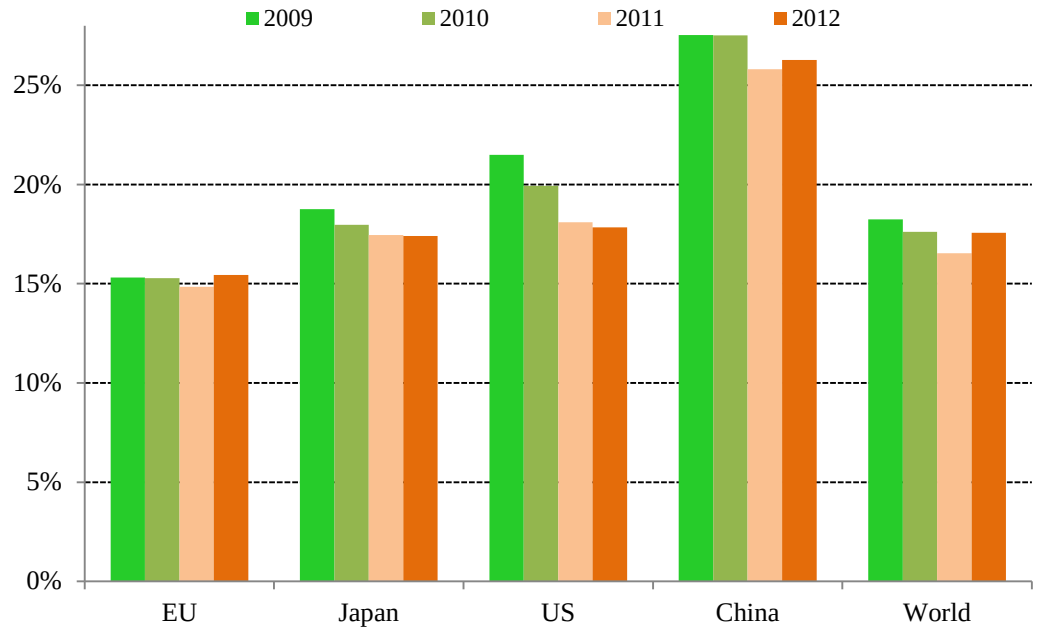
Revealed comparative advantage indices are traditionally calculated using trade data, which are detailed and can be disaggregated to the level of individual products or groups of products. Using such disaggregated data to calculate revealed comparative advantage indices gives a more complete picture of the advantages and medium-low and low technology intensity than in this chapter. However, it fails to measure the real sophistication of the output of the EU economy. Even at the most disaggregated product level, two products with the same trade data identifier can differ in terms of sophistication or complexity. Aspects such as quality and complexity are not easily captured by trade data. Also, trade data do not reveal the domestic and foreign content in a traded product (the domestic and foreign proportions of its value added). In other words, an exported product assembled in one country using components from other countries will appear in trade data as identical to the same product made entirely in the exporting country.

At this high level of aggregation — across industries as well as Member States — EU manufacturing has comparative advantages in one high-technology sector (pharmaceuticals) and disadvantages in the other (computer, electronic and optical products). Pharmaceutical products and preparations are especially over-represented in the export baskets of Belgium, Ireland and Cyprus, while they represent a very small part of the total exports of Estonia, Luxembourg and Slovakia. Computer, electronic and optical products are under-represented in the export baskets of most Member States, with some exceptions: they are slightly over-represented in the exports of Hungary, Malta and Slovakia.

[5] The classification of NACE rev. 2 sectors into high, medium-high, medium-low and low technology intensity follows Annex 3 to Eurostat (2014).

[6] It should be pointed out that the manufacturing sectors discussed here are highly aggregated (two-digit NACE level). At a more disaggregated level, there is considerable dispersion and variability within each sector, including with respect to RCAs and technology intensity.

Figure 1.12: High-technology exports as a proportion of total manufacturing exports, 2009–2012



Source: World Bank

These limitations complicate comparisons of industrial competitiveness. They also mean that the picture of EU competitiveness based on RCAs, as presented in Figure 1.1 and Table 1.1, needs to be extended to account for these additional dimensions of international competitiveness.

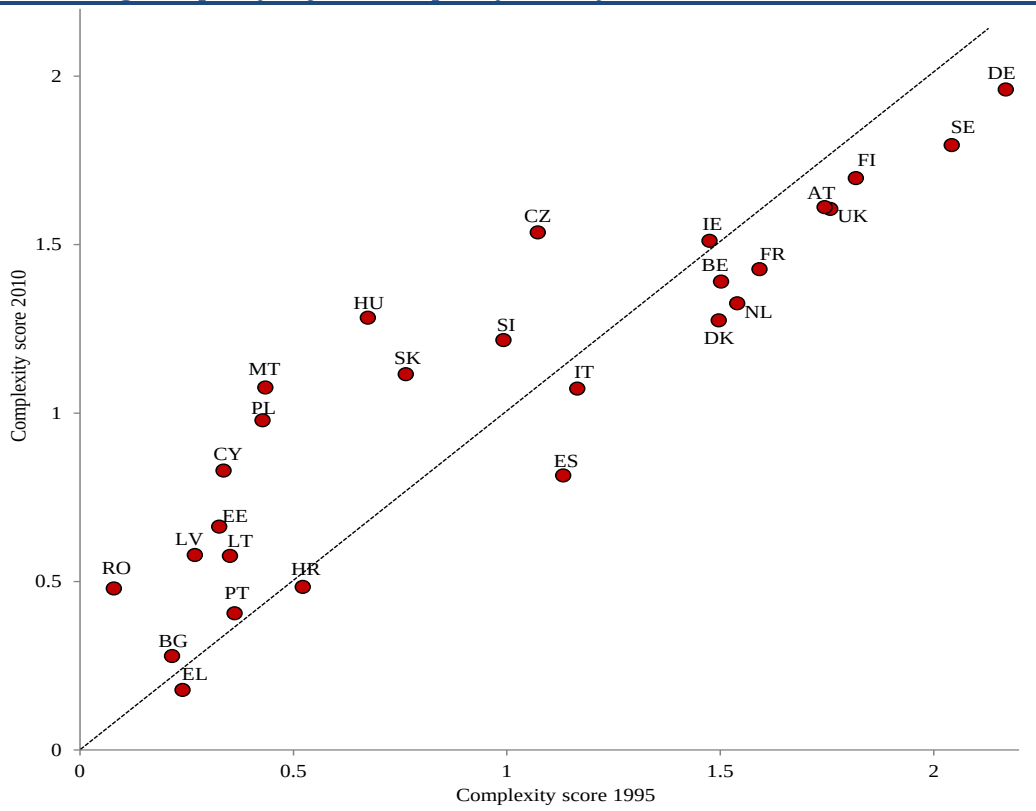
Last year's edition of this report (European Commission 2013a) addressed the quality and complexity of EU exports by analysing their sophistication and the diversification of exporting economies by means of the 'product space' analytical framework developed by Hidalgo et al. (2007) and Hidalgo and Hausmann (2009). The two most important findings in concern the levels of complexity of various EU exports with comparative advantages (in the sense that RCA>1) and the dynamics of product complexity between 1995 and 2010.

As regards the complexity of EU exports with RCA>1, the report found that almost all such exports in sectors such as tobacco, clothing, leather and footwear, and wood and wood products are relatively unsophisticated and of low complexity, making it difficult for EU exporters to compete on quality. By contrast, in sectors such as office machinery and computers, electrical machinery, radio/TV and communication equipment, scientific and other instruments, and motor vehicles, most EU exports with RCA>1 are highly sophisticated and complex, enabling exporters to compete on quality.

The other important finding was that, from 1995 to 2010, EU exporters of goods with RCA>1 managed to increase the average complexity of their exports in many sectors, most notably in radio/TV and communication equipment, non-metallic mineral products, furniture and other manufacturing, wood and wood products, leather and footwear, and coke and refined petroleum products. At the same time, EU exports of tobacco products, basic metals, office machinery and computers, printed material and recorded media, pulp and paper and from some other sectors were, on average, less complex in 2010 than in 1995.

In this context, it is striking how all Member States that joined the EU in 2004 and 2007 managed to raise the complexity of their exports between 1995 and 2010, whereas Croatia and virtually all pre-2004 Member States saw the average complexity of their exports fall over the same period (the only exceptions being Ireland and Portugal). To the extent that there was, in 1995, a cluster of southern and eastern Member States with comparative advantages in relatively unsophisticated and simple export goods and another cluster of northern and western Member States with comparative advantages in more sophisticated and complex exports, by 2010 there were no clear clusters. Most Member States in the former 'low-complexity' cluster (except for Greece, Spain, Croatia and Italy) had increased the complexity of their exports, while most Member States in the more sophisticated cluster (except Ireland) had seen the complexity of their exports fall.

Figure 1.13: Changes in quality-adjusted complexity score by Member State, 1995–2010



Note: Dotted line denotes no change in complexity between 1995 and 2010. 'BE' combines Belgian and Luxembourg data.
Source: European Commission (2013b)

As regards the second shortcoming identified above — the lack of information in trade data about the domestic and foreign content of exported goods — it is important to note that trade data do not fully reflect the impact of fragmentation of production in global value chains, a development comprehensively studied in European Commission (2012a). In order to take global value chains into account and compensate for the fact that RCAs based on export value exaggerate the competitiveness of economies relying on imported intermediate goods for their exports of finished goods (and underestimate the competitiveness of economies exporting mainly intermediate goods), one approach is to use input-output tables to calculate how much foreign and domestic value added is embedded in each economy's exports.

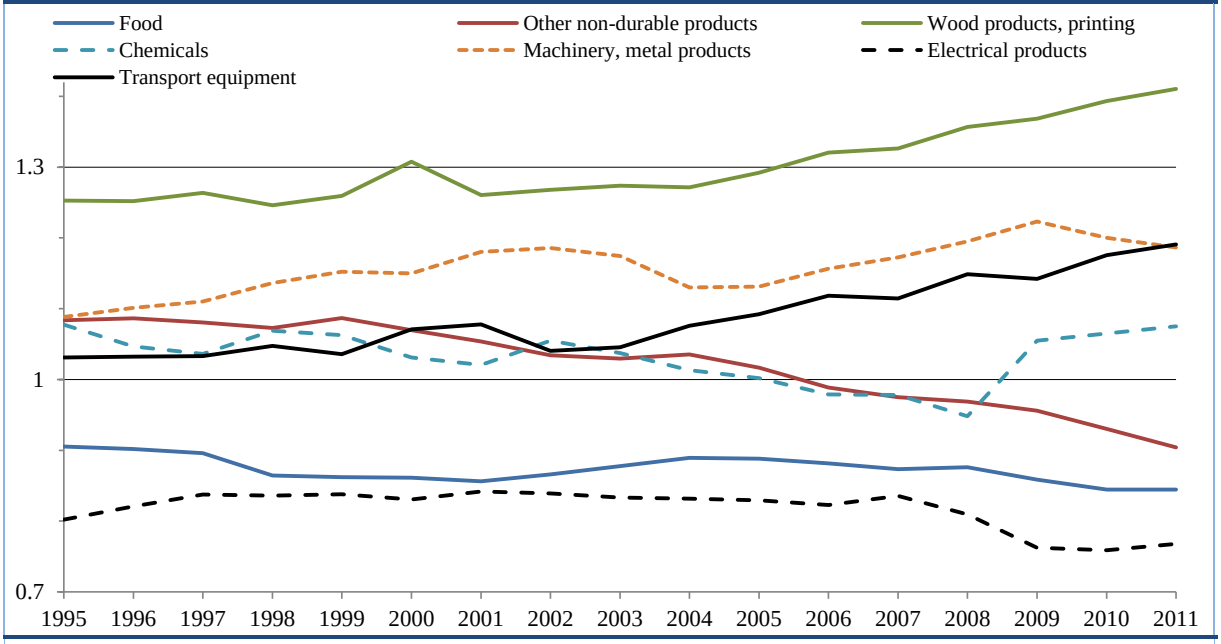
This approach was followed by the European Commission (2012a, 2013a) to demonstrate that from 1995 to 2009, the proportion of non-EU value added content in EU manufacturing exports increased from 8.9% to 14.4%, while consistently remaining more than twice as high in the 2004 and 2007 accession countries as in the pre-2004 Member States. The rise was very similar to the increase (from 6.7% to 14.6%) in the proportion of non-Japanese value added content in Japanese manufacturing exports over the same period, but smaller than the non-US proportion in US manufacturing exports (13.1% in 1995; 15.5% in 2009). Chinese and South Korean exported goods have much higher foreign value added content: for China, the proportion rose from 17.3% in 1995 to 26.4% in 2009, while in South Korea it rose from 26.7% to 38.7% over the same period.

In both China and South Korea, approximately a sixth of the foreign value-added content in 2009 came in the form of intermediate goods from the EU.

Of the 14.4% of value added in EU manufacturing exports in 2009 that originated outside the EU, most was embedded in intermediate goods from the US, China, and Russia.

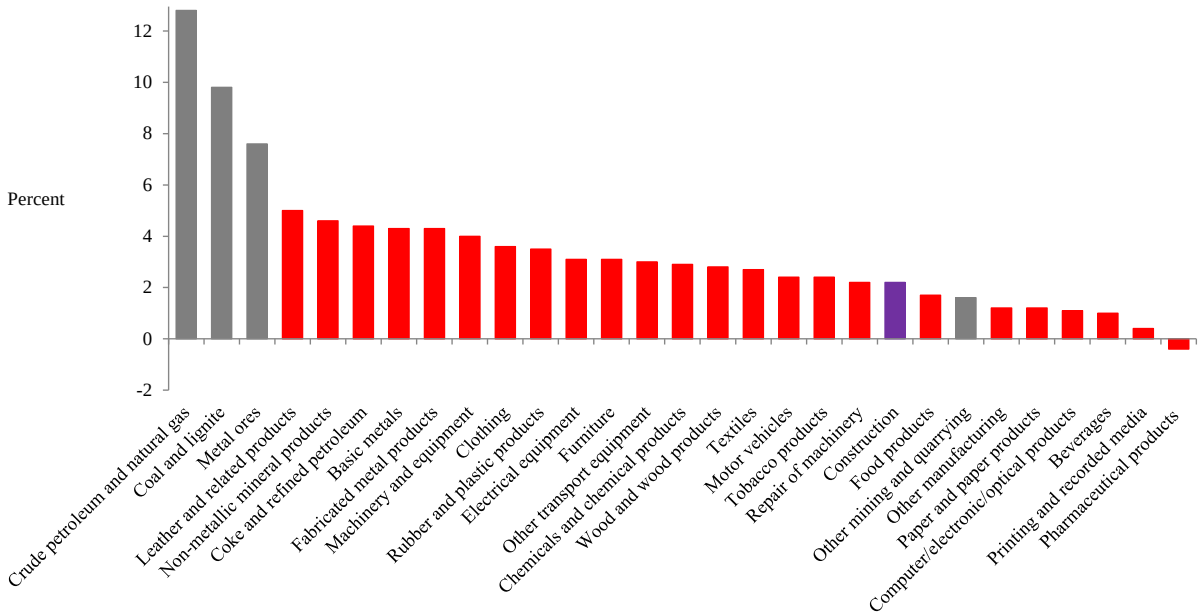
An alternative approach, also based on global value chains and using input-output tables, is to break down the value of final products into the respective value added by each economy involved in their production, in order to calculate RCA indices not on the basis of export proportions but using the proportions of global value chain income added by each economy. If an economy adds relatively more value to the global value chain of a certain product or sector than it does for manufacturing in general, the index exceeds 1 and the economy can be said to have a comparative advantage in the global value chain of that product or sector. Conversely, index

Figure 1.14: Comparative advantage indices for EU-27 based on global value chain income, 1995–2011



Note: Data for Croatia not available
Source: Timmer et al. (2013)

Figure 1.15: Average annual ULC growth in EU manufacturing, construction, and mining and quarrying, 2007–2012

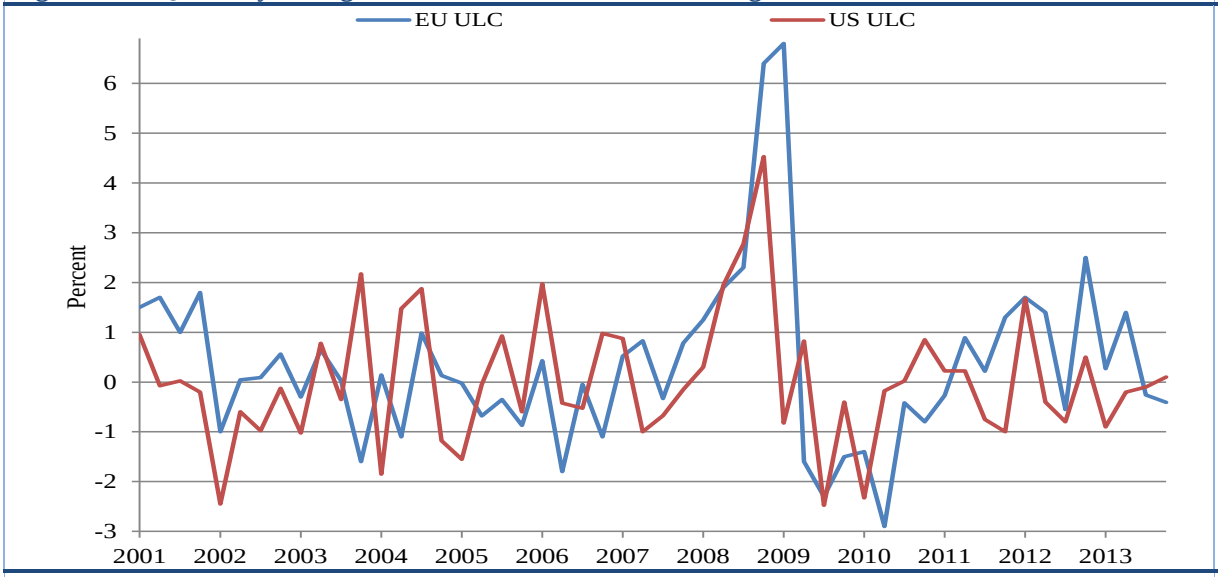


Source: Own calculations based on Eurostat data

values below unity indicate that the economy in question has a comparative disadvantage in the global value chain of that particular product or sector.

Figure 1.14 shows that, from 1995 to 2011, EU-27 manufacturers of transport equipment, wood products and printed material, machinery and fabricated metal products generated a higher proportion of total value added along the global value chain than for EU-27 manufacturing sectors on average, and in those sectors their comparative advantage increased over time. By contrast, EU-27 manufacturers of food and electrical products generated a smaller proportion of total value added along the global value chain than EU-27 manufacturing in general, and their comparative disadvantage increased over time. EU-27 manufacturers of chemical products and non-durable products other than food initially generated a higher share of value added along the global value chain

Figure 1.16: Quarterly ULC growth in EU and US manufacturing, 2001–2013



Source: Own calculations based on Eurostat and Bureau of Labor Statistics data, seasonally adjusted

than other EU manufacturers, but by 2006 they had lost their comparative advantage. While makers of non-durable products continued to lose out in terms of value added along the global value chain, chemical products benefited from the gradual recovery of the EU economy from 2009 onwards and regained the comparative advantage they had previously enjoyed.

For the four aggregated sectors in Figure 1.14 with index values greater than 1, the results are very similar to the export value-based RCA values in Figure 1.11. In other words, their over-representation in the EU-27 export basket (see Figure 1.11) is similar to their over-representation in terms of value added. For electrical products, on the other hand, a picture of EU comparative disadvantage emerges from Figure 1.14 which is not evident in Figure 1.11: when using export value to calculate the RCAs in Figure 1.11, electrical products are found to be very close to RCA=1. In other words, they represent more or less the same proportion of EU exports as they do of world exports. In terms of value added though, Figure 1.14 clearly shows a less than proportionate (and falling) contribution of EU-27 manufacturing to this global value chain. The implication is that EU manufacturers of electrical products import intermediate products and export final goods, but add relatively less value than EU manufacturers in other sectors.

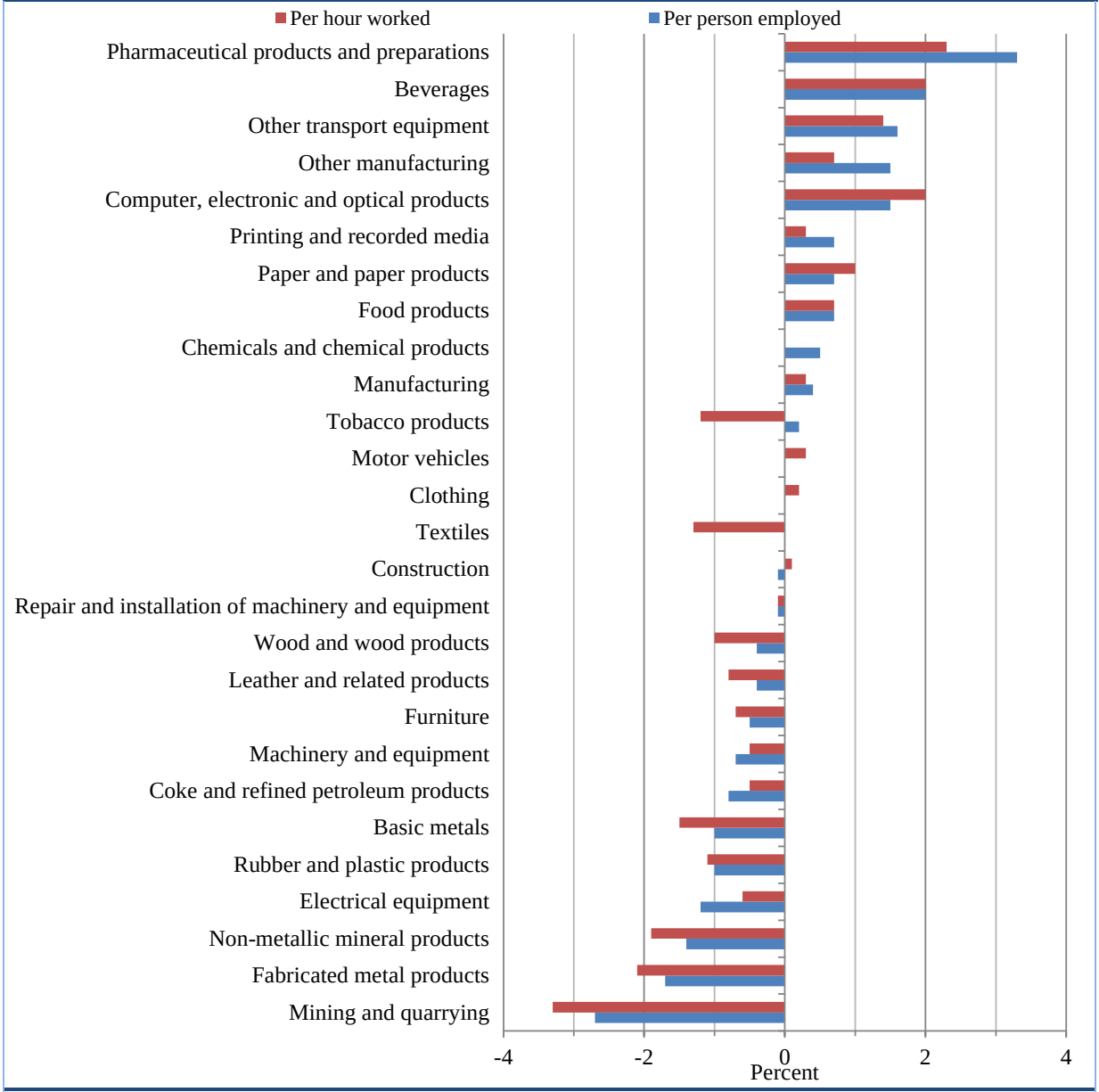
1.3. LABOUR PRODUCTIVITY AND LABOUR COSTS BY SECTOR

A measure commonly used to assess the development of labour costs in relation to labour productivity is unit labour cost (ULC) — the ratio between labour compensation and labour productivity. It measures the extent to which labour costs rise in line with productivity gains, going up if compensation rises faster than productivity — a possible indication of falling cost competitiveness. Conversely, if labour productivity increases faster than compensation, ULC goes down: a possible sign of improved cost competitiveness.

It should be noted, however, that ULC developments tend to be dictated (perhaps more in Europe than in other economies) by business fluctuations which affect labour productivity growth by causing production and value added to fluctuate more over the cycle than the input of labour. Also, cost competitiveness is not determined by unit labour costs alone, as the cost of capital, energy, raw materials and other inputs is not taken into account. ULC comparisons are therefore more useful for labour-intensive sectors than for sectors primarily intensive in capital, energy or material.

Figure 1.15 indicates that, on average between 2007 and 2012, the highest ULC increases in the EU were in certain extractive industries (in grey), followed by a number of manufacturing sectors mostly characterised by low technological intensity, and by construction. On the whole, average ULC growth rates were lower in manufacturing and construction than in mining. In pharmaceutical products — a sector characterised by high technology intensity — labour productivity grew more than labour compensation over the period, giving rise to negative ULC growth, on average, between 2007 and 2012.

Figure 1.17: Average annual labour productivity growth in EU manufacturing sectors, construction and mining, 2007–2012



Source: Own calculations based on Eurostat data

Because unit labour costs are more useful as indicators of cost competitiveness for labour-intensive sectors than for sectors with high intensities in other production factors, it is often more meaningful and interesting to compare unit labour costs across economies rather than sectors. Such a comparison could, for instance, benchmark the competitiveness of a sector in the EU economy against the corresponding sector in other economies (with similar labour intensity).

For instance, Figure 1.16 shows quarterly growth rates of ULCs in EU and US manufacturing. For most of the time, the two growth rates have been relatively similar, with no systematic patterns suggesting an advantage for one or the other — both frequently shifting from positive to negative growth. On one occasion, in connection with the financial and economic crisis that triggered the recession, EU manufacturing ULCs shot up much more than their US equivalents. In both economies, ULCs rose because labour productivity fell while labour compensation adjusted less, and much more slowly. That it rose much more in EU than in US manufacturing is indicative of a less flexible labour market, causing a sharper fall in labour productivity as well as slower adjustment of labour compensation. Moreover, in the early years of the recession, there may have been more 'labour hoarding' in EU than in US manufacturing (whereby firms attempt to avoid the costs associated with redundancies, and subsequently with recruiting and

training, by keeping staff on their payroll until demand picks up again).

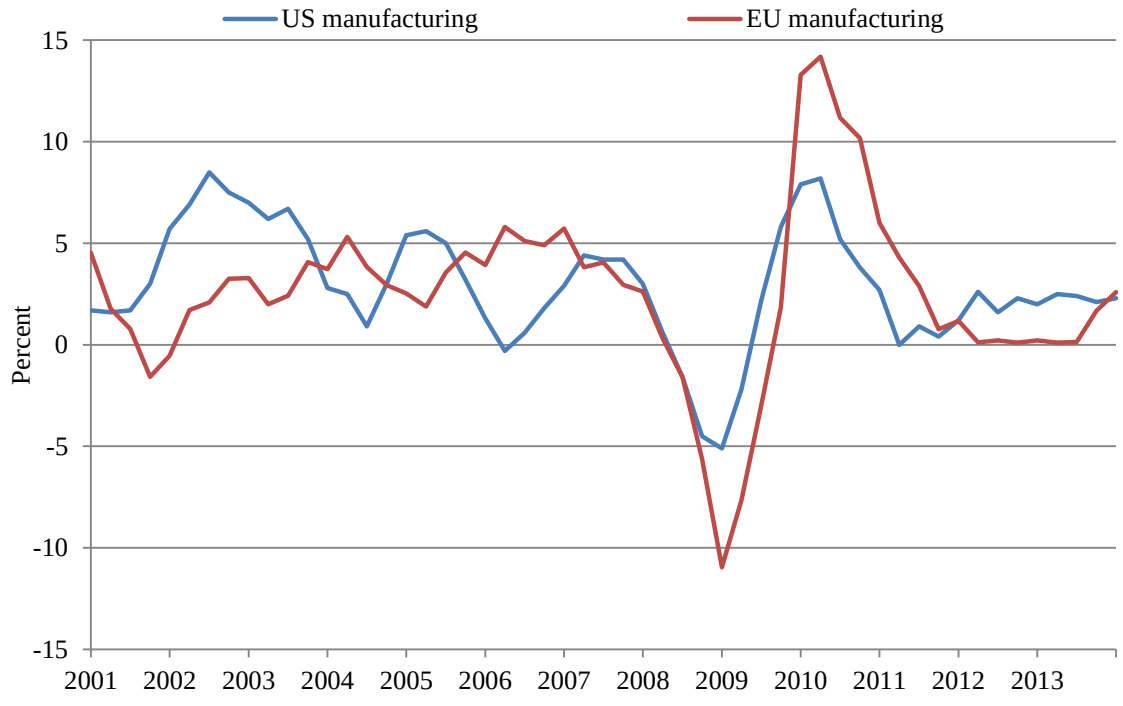
In fact, in most economies ULCs are driven more by labour productivity developments than by labour compensation. At the same time, labour productivity growth also matters for price and non-price competitiveness and is often regarded as an indicator of technical progress. The ability to produce more or higher-quality output with less input of labour — by means of technological improvements, organisational reforms, or in other ways — is an important way to gain a competitive edge, as it allows firms to lower their prices (or increase their margins) at given labour costs.

Labour productivity can be measured either per person employed or per hour worked. As shown in Figure 1.17, the difference between the two can be considerable, notably during a recession, when firms may be forced to cut down on staff. Remaining employees typically have to work more as a consequence in order to keep production up, which in turn causes labour productivity per person employed to grow more (or contract less) than when measured per hour worked. Another reason for discrepancies between the two measures is that no distinction is made between full-time and part-time employees when labour productivity is measured per person employed.

From 2007 to 2012, average labour productivity growth in EU manufacturing was 0.3% per year when measured per hour worked and 0.4% per year when measured per person employed. Manufacturing sectors with higher-than-average annual productivity growth include the two high-technology sectors (pharmaceutical products and preparations; computer, electronic and optical products) and several low-technology sectors (food products, beverages, paper and paper products, printing and recorded media, other manufacturing). In most sectors characterised by medium-low or medium-high technological intensity, labour productivity hardly grew at all, or diminished, between 2007 and 2012, whether measured by hours worked or persons employed. Outside manufacturing, labour productivity in mining and quarrying also fell from 2007, while in the construction sector it remained relatively stable.

As in the case of ULCs, the interpretation of labour productivity is less straightforward when comparing labour-intensive sectors with sectors more intensive in other production factors (such as capital, energy or raw materials). Also, there is no clear link between labour productivity and market share: firms under attack from competitors trying to undercut their prices may need to downsize, which is likely to result in higher labour productivity, while their market share may go up or down depending on how

Figure 1.18: Manufacturing labour productivity growth in the EU and US, 2001–2013



Note: Changes in labour productivity per hour worked, as compared with four quarters earlier
Source: Own calculations based on Eurostat and Bureau of Labor Statistics quarterly data

the competitive situation evolves.

For these two reasons, it may be more useful to compare labour productivity developments in specific EU sectors with similar sectors in other economies. Figure 1.18 shows quarterly labour productivity developments in EU and US manufacturing. The first thing to note is that in both economies, manufacturing productivity growth is positive most of the time. This is characteristic of manufacturing in most economies, not only the EU and US, and a reflection of the stylised fact illustrated in Figure 1.1 that manufacturing production tends to go up while employment decreases.

Another thing to note is that labour productivity has grown more in US than EU manufacturing: on average from 2001 to the first quarter of 2014, US manufacturing labour productivity grew by 2.9% and the EU equivalent by 2.5% (both year-on-year). Both averages are of course influenced by the sharp drop in labour productivity from 2008 to 2009 and the subsequent upswing on a similar scale (mainly a base-year effect), but the figure clearly shows that before as well as after the swings of 2008-09, labour productivity growth was stronger in US than in EU manufacturing. In fact, for most of 2012 and 2013, there was hardly any increase at all in EU manufacturing labour productivity, while US manufacturing labour productivity increased at close to its average growth rate.

Finally, at the start of recessions (2001 and 2008), manufacturing productivity has tended to drop more in the EU than the US because the input of labour (hours worked) fell further and faster in the US.[7]

A slightly different picture emerges when zooming in on manufacturing SMEs. It should be stressed that definitions differ between the EU and the US: in the EU, SMEs are defined as having up to 250 employees and a turnover of no more than € 50 million or a balance sheet total of no more than € 43 million, while US manufacturing companies are typically defined as 'small' if they have fewer than 500 employees.

Bearing these differences in mind, the start of the recession caused much larger labour productivity losses in 2008 and 2009 in EU manufacturing SMEs than in the EU economy as a whole, followed in 2010 by greater gains than in the rest of the EU economy. The much larger drop in labour productivity than elsewhere in the economy may be explained by the fact that the recession hit manufacturing SMEs harder than other businesses, while the way in which SMEs and large firms adjusted their input of labour in response to the recession may have differed less.

The loss of labour productivity in US manufacturing SMEs in 2008 was virtually identical to the loss for SMEs in the economy as a whole, and smaller than that for SMEs in the EU. This suggests that the US labour market operated more flexibly than the EU labour market during the recession and that US manufacturing SMEs were not hit harder than other US SMEs by the crisis — unlike EU manufacturing SMEs.

It is also clear from Table 1.2 that, while US manufacturing SMEs made labour productivity gains already in 2009, manufacturing SMEs in the EU had not yet reached that point and their labour productivity was still going down. Incidentally, the same can be said for Japanese SMEs in manufacturing (European Commission 2013c).

1.4. SKILLS AND HUMAN CAPITAL

Differences in skills can be important when trying to explain differences in competitiveness or growth. Since human capital does not readily adjust — geographically or between sectors — to changing demand for labour, and because skills take a long time to build up, including through retraining when necessary, it is easy to see how mismatches can arise between available and required skills. Such mismatches, whether at firm, sector or economy level, are crucial to success and competitive performance; avoiding or minimising skills mismatches inevitably gives the firm, sector or economy a competitive advantage over rivals and puts it in a stronger position to gain market shares.

Table 1.2: Labour productivity growth rates in EU and US manufacturing SMEs, 2008–2011

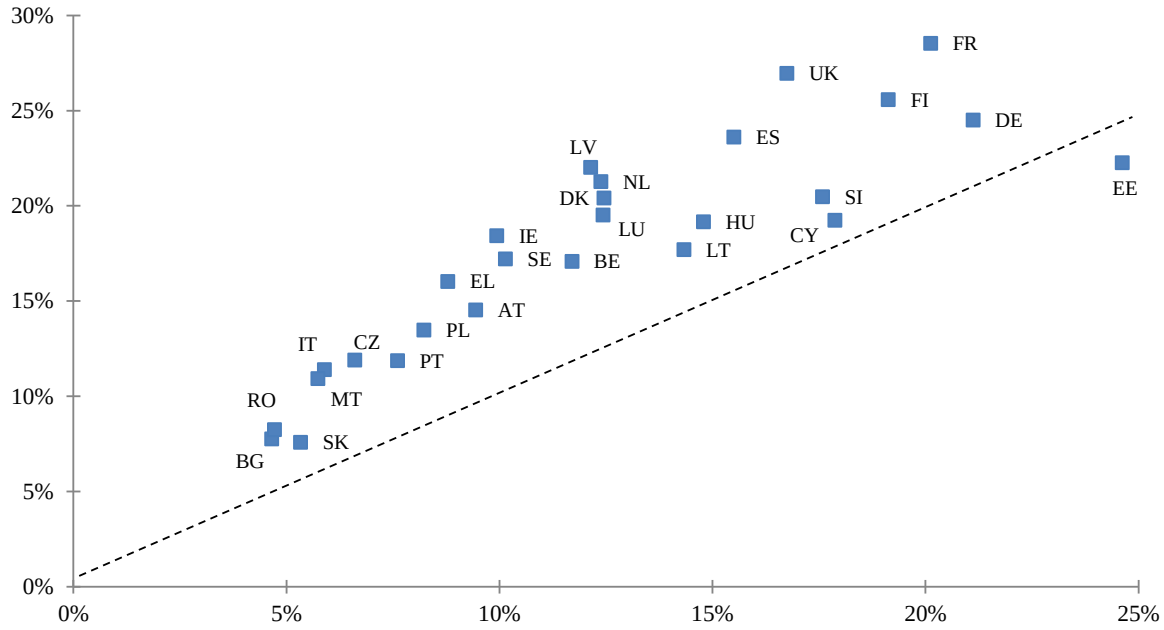
	2008	2009	2010	2011
EU manufacturing SMEs	–0.4%	–10%	+12%	+3%
US manufacturing SMEs	–3%	+10%	NA	NA

Note: NA = not available
Source: Key figures on European business (Eurostat 2011); Are EU SMEs recovering from the crisis? (2011); EU SMEs in 2012: at the crossroads (2012)

Analysing the importance of skills to competitiveness is complicated, however, by their very nature: skills are not directly observable and can be hard to measure, even indirectly. Any analysis of skills supply typically relies on proxy

[7] For a comprehensive discussion of the EU-US productivity gap and its causes, see European Commission (2013a).

Figure 1.19: Shares of high-skilled labour (ISCED 5 and 6) in the value added of global value chains, 1995 and 2008



Note: ISCED 5 & 6 correspond to stages of tertiary education. The dashed line indicates no change from 1995 to 2008. Data for Croatia not available.
Source: Timmer et al. (2014)

variables. For instance, European Commission (2013a), where EU Labour Force Survey (LFS) data on educational attainment were broken down by sector, found that the manufacturing sector with the highest proportion of tertiary-educated employees was pharmaceutical products and preparations, followed by coke and refined petroleum products, and computer, electronic and optical products. This result is entirely in line with Eurostat's aggregations of knowledge-intensive activities (Eurostat 2014). The manufacturing sectors with the smallest proportions of tertiary-educated employees were leather and related products, clothing, wood and wood products (European Commission 2013a).

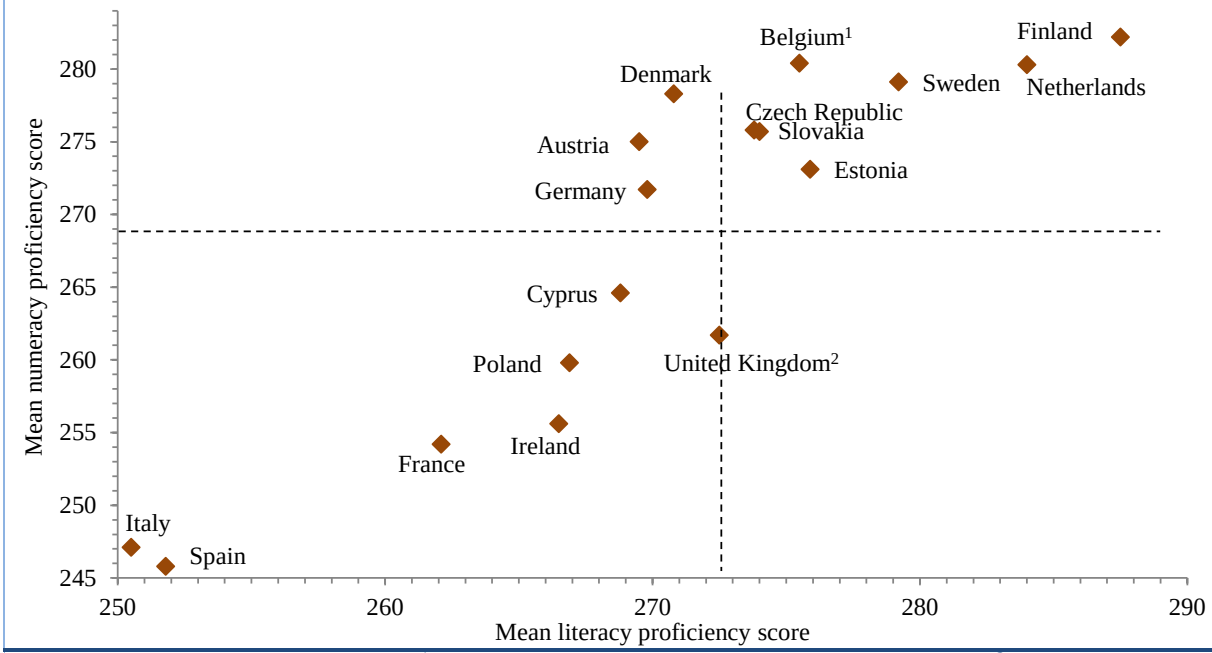
Educational attainment is used as a proxy for skills also by Timmer et al. (2014), who use input-output tables to calculate the factor shares of capital and low-skilled, medium-skilled and high-skilled labour in 560 identified global value chains across 40 countries (including all Member States but Croatia). One of the results obtained is that between 1995 and 2008, the share of high-skilled labour in the value added of the global value chains increased in all EU-27 Member States except Estonia. The lowest shares of high-skilled labour were in Bulgaria, Romania and Slovakia, where it rose from around 5% in 1995 to around 7% in 2008 (Figure 1.19). The highest shares were in France, the UK, Finland and Germany, rising from around 20% in 1995 to around 25% in 2008. In the 26 Member States with rising shares of high-skilled labour, the increase was often at the expense of low-skilled labour (except for the Czech Republic, Latvia and Romania, where both factor shares went up). In some Member States, the share of capital or medium-skilled labour decreased when the share of high-skilled labour went up.

However, educational attainment is a far from perfect proxy for skills because it does not take account of the often significant time that has elapsed since primary, secondary or tertiary education was attained; it does not reflect the accumulation of skills and experience by means of additional training, learning and development over time; and it does not take into account the relevance of the education attained to the activities of the firm, sector and economy concerned (OECD 1998).

An alternative approach, though not without shortcomings of its own, is to use survey results to assess adult skills. They can be more useful than educational attainment data, for the three reasons mentioned above.

Two recent surveys on adult skills are OECD (2013a) and Eurofound (2014). The OECD Survey of Adult Skills, conducted as part of its Programme for the International Assessment of Adult Competences (PIAAC), is the larger of the two. It tests adults aged 16 to 65 years for literacy, numeracy and their ability to solve problems in technology-rich environments.

Figure 1.20: Adult numeracy and literacy skills in selected Member States/regions, 2012



Note: Lines represent OECD averages. [1] *Belgian scores represent the region of Flanders only.* [2] *UK scores represent England and Northern Ireland only.*
Source: OECD (2013a)

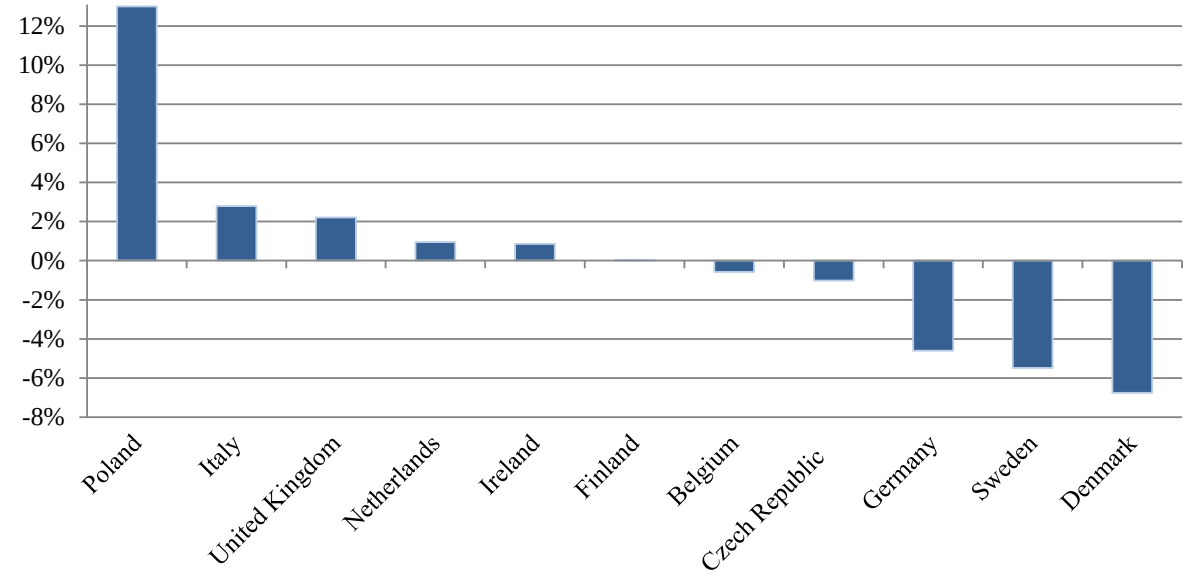
Figure 1.20 shows the results of the 17 participating Member States (or, in two cases, Member State regions) in the 2012 assessment of literacy and numeracy proficiency. At the top end of the scale, the average results for adults in Finland were second only to Japanese adults (not shown) in both. In six other cases, average scores exceeded the OECD average both for literacy and numeracy, while the average results in Denmark, Germany and Austria exceeded the OECD average for numeracy but did not reach the OECD average for literacy. In the remaining seven countries, results were below the OECD average in both numeracy and literacy. In Spain and Italy, average proficiency levels were not only much lower than for other participating Member States and regions, but also lower than for any of the 24 OECD countries and partner countries taking part in the survey. Regarding the ability to solve problems in technology-rich environments (results not shown in Figure 1.20), it was found that 25% of adults lack the digital skills needed to effectively use ICT.

As might be expected, literacy and numeracy proficiency scores are closely correlated (Table 1.3). There is also a positive correlation between each of them and GDP per capita adjusted for purchasing power, though this is stronger for numeracy than for literacy proficiency.

The positive correlations between average proficiency scores and GDP per capita are not surprising: countries with high GDP per capita are not only better equipped to invest in education systems; they also have an incentive to invest in order to safeguard or raise their high GDP per capita through better education. The converse also holds: the positive correlations also reflect the importance of basic skills such as numeracy and literacy in generating economic growth.

A comparison of numeracy proficiency results over time is unfortunately possible for only two of the Member States represented in Figure 1.20. In terms of literacy proficiency, on the other hand, most of the Member States and regions in Figure 1.20 were surveyed also in 1994–98, so the development over time of their average literacy proficiency can be assessed and related to their economic development over the same period. Figure 1.21 shows the relative changes in average literacy proficiency scores between 1994–98 and 2012 for the eleven Member States (or regions of Member States) for which data exist.

Figure 1.21: Change in adult literacy skills in selected Member States/regions, 1994/98–2012



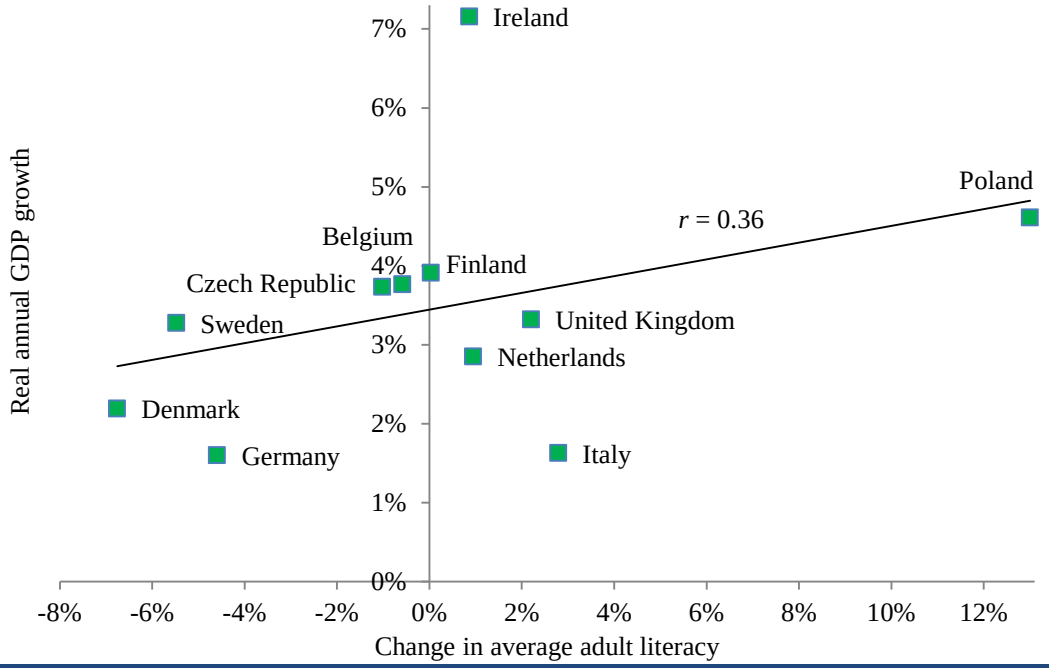
Note: Belgian data represent the region of Flanders only; UK data represent England and Northern Ireland only.
Source: Own calculations based on PIAAC data

Table 1.3: Correlations between adult numeracy and literacy scores and GDP per capita (PPS) in selected Member States/regions, 2012

	Numeracy	Literacy	GDP
Numeracy			
Literacy	0.89		
GDP per capita PPS	0.25	0.19	

Note: based on data for Belgium (region of Flanders only), Czech Republic, Denmark, Germany, Estonia, Spain, France, Ireland, Italy, Cyprus, Netherlands, Austria, Poland, Slovakia, Finland, Sweden, and the UK (England and Northern Ireland only)
Source: Own calculations based on PIAAC data

Figure 1.22: Real GDP growth 1994–2007 and changes in adult literacy skills 1994/98–2012



Note: Belgian data represent the region of Flanders only; UK data represent England and Northern Ireland only.
Source: Own calculations based on PIAAC and Eurostat data

Over that period, average literacy proficiency rose in Poland, Italy, the UK (England and Northern Ireland), the Netherlands, Ireland and Finland, while it decreased in Belgium (Flanders), the Czech Republic, Germany, Sweden and Denmark.

However, when relating PISA results to recent surveys of adult skills and to economic performance, it is more informative to look at the cohorts of 15-year-olds in 2000, 2003, 2006 and 2009, and compare their average PISA scores in reading and mathematics with the average literacy and numeracy proficiency scores in 2012 for the corresponding cohorts in the Survey of Adult Skills.

Table 1.4: Correlations between adult literacy and numeracy scores 2012 and previous PISA scores in reading and mathematics

	Literacy	Numeracy
PISA 2000/ aged 26 to 28 in 2012	$r = 0.60$	$r = 0.75$
PISA 2003/ aged 23 to 25 in 2012	$r = 0.77$	$r = 0.85$
PISA 2006/ aged 20 to 22 in 2012	$r = 0.72$	$r = 0.85$
PISA 2009/ aged 17 to 19 in 2012	$r = 0.60$	$r = 0.70$

Note: based on data for Belgium (Flemish region only), Czech Republic, Denmark, Germany, Estonia, Spain, Ireland, Italy, Netherlands, Austria, Poland, Slovakia, Finland, Sweden, UK (England and Northern Ireland only)
Source: Own calculations based on PIAAC and PISA data

Relative changes in average literacy proficiency for this subset of Member States show the extent to which the changes correlate (if at all) with real GDP growth over the same period. The idea is that literacy proficiency is a basic and generic skill that can be regarded as a proxy for the more specialised and job-specific skills needed in the economy. Therefore, increased literacy proficiency should coincide with increased skill levels across the whole economy, which in turn should lead to higher productivity and economic growth. To test this idea, Figure 1.22 shows the same changes as Figure 1.21, but in relation to real GDP growth rates between 1994 and 2007 (GDP data for 2008–2012 were excluded to avoid a distortion of the results due to the recession).

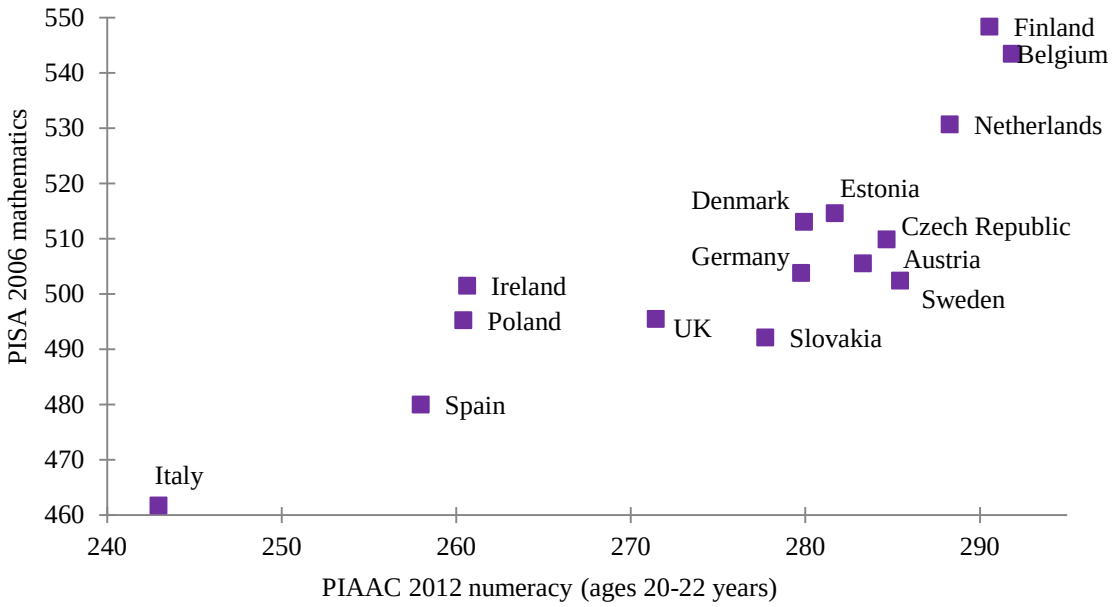
For this limited subset of Member States and regions of Member States, there is a modest positive correlation between changes in literacy proficiency and real growth ($r=0.36$), as demonstrated by the fitted line in Figure 1.22. Ireland is an obvious outlier: its strong growth prior to the recession can be attributed to a number of factors, many of which are more important than increased skills levels. Excluding the Irish outlier improves the fit considerably among the remaining ten Member States or regions, to $r=0.53$.

A final remark about the OECD's Survey of Adult Skills concerns the degree to which it confirms earlier results from the Programme for International Student Assessment (PISA), a much larger survey run by the OECD every three years to assess the skills of 15-year-old students in reading, mathematics and science. The results of the 2012 PISA survey, which covered around 510 000 students in 65 economies (including all Member States except Malta), show that in 14 Member States, average scores were higher than in 2009 in all three disciplines, while in five Member States they were lower in all three disciplines (OECD 2013b).

Table 1.4 shows the strength of positive correlations between literacy and numeracy proficiency scores in the 2012 survey with previous PISA scores.

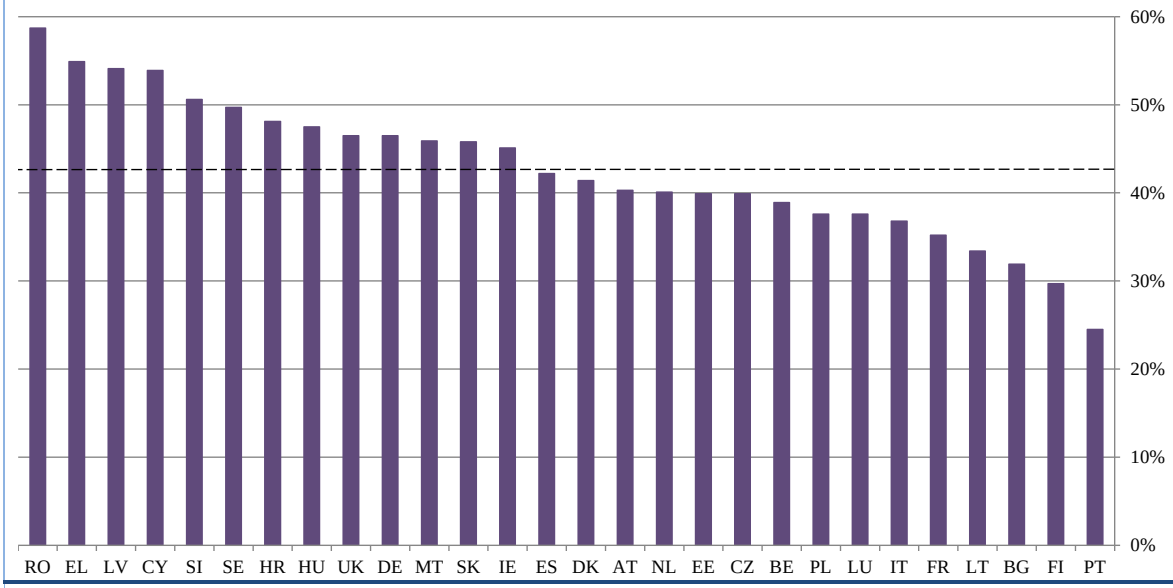
One of these correlations is illustrated in Figure 1.23 to show the fit by Member State (or region). It is clear that, where PISA scores in mathematics were high in 2006, six years later adults did well in numeracy in the Survey of Adult Skills, and vice versa. The conclusion is that, while school education is not the only determinant of adult skills, it is clearly the most important factor. Investing in good education for young students pays off later in the form of a highly skilled adult population, which in turn leads to higher productivity and economic growth, as seen in Figure 1.22.

Figure 1.23: PISA 2006 and PIAAC 2012 results for selected Member States/regions



Note: Belgian scores represent the region of Flanders only; UK scores represent England and Northern Ireland only
Source: Own calculations based on PIAAC and Eurostat data

Figure 1.24: Perceived mismatch between skills and duties: share of surveyed industry workers, 2010



Note: Combined share of responses 'I need further training to cope well with my duties' or 'I have the skills to cope with more demanding duties' among surveyed workers in EU industry. The dashed line indicates EU average.
Source: Own calculations based on Eurofound data

A much smaller survey of adult skills (as well as other working conditions) is carried out every five years by the European Foundation for the Improvement of Living and Working Condition (Eurofound). In its most recent survey (2010), one of the questions asked how workers felt about the adequacy of their skills in relation to their duties. Respondents could reply that their skills corresponded well to their duties; that further training was needed to cope well with their duties; or that their skills would enable them to cope with more demanding duties.

Almost 44000 workers in 34 European countries (including all Member States) were interviewed, with results broken down by 33 aggregated sectors, including five manufacturing sectors (textiles and clothing, chemical industry, metal industry, the agro food industry, and furniture) and construction.[8]

[8] Textiles and clothing correspond to C13–14 in NACE Rev. 2; chemical industry to C20–22; metal industry to C25–30;

Table 1.5: Skills in relation to duties, 2010			
	Skills and duties correspond well	**Need further training to cope well with duties**	**Current skills would allow new duties**
Construction	58%	11%	31%
Textiles and clothing industry	63%	2%	35%
Chemicals	57%	14%	29%
Metal industry	54%	14%	32%
Agro food	60%	10%	29%
Furniture	62%	12%	26%
All sectors	55%	13%	32%

Source: Own calculations based on Eurofound data

Across all 33 sectors and all Member States, 55% of the surveyed workers considered that their skills corresponded well to their duties, while 13% felt underqualified for their duties and 32% considered that they had skills that would enable them to take on more demanding duties. Based on these results, the skills mismatch on the EU labour market could therefore be estimated as affecting 45% of the EU workforce (Table 1.5).

In construction and four of the five aggregated manufacturing sectors, the mismatch was generally smaller, as a higher proportion of respondents felt their skills corresponded to with their duties. Metal industry was the only manufacturing sector with a slightly higher perceived mismatch (46%) than that across all sectors in all Member States.

The manufacturing sector with the lowest perceived mismatch was textiles and clothing (37%). At the same time, of the 468 workers surveyed in that sector, only 2% reported that they needed further training to cope with their duties. Accordingly, to the extent that they perceived themselves as mismatched in terms of skills, they were much more likely to think that their skills enabled them to take on more demanding tasks.

Looking specifically at the proportion of surveyed industry workers in each Member State who responded either that they needed further training to cope well with their duties or that they had the skills to cope with more demanding duties, Figure 1.24 reveals that the perceived mismatch was high in Romania, Greece, Latvia and Cyprus, where it was felt by more than half the respondents, and low in Portugal, Finland and Bulgaria. Across all Member States, 58% of all surveyed industry workers responded that their skills corresponded well to their duties, a higher figure than for services (54%).

agro-food industry to C10–11; furniture to C31; and construction to class F.

1.5. INVESTMENT

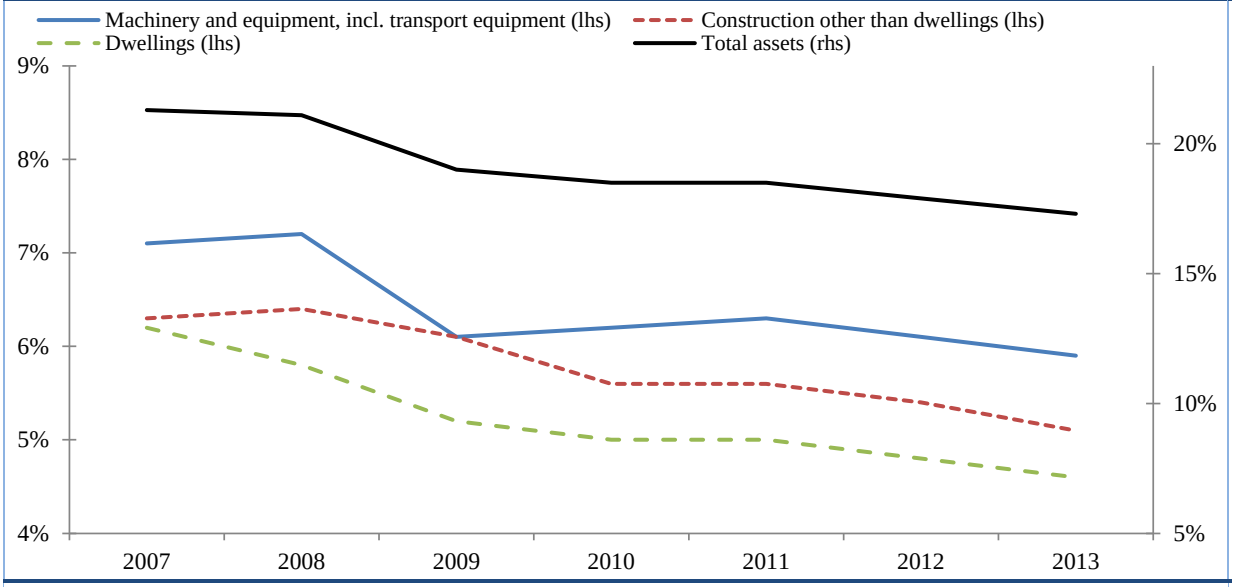
By investing in physical capital such as buildings, machinery and equipment, firms can increase their output capacity, capital stock and innovative capacity. Investing in physical capital also facilitates reorganisation, streamlining, and rapid adaptation to changing market conditions.

The Commission has identified low investment by EU manufacturers as a major obstacle to restoring growth, noting that '*if Europe does not keep up with investment in the adoption and diffusion of these [new] technologies, its future competitiveness will be seriously compromised*' (European Commission 2012b).

To rise to this challenge, the Commission has put forward specific targets for gross fixed capital formation (GFCF) and investment in equipment (one of the most important components of GFCF), to be achieved in the short term and by 2020: GFCF should reach pre-crisis levels in 2015 and average levels above 23% of GDP until 2020, while investment in equipment should return to pre-crisis levels and grow steadily at rates above 9% of GDP by 2020.

However, as Figure 1.25 shows, EU investment levels are falling short of the targets and are going down in relation to GDP: total GFCF dropped from 21.3% of GDP in 2007 to 17.3% last year, while investment in machinery and equipment has decreased from over 7% to less than 6% of GDP in the same period.

Figure 1.25: EU gross fixed capital formation as a proportion of GDP, 2007–2013



Source: Own calculations based on Eurostat data

In its 2012 Communication, the Commission also noted that investment and innovation are impossible without adequate access to finance. Chapter 2 of this report, which examines the role of such access and how important it is to the growth of firms, addresses many aspects, including the sensitivity of investment at the firm level to a number of financial factors: long-term and short-term credit flows; leverage and interest burden; trade credit; stocks and flows of internal cash.

On the basis of data for over 22000 firms in eleven Member States[9] for the period 2004–2012, statistically significant (at the 5% level) sensitivities have been found for firm-level investment with respect to long-term credit flows, internal cash flows and leverage (European Commission 2014a). The results show that changes in leverage or in flows of internal cash or long-term credit have a significant impact on firm-level investment, in the same direction as the change, and that changes in leverage are more influential than changes in internal cash flow or long-term credit flows.

Returning to gross fixed capital formation at a more aggregated level, Table 1.6 presents the ratio of GFCF to value added for a range of EU sectors in industry and services. Because the denominator is value added rather than GDP, the investment ratios in Table 1.6 are slightly higher than the GFCF-to-GDP proportion in Figure 1.25. Interestingly, unlike the proportion in Figure 1.25, the GFCF-to-GVA ratio is no longer falling: it reached its lowest point in 2010 and has since recovered slightly. This is a denominator effect and reflects that GDP has so far recovered slightly more than GVA.

Sectors with high investment ratios, reflecting a high proportion of capital-intensive firms, are mainly industrial sectors such as motor vehicles, coke and refined petroleum products, mining and quarrying, electricity and gas production, water supply, sewerage and waste. Other industrial sectors, such as construction, textiles, clothing and leather products, furniture and other manufacturing, are more labour-intensive, so their investment ratio is much lower.

Most services sectors have lower investment ratios than industry, but real estate activities, transportation and storage, telecommunications and arts, entertainment and recreation are sectors with remarkably high ratios. It is understandable that in real estate, transportation and storage, and telecommunications, large investments are needed to generate value. In the case of arts, entertainment and recreation, the high ratio may be due to low value added rather than high investment.

[9] Belgium, Bulgaria, Czech Republic, Germany, Spain, France, Italy, Portugal, Finland, Sweden and the UK.

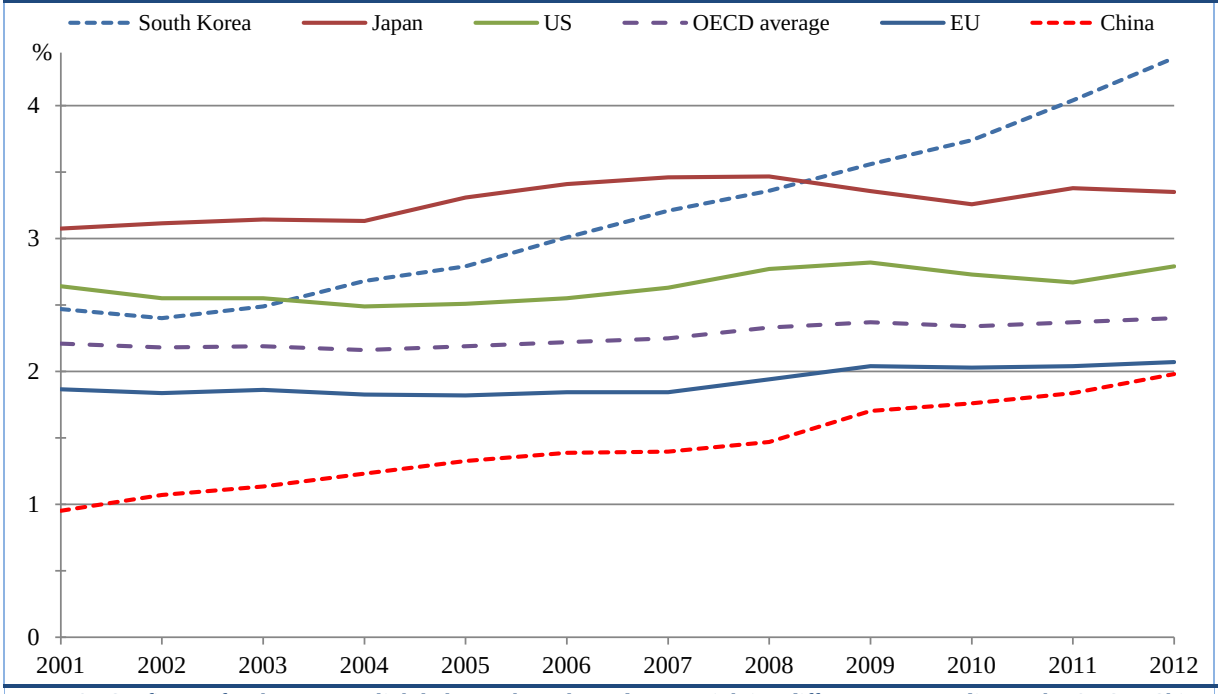
Table 1.6: Investment ratios in the EU, 2007–2012 (%)

		2007	2008	2009	2010	2011	2012
TOTAL	**Total**	**24.0**	**23.7**	**21.2**	**20.8**	**20.9**	**21.0**
B	Mining and quarrying	32.4	26.8	31.6	27.5	27.9	29.2
C10–12	Food, drink and tobacco products	18.6	19.5	16.1	17.4	17.7	19.8
C13–15	Textiles, clothing, leather and related products	9.6	10.4	8.7	8.9	9.0	9.8
C16	Wood and products of wood and cork	18.7	18.8	15.5	15.4	16.7	15.4
C17	Paper and paper products	19.0	24.8	17.9	16.6	17.5	32.2
C18	Printing and recorded media	12.6	13.9	13.4	13.8	14.6	13.4
C19	Coke and refined petroleum products	36.4	34.1	52.8	37.9	36.4	37.8
C20	Chemicals and chemical products	18.6	20.4	19.3	15.4	16.7	21.4
C21	Pharmaceuticals	14.9	14.0	12.5	11.8	12.4	16.5
C22	Rubber and plastic products	19.1	20.6	15.8	16.6	17.8	18.4
C23	Other non-metallic mineral products	20.7	23.0	17.8	16.9	18.1	17.6
C24	Basic metals	20.7	25.0	28.7	20.9	22.1	26.4
C25	Fabricated metal products	14.7	15.7	14.6	13.2	13.6	14.8
C26	Computer, electronic and optical products	18.8	19.2	18.6	18.0	20.7	24.8
C27	Electrical equipment	12.7	13.3	11.5	10.4	11.6	14.6
C28	Machinery and equipment	13.9	14.1	13.2	12.8	12.9	12.4
C29	Motor vehicles, trailers and semi-trailers	22.5	29.1	29.4	19.5	22.1	36.1
C30	Other transport equipment	16.1	17.5	16.9	15.5	16.2	13.0
C31–32	Furniture, other manufacturing	11.8	13.2	12.5	9.5	10.4	13.1
C33	Repair and installation of machinery and eq.	9.6	10.4	10.5	7.8	8.9	6.1
D	Electricity, gas, steam and air conditioning	44.5	43.2	42.7	44.0	50.8	37.1
E	Water supply, sewerage, waste	58.7	58.9	54.3	46.7	47.1	38.8
F	Construction	14.2	14.9	9.9	11.7	11.1	8.9
G	Wholesale and retail trade	11.9	11.7	9.7	9.6	10.1	9.5
H	Transportation and storage	40.3	41.9	38.9	41.0	37.9	35.0
I	Accommodation and food service activities	12.6	13.8	10.8	10.9	11.4	11.5
J58–60	Publishing, motion picture and broadcasting	24.2	24.0	21.6	20.7	19.9	27.7
J61	Telecommunications	32.5	32.5	27.2	29.9	30.5	31.2
J62–63	Computer programming and consultancy activities	13.9	14.6	13.0	14.5	14.3	17.0
K	Financial and insurance activities	10.8	12.2	9.7	9.8	11.4	11.0
L	Real estate activities	76.6	69.3	61.4	59.2	55.7	56.8
M69–71	Legal and accounting activities and architectural and engineering activities	8.3	8.3	7.2	7.6	7.3	9.4
M72	Scientific research and development	25.2	26.3	25.5	24.3	26.3	27.2
M73–75	Advertising and market research, other professional services, scientific and veterinary activities	8.7	9.2	7.6	8.5	7.3	11.0
N	Administrative and support service activities	29.9	27.2	21.7	22.2	22.6	27.8
O	Public administration and defence	22.5	20.1	21.2	19.1	17.4	20.4
P	Education	16.0	15.4	15.2	13.3	15.6	9.0
Q86	Healthcare	12.2	10.9	9.9	8.4	9.6	10.9
Q87–88	Residential care activities and social work activities	11.8	13.8	11.4	11.3	11.7	7.1
R	Arts, entertainment and recreation	32.4	32.0	31.7	32.3	31.8	25.4
S	Other service activities	9.7	9.3	7.9	7.4	7.2	7.1

Source: Own calculations based on Eurostat data

In general, investment ratios are relatively stable over time. However, the sharp fall in production and value added in many industries in 2009, at the start of the recession, was not accompanied by a commensurate falls in investment. As a result, investment ratios in many of the worst affected sectors — motor vehicles, coke and refined petroleum products, mining and quarrying — shot

Figure 1.26: R&D expenditure as a share of GDP (GERD), 2001–2012



Note: OECD figures for the EU are slightly lower than above due to weighting differences; according to the OECD, China bypassed the EU in 2012
Source: Eurostat, OECD and World Bank

up in 2009, before returning to more normal levels in 2010 and subsequent years. In sectors less affected by the recession, including all services sectors, investment ratios remained more or less unchanged during the recession. In this context it is worth recalling that investments are longer-term in sectors such as motor vehicles, mining and quarrying than in sectors such as food products and beverages, making it more difficult for the former to adjust to sudden cyclical swings.

It is important to note that, while investment has again started to increase faster than value added in many manufacturing sectors (as in the EU economy as a whole), some manufacturing sectors were still characterised by falling investment ratios in 2012. This was the case notably in machinery and equipment, other transport equipment, printing and recorded media (and possibly also in the case of other non-metallic mineral products). As the recovery of the EU economy has since made further progress, it is reasonable to expect investment ratios to have meanwhile risen in these sectors, too.

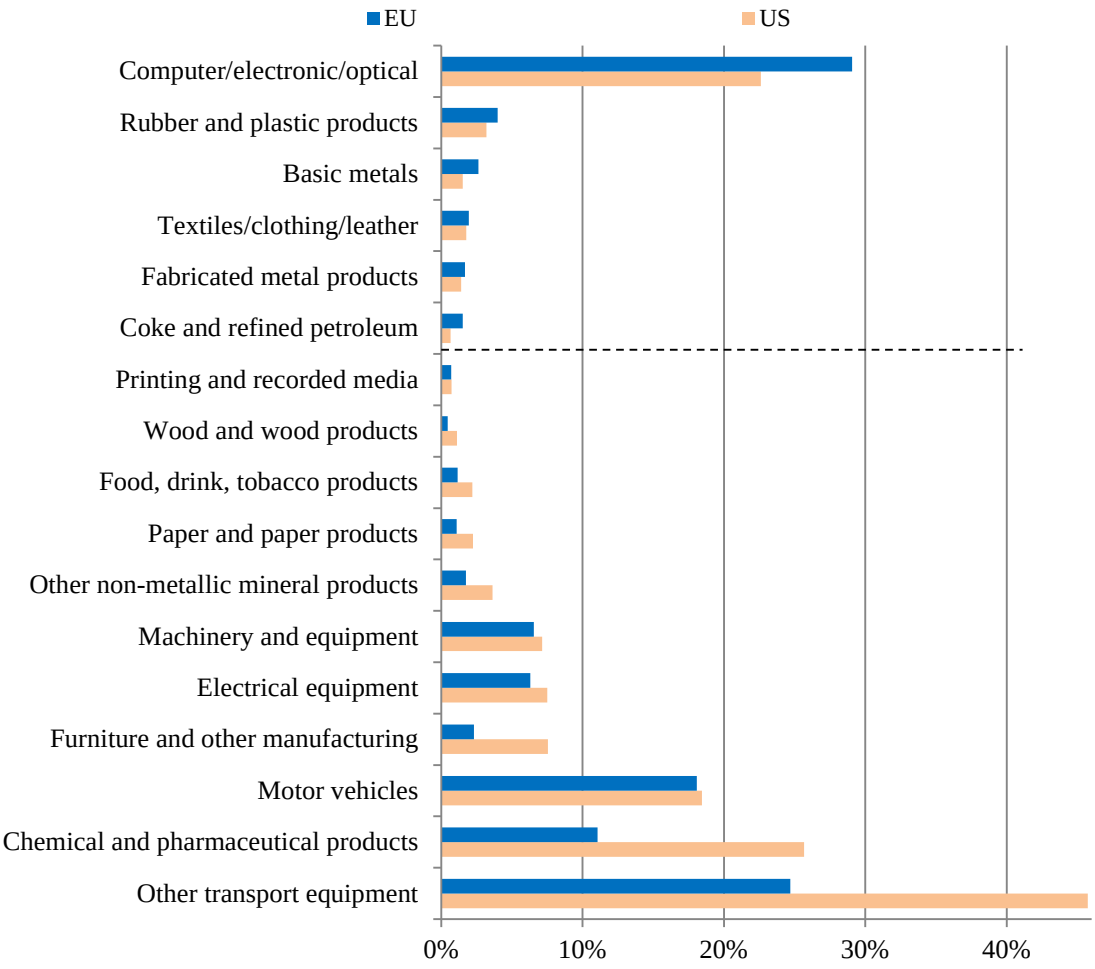
1.6. RESEARCH, DEVELOPMENT AND INNOVATION

Research, development and innovation efforts are important drivers of non-price competitiveness, as they can lead to increased demand for goods and services following the development of new, improved or differentiated products or services. R&D and innovation efforts can also affect the production process by making it more efficient, for instance through the introduction of new technology or new organisational solutions. The adoption of new, improved technology determines the efficiency frontier for the combination of production factors and inputs, and thereby the upper bound on potential long-term growth.

The Commission has pointed out that in order fully to harness the potential of research and innovation to generate growth, it is crucial that Member States prioritise growth-enhancing expenditure, notably on research and innovation, and that such expenditure should be accompanied by reforms to improve the quality, efficiency and impact of public spending on research and innovation, including by leveraging business investment in research and innovation (European Commission 2014c).

Because R&D&I efforts are so important to production, prosperity and growth, defining and measuring relevant R&D&I indicators and setting targets has become a priority in most economies. One of the most commonly used indicators is gross domestic expenditure on R&D as a share of GDP. In the Europe 2020 strategy for smart, sustainable and inclusive growth, the EU set itself a target of 3% of GDP by 2020. As Figure 1.26 shows, R&D expenditure has increased slightly faster than GDP in the EU over the last ten years, resulting in a gradual increase in R&D expenditure from below to just above 2% of GDP, but still far from the 3% target (and below the OECD average).

Figure 1.27: R&D intensity by manufacturing sector in selected Member States and the US, 2010



Note: EU represented by BE, CZ, DK, DE, FR, IT, HU, NL, AT, SI and FI. The dashed line separates the sectors with higher intensity in the EU from those with higher intensity in the US.
Source: Own calculations based on OECD data

The relatively stable development in the EU is similar to the development over time in Japan, the US and the OECD as a whole. In South Korea and China, on the other hand, R&D expenditures have increased much faster than GDP, leading to considerably higher ratios than a decade ago. Chinese R&D spending has increased to a GDP proportion very close to or above the EU share (it has been claimed that China actually overtook the EU in 2012) and is set to continue rising faster than in the EU or the OECD.

As shown in the figure, R&D expenditure in the EU and the US has been relatively stable in relation to GDP in recent years, with the EU spending around 2% and the US more than 2.5%.

To show how the higher US expenditure ratio translates into R&D in different manufacturing sectors, Figure 1.27 illustrates differences between sectors for a subset of Member States and the US for those sectors. It shows that in many manufacturing sectors, R&D investments represent only a few per cent of gross value added. This is the case, in both the EU and the US, in sectors such as textiles, clothing, leather and related products; fabricated metal products; coke and refined petroleum products; printed matter and recorded media; wood and wood products; food, drink and tobacco products; and paper and paper products. It could be argued that any differences between the EU and the US in R&D spending in such sectors are less important than other factors, such as differences in unit costs or productivity (see Section 1.3) or in value added.

There are, however, several manufacturing sectors with high or even very high R&D intensities: computer, electronic and optical products; motor vehicles and other transport equipment; chemical and pharmaceutical products. In motor vehicles, the subset of Member States had almost the same R&D intensity in 2010 as the US: 18% of gross value added in the sector. For other transport equipment though, the US sector invested a much higher proportion (46%) in R&D than the subset of

Table 1.7: US outward R&D investment flows to the EU-27, 2007–2010		
	USD billion	**Proportion of total**
2007	21.4	62.0%
2008	25.1	60.3%
2009	23.4	59.8%
2010	22.6	57.2%

Source: Dachs (2014)

Member States (25% of value added). As the sector includes not only shipbuilding, trains and trams, but also aircraft and spacecraft, it is not surprising that it is highly R&D-intensive, both in the EU and the US, nor that the intensity is higher in the latter.

Another sector with considerably higher R&D intensity in the US than in the subset of Member States is chemical and pharmaceutical products, where US manufacturers invested 26% of value added in R&D in 2010, and EU manufacturers only 11%. However, part of the explanation may lie in the high level of aggregation and in differences in the sector composition between the EU and the US. Manufacturing pharmaceutical products and preparations is exceptionally R&D-intensive, while the manufacture of chemical products is much less so, at around 5–7% of value added (European Commission 2013a). Economies with a high proportion of pharmaceutical manufacturing in the 'chemical and pharmaceutical products' aggregate will therefore have higher R&D intensity than those with a lower proportion.

The only aggregated sector in which the subset of Member States had a clearly higher R&D intensity than the US was computer, electronic and optical products, where EU manufacturers invested 29% of value added in R&D, while US manufacturers invested 23%. In rubber and plastic products, basic metals, light industries, metal products, and coke and refined petroleum products, their R&D intensity was slightly higher than for the US.

In order to fully understand the origin and nature of these differences and the implications related to reaching the 3% target by 2020, it is useful to study company data of cross-border activities (production and sales, as well as R&D investments abroad).[10] Industrial activities of foreign-controlled companies account for a large share of the domestic industry, in particular in high-technology manufacturing. Significant differences in R&D intensities across sectors and between home and host countries occur because companies do not delocalise production and R&D facilities in the same way and to the same extent. In each sector (such as pharmaceuticals or ICT), R&D intensities reflect the internationalisation strategies of individual companies and the capacity of regions or countries to attract multinational companies.

When discussing R&D investments in the EU and the US, it is important to take into account the cross-border flow between the two economies. Most inward R&D investments in the EU are made by US firms — the EU is by far their preferred investment destination. Conversely, when EU firms make R&D investments outside the EU, they prefer to invest in the US market, where they represent the lion's share of all inward investments in R&D. Another important property of R&D investment across borders is that most of it is related to manufacturing.

Table 1.7 shows US outward R&D investment flows to the EU (except Croatia). Measured in current US dollars, the flows peaked in 2008 and have since fallen back as a consequence of the recession. At the same time, in terms of its share of total US outward R&D investments, the EU has become a less attractive destination than it used to be. Though it still attracts more than half of all US R&D investments abroad, US firms are gradually redirecting their international R&D investments away from the EU, in favour of China and other emerging economies.

Conversely, a survey of the largest R&D investing companies in the EU showed that they expect their R&D investments to grow by around € 1.2bn over three years outside the EU (similar to the increase in R&D investment in the EU), with the fastest growth rates in China and India, followed by the US and Canada. As in the case of the US investment flows in Table 1.7, their growing interest in non-EU R&D investment is a reflection of their participation in an increasingly globalised economy and should not be interpreted as steps in the direction of a radical erosion of the European R&D base (Tübke et al. 2013).

1.7. CONCLUSIONS

As the EU economy emerges from recession and the recovery gains momentum, it is clear that the recession has taken a heavier toll on manufacturing than other sectors and that EU manufacturing suffered greater losses than manufacturing in many other economies, as shown in Figure 1.2.

[10] EU Industrial R&D Scoreboard 2012.

At the same time, the considerable variation between Member States, industrial sectors and individual firms should not be ignored. The Polish economy avoided recession thanks to strong domestic demand, while Germany and other strong exporters were helped by growing extra-EU demand for their export goods. Manufacturing sectors producing food products, pharmaceutical products and preparations, and transport equipment other than motor vehicles fared much better than EU manufacturing as a whole, while non-metallic mineral products, furniture, clothing and textiles fared much worse.

In terms of de-/reindustrialisation, the chapter has demonstrated that the gradual fall in the proportion of total EU value added coming from manufacturing is driven mainly by falling relative prices in relation to services, which in turn are the result of faster productivity growth. Only a small part of the drop can be attributed to structural factors such as deindustrialisation, as shown in Figure 1.8.

Looking ahead, it is important to recognise that EU manufacturing remains highly competitive in several sectors. Whether measured by export value or by global value chain income, the EU's revealed comparative advantage in manufacturing sectors such as transport equipment, printing, wood and wood products, chemicals, machinery, and metal products is evident. Conversely, it is clear from both types of RCA analysis that the EU does not have a comparative advantage in the production of electrical equipment.

Of the two manufacturing sectors characterised by high technology intensity, the EU has comparative advantages in one (pharmaceuticals) but not the other (computer, electronic and optical products). Of the five aggregated sectors characterised by medium-high technological intensity, the EU has comparative advantages in all but one.

EU manufacturing output is often highly sophisticated and specialised, and many Member States, especially in Central and Eastern Europe, managed to raise the complexity and sophistication of their manufacturing output between 1995 and 2010.

Many EU manufacturing sectors are also characterised by highly skilled labour needs. In all Member States but one, the proportion of high-skilled labour input has increased in 1995–2010. The demand for skilled workers is met by education and training systems, and on-the-job training, but at the same time surveys suggest that skills mismatches are emerging in some sectors and that, as the EU economy returns to normal levels of output and growth after the recession, shortages may occur in certain manufacturing sectors.

In view of the importance of investment for growth and job creation, the EU has set ambitious targets for the short and medium term. While aggregated data suggest it is further from its short and medium-term targets than when they were set, sectoral data indicate that investment ratios have begun to recover and increase in several manufacturing sectors, a development likely to spread to other sectors as the recovery progresses.

Research and innovation are also of crucial importance. In many Member States, the ratio of R&D expenditure to GDP is lower than before the recession and for the EU as a whole it is still far from the 3% target. At the same time, the ratio is rising fast in economies such as China and South Korea. Member States will need to step up to the plate if they are to meet their individual R&D expenditure targets and the 3% EU target.

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Chapter 2.
ACCESS TO EXTERNAL FINANCING AND FIRMS' GROWTH

Europe's economic success depends on the competitiveness and growth of European enterprises. Access to external financing is essential for enterprises to invest, innovate and grow. As a consequence of financial market imperfections, 'financing gaps' may limit enterprises' investment and growth options when viable projects cannot be financed. Evidence based on theory, empirical analysis and surveys indicates that such 'financing gaps' are likely to be more binding for certain types of enterprises including start-ups, young, innovative, small scale, domestic enterprises and more technologically advanced industries. It has been widely documented that during recessions and financial crises, financial factors, such as collateral constraints and debt overhang, exacerbate the financial constraints faced by enterprises. The overall functionality of the financial system and its efficiency in the allocation of capital varies considerably across countries and regions. Given this heterogeneity, the recent financial crisis has had uneven effects across enterprises, industries and countries.

Small and medium-sized enterprises (SMEs) contribute more than half of the total value added in the non-financial business economy and have provided 80% of all new jobs in Europe over the past five years.[11] In contrast to large multinational enterprises, which have access to external financing via international capital markets, SMEs are highly dependent on domestic bank loans and credit lines to finance their investment projects. Existing theoretical and empirical research has established that SMEs tend to face higher capital costs and tighter credit conditions than larger enterprises due to their higher rates of failure and asymmetric information linked to the lack of a successful track record, insufficient collateral and a dearth of credit guarantees. Following on from the recent financial crisis, SMEs' access to external financing has been restrained due to weak demand and banks' increased risk aversion in the uncertain macroeconomic environment. *While the sharp fall of private sector investment since 2008 is largely a consequence of weak demand, financial market imperfections may have also played a role.*

Understanding the nature and extent of financing constraints faced by specific types of enterprises and industries and how they impact on their investment and growth is crucial in the design of effective enterprise and industry policies. This chapter provides novel empirical evidence to inform policy measures and instruments in order to help EU SMEs in obtaining access to external financing and to support enterprise growth. The empirical analysis undertaken for this chapter is based on insights from the most recent relevant theoretical and empirical literature.[12] The empirical analysis is threefold: (i) it considers both supply-side and demand-side financial market imperfections and identifies the nature and extent of financing constraints for specific types of enterprises and industries, and in particular EU countries, following the recent financial crisis; (ii) it uses a unified econometric framework to analyse the effects of financing constraints on investment, employment, productivity and exporting over and above demand and cyclical factors across different types of enterprises and industries; (iii) it shows how the recent financial crisis has affected the responsiveness of investment, employment, and productivity to financial factors across different types of enterprises and industries.

This chapter focuses on the following three key policy issues: (i) the nature and extent of financing constraints faced by specific types of enterprises and industries and the extent to which they are linked to financial market imperfections; (ii) how financial dependence has affected the behaviour and the performance of EU firms over the recent period with respect to investment, employment, productivity and export performance; and (iii) policy implications and policy recommendations to help domestic SMEs in obtaining access to external financing and support the growth of firms by addressing financial market imperfections.

2.1. EU FIRMS FINANCING CONSTRAINTS

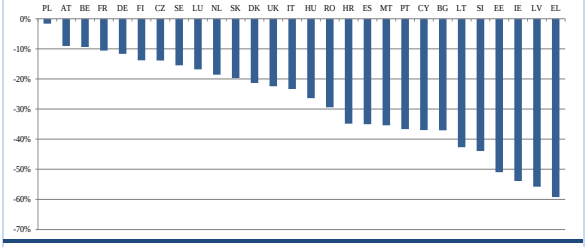
The global financial crisis and the resulting macroeconomic shocks have presented major challenges to the functioning of European economies. Domestic demand has fallen off the back of rising unemployment and macroeconomic uncertainties, export demand has weakened and many countries have experienced severe banking

[11] Structural Business Statistics (Eurostat), http://epp.eurostat.ec.europa.eu/portal/page/portal/european_business/data/database.

[12] The full analysis is available in the background study for this chapter, Siedschlag et al. (2014).

and financial crises. This has led to considerable strains in interbank lending markets and sharp reductions in credit to the real economy.

Figure 2.1: Peak-to-trough fall in investment – EU-28



Note: Peak occurred between 2003 and 2007, and the trough between 2008 and 2013.
Source: ESRI analysis of Eurostat national accounts data.

In this context, a key concern for enterprises has been access to finance. To grow and develop, EU firms need an adequate supply of working capital and investment finance priced at market rates. This is particularly important for SMEs, whose reliance on domestic banking sectors heightens their vulnerability to credit supply shocks.

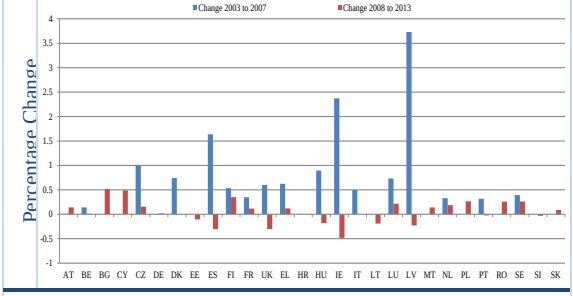
This section provides new empirical evidence on the effect that access to finance has on the growth of EU enterprises. Firstly, it gives a broad overview of trends in access to external finance at enterprise, industry and country level. Secondly, it presents an econometric analysis of the determinants of financing constraints faced by EU enterprises and, thirdly, it describes the implications of the findings for economic policy.

2.1.1. Broad trends in access to external financing

In the period up to 2008, firms in many EU countries accumulated large amounts of debt. These elevated leverage levels were unsustainable and, following the financial crisis, corporate investment has declined sharply. As shown in Figure 2.1, the largest falls in investment from peak to through have been in Greece, Latvia, Ireland, Estonia, Slovenia, and Lithuania. While much of the declines in investment can be attributed to poor macroeconomic conditions and a lack of profitable investment opportunities (EIB, 2013; Kraemer-Eis et al., 2013a; 2013b), credit market developments may have played a role.

The fall in investment has coincided with a fall in credit to enterprises. Figure 2.2 indicates that, with the exception of Germany and Austria, where credit growth to EU non-financial corporations has been largely unaffected by the crisis, credit growth has slowed down or fallen sharply in the rest of the EU since 2008. The largest declines have been in Latvia, Ireland, and Spain.

Figure 2.2: Credit to non-financial corporations - EU-28 (2003=100)



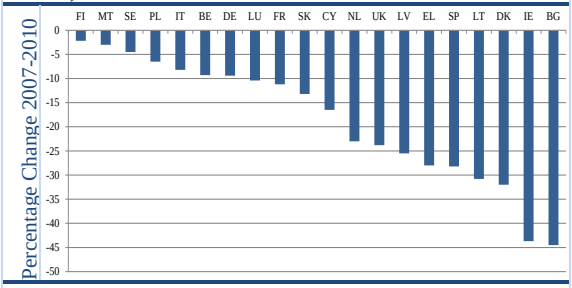
Source: ESRI analysis of ECB data.

In parallel with the reversal of the pre-crisis trend in credit growth throughout much of the EU, there has been a sharp decline in the proportion of successful bank loan applications. Based on Eurostat data, there was a sharp decline in bank loan acceptances from 2007 to 2010. While in a number of countries the declines have been modest, such as Finland, Malta and Sweden, the declines have been modest, in others they have approached or exceeded 30%, such as in Bulgaria, Ireland, Denmark, Lithuania, Spain and Greece.

Financing constraints faced by enterprises

The scale of the banking crisis in Europe has drawn greater attention to the issue of firms' access to finance and the functioning of the financial sector as a whole. There is evidence that EU firms, in particular small and young firms, are very dependent on bank financing and lack diversification in the supply of finance. This makes them vulnerable to shocks in the supply of bank lending as occurred during the recent financial crisis.

Figure 2.3: Percentage change in bank loan acceptances – selected EU countries (2007 - 2010)



Note: The access to finance survey covers a subset of EU Member States
Source: ESRI analysis of Eurostat access to finance data.

One of the main objectives of this chapter is to identify the nature and extent of financing constraints faced by EU SMEs and to examine whether they are linked to financial market failure. According to the economic literature, a 'financing gap' or financial market failure occurs when viable

Box 2.1: Financial market imperfections

Financial market imperfections exist mainly because of *information asymmetries* between lenders and borrowers. These asymmetries arise due to: (i) a lack of information on the side of lenders about the profitability of an investment and (ii) a lack of information on the borrowers' side about external funding sources.

For lenders, a lack of information about the profitability of an investment may increase the costs related to evaluating collateral and monitoring. It is difficult for lenders to distinguish between high and low risk entrepreneurs without incurring significant transaction costs. As a consequence, lenders base their decisions on collateral and track record rather than the economic viability of enterprises (BIS, 2012). Furthermore, the higher the debt relative to net worth, the higher the risk of bankruptcy and the higher the lending costs (Nickell and Nicolitsas, 1999). For borrowers, a lack of information/knowledge about external funding sources and investment opportunities limits their demand for external funding and, hence, their possibilities for expansion, in particular for small firms who do not have the skills/capacity to assess the range of investment opportunities. Furthermore, a number of firms do not apply for external finance due to fear of rejection (BIS, 2012).

These information asymmetries raise the cost of external funds compared to internal funds. As a result, due to restricted access of some potentially viable enterprises, there will be under-investment, a suboptimal allocation of capital and foregone enterprise growth. Information asymmetries do not affect all types of enterprises and industries in the same way. Economic theory and research, based on surveys and empirical analysis[13], indicates that financial constraints are likely to be more binding for start-ups, young, innovative, small and domestic enterprises.

Furthermore, *knowledge spillovers* restrict access to external finance for good quality projects conducted by viable enterprises, particularly in the case of R&D investment by innovative enterprises. This market failure has been established theoretically by Nelson (1959) and Arrow (1962). R&D investment is also more difficult to fund relative to other types of investment due to a number of distinct characteristics (Hall and Lerner, 2010) including assets intangibility and higher project uncertainty.

In recessions, financial market imperfections may increase the financial constraints enterprises face. The presence and role of financial mechanisms, which exacerbate financial constraints during recessions, has been confirmed by empirical evidence from past recessions including the recent recession triggered by the global economic and financial crisis.[14]

projects cannot be financed due to financial market imperfections (O'Sullivan, 2005; Oxera, 2005; BIS, 2012). This perceived 'financing gap' has been mainly linked to *information asymmetries* (Oxera, 2005; Hall and Lerner, 2010; Peneder, 2012; Moncada-Paternò-Castello et al., 2014). Box 2.1 provides a detailed overview of the nature of financial market imperfections.

Measuring financing constraints

While there are a range of methods to test for financing constraints, one of the most effective is to analyse enterprises' - *perceived financing constraints* (Beck et al., 2006; Clarke et al., 2006), and to use statistics on credit applications and rejections - *actual financing constraints* (Brown et al., 2012; Popov and Udell, 2012; Gerlach-Kristen et al., 2013).[15]

The measurement of financing constraints in this chapter follows the aforementioned studies to identify perceived and actual financing constraints. The empirical analysis uses the ECB Survey on Access to Finance for SMEs (SAFE). Using this dataset, indicators are defined for whether or not firms face financing constraints or view finance as an obstacle to growth and development.

Using the ECB SAFE data, the first financing constraints indicator captures *perceived financing constraints*, as in Ferrando and Greisshaber (2011)

[13] See for example, reviews by Gertler and Gilchrist (1993) and Hall and Lerner (2010).

[14] For a review of this evidence see IMF (2013).

[15] Other methods include testing for the cash flow sensitivity of investment (for example Fazzari et al., 1988; Bond and Soederbom, 2013;
Ryan et al., 2014; O'Toole et al, 2014) or linking real variables to financial factors (net worth, liquidity management, interest coverage)
(Whited, 1992; Bond and Meghir, 1993).

and Ferrando and Mulier (2013b). This indicator takes the value of 1 if the firm indicates that access to finance is the most pressing problem that it faces and zero otherwise. The second indicator focuses on actual financing constraints. (While bank financing is critically important to EU SMEs, the SAFE survey also takes into account trade credit and other forms of external finance.) In SAFE, data on credit applications covers bank loans, bank credit for working capital, trade credits, and other forms of external finance.

Using the aforementioned SAFE data, and following Popov and Udell (2012), *actual financing constraints* are considered to have been incurred in the following three instances:

– when firms have been credit rationed (applied for finance in any one of the categories of financing and were rejected outright, applied and got most of it – between 75-99%, applied and got a limited part – between 1 and 74%);

– when firms have been discouraged from

– borrowing, where the firm did not apply due to possible rejection;

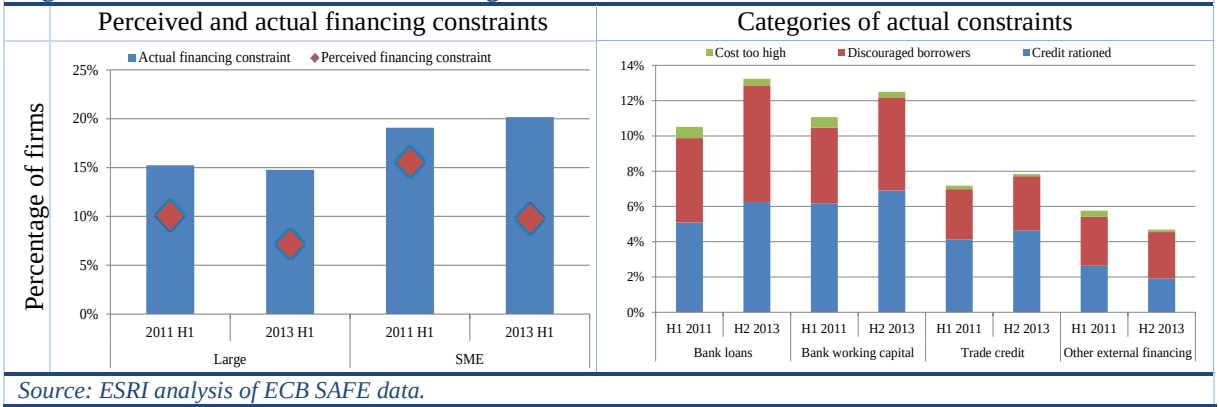
when firms have refused an offer of credit as the costs associated were too high.[16] An important consideration in measuring financing constraints relates to the comparison group of unconstrained firms.

In this context, the baseline grouping is firms that applied for credit and were successful in their application. The sample is limited to these firms and those that are constrained by each of the above measures for the overall evaluation. Therefore, firms that did not make an application for credit are excluded from the sample. The overall indicator of "actual financing constraints" takes the value of 1 if firms are credit rationed, discouraged or the costs of the offer were too high, and zero if firms made a successful application. The definitions of financing constraints are included in Box 2.2.

Box 2.2: Indicators of financing constraints

Indicator	DEFINITION
Perceived financing constraint	Indicator = 1 if firm viewed finance as the most pressing problem, 0 otherwise.
Actual financing constraint	Indicator = 1 if firm is credit-rationed, cost of offer is too high or firm is a discouraged borrower; 0 if firm is unconstrained.
Credit rationing	Indicator = 1 if firm has applied for finance and been rejected; 0 if firm is unconstrained.
Cost of offer too high	Indicator = 1 if firm has applied but rejected the offer due to cost; 0 if firm is unconstrained.
Discouraged borrowers	Indicator = 1 if firm did not apply due to possible rejection, 0 if firm is unconstrained.

Figure 2.4: Perceived and actual financing constraints – EU28



Source: ESRI analysis of ECB SAFE data.

[16] The ECB questionnaire does not make a distinction as to whether or not the cost indicated relates to interest rates or loan conditions, or a combination of the two

Descriptive analysis of financing constraints

Figure 2.4 charts the indicators of perceived and actual financing constraints and the components of actual constraints for both large firms and for SMEs in the EU. Two periods are analysed, corresponding to the data available in the ECB/EC SAFE survey for all EU Member States: April to September 2011 (H1 2011) and April to September 2013 (H1 2013).

In general, *large firms face lower perceived and actual constraints than SMEs*. Credit rationing (rejection of credit applications) is the most common financing constraint, particularly for large firms. The second most common constraint is 'discouragement' (fear of rejection), which is quite high for SMEs. *Firms who rejected finance due to the cost of the credit make up only a small proportion of financially constrained enterprises. This suggests that credit rationing over the two periods was volume- rather than price-based.*

Although it may be surprising that perceived constraints are lower than actual constraints, it should be noted that they are recorded only if firms indicate that they are the greatest obstacle to growth.

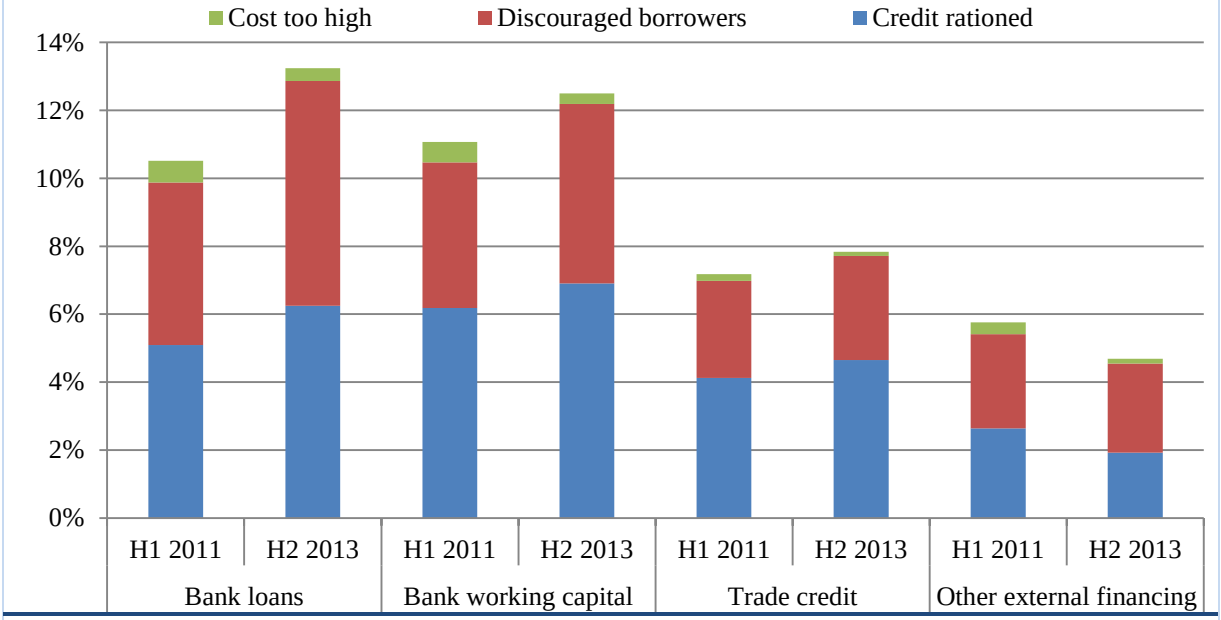
As regards SMEs, actual financing constraints are greater for bank loans, including loans for the purposes of working capital and investment. The proportion of discouraged borrowers is higher with respect to bank loans than to trade credit or other forms of financing. When the banking sector is under strain, there is evidence that firms turn to trade credit as a substitute form of financing, as this may be considered easier to obtain (Ferrando and Mulier, 2013a; Casey and O'Toole, 2014).

Figure 2.6 presents the degree of actual financing constraints across the EU Member States for all firms. In general, the level has been higher in the Member States hit harder by the financial crisis, e.g. Ireland, Greece and Spain. Conversely, the lowest

Box 2.3: Indicators of financing constraints

Indicator	DEFINITION
Perceived financing constraint	Indicator = 1 if firm viewed finance as the most pressing problem, 0 otherwise.
Actual financing constraint	Indicator = 1 if firm is credit-rationed, cost of offer is too high or firm is a discouraged borrower; 0 if firm is unconstrained.
Credit rationing	Indicator = 1 if firm has applied for finance and been rejected; 0 if firm is unconstrained.
Cost of offer too high	Indicator = 1 if firm has applied but rejected the offer due to cost; 0 if firm is unconstrained.
Discouraged borrowers	Indicator = 1 if firm did not apply due to possible rejection, 0 if firm is unconstrained.

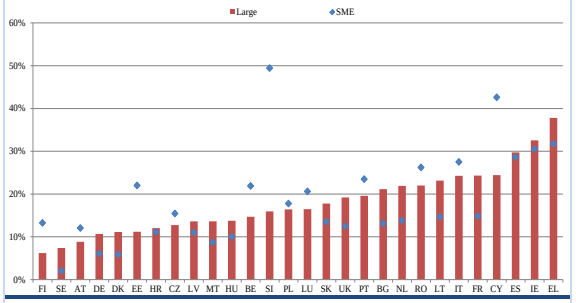
Figure 2.5: Actual financing constraints of SMEs



Source: ESRI analysis of ECB SAFE data.

levels have been registered in those Member States where the impact has been less and, in some cases, where the financial sectors have remained stable, e.g. Finland and Sweden.

Figure 2.6: Actual financing constraints of firms by Member State

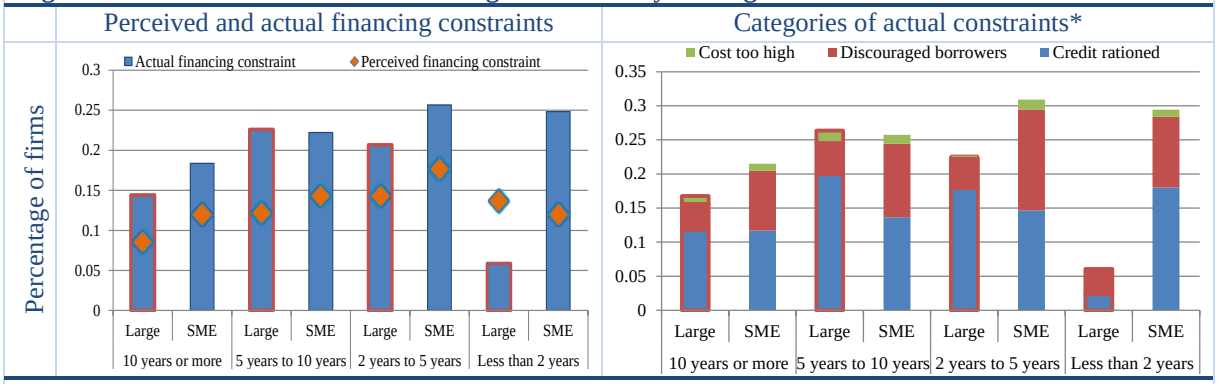


Source: ESRI analysis of ECB SAFE data.

five years, while the most constrained large firms are those aged between five and 10 years. *The largest difference between financing constraints faced by SMEs and larger firms is for the youngest firms (less than two years)*, primarily due to much less credit rationing for large firms, though this may be partly due to low numbers of observations for large firms in the dataset. As shown in Figure 2.4, *there is a larger proportion of discouraged borrowers among SMEs than among large firms across all age brackets*.

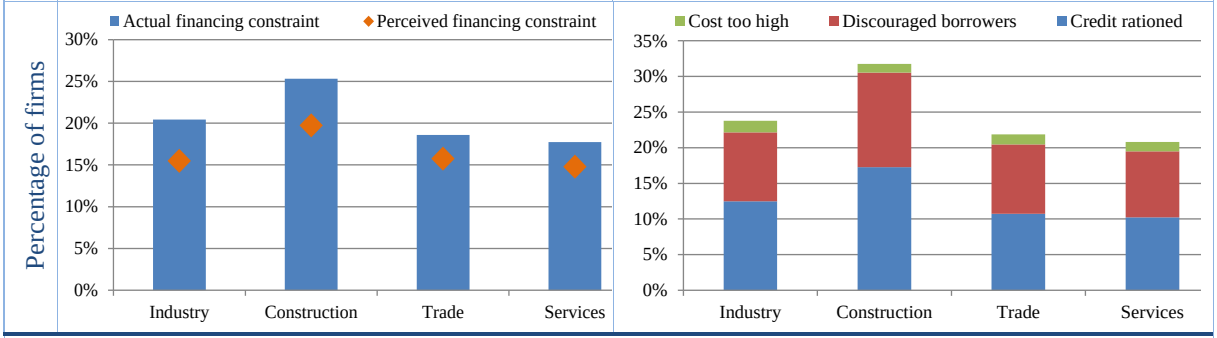
Figure 2.8 demonstrates the average levels of perceived and actual financing constraints for SMEs across different sectors between 2011 and 2013. As noted in Box 2.2, perceived constraints apply to firms who consider that access to finance is the biggest problem they face whereas actual constraints apply to rejected applications for financing and

Figure 2.7: Perceived and actual financing constraints by firm age – EU28



*Note: * Components of actual financing constraints can sum to greater than the total as firms may be counted in each category depending on their answers relating to different financing types. Large firms are highlighted in red.*
Source: ESRI analysis of ECB SAFE data.

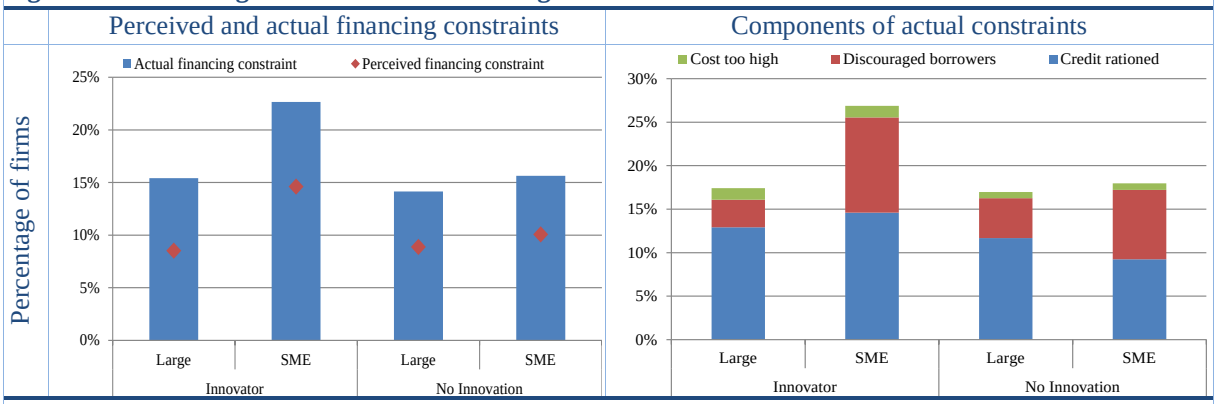
Figure 2.8: Perceived and actual financing constraints of SMEs by sector – EU28



Note: Components of Actual financing constraints can sum to greater than the total as firms may be counted in each category depending on their answers relating to differing financing types.*
Source: ESRI analysis of ECB SAFE data.

Figure 2.7 below gives a breakdown of perceived and actual financing constraints across firm age categories and sizes for 2011-13. *Large firms in almost all age categories face lower perceived and actual constraints.* The only exception is for firms aged between five and 10 years, where large firms face slightly higher actual constraints. *The most constrained SMEs are those aged between two and* discouraged borrowers. *SMEs in the construction industry display both the highest level of perceived and actual constraints whereas SMEs in the services sector appear to be the most unconstrained in terms of both actual and perceived constraints.* These findings can be linked to the relative performance of these sectors; whereby the construction sector and industry, in general, have been weaker than services

Figure 2.9: Financing constraints for innovating firms - EU-28



Note: Innovation refers to product, process, organisational and sales innovation.
Source: ESRI analysis of ECB SAFE data.

over the period. The actual financing constraints across all sectors are primarily credit rationing and discouraged borrowers, with those firms rejecting financing due to prohibitive costs being in a small minority across all sectors. Hence, as noted above, credit rationing that occurred over the two periods appears to have been volume rather than price based.

Figure 2.9 provides a breakdown of perceived and actual financing constraints according to whether firms are engaged in innovation (which includes innovation in terms of organisational structure, sales, products or processes). *Actual financing constraints are greater for innovating firms (large firms and SMEs)*. Perceived constraints are more or less the same for large firms irrespective of whether they are innovators, whereas *innovating SMEs also face higher perceived constraints*. In general, these findings indicate that innovation entails up-front costs that have to be at least partially covered by external financing.

2.1.2. Determinants of firms' financing constraints

This section presents a deeper and wider analysis of the link between financing constraints and a range of firm characteristics. The purpose is to estimate the effect of various firm characteristics on financing constraints, in order to pin down the determinants of financing constraints faced by EU enterprises. This analysis provides an understanding of the determinants of constraints and the firms groups which face more binding financing constraints. The methodological framework follows Ferrando and Greisshaber (2011) and Ferrando and Mulier (2013b) in estimating actual and perceived constraints simultaneously in a bivariate probit model involving equations for the perceived and actual constraints defined in Box 2.2. We use ECB/EC SAFE data, which provides survey information on firms' access to credit. The following two-equation bivariate model was estimated:

$$PC^*_{icj} = X'_{1:ijc}\beta + \varepsilon_{1:icj}$$

$$AC^*_{icj} = X'_{2:ijc}\beta + \varepsilon_{2:icj}$$

To model the determinants of financing constraints, the vector $X'_{i:ijc}$ contains the following general firm-level characteristics: categorical variables for firm age: 10 years or more, 5-10 years, 2-5 years, and less than 2 years, and firm size: micro firm size categories: micro (less than 9 employees), small (10 to 49), medium-sized (50 to 249) and large (over 250)..

As discussed in Box 2.1, there are many market and regulatory failures that determine the degree of financing constraints affecting enterprises, in particular SMEs. To identify the drivers of financing constraints, the main determinants are selected from the relevant literature. While direct measures of information asymmetries are not available, a number of proxies have been used in the empirical literature.

For example, the *age* of an enterprise decreases the severity of information asymmetries, because more mature enterprises have an established track record and are likely to have established relationships with lenders. Conversely, *younger* firms can have underdeveloped business and management practices and can appear very opaque to financial institutions. This leads to difficulties in evaluating borrower risk and may increase financing constraints.

Firm *size* (measured by the number of employees) is included in the econometric analysis as an explanatory variable for financing constraints. It is generally accepted that small firms find it more difficult to access financial services, due to greater costs associated with information gathering and higher transaction costs, whereas they are more likely to be dependent on external financing. By comparison, large firms internalise many of the functions of capital market allocation and may have greater internal financial resources. Additional

controls for whether or not the firm is a subsidiary and whether or not the firm undertook product, process, or organisational innovation are also included, as are controls for country and time dimensions of the panel data.

In isolating the determinants of financing constraints, it is important to control for borrower-specific profitability and firm performance. When financial institutions make credit allocation decisions, they take borrower risk and quality into account. In line with the proper functioning of the credit market, credit providers reject loan applications from firms with poor 'fundamentals'. To capture this, controls are included for whether or not the firm's turnover has increased, remained constant or decreased in the previous six months, as is a binary variable for whether or not the firm posted a profit, made a loss or broke even in the previous six months. Indicators are also included for whether or not the firm's credit history has improved, remained constant or deteriorated and whether its (self-reported) capital position has improved, remained constant or deteriorated.

Results of the econometric analysis

Table 2.1 presents the results of the econometric analysis using the SAFE data set. A number of findings emerge which are consistent in nature with the descriptive statistics presented previously. *Both actual and perceived constraints are higher for small and micro firms with actual constraints decreasing with firm age.* These findings hold when controlling for demand-related factors such as turnover, profitability and indicators of firm financial health. There is evidence that firms conducting organisational innovation[17] face higher actual financing constraints, however, this result should not be interpreted as causal.[18] Focusing on actual constraints, *there is variation by industry with firms in the construction sector most constrained and trade and service firms less so*.[19]

In this analysis, the following base categories are used: construction (sectors), listed firms (ownership), > 10 years (age), medium (size), no subsidiary. The reference category for all innovation variables is 'no innovation'. The reference categories for turnover, profit, credit history and capital position are the respective categorical variables for decreased turnover, profit, credit history and capital position. *Within the overall category of actual financing constraints, trade and service firms are less credit rationed than firms in the construction sector.* However, only firms in the trade sector are less discouraged borrowers relative to firms in construction. There is very little variation across firm ownership when demand factors are controlled for. There is some evidence that firms owned by venture capital (VC) or business angels (BA) are more credit rationed, although the effect is not significant.

The coefficients are negative on positive turnover, positive profit, improved credit history and improved capital position because these firms face lower financing constraints relative to the respective reference categories. This is intuitive as firms displaying these characteristics are more financially viable and hence carry less risk as borrowers from financial institutions.

2.1.3. Summary

This section has considered the nature and extent of financing constraints in the EU in terms of both actual and perceived constraints. The empirical results indicate that both actual and perceived financing constraints are higher for small and micro firms, with actual financing constraints decreasing with firm age. These findings hold when controlling for demand-related factors such as turnover, profitability and indicators of firm financial health.

The descriptive statistics highlight that credit-rationed firms make up the largest group of these firms, followed closely by discouraged borrowers, with only a small proportion of firms indicating that the cost of borrowing was too high. These findings indicate that financing constraints faced by enterprises in the EU appear to be volume rather than price-based, highlighting supply-side difficulties.

The econometric analysis revealed that more indebted firms are more likely to face actual financing constraints. If leverage ratios are elevated, this may deter financial institutions from providing additional finance and act as an impediment to obtaining further credit. While in the main, the findings for actual and perceived constraints are similar, actual constraints appear to vary by sector whereas perceived constraints do not.

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[17] The definition of organisational innovation in the ECB/EC SAFE Survey is as follows: "Has your firm in the last 12 months introduced a new organisation of management"?

[18] A causal interpretation would require the application of an instrumentation model which is not possible with the data available.

[19] The construction sector is the omitted category in the set of industry dummies so all coefficients are estimated relative to this sector.

Table 2.1: Determinants of financing constraints for EU SMEs – EU28; bivariate probit analysis – H1 2011 & H1 2013

	Models with firm characteristics		Broader model	
Y = 1 if constrained, 0 otherwise	**Perceived constraints**	**Actual constraints**	**Perceived constraints**	**Actual constraints**
	1(a)	**1(b)**	**2(a)**	**2(b)**
Industry	0.001	-0.042*	0.007	-0.018
Trade	-0.023	-0.098***	-0.018	-0.073***
Services	-0.013	-0.065***	-0.000	-0.037*
Family owned	-0.012	-0.025	-0.014	-0.006
Other firm	-0.039	-0.048	-0.045	-0.025
VC or business angel	-0.002	0.095	-0.009	0.092
Sole trader	-0.001	0.031	-0.009	0.042
Other owner	-0.014	-0.052	-0.014	-0.057
Age: 5 to 10	0.020	0.032*	0.025	0.041**
Age: 2 to 5	0.052**	0.106***	0.047**	0.117***
Age: less 2 years	-0.035	0.102**	-0.022	0.163***
Small	0.032***	0.056***	0.032***	0.037***
Micro	0.058***	0.156***	0.052***	0.108***
Innovation (product)	-0.008	0.002	-0.008	0.010
Innovation (process)	0.012	0.008	0.011	0.017
Innovation (organisation)	0.043***	0.069***	0.039***	0.064***
Innovation (sales)	0.040***	0.032**	0.039***	0.025
Subsidiary	-0.074***	-0.021	-0.037*	0.009
Turnover – unchanged			0.012	-0.049**
Turnover – positive			0.047***	-0.063***
Profit – unchanged			0.005	0.004
Profit – positive			-0.024	-0.065***
Credit history - unchanged			-0.102***	-0.170***
Credit history – improved			-0.090***	-0.173***
Firm capital position - unchanged			-0.004	-0.099***
Firm capital position - improved			-0.035*	-0.106***
Number of firms	9,691	9,691	9,123	9,123
Error correlations (ρ) – p-value	0.000	0.000	0.000	0.000

*Note: * significant at the 10% level; ** significant at the 5% level; ***significant at 1% level.*
Source: ESRI analysis of the ECB SAFE data.

2.2. ACCESS TO EXTERNAL FINANCING AND FIRM GROWTH

2.2.1. Introduction

This section examines the effects of access to external finance and of financial dependence on investment, employment, productivity and exports. Specifically, it tries to answer the following policy-relevant questions:

- how are firms' real decisions (investment, employment, productivity and propensity to export) affected by dependence on external finance and access to finance?
- to what degree are these effects structural, or have they changed since the onset of the financial crisis? and
- how do the effects differ across sectors and types of firm?

An adequate supply of appropriately priced capital is important for firm performance (Levine, 2005). The financial sector plays a critical role in allocating capital across enterprises and industries by intermediating finance between savers and borrowers. It allows firms to manage risk, fund innovation, break into new markets and create jobs. As noted in the previous section, financial market imperfections can reduce the efficiency of this transmission mechanism. These may be structural in nature and may be exacerbated by strains in the financial sector. Such financing constraints can have serious impacts on enterprises' real activities and harm long-term competitiveness.

We explore the extent to which financial dependence has affected the growth prospects of European firms through financial channels in recent years. While much policy-oriented research to date has focused mainly on financing investment or providing adequate working capital financing (EIB, 2013; ECB, 2013; Bain, 2013), financing conditions can also influence firms' competitiveness through employment, productivity and their capacity to export (Nickells and Nicolitsas, 1999; Guariglia, 2008; Greenway et al., 2007, Peneder, 2012).

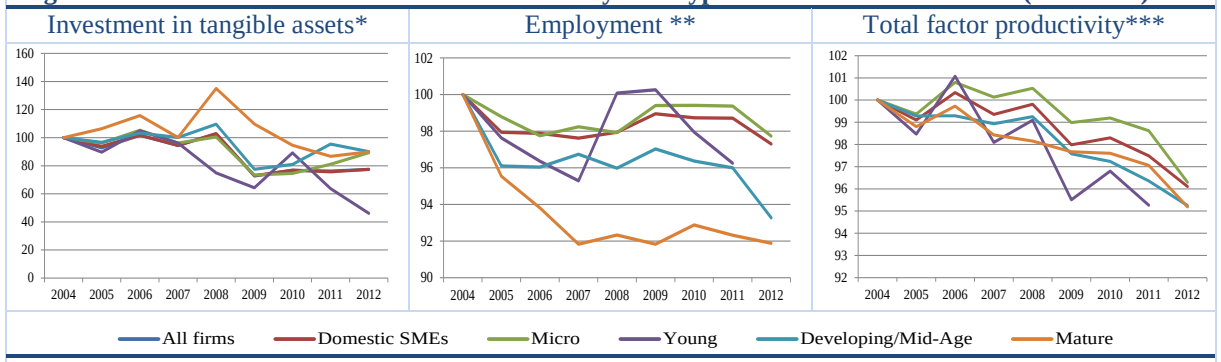
2.2.2. Data and summary statistics

The analysis draws on data from the Amadeus dataset provided by Bureau Van Dijk, which includes financial information from EU public and private firms' balance sheets for 2003-12.

The charts present data for all firms and the sub-samples described in Box 2.3. Figure 2.10 shows trends in investment, total factor productivity (TFP)[20] and employment for non-financial companies in 2004-12. For investment in tangible assets,[21] it can be seen that for the majority of firm groups, investment levels fell considerably following the onset of the financial crisis. The fall seems particularly steep for young firms. The level of TFP falls over the period, but this trend does not seem to accelerate after 2008. The chart shows considerable variation in employment across firm types.

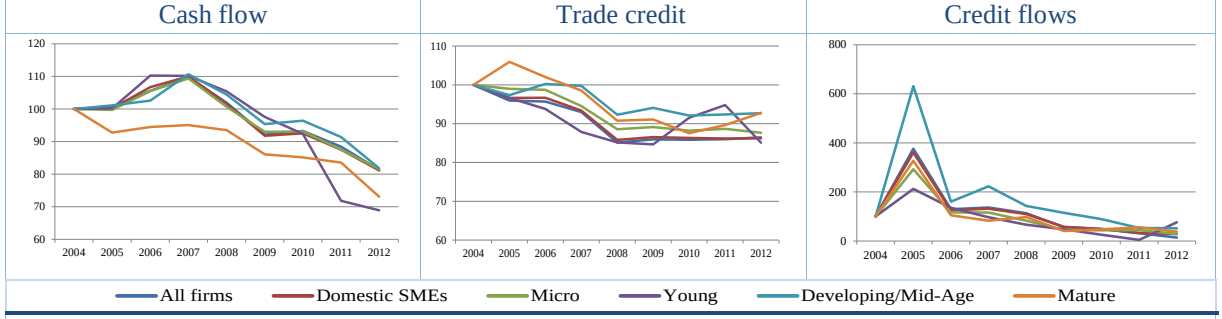
Figure 2.11 shows trends in three important financing channels used by SMEs: internal cash flows, trade credit, and total short- and long-term debt flows. The use of internal cash flows has fallen off since the onset of the crisis, reflecting operating environment challenges and declines in profitability. The trends seem more severe for mature and young firms. Credit flow volumes have also declined considerably; there was a sharp fall-off as early as 2006, followed by a more gradual decline. The use of trade credit declined in the period to 2008 and has broadly stabilised since. It is interesting to observe that young firms have actually used more trade credit since the crisis. As they are more likely to face difficulties in obtaining external finance, possibly

Figure 2.10: Overview of main outcome variables by firm types – indices of main trends (2004=100)



*Note: * investment in tangible assets/total assets; ** ln number of employees; *** ln TFP.*
Source: ESRI analysis of Amadeus data.

Figure 2.11: Overview of flows in external finance by firm type – indices of main trends (2004=100)



Source: ESRI analysis of Amadeus data.

[20] TFP is estimated using the Levinsohn-Petrin methodology (Levinsohn and Petrin, 2003) to correct for simultaneity and selection biases relating to firms' decisions on factor inputs and unobserved productivity shock.

[21] Investment in tangible assets includes spending on new capital inputs such as machinery and equipment, buildings and structures, transport equipment, other machinery and equipment, and cultivated assets.

because of market imperfections, this may reflect a substitution of financing sources.

2.2.3. The effect of financial constraints on investment decisions

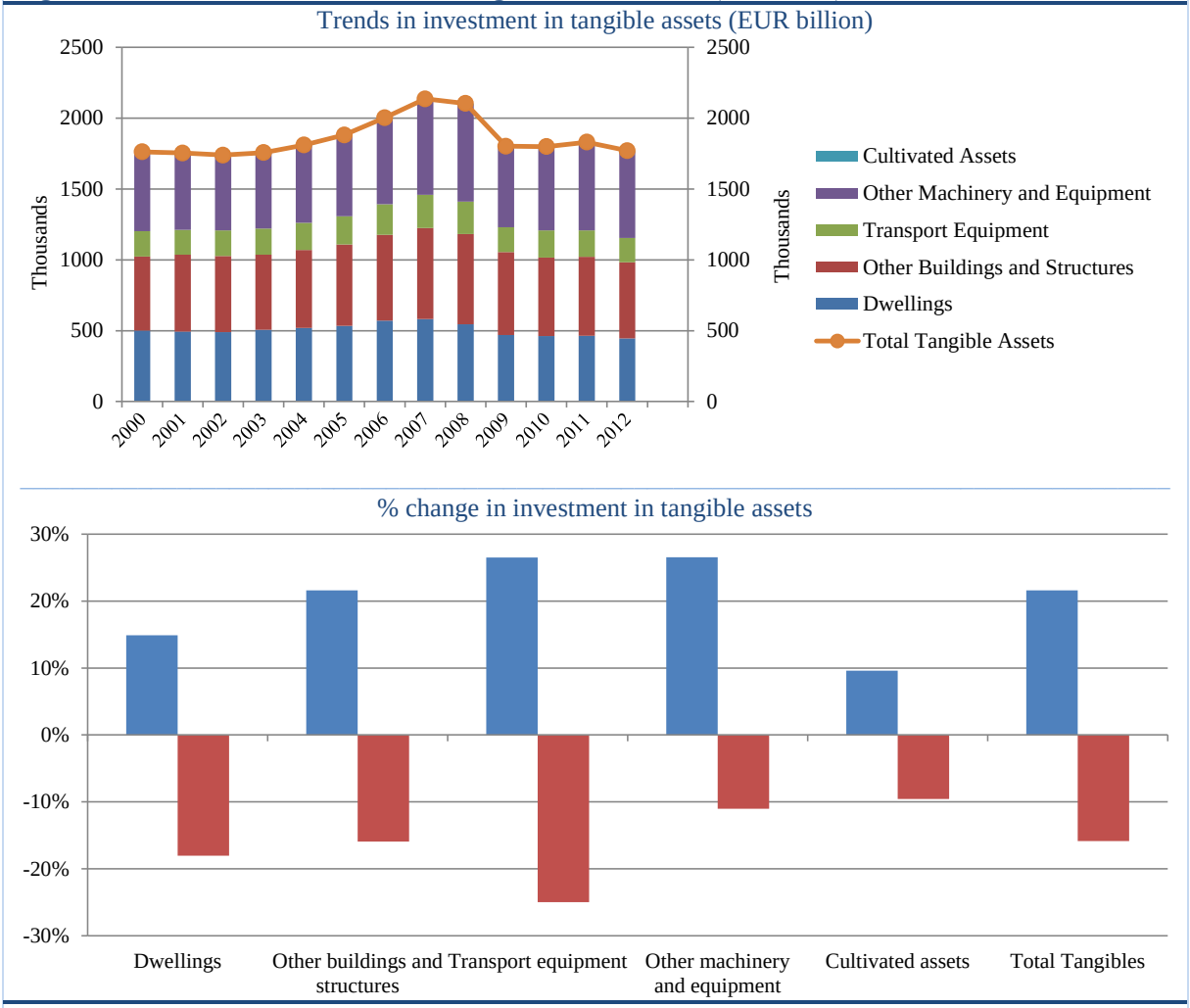
This sub-section analyses firms' behaviour as regards investment in tangible assets in order to answer the following questions:

(i) to what extent is such investment dependent on external finance? and
(ii) has some of the decline in such investment been due to increased financing constraints?

Fixed capital accumulation by firms is one of the most important drivers of economic growth. Investment in productivity-enhancing fixed capital increases the productive capacity of the economy. In Europe, investment in fixed tangible assets, including machinery and equipment, construction and buildings, and other physical capital, accounts for approximately a fifth of total GDP (EIB, 2013).

Since the start of the crisis, there has been a sharp fall in investment in the EU. The peak-to-trough fall in business investment has ranged from 2% in Poland to 59% in Greece, with the more pronounced declines in countries hardest hit by the crisis. In many Member States, investment levels have partially rebounded but they remain far below pre-crisis levels. Eurostat data on the level of investment for particular assets are presented in Figure 2.12. While investment fell in all asset classes, the drop was particularly marked in transport equipment and dwellings.

Figure 2.12: Overview of investment in tangible assets – EU28 (2000-2012)



Source: ESRI analysis of Eurostat data.
Note: Disaggregated gross fixed capital formation data, as published by Eurostat for the EU28.

Box 2.3: Financial variables and firm subsamples

Our analysis includes several financial variables aimed at capturing the influence of both internal and external financing on firm outcomes. Below is a list of these financial variables and their definitions.

Overview of variable definitions used in empirical models

Variables	Construction	Period
	Economic outcome variables	
Tangible investment	Δ Tangible fixed assets plus depreciation/ Tangible fixed assets (t-1)	
Employment	Log of number of employees	
Productivity	Δ log of total factor productivity**	
	Financial variables	
Cash flow	Operating profit plus depreciation / Total assets*	t
Cash stock	Cash and cash equivalents / Total assets*	t-1
Trade credit	(Accounts payable + Receivables) / Total assets*	t-1
Leverage	Total outstanding liabilities (short and long) / Total assets	t-1
Long-term credit flows	Δ Long-term outstanding liabilities / Total assets*	t
Short-Term credit flows	Δ Short-term outstanding liabilities / Total assets*	t
Interest burden	Payments on interest costs / Cash flow	t-1
	Other control variables	
Log age	Log of the number of years for which the enterprise is in operation	t
Non-listed	Dummy indicator for whether or not the enterprise is listed on a formal stock exchange	t
Fundamental Q	Linear combination of sales-to-capital and operating profit to capital ratio ***	t-1
lnY	Log of value of sales	t-1
Market share	Firm i's share of its 2 digit sector's sales	t-1
LnTA	Log of total assets	t-1
LnK	Log of tangible fixed capital	
lnW/Emp	Log of wages per employee	
lnW	Log of wages	t-1

* In the investment model, these variables are scaled by the capital stock so as to equate them with the dependent variable.

** TFP is estimated using the Levinsohn-Petrin methodology which uses intermediate inputs as a proxy for unobserved productivity shocks. An alternative TFP estimation method proposed by Olley and Pakes (1996) uses investment as a proxy for unobserved productivity shock. The choice of the Levinsohn-Petrin method is based on the better data coverage for intermediate inputs than for investment.

*** This method of estimating the Q statistic is in line with Gilchrist and Himmelberg (1995) and Ryan et al. (2014).

* For the investment analysis, the cash flow and cash stock variables are scaled by fixed tangible asset as in the related literature.

Using these financial variables the analysis is carried out on several sub-samples of firms from the Amadeus data. The description of these sub-samples is given below.

Sub-Sample	Firms Included
All firms	All firms regardless of firm size, age, ownership or sector.
All domestic SMEs	All domestic firms with less than 250 employees.
Micro enterprises	All domestic firms with less than 10 employees.
Young enterprises	All domestic firms which have been in existence for less than 6 years.
Developing / mid-age Enterprises	All domestic firms which have been in existence for between 6 and 20 years.
Mature enterprises	All domestic firms which have been in existence for more than 20 years.
Construction	All domestic firms operating in the construction sector.
High-tech manufacturing	All domestic firms in high-tech manufacturing (Eurostat classification using NACE Rev. 2). Includes firms engaged in the manufacture of pharmaceuticals, computer components and aircraft.
High-tech knowledge Intensive market services	All domestic firms in high-tech knowledge intensive market services (Eurostat classification using NACE Rev. 2). Includes firms operating in telecommunications, computer related activities and research and development.
Other manufacturing	All domestic manufacturing firms not classified as high-tech.
Other services	All domestic firms engaged in the services sectors which are not classified as high-tech knowledge intensive.

Econometric analysis of the effects of financial dependence on tangible investment

This section describes the methodology and results of an econometric analysis of the effects of financial dependence on investment. The empirical estimation equation used to analysis the relationship is as follows:

$$\left(\frac{I}{K}\right)_{itcj} = \alpha_0 + \beta_1 \left(\frac{I}{K}\right)_{it-1cj} + \beta_2 Q_{it-1cj} + \gamma F(1)_{it} + \delta F(2)_{it-1} + \pi Z_{it} + \varepsilon_{it}$$

where ε_{it} is a composite error containing firm-specific, time-invariant heterogeneity, sector-time and country-time factors to control for any sector-specific and country-specific cyclical factors and macroeconomic developments. The Q statistic captures the marginal benefit to the firm of an additional unit of capital e.g. how much does profitability increase if the capital stock increases by one unit. It is required in the analysis to capture demand factors as it captures the firm-specific profitability of investing i.e. the signal to the firm that it can profitably employ more fixed capital. It should be positively related to investment. In the empirical model, these factors are controlled for by including binary controls. To capture a range of financial channels available to the firm, two sets of financial variables are included in the vectors F(1) and F(2) which are described above in Box 2.3. The vector Z contains standard controls for firm size, age and stock market listing status. F(1) contains three financial variables which enter the model contemporaneously. These are cash flow and short and long-term credit flows. The vector F(2) contains financials that enter the model in lagged values.

Table 2.2: The effect of financial factors and the financial crisis on tangible investment – enterprise types

	All firms	Domestic SMEs	Micro enterprises	Young enterprises	Developing/ mid-age enterprises	Mature enterprises
Cash Flow	0.351***	0.339***	0.285***	0.260***	0.395***	0.265***
Pre-crisis	0.103	0.121	0.081	0.016	0.156	0.106
Post-crisis	0.2987***	0.298***	0.289***	0.122**	0.362***	0.311***
Cash stock	-0.024	-0.032*	-0.024	-0.043	0.007	-0.057***
Pre-crisis	0.018	0.013	0.018	-0.086***	0.025	-0.016
Post-crisis	-0.027**	-0.027***	-0.033***	.0611**	-0.022*	-0.046***
Trade credit	-0.085	0.007	0.121	-0.324	-0.024	0.152
Pre-crisis	0.184	0.148	-0.091	1.334	-0.066	0.751**
Post-crisis	0.050	0.077	0.045	0.183	0.135	0.127
Interest burden	-0.140	-0.185*	-0.113	-0.598***	0.006	-0.139
Pre-crisis	-0.081	-0.187	-0.097	-2.068***	-0.509	-0.326*
Post-crisis	0.008	-0.015	-0.006	-0.259**	0.009	-0.198*
Leverage	0.944**	0.967**	0.219	0.567	0.103	0.853
Pre-crisis	1.426*	1.542*	1.987**	1.889	1.878*	1.085*
Post-crisis	0.284*	0.344**	0.309	0.909	0.402*	0.701***
Credit flows (long)	0.147***	0.149***	0.181***	0.415***	0.142***	0.080
Pre-crisis	0.097	0.145	0.143	-0.317	0.344*	0.021
Post-crisis	0.1216*	0.112***	0.132***	0.391***	0.119***	0.075
Credit flows (short)	0.057	0.079*	0.038	0.146*	0.072*	0.045
Pre-crisis	0.226	0.261*	0.232**	0.488***	0.291**	-0.028
Post-crisis	0.029	0.042	0.016	0.120***	0.029	0.035
Number of firms	22,540	22,040	7,979	3,262	14,810	12,183
Overall model						
AR(1)	0.272	0.351	0.035	0.079	0.135	0.071
Hansen Test	0.388	0.448	0.717	0.606	0.482	0.752
Pre/post-crisis model						
AR(1)	0.127	0.197	0.061	0.099	0.184	0.023
Hansen Test	0.134	0.135	0.819	0.731	0.648	0.606

*Note: Estimates obtained using a structural Q model of investment estimated using system GMM. Lags of all variables are included as instruments dated t-3, t-4 and t-5. Full estimates are provided in the Background Study. Demand controls include Tobin's Q. Other explanatory variables include lagged investment, firm size, age and an indicator for non-listed firms. Estimates for the pre and post crisis periods are based on model specifications that include a financial crisis dummy interacted with financial variables. *significant at 10% level; **significant at 5% level; ***significant at 1% level. Source: ESRI analysis of Amadeus data.*

These are cash stock, leverage, trade credit and the interest burden. These variables are lagged so as to control for contemporaneous reverse causality.

To estimate the effects of the financial crisis on the relationship between investment and financing constraints, the financial factors are interacted with a binary indicator for the period 2008-2012 to pick up on any differences in effects before and after the start of the financial crisis:

The coefficients on the interaction terms will provide insight into whether or not there is a differential effect following the financial crisis. Of particular importance is the coefficient on cash flow. Cash flows are internally generated funds and distinct from external flows. Examining the relationship between investment and cash flow is the main methodology that is used in the literature (Guariglia, 2008; O'Toole et al., 2014) to identify firms facing external financing constraints. As noted in Bond and Soderbom (2013), if firms receive a one

$$\left(\frac{I}{K}\right)_{itcj} = \alpha_0 + \beta_1 \left(\frac{I}{K}\right)_{it-1cj} + \beta_2 Q_{it-1cj} + \gamma_1 F(1)_{it} + \delta_1 F(2)_{it-1} + \gamma_2 F(1)_{it} \times FC + \delta_2 F(2)_{it-1} \times FC + \pi Z_{it} + \varepsilon_{it}$$

Table 2.3: The effect of financial factors and the financial crisis on tangible investment – industry groups

	High-tech knowledge-intensive services	High-tech manufacturing	Other services	Other manufacturing	Construction
Cash flow	0.701***	0.123	0.314***	0.291***	0.293***
Pre-crisis	0.564***	0.374***	0.358***	0.104	0.089
Post-crisis	0.698***	0.162	0.258***	0.303***	0.249***
Cash stock	-0.05	0.297*	-0.058*	-0.012	-0.033***
Pre-crisis	-0.097*	-0.234**	-0.094**	0.022	0.017
Post-crisis	-0.053	0.275*	-0.006	-0.039*	-0.028***
Trade credit	-0.286	-0.276	-0.364	-0.052	0.279
Pre-crisis	-0.603	-0.717	0.341	-0.032	-0.217
Post-crisis	-0.387	-0.644	0.146*	-0.083	0.241
Interest burden	-0.048	0.135	-0.141	-0.081	0.031
Pre-crisis	-0.797	0.22	-0.226	0.337	0.635*
Post-crisis	-0.058	0.114	0.006	-0.089	-0.003
Leverage	1.602**	2.141**	0.693	0.307	-0.42
Pre-crisis	0.612	1.715	2.374	0.262	0.025
Post-crisis	1.616**	1.038	0.375**	0.314	0.113
Credit flows (long)	0.247*	0.112*	0.139	0.138***	0.163**
Pre-crisis	0.158	0.279	0.107	0.279	0.083
Post-crisis	0.318**	0.113*	0.115***	0.087	0.237
Credit flows (short)	0.168**	0.064	0.07	0.059	-0.007
Pre-crisis	0.065	-0.072	-0.097	0.308**	-0.187
Post-crisis	0.170**	0.092	0.048	0.046	0.023
Number of firms	445	246	11,362	7,718	2,769
Overall					
AR(1)	0.760	0.891	0.316	0.800	0.347
Hansen Test	0.383	0.866	0.070	0.509	0.334
Pre/post-crisis model					
AR(1)	0.617	0.669	0.542	0.853	0.175
Hansen Test	0.591	0.975	0.064	0.210	0.361

Note: Estimates obtained using a structural Q model of investment estimated using system GMM. Lags of all variables are included as instruments dated t-3, t-4 and t-5. Full estimates are provided in the background study. Demand controls include Tobin's Q. Other explanatory variables include lagged investment, firm size, age and an indicator for non-listed firms. Estimates for the pre and post crisis periods are based on model specifications that include a financial crisis dummy interacted with financial variables. significant at 10% level; ** significant at 5% level; *** significant at 1% level.*
Source: ESRI analysis of Amadeus data.

off increase in cash flow which is used immediately for investment, it is very likely that they had profitable projects which could not be financed externally. This important channel is also tested here.

Table 2.2 and Table 2.3 present the summary of estimates across the firm and industry groups described in Box 2.3. The findings suggest that the main financial drivers of investment for European firms are external debt financing through long-term credit flows and internal cash flows. Firstly, total leverage is found to have the greatest effect on investment. The findings suggest that the cash flow reliance is only significant in the post crisis period which may reflect tightened borrowing conditions and increased difficulties in obtaining bank credit.

Long-term credit flows are also found to have positive and significant effects on investment. It is, therefore, crucial that adequate supplies of long-term financing are available to firms to fund capital investment. For the overall sample, the coefficient on long-term credit flows is 0.14%. The sensitivity is higher for young firms (0.41 %) and micro-sized firms (0.18%). These results suggest that *while external finance is a factor in driving investment for all firms, young and micro-sized firms are more reliant on such credit and*, in general, *the reliance on external credit for investment decreases as firms grow and mature*. The large negative coefficient on the interest burden for young firms is a further indication of their comparatively high dependency on external finance to support investment. If their interest burden increases they appear to face greater difficulties supporting new investment than more mature enterprises.

The results also show that short-term credit flows are important to young firms for funding new investment. This may indicate that *financial market imperfections are preventing young firms from obtaining credit at maturities appropriately aligned to investment payback periods.* This may hinder new investment and the growth of firms.

Regarding sectors, cash flow has a positive and significant effect on investment in all sectors except high-tech manufacturing. This suggests the sector does not face the same degree of constraints as other sectors. However, the sector may be receiving outside equity financing which is not captured in data. This may be due to the fact many of these firms have good collateral and financing track records. The coefficient is largest for the high-tech knowledge intensive services firms suggesting these firms are most reliant on internal finance, and potentially have greater difficulties in accessing external credit. However, they also rely on external financing sources, such as long and short-term credit, more than other sectors, suggesting they may have a higher demand for finance to support investment, from both internal and external sources.

Investment by firms in the high-tech manufacturing sector appears highly sensitive to leverage. This can perhaps be explained by a need to externally finance the complex development of production technologies. However, it could also possibly reflect a bias in this industry towards lending being channelled into tangible fixed assets, more so than in other industries.

In relation to external credit flows, for the overall sample, long-term financing has an impact on investment for firms in all sectors except for services. However, since the crisis, the effect of long-term credit flows is positive and significant for high-tech firms (both services and manufacturing) and other service firms.

2.2.4. The Effect of Financial Constraints on Employment

This sub-section addresses the following questions:

(i) how does access to external financing impact on employment?
(ii) how do financing constraints affect employment for different types of firms?
(iii) how do financing constraints affect employment in different industrial sectors?

A number of channels have been examined to explore the link between finance and employment. As the hiring of new employees is linked to investment choices, and investment is partly driven by access to finance, employment growth should be partially dependent on external financing (Nickell and Nicolitsas, 1999). There is also empirical evidence to suggest that increased pressure on finances can have large negative effects on employment (Nickell and Nicolitsas, 1999; Hernando and Martínez-Carrascal, 2008). In this respect, recent research has shown that young, small firms experienced a relatively larger decline in net employment growth compared with large firms during the 2007-2009 financial crisis (Fort et al., 2013).

To examine these effects, a labour demand equation augmented with financial variables was estimated for the groups of firms and industries described in Box 2.3. Firstly, the average effect on the demand for labour from a range of financial variables was estimated for all firms for the full period, between 2004 and 2012. The relationship was also estimated on separate firm samples for different types of firms and industry groups. An additional model was also estimated to examine the change in the relationship between financial variables and firm employment before and after the crisis. The financial variables

used in model specifications are described in Box 2.3. The main findings of the effects of the financial variables on employment are summarised in Table 2.4 and 2.5.

Econometric analysis of the effect of financial dependence on employment

To analyse the effects of financial variables on firm employment, a labour demand equation augmented with financial variables is estimated as follows:

$$LnEmp_{itcj} = \alpha_0 + \beta_1 LnEmp_{it-1cj} + \beta_2 LnEmp_{it-2cj} + \beta_3 LnK_{it-1cj} + \beta_4 \Delta Ln\left(\frac{W}{Emp}\right)_{itcj} + \beta_5 Ln\left(\frac{W}{Emp}\right)_{it-1cj} + \beta_6 \Delta LnY_{itcj} + \gamma F(1)_{it} + \delta F(2)_{it-1} + \pi Z_{it} + \varepsilon_{it}$$

The dependent variable is the natural logarithm of employees in firm i, industry j, country c, at time t. The explanatory variables are firm characteristics: lagged employment in t-1 and t-2, the log of capital stock (tangible assets), the change in the log of the average firm wage, lagged level of average real wage and the change in log of output. The financial variables are included as before in vectors F(1) and F(2).

Table 2.4 shows that on average, for the full sample

Table 2.4: The effect of financial factors and the financial crisis on employment – enterprise types

	All firms	Domestic SMEs	Micro enterprises	Young enterprises	Developing/ mid-age enterprises	Mature enterprises
Cash flow	0.041	0.110	0.127	-0.160	0.064	-0.270
Pre-crisis	-0.236	-0.167	-0.170	1.823*	-0.080	-0.270
Post-crisis	0.076	0.138	0.144	-0.486*	0.266*	0.028
Cash stock	0.109	0.090	0.185	0.357***	0.007	0.090
Pre-crisis	0.004	0.010	0.163	0.249	-0.060	0.040
Post-crisis	0.094*	0.055	0.118	0.322***	0.001	0.131**
Trade credit	0.069	0.060	0.138	-0.056	0.024	-0.076
Pre-crisis	0.169	0.197	0.385	-0.093	0.168	0.145
Post-crisis	0.002	0.008	0.053	-0.059	0.050	-0.044
Interest burden	-0.012	-0.028	-0.041	-0.022	-0.035	-0.039
Pre-crisis	-0.108	-0.104	-0.081	-0.057	-0.096	-0.128**
Post-crisis	-0.008	-0.023	-0.057	-0.016	-0.025	-0.003
Leverage	0.148**	0.111*	0.187***	0.067	0.028	0.131**
Pre-crisis	0.101***	0.086**	0.124**	0.319	0.107**	0.053
Post-crisis	0.080***	0.072***	0.116**	0.025	0.053	0.106***
Credit flows (long)	0.452**	0.531**	0.763**	-0.008	0.328*	0.137
Pre-crisis	1.239	1.257	1.229	-0.490	0.026	0.883
Post-crisis	0.302	0.405*	0.669**	0.034	0.343*	0.163
Credit flows (short)	0.175	0.287	0.290	-0.161	0.308	0.518
Pre-crisis	-0.298	-0.161	-0.312	-0.576	-0.336	0.713
Post-crisis	0.244	0.355	0.347	-0.163	0.490*	0.390
Overall model						
Number of firms	22,540	22,040	7,979	3,262	14,810	12,183
AR(1)	0.667	0.881	0.779	0.839	0.939	0.614
Hansen Test	0.147	0.136	0.228	0.499	0.035	0.371
Pre/post-crisis						
AR(1)	0.550	0.993	0.599	0.556	0.894	0.694
Hansen Test	0.240	0.250	0.298	0.780	0.103	0.407

*Note: Estimates were obtained with a system GMM estimator. Estimates presented here are based on full estimation results presented in the background study. Model specifications also include natural log of employment in periods t-1 and t-2, wage per employee in t-1, growth in average wage in t, log of capital stock in total assets in t, dummy for non-listed firms, firm age, growth in firm turnover and a financial crisis dummy. Estimates for the pre and post crisis periods are based on model specifications that include a financial crisis dummy interacted with financial variables. * significant at 10% level; ** significant at 5% level; *** significant at 1% level.*
Source: ESRI analysis based on Amadeus.

of firms, long-term credit flows have a significant and positive impact on employment demand. The responsiveness of employment demand to long-term credit flows varies for different types of firms, with effects being most important for domestic-owned SMEs and micro firms. For young firms, aged 5 years or less, the share of cash stock was also found to be important for employment.

Table 2.5 shows the estimates for the industry groups. On average, access to trade credit appears to be significant for all sectors with the exception of the high-tech knowledge-intensive services sector.

Comparing the relationship between the labour demand and sources of financial dependence between the pre- and post-crisis period, trade credit had a significant impact on labour demand for domestic, micro and firms aged between 6-20 years in both periods. Access to more long-term credit was found to have had a positive effect on labour demand for SME, micro firms and firms aged between 6 and 20 years in the post financial crisis period. An increased use of trade credit appears to have had a positive effect on labour demand for high-tech manufacturing, other services and other manufacturing in both periods.

2.2.5. The effect of financial constraints on productivity growth

This sub-section examines the relationship between financial constraints and productivity growth and the impact of the financial crisis on this relationship. The effects of financing constraints on productivity growth are also considered across different groups of firms and different industry sectors.

Long-term, output per capita growth is largely driven by productivity growth and cross-country

Table 2.5: The effect of financial factors and the financial crisis on employment - industry groups

	High-tech knowledge intensive services	High tech manufacturing	Other services	Other manufacturing	Construction
Cash flow	0.333*	-0.018	-0.042	0.337	0.293
Pre-crisis	1.719	-0.119	-0.192	-0.193	0.896
Post-crisis	0.242	-0.065	0.062	0.248	0.158
Cash stock	-0.143	0.148	0.257**	-0.055	0.484**
Pre-crisis	0.196	-0.018	0.084	-0.176	0.297
Post-crisis	-0.127	0.104	0.108	0.040	0.261*
Trade credit	-0.592***	-0.122	0.156	0.030	-0.103
Pre-crisis	0.573	-0.152	0.363	0.187	-0.217
Post-crisis	-0.650***	-0.061	0.102	-0.030	-0.248
Interest burden	-0.044	0.000	0.023	0.003	-0.090
Pre-crisis	0.050	-0.086*	-0.099	-0.103	-0.020
Post-crisis	-0.045	0.014	0.014	0.014	-0.091
Leverage	-0.023	0.146**	0.142**	0.122**	0.210**
Pre-crisis	0.179	-0.254*	0.104**	0.172***	0.289**
Post-crisis	-0.010	0.080*	0.073**	0.082***	0.130
Credit flows (long)	0.406*	0.096	0.231	0.145	0.397
Pre-crisis	0.631	0.871**	0.655	0.282	0.569
Post-crisis	0.356	0.104	0.217	0.092	0.289
Credit flows (short)	1.236**	0.238	0.190	-0.241*	0.591**
Pre-crisis	1.921***	-0.299	-0.356	-0.531	0.470
Post-crisis	0.948	0.190	0.292	-0.207	0.725***
Number of firms	445	246	11,362	7,718	2,769
Overall model					
AR(1)	0.24	0.263	0.849	0.499	0.094
Hansen Test	0.45	0.348	0.009	0.105	0.357
Pre/post-crisis model					
AR(1)	0.497	0.09	0.728	0.484	0.097
Hansen Test	0.144	0.259	0.013	0.076	0.118

*Note: Estimates were obtained with system GMM estimators. Estimates presented here are based on full estimation results presented in the background study. Model specifications also include natural log of employment in periods t-1 and t-2, wage per employee in t-1, growth in average wage in t, log of capital stock in total assets in t, dummy for non-listed firms, firm age, growth in firm turnover and a financial crisis dummy. Estimates for the pre and post crisis periods are based on model specifications that include a financial crisis dummy interacted with financial variables. * significant at 10 per cent level; ** significant at 5 per cent level ; *** significant at 1 per cent level.*
Source: ESRI analysis based on Amadeus.

differentials in productivity growth can be explained by differences in total factor productivity (TFP) (Hall and Jones, 1999; Easterly and Levine, 2001). Financial frictions may lead to lower firm productivity by hampering investment in high quality projects (Moreno-Badi and Slootmaekers, 2009). Liquid financial markets facilitate long-term productivity-enhancing investments (Bencivenga et al., 1995) and efficient financial markets allocate savings to productivity-enhancing projects (King and Levine, 1993). However, exiting evidence also indicates that the pressure from financial constraints may also lead to improved firm productivity (Nickell and Nicolitsas, 1999; Pushner 1995; Lang et al. 1996; and Smith et al., 2004).

Econometric analysis of the effects of financial dependence on productivity growth

The analysis of the impact of financial constraints on firm productivity follows a production function approach similar to Nickell and Nicolitsas (1999). This analysis is based on the following dynamic empirical model for total factor productivity:

$$\Delta \mathrm{LnTFP}_{\mathrm{itcj}} = \alpha_0 + \beta_1 \Delta \mathrm{LnTFP}_{\mathrm{it-1cj}} + \beta_2 \Delta \mathrm{LnY}_{\mathrm{it-1cj}} + \beta_3 \mathrm{MS}_{\mathrm{it-1cj}} + \beta_4 \Delta \mathrm{LnTA}_{\mathrm{it-1cj}} + \gamma_1 \mathrm{F(1)}_{\mathrm{it}} + \delta_1 \mathrm{F(2)}_{\mathrm{it-1}} + \pi \mathrm{Z}_{\mathrm{it}} + \varepsilon_{\mathrm{it}}$$

Table 2.6: The effect of financial factors and the financial crisis on TFP growth – enterprise types

	All firms	Domestic SMEs	Micro enterprises	Young enterprises	Developing/mid-age enterprises	Mature enterprises
Cash Flow	0.465***	0.498***	0.667***	0.175	0.606***	0.622***
Pre-crisis	-0.030	-0.046	0.085	0.319	-0.047	-0.023
Post-crisis	-0.000	0.007	0.130*	0.339***	-0.016	0.237***
Cash stock	0.006	0.007	0.004	-0.685	-0.061	-0.069
Pre-crisis	-0.059	-0.074*	-0.123*	0.099	-0.075	-0.028
Post-crisis	-0.041**	-0.044***	-0.065***	-0.176***	-0.037*	-0.052***
Trade credit	0.010	0.006	0.019	-0.096	0.019	0.021
Pre-crisis	-0.010	-0.01	-0.017	-0.036	-0.037	-0.028
Post-crisis	-0.003	-0.002	-0.003	0.034	-0.008	-0.002
Interest burden	-0.001	0.001	0.016	-0.12	-0.018	0.004
Pre-crisis	-0.013	-0.031	-0.028	-0.095	-0.032	-0.042
Post-crisis	0.004	0.006	0.015	0.005	0.002	0.004
Leverage	-0.065	-0.057	-0.132	0.648**	0.005	-0.016
Pre-crisis	-0.057	-0.064	-0.149	-0.191	-0.173	-0.073
Post-crisis	-0.011	-0.015	-0.047*	-0.068	0.002	-0.065***
Credit flows (long)	-0.002	-0.001	-0.005	0.083	-0.001	0.001
Pre-crisis	0.004	0.016	0.03	-0.062*	0.032	0.026
Post-crisis	-0.002	-0.003	-0.002	-0.012***	0.011	-0.010
Credit flows (short)	0.001	0.000	-0.002	-0.042	-0.001	0.011**
Pre-crisis	0.011	0.009	-0.005	-0.042	0.002	-0.006
Post-crisis	0.012*	0.011	0.004	-0.000	0.004	0.005
Number of firms	22,540	22,040	7,979	3,262	14,810	12,183
Overall model						
AR(1)	0.027	0.052	0.067	0.366	0.862	0.019
Hansen Test	0.052	0.112	0.148	0.89	0.263	0.252
Pre/Post crisis model						
AR(1)	0.381	0.414	0.175	0.251	0.707	0.106
Hansen Test	0.472	0.493	0.324	0.549	0.887	0.221

*Note: Estimates were obtained with system GMM estimators. Estimates summarised here are based on full estimation results presented in the Background Study. Model specifications also include the growth rate of TFP in period t-1, sales growth, market share, dummy for non-listed firms, firm age, firm size and a financial crisis dummy. Estimates for the pre and post crisis periods are based on model specifications that include a financial crisis dummy interacted with financial variables. *significant at 10 per cent level; **significant at 5 per cent level; ***significant at 1 per cent level.*
Source: ESRI analysis of Amadeus data.

The dependent variable, ΔLn TFP, is the difference in the natural logarithm of total factor productivity in firm i, industry j, country k, at time t, and in the previous year. Total factor productivity is obtained using the Levinsohn-Petrin methodology (Levinsohn and Petrin, 2003) to correct for simultaneity and selection biases related to firms' decisions on factor inputs and unobserved productivity shocks. As explanatory variables, the lagged change in TFP, the lagged changes in output to capture demand shocks, the lagged values of the firms' market power (MS0, and the lagged change in total assets (TA) to capture firm growth effects are also included. The financial factors contained in the vectors F(1) and F(2) are identical to those included in the employment model discussed above.

is evident in the positive and significant coefficient for cash flow in almost all iterations of the model without financial crisis interactions. The positive and significant coefficient indicates that TFP growth is sensitive to cash flow shocks. This finding implies that firms' TFP growth is constrained by the availability of internal funds. The effect is particularly large for micro enterprises suggesting their productivity growth is more sensitive to internal financing which implies greater financing constraints for this group.

The results indicate that, post-crisis, productivity growth was very sensitive to cash flow for the youngest firms, mature firms, firms in the construction sector and firms in the high-tech manufacturing and high- tech services sectors. The

Table 2.7: The effect of financial factors and the financial crisis on TFP growth – industry groups

	High-tech knowledge intensive services	High-tech manufacturing	Other services	Other manufacturing	Construction
Cash Flow	0.206**	0.422***	0.372***	0.567***	0.301***
Pre-crisis	1.140***	-0.227	-0.087	0.291	0.437*
Post-crisis	0.274***	0.357***	0.098	0.082	0.193***
Cash stock	-0.136	-0.170**	-0.018	-0.034	-0.113
Pre-crisis	-0.049	-0.142	-0.097*	-0.034	-0.039
Post-crisis	-0.053	-0.134	-0.046**	-0.060**	-0.089***
Trade credit	-0.014	-0.057*	-0.024	-0.043	0.000
Pre-crisis	-0.029	0.145	-0.031	-0.002	0.041
Post-crisis	0.014	-0.033	-0.002	0.005	-0.017
Interest burden	-0.002	0.006	-0.008	0.013	0.014
Pre-crisis	-0.022	0.082	-0.011	-0.011	0.057
Post-crisis	-0.019**	0.011	0.013	0.003	0.019
Leverage	0.015	0.048	-0.054	0.036	-0.049
Pre-crisis	0.049	-0.100	-0.167	-0.035	-0.041
Post-crisis	0.087*	0.030	-0.014	-0.010	-0.049
Credit flows (long)	0.002	0.000	-0.01	0.014	0.008
Pre-crisis	0.039	-0.091*	0.025	-0.024	0.005
Post-crisis	0.005	-0.000	-0.003	0.004	0.006
Credit flows (short)	-0.007	0.000	-0.007*	0.009**	0.006
Pre-crisis	0.027	0.021	0.008	0.004	-0.006
Post-crisis	-0.006	-0.001	-0.001	0.009	0.003
Number of firms	445	246	11,362	7,718	2,769
Overall model					
AR(1)	0.739	0.346	0.131	0.022	0.056
Hansen Test	0.082	0.352	0.143	0.356	0.185
Pre/Post crisis model					
AR(1)	0.068	0.328	0.169	0.314	0.274
Hansen Test	0.209	0.169	0.487	0.138	0.288

*Note: Estimates were obtained with system GMM estimators. Estimates summarised here are based on full estimation results presented in the Background Study. Models specifications also include the growth rate of TFP in period t-1, sales growth, market share, dummy for non-listed firms, firm age, firm size and a financial crisis dummy. Estimates for the pre and post crisis periods are based on model specifications that include a financial crisis dummy interacted with financial variables. * significant at 10 per cent level; ** significant at 5 per cent level; *** significant at 1 per cent level.*
Source: ESRI analysis of Amadeus data.

The econometric estimates indicate that, over the analysed period, financing constraints affected the productivity growth of European SMEs. This effect

sensitivity effect is stronger for younger firms relative to mature firms. These findings suggest that financing constraints have become an important

issue for the productivity growth of these firms in the wake of the crisis.

The empirical estimates highlight a negative relationship between cash stocks and productivity growth across all sectors, although not all estimates are significant. In the post-crisis period, a negative and significant link appears for firms in construction, other services and other manufacturing. This could be interpreted as cash stock being used to make productive investments.

2.2.6. The Effect of Financial Constraints on Exports

Exporting is an important driver of firm growth. It has been established through theoretical and empirical research that exporting involves high sunk costs that can only be overcome by firms which achieve a productivity level above certain thresholds

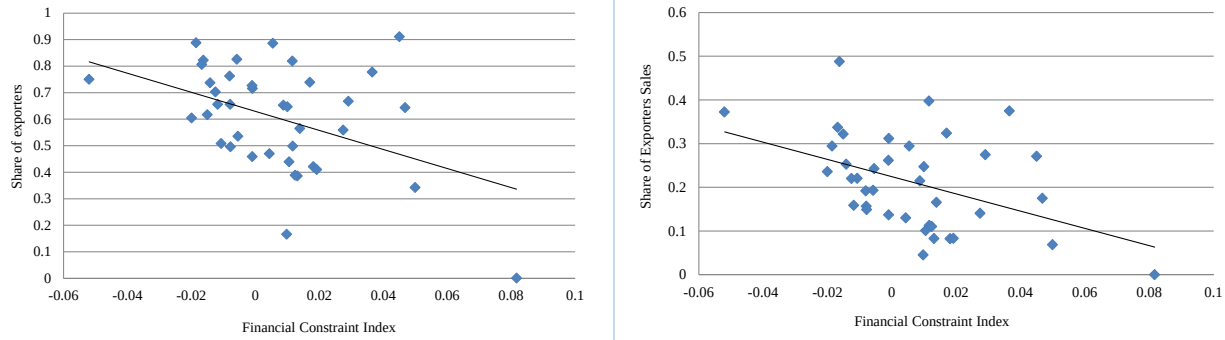
The EFIGE dataset was used to examine these questions.[22]

Figure 2.13 shows the relationship between financial constraints measured as a composite index[23] and export behaviour. The negative sloping fitted lines suggest that industries with a higher average financial constraint index had a lower proportion of exporters and a lower share of export sales. This suggests that financial constraints may have an adverse effect on firms' export performance.

To examine the effect of financial constraints on export participation and how much firms export, a Heckman two stage model specification was estimated. The empirical model is specified as follows:

$$ln(X_{ickt}) = \theta + \rho Z_{ickt-1} + \sigma F_{ickt-1} + \mu_{ickt-1} \quad if \quad X_{ickt} > 0$$

Figure 2.13: Financial constraints and export performance by country-industry groups



Note: The share of exporters is defined as the mean number of exporters for each country-industry group. The share of exporters' sales is defined as the mean share of sales from exports in total firm sales for each country-industry group. The financial constraint index is the mean value for each country-industry group.
Source: ESRI analysis of EFIGE dataset.

(Bernard and Jensen, 1999; Melitz 2003; Bernard et al., 2007. It has also been shown that in imperfect financial markets, increased access to external financing magnifies the effect of productivity on the selection of firms which export (Manova, 2008; Berman and Héricourt, 2010; Bellone et al., 2010). Given that access to external financing impacts on productivity, and that productivity is a driver of exports, financial conditions are likely to influence the likelihood of firms to export, as well as their level of export sales.

This sub-section addresses the following policy relevant questions:

(i) How do financing constraints relate to the decision of firms to export?
(ii) How do financing constraints affect how much firms export?
(iii) What are the effects of financing constraints on export performance for different groups of firms?

The dependent variable X_{ickt} is the share of turnover that is exported by firm *i* in country *c* industry *k* during year *t*. The selection equation is a function of firm characteristics, financial constraint index and controls for unobserved industry and country specific effects. The export intensity was estimated as a function of the same determinants

[22] The EFIGE data set combines information on financial variables and export activity at firm level obtained with a survey of a representative sample of firms in Austria, France, Germany, Hungary, Italy, Spain, and the United Kingdom. Altomonte and Aquilante (2012) provide a description of the survey and data set.

[23] The financial constraints index is constructed using the estimates from a structural investment model taken from Whited and Wu (2006). The variables included in the model are: the ratio of cash flow to total assets; a binary variable which is equal to one if the firm pays cash dividends, and zero otherwise; the ratio of the long-term debt to total assets; the natural logarithm of total assets; firm's two digit industry sales growth; firm's sales growth. Further details on the model specification and data are available in the Background Study for this chapter.

except for the firm employment variable which was excluded for identification purposes. In order to assess the effects of financial constraints on export performance across different groups of firms, the financial constraints index was interacted, separately, with ownership, age, size and sector group characteristics of firms. This advantage of the Heckman selection model approach is that it addresses the selection bias that arises if only exporting firms are used as a basis for examining export sales.

Table 2.8 presents a summary of empirical estimates of the effect of financial constraints on export participation and export sales across different groups of firms. Financial constraints reduced the export participation of firms younger than 20 years, domestically-owned firms, and firms in traditional industries. Also, financial constraints reduced the export propensity of small firms, as measured by the number of employees. The relationship is weaker as firm size increases and becomes insignificant for firms above the median percentile. The average marginal effect of the firms' financial constraint index on export sales intensity was not significant across all categories.

In summary, the empirical evidence indicates two main findings: firms which are less constrained financially are more likely to export, possibly because these firms have the available funds to overcome the sunk costs of entry into export markets. Secondly, financial constraints do not affect the export sales (intensity) of those firms who are already exporting.

2.3. CONCLUSIONS AND POLICY IMPLICATIONS

This chapter has assessed if there are financial market imperfections which affect certain types of firms and examined the effect of various financial drivers on the growth of firms. These two issues are complementary in the sense that financial market imperfections will hinder firm growth if they obstruct the provision of the main drivers of firm growth, i.e. investment, employment, productivity and exports.

Consistent with the descriptive statistics drawn from the SAFE data set, the econometric analysis of determinants of financial constraints revealed that both actual and perceived constraints are higher for smaller and younger firms, with actual constraints decreasing with firm age when controlling for demand-related factors such as turnover, profitability and indicators of firms' financial standing. This indicates that small and micro firms are disadvantaged in terms of access to bank credit. This is most likely due to financial market imperfections stemming from *information asymmetries* which can occur on both the demand and supply-side.

Table 2.8: The effects of financial constraints on export participation and export sales intensity

	Export participation	Export sales intensity
Foreign owned firms	-0.092	0.292
	(0.504)	(1.396)
Domestic owned firms	-0.429*	-0.766
	(0.242)	(0.871)
Firms 20 year old or less	-0.810***	-0.623
	(0.301)	(1.281)
Firms older than 20 years	-0.149	-0.734
	(0.268)	(0.862)
Employment (25th percentile)	-0.638**	-0.560
	(0.270)	(1.109)
Employment (50th percentile)	-0.468*	-0.535
	(0.240)	(0.909)
Employment (75th percentile)	-0.297	-0.532
	(0.244)	(0.794)
Scale-intensive industries [a]	0.230	-0.034
	(0.332)	(1.169)
Traditional industries [a]	-0.894***	-0.842
	(0.276)	(1.081)
Specialised industries [a]	0.444	-0.171
	(0.416)	(1.139)
Science-based industries [a]	-0.842	-0.227
	(0.621)	(1.826)

*Note: The figures shown are marginal effects obtained from a Heckman selection model. Full estimates are presented in the Background Study. Robust standard errors in parentheses. *significant at 10 per cent level; **significant at 5 per cent level; ***significant at 1 per cent level. [a] Firms are classified following Pavitt (1984). This classification is based on the technological class of the industry the firm is in.*
Source: ESRI analysis of the EFIGE dataset.

The descriptive statistics of the SAFE data set highlighted that credit-rationed firms make up the largest group of financially constrained firms, followed closely by discouraged borrowers, with only a small proportion of firms indicating that the cost of borrowing was too high. These findings indicate that financing constraints faced by enterprises in the EU appear to be volume rather than price-based, highlighting supply-side difficulties.

In general, policy measures aimed at improving access to external financing should target smaller and younger firms, as well as innovative firms. With respect to industries, firms in the high-tech knowledge-intensive services sector appear to face the greatest barriers to obtaining external financing. Policy measures should address information asymmetries which may be obstructing the flow of credit from the supply and demand side.

On the supply side, traditional policy support mechanisms such as loan guarantees, risk-sharing

initiatives and direct loan facilities are able to support credit to SMEs. In addition, public support for other sources of financing, such as equity financing in the form of venture capital financing, for small and young firms, also helps counter the disadvantages that these firms face in the market for bank credit by diversifying the sources of finance available to them. A way of addressing information asymmetries is to standardise the financial information on SMEs available made available to lenders across the market for financial products. This could be in the form of a standardised credit rating that could be used as a reference by all banks similar in purpose to the standardised credit ratings issued for government, municipal and corporate debt.

On the demand side, policy measures aimed at reducing the amount of discouraged borrowers amongst SMEs can potentially have a significant impact. Policy measures that facilitate the development of borrower financial capabilities and capacities would be beneficial, such as training in the preparation of financial documentation for bank-lending applications and raising the awareness of SMEs to the different financing sources available to them. These measures are of particular importance for *micro and small enterprises and young firms*.

Given the variation of the severity of the financial crisis across countries, policy measures and instruments to improve SMEs' access to external financing should consider country specific conditions. SMEs' financing constraints have been highest in Ireland, Greece and Spain, the countries with the most severe banking and sovereign debt crises.

Small and young firms are disadvantaged in the market for bank credit but these types of firms also benefit the most from such bank credit. Small and young firms are also the most sensitive to the interest burden on lending, underlining the need to provide affordable credit. For young firms, short-term credit is also important for funding *investment*. This may indicate that financial market imperfections are preventing young firms from obtaining credit at maturities appropriately aligned to investment payback periods.

The main financial drivers of *employment* were found to be long-term credit flows. The responsiveness of employment demand to long-term credit flows varies for different types of firms, with effects being most important for domestic-owned SMEs and micro firms. For young firms, aged 5 years or less, the share of cash stock was also found to be important for employment. In general, there was found to be a negative relationship between cash stock and investment which may suggest that firms choose between new hiring and tangible investment to drive firm growth. While for young firms employment seems to be more responsive to the availability of internal funding, in mature firms employment is funded to a greater extent by access to trade credit. Access to trade credit appears to be important for employment, particularly in manufacturing and services other than high-tech services.

The econometric estimates indicate that, over the analysed period, financing constraints affected the *productivity* growth of European SMEs. The evidence indicates a strong positive relationship between access to external financing and total factor productivity for young firms. This result reinforces other findings on the importance of access to external financing for young firms.

With regard to firms' growth through exports, the study supports the notion that improved access to external financing is likely to foster export participation over the long term. This implies the need to slightly depart from current trade policy which puts more focus on supporting existing exporters.

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Chapter 3.
DRIVERS OF SME INTERNATIONALISATION

Small and medium-sized enterprises (SMEs) represent the backbone of the European economy. In the EU, SMEs comprise 99 per cent of all firms and about 60 per cent of total output in the business enterprise sector[24]. However, SMEs are less likely to enter international markets compared to larger firms suggesting that they face particular disadvantages competing outside their domestic markets. At the same time SMEs are less competitive than their larger counterparts with lower levels of productivity and innovation activities.

Advances in ICT and logistics systems, deregulation of markets, reduced trade barriers, new forms of international financial transfer options, and the establishment of the EU Single Market have reduced the costs of exporting and given SMEs opportunities to enter foreign markets. SMEs tend to enter foreign markets primarily as exporters since doing so requires little capital investment and is therefore less risky. Indirect exports through intermediaries also play a role. This type of exporting is regarded as the least risky entry mode. Foreign direct investment, meanwhile, is considered the second-most important mode of internationalisation[25]. Other forms of internationalisation, such as non-equity contractual modes, are rarely seen in manufacturing and business services. Franchising and licensing, on the other hand, are dominant foreign entry modes in retail, accommodation, and restaurants, where exports do not play a role.

However, not all SMEs face the same opportunities to internationalise their production. Internationalisation strategies differ systematically according to inherent firm characteristics such as initial productivity, skill intensity, innovation activities, and management characteristics. The related literature suggests that internationally active SMEs are generally more productive and more innovative and employ a larger share of skilled workers. That said, there is little evidence available on how these relationships vary across industries and different groups of SMEs (i.e. micro enterprises versus larger SMEs). Similarly, there is little evidence as to whether these differences vary across destination markets.

The factors influencing the internationalisation decisions of SMEs can be divided into two groups: internal firm-specific factors and external factors. Firm-specific factors include firm size, labour productivity, skill intensity, innovation activities, and foreign ownership. External factors consist of home-country characteristics such as export promotion programmes, costs and time involved in exporting, and transport costs; and host-country characteristics such as tariffs, regulations, political risk factors, and geographical and cultural distance.

To the extent that internationalisation is an important strategy used by SMEs to enhance their competitiveness and growth performance, it is clearly important to develop an understanding of the reasons underlying firms' outward internationalisation activities, both in terms of their mode choices and how intensively they engage in them. Such insights can be used to inform policymakers as they continue to develop schemes that best promote SME internationalisation in Europe.

This chapter provides new empirical evidence on the degree and modes of internationalisation of European SMEs using internationally comparable data. It highlights the trends, determinants, and impacts of SME internationalisation while distinguishing between different internationalisation modes, such as exporting and outward FDI activities. In particular, it investigates the firm characteristics and key drivers that influence the internationalisation of SMEs. For instance, these firms' export participation varies widely by firm size, industry affiliation, firm age, and destination market. Possible factors influencing the export decisions of SMEs include the initial level of labour productivity, innovation activities, foreign ownership, and geographical location, as well as home- and host-country factors (e.g. business climate conditions and export regulations). Furthermore, it provides evidence on the benefits of internationalisation in terms of firm growth. In addition, the chapter places special emphasis on the internationalisation activities of micro enterprises.

[24] Figures are based on Structural Business Statistics 2010. In line with the European Commission recommendation (2003/361/EC), small and medium-sized enterprises (SMEs) are defined as firms with less than 250 employees. Within this categorisation, small firms are those with less than 50 employees, microenterprises less than 10 employees, and medium-sized firms between 50 and 250 employees. The European Commission also definition includes alternative references to annual turnover and balance sheet totals by size class.

[25] Internationalisation modes are described in the first section of this chapter and analysed in subsequent sections. In the context of the EU, SME internationalisation refers to transnational activities outside the EU although intra- and extra-EU distinctions are made where appropriate.

Little is known about the export participation of micro enterprises[26] and their primary export destinations. Several data sources are used to describe internationalisation activities of European SMEs across industries, time, and destination markets[27]. A set of policy conclusions is then developed based on the empirical results.

Section 3.1 provides the theoretical background with an overview of the different internationalisation modes and provides a brief survey of the empirical literature. Section 3.2 investigates the trends, patterns, and sectoral breakdown of SME internationalisation, focusing primarily on SME exporting, the main destination markets and, to a lesser extent, on outward FDI activities. Section 3.3 provides a detailed empirical analysis of the drivers of internationalisation while distinguishing between internal and external factors. Section 3.4 then provides a detailed analysis of the effects of exporting on SME performance while Section 3.5 presents the broader policy dimension.

3.1. SME INTERNATIONALISATION RESEARCH

Internationalisation is a key factor in SME performance in terms of productivity, profitability, innovation, and growth. At the same time, firm size, innovation, and performance are key determinants of SME internationalisation choices and their success in foreign markets. In other words, only the best firms can bear the higher fixed costs of international operations. The costs and the characteristics that enable SMEs to overcome these elements are examined below.

3.1.1. Modes and stages of internationalisation

Possible modes of entry into international markets include direct and indirect exports via a domestic intermediary, non-equity contractual modes (for example, licensing, franchising, and management contracts; subcontracting, long-term contracts and offshoring), and equity-based modes. The latter include foreign direct investment (in the form of both greenfield investment and mergers and acquisitions, or M&As) and other forms of international involvement (such as joint ventures).

Since SMEs face higher resource constraints in terms of financing, information, and management capacity – as well as external barriers such as market imperfections and regulations – they tend to resort more often to forms of internationalisation that require less commitment. This explains why exporting is still the most frequent type of international activity (Welch et al. 2007). For similar reasons, SMEs choose contractual arrangements more often than large firms and prefer minority stakes to full ownership (Nakos et al., 2002).

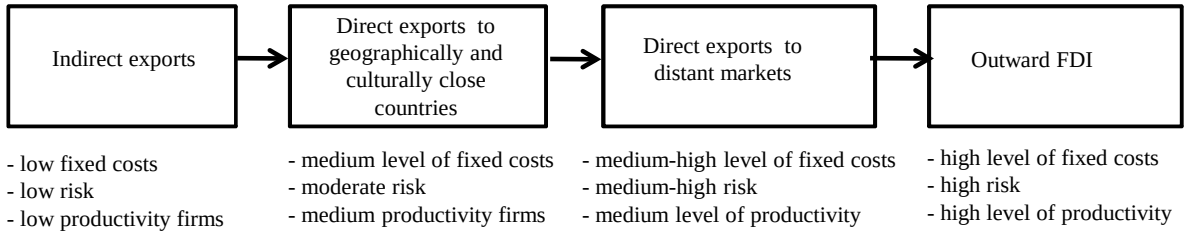
There are two major views of the internationalisation process of SMEs. The first perspective sees internationalisation as a gradual, learning progression from the domestic market in question to foreign operations, often referred to as the "Uppsala model" after Johanson and Vahlne (1977). The second perspective argues that an SME can be born global, meaning that it can be international right from its foundation. Previous literature suggests that SMEs in mature industries are more likely to follow a gradual approach to internationalisation. The "born-global" approach, on the other hand, is more common in technology-intensive firms (Armario et al., 2008).

The gradual approach to SME internationalisation results from incremental decisions (Figure 3.1). SMEs usually start to internationalise by means of ad hoc exporting through domestic intermediaries (indirect exports) before eventually engaging with foreign agents. Indirect exporting is commonly regarded as the least risky entry mode. As sales grow, domestic agents are replaced by their own foreign sales organisations (another aspect of the Uppsala model). Ultimately, rising sales enable firms to begin establishing a production unit abroad. At this stage, complex outward internationalisation activities are often undertaken, including exporting, FDI, and offshoring; followed at the same time, these different internationalisation strategies are complementary to each other. Another feature of this type of gradual internationalisation process is that SMEs start to export to countries that are in close proximity to their respective countries of origin. Close proximity can be defined in several ways; in this context, it includes geographical distance; cultural factors, such as a common language or a former colonial relationship; and political and economic factors. After some time, companies expand their activities to more distant markets. Within the gradual approach, the internationalisation decision is limited by two main factors: firms' resources and information problems. To minimise risk, firms choose foreign markets with less uncertainty. It should be noted that the gradual approach to SME internationalisation implicitly assumes that exports and FDI are substitutes.

[26] Note that micro firms with less than 10 employees account for the majority of firms in the European Union with a share of 94 percent of the 24 million firms in 2010 (Eurostat New Cronos).

[27] Previous studies on internationalisation of SMEs using comparable data can be found in OECD (2013).

Figure 3.1: Stages of the internationalisation process of SMEs



However, it is likely that exports and FDI are complementary (Markusen, 1997). This suggests that SMEs may start to export and open up a foreign affiliate at the same time. The born-global approach, meanwhile, involves technology-intensive firms entering a number of foreign markets at the same time. These firms exhibit the innovativeness necessary to succeed in international markets.

3.1.2. Productivity and internationalisation of SMEs

Serving a foreign market, either through exports, foreign production, or contractual modes, is an opportunity for SMEs[28], but one that comes with costs. In particular, firms engaging in international activities face both variable and fixed, often sunk, costs. These costs act as barriers to internationalisation by preventing some firms from making profits in international markets. Only the best firms can extract a profit from their international operations once they have borne the cost of doing business abroad. It is then rational for only a few firms (those achieving higher performance *ex ante*) to bear the cost of internationalisation. It is likely that exporting involves some sunk costs – due to the need to acquire information on foreign markets and find suitable contacts for selling products abroad – and substantial variable (transport) costs, while foreign production entails higher fixed (and sunk) and lower variable costs. As can be seen in Figure 3.1, this encourages the best performers to become multinationals; the intermediate performers to become exporters; and the worst performers to focus on their domestic markets, serving foreign markets through indirect exports, or end their business endeavours. This idea, formalised by Melitz (2003) echoes the much older idea put forward by Hymer (1960), who suggests that firms operating in foreign markets need to overcome some liability of foreignness. Therefore, only firms that have certain market power can do business abroad, which mainly comes from possessing proprietary assets (such as patents, or, more generally, firm expertise) that enable them to achieve superior performance, which Dunning, (1970) describes as ownership advantages. For SMEs, these costs of doing business abroad can be a major obstacle. In particular, the presence of the fixed costs of internationalisation affects the profitability of international operations more for smaller firms than for larger ones.

A large number of studies have investigated the extent to which higher productivity explains firms' internationalisation decisions. A robust finding in these studies is that more productive firms are more likely to export (see Greenaway and Kneller, 2007 and Wagner, 2007 for surveys). This fact has also been confirmed in studies based on internationally comparable firm-level data (ISGEP, 2008; Mayer and Ottaviano, 2007). Particularly interesting is the fact that the productivity premium of exporting is larger for SMEs, while large exporting firms are not always more productive. This is consistent with the idea that larger firms are in a better position to bear the sunk costs of exporting, while only very productive SMEs are able to engage in exporting. In general, the relationship between productivity and exporting goes in both directions, which makes it difficult to draw conclusions about causality. The two way relationship between exports and productivity is usually referred to the "selection hypothesis" (Bernard and Jensen, 1999; and Bernard and Wagner, 1997) versus the "learning-by-doing" hypothesis (Clerides, Lach and Tybout, 1998). By and large the evidence is in favour of the selection of more productive firms into exporting (Wagner, 2007).

Castellani and Zanfei (2007) find evidence that companies with the highest international involvement, namely firms with production activities abroad, are characterised by the highest productivity premiums, greatest R&D efforts, and best innovative performance. In line with the idea that foreign production entails higher fixed costs than exporting, there is evidence that the productivity of firms that are about to engage in FDI

[28] A review of the factors that affect internationalisation decisions of SMEs can be found in Leonidou (2004) and Leonidou et al (2007).

is higher than that of future exporters.[29] While evidence on the role of productivity in the internationalisation choices of SMEs is scarcer, the findings of Hollenstein (2005) for a large sample of Swiss SMEs suggest that labour productivity is more important as a determinant of initiating foreign production than of exporting.

The role of trade intermediaries can also be motivated by the theoretical model of Melitz (2003). The largest firms choose a direct distribution channel to reach foreign consumers themselves (Blum et al, 2010). Less productive firms opt for intermediation by pairing up with large trading firms to export indirectly. Ahn et al. (2011) find that the fixed cost of selling to an intermediary in a firm's own country is lower than the fixed cost of exporting directly. This leads to a sorting process in which the most productive firms export directly, less productive firms export through intermediaries, and the least productive active firms sell only on their respective domestic markets. This is confirmed using data from the Business Environment and Enterprise Performance Survey (BEEPS) for Eastern European countries (McCann 2013). In another finding consistent with this theoretical framework, Abel-Koch (2013) reveals that the propensity of indirect exporting decreases with firm size, while direct exporting becomes more important as firms get larger. In fact, indirect exporters are mostly small firms that are not profitable enough to cover the high fixed costs of building their own distribution networks abroad. Overall, the literature suggests that intermediaries play an important role in facilitating entry into foreign markets, as well as in export discovery and the experimentation of firms with uncertain profit horizons on their exports.

3.1.3. Internationalisation and firm growth

The link between export participation and firm growth and/or performance has been studied for quite some time. Since the seminal work of Bernard and Jensen (1999) on a large sample of US firms, the literature has found a consistently positive effect of exporting activities on firm employment and sales. Results based on European firm-level data shows that exporting activity has a positive causal effect on firms' employment and/or sales growth (see, among others, Wagner 2002 for Germany and Serti and Tomasi 2008 for Italy). Furthermore, there is also evidence that commencing production activities abroad (or offshoring) has a positive causal effect on sales and the value added by domestic activities.[30] In the case of SMEs, Lu and Beamish (2006) find that while the effect of exporting and FDI on profitability is mixed, internationalisation unequivocally boosts firm growth. Sapienza et al. (2006) show that early internationalisers are more likely to grow rapidly than older entrants because of the "learning advantages of newness". Golovko and Valentini (2011) introduce the hypothesis that innovation and exporting are complementary strategies for SME growth. Participating in export markets can help firms learn, thereby enhancing their innovation performance. At the same time, firms can enter new geographical markets with novel and better products which makes their exports more successful and also improves the quality – and consequently increases the sales – of the products they offer domestically. In broad terms, the effect of innovation activities on firm growth rates is higher for firms that also engage in exports, and vice versa.

3.1.4. Drivers of and barriers to internationalisation

The barriers and other factors that influence SMEs are typically divided into internal and external factors. The former are those associated with influences in the "corporate environment of the firm", while the latter originate in the "firm's domestic or foreign external environment" (Leonidou 2004; Leonidou et al. 2007). Figure 3.2 provides a synthetic overview of the drivers of internationalisation. In addition to internal and external factors, those of an operational or informational nature are often considered. Operational barriers occur within the process of exporting, while informational barriers are linked to identifying, selecting and contacting international markets.

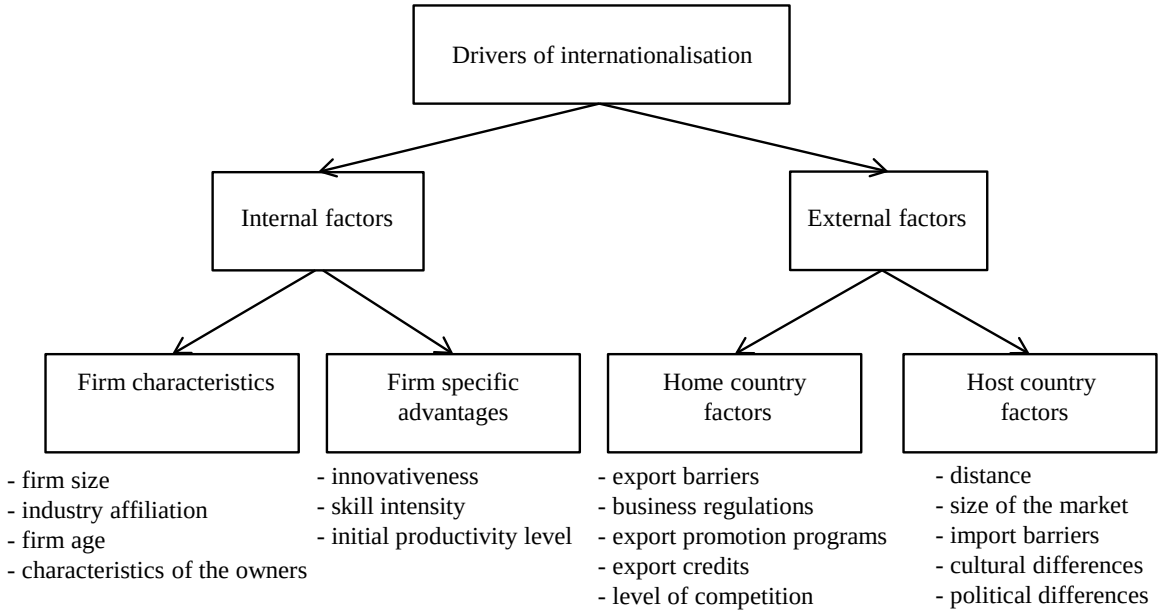
Internal factors

Internal factors include human resources and managerial knowledge, technological innovations, ICT capacity, and firm size. Previous empirical evidence shows very clearly that larger firms are more likely to export and also exhibit better export performance (see e.g. Wagner 2001; and Harris and Li 2009). However, there are differences between manufacturing and service SMEs. A possible explanation of the negative dependence of exporting on firm size is that SMEs – and especially micro enterprises – have lower resource capacities in terms of financing, knowledge, and managerial experience.

[29] See, among others, Barba Navaretti et al. (2010), for France and Italy; Arnold and Hussinger (2010) for Germany.

[30] See, for example, Wagner (2011) for Germany; Hijzen et al. (2011) and Barba Navaretti et al. (2010) for France.

Figure 3.2: Drivers the internationalisation process of SMEs



Human resources and related expertise

Inadequate managerial knowledge is often considered a major barrier to exporting (OECD 2009). The corresponding management factors include level of international experience, foreign language proficiency, scope of vision, and market knowledge. According to Leonidou et al. (2007), these skills are mainly related to three proactive drivers: special managerial interest/motivation, utilisation of special managerial talent/skills/time, and management trips overseas. In addition, not only management factors, but the general lack of qualified human resources is also regarded as a main internal export barrier. Studies based on European SMEs show that foreign language proficiency and international experience are important drivers of internationalisation (Castellani and Zanfei 2002 and 2004; Dow and Larimo 2009; Fernandez-Ortiz and Lombardo 2009; Herrmann and Datta 2006; Nakos and Brouthers 2002). In contrast, management trips overseas are regarded as the least influential factor in decisions to internationalise (Leonidou et al. 2007; Fillis 2008). Managers' demographic attributes (age, educational level) and personalities/subjective characteristics (attitude towards risk, perception of costs/benefits, commitment) can also affect these decisions. Serra et al. (2012) find that manager education is a key determinant of the propensity to export.

Technological innovation

In addition to the initial level of productivity and human resources, innovation activities are generally identified as the other main determinant of internationalisation. Successful product innovations in particular are a prerequisite of doing well in international markets. However, the evidence of other indicators of innovation activities is less clear. There is also a relatively broad consensus that firms that introduce product innovations are *ex post* more likely to export. For instance, using Community Innovation Survey (CIS) data for two time periods in Belgium, Van Beveren and Vandenbussche (2010) find that Belgian firms self-select into innovation in anticipation of export market entry rather than that technological innovations drive entry to the export market. This indicates that firms start exporting after successful introduction of new products and production processes.[31] Based on SMEs in the UK, Añón Higón and Driffield (2010) find that exporting businesses are also characterised by high levels of both process and product innovation. Using matching CIS data for the UK, Criscuolo et al. (2010) show that globally engaged firms (multinational firms and exporters) do generate more innovation output and use more knowledge input. However, there appears to be a two-way relationship between exporting and technological innovation: export entry or export intensity are likely to boost technological innovation, and successful innovation is likely to lead to higher exports. For instance, Love and Ganotakis (2013) analyse the effect of exporting on the subsequent innovation performance of a sample of high-tech SMEs based in the UK. They

[31] See, also among others, Basile (2001) for Italy; Roper and Love (2002) for the UK; Cassiman and Golovko (2011) for Spain.

find that exporting subsequently helps high-tech SMEs innovate. For Spanish firms, Esteve-Perez and Rodriguez (2013) show that engaging in export activities increases a firm's chances of also engaging in R&D activities, which in turn makes the firm's export activities more likely to succeed. Siedschlag and Zhang (2014) find that in Ireland, foreign ownership and engagement in exporting are positively linked to innovation output over and above other firm characteristics such as size and industry affiliation.

ICT capacity

Technological advances like the internet have reduced the costs of exporting and led to new opportunities for SMEs to extend their business into global markets. However, it is not only online sales that directly contribute to exports through the use of ICT; internet technology has also been increasingly integrated into marketing activities. Having a website is important because it attracts potential customers from abroad and makes it possible to place an international order. The internet can be an alternative to a physical market presence and traditional market intermediaries in establishing direct customer contacts (Lohrke et al. 2006) and providing better customer service and support. Additionally, the internet facilitates information gathering on competitors, specific markets, and above all, customers (Borges et al. 2009). Overall, the use of the internet may reduce the costs of entering foreign markets and the per-unit cost of exporting once a market presence is established.

Empirical evidence on the role of ICT in trade is scarce, being based mainly on aggregate country-level data rather than on firm-level data. (Freund and Weinhold 2004). Firm-level studies show that that online activities affect export sales (Bennett 1997), emphasizing how internet technology is used (Morgan-Thomas and Bridgewater 2004) and that ICT – in combination with offline strategies – drives export performance (Sinkovics et al. 2013). Previous literature finds that ICT-intensive firms perform better and internationalise faster and more extensively than less ICT-intensive firms (Aspelund and Moen 2004). Morgan-Thomas and Jones (2009) show that firms with fast-growing exports rely heavily on ICT. Morgan-Thomas (2009) distinguishes among different types of online capabilities, and the empirical results show that the key benefit of internationalising lies in supporting customer relationships rather than in online sales. Further, separate research on the use of eBay sales data from five countries explains how this platform has opened up export markets to SMEs at lower costs (Martens 2013).

External factors: home- and host-country factors

The characteristics of home and host markets, as well as the policies of governments at home and abroad, are drivers of international engagement. These characteristics include gravity factors (geographical and cultural distance, size of the domestic and host markets), business and export regulations in the home and host markets, including tax considerations, and quality of transport infrastructure. Surveys among European SMEs reveal that SME export decisions are primarily motivated by the growth and size of the host market in question, combined with a small domestic market size (see Crick 2007b). Home-country characteristics include business and export regulations and export promotion programmes. The lack of domestic governmental assistance/incentives and unfavourable domestic rules and regulations in general (e.g. costs of starting a business) and export regulations in particular can be severe barriers to internationalisation (Leonidou 1995). Export regulations increase the costs of exporting. These costs to export include documents (fillings of export declarations and supporting documents), administrative fees for customs clearance and technical inspection, customs brokering fees, terminal handling charges, and inland transport. Other costs occur due to safety and security legislation, labelling rules and packaging requirements. Therefore, efficient customs administration and the availability of standardized and harmonized trade documents are crucial to success in exporting.

Export promotion programmes (EPPs) are provided by governments to help firms – particularly SMEs – overcome perceived obstacles to exporting. They can be classified as the following direct measures: (i) country image building (e.g. advertising and promotional events); (ii) export support services (e.g. export training and technical assistance); and (iii) marketing (e.g. trade fairs and export missions), market research, publications (e.g. market surveys), and trade finance support (export credits, export guarantees/insurance) (Lederman, Olarreaga, and Payton 2006). Governments set up export credits through direct loans, subsidies, insurance and guarantees (Fleisig and Hill 1984). These tools are intended to help firms overcome financial and liquidity difficulties related to their international activities or credit constraints. Export guarantees are mainly provided on exports to countries that present significant political risks. However, SMEs are underrepresented in these distant markets (see Section 3.2). It should be emphasized that the use of selective export subsidies is currently severely limited by WTO rules. Previous studies show that export credits and guarantees have a positive impact on the level and intensity of exports (see Janda et al, 2013, and Badinger and Url, 2013). Even though

governments have extensively adopted EPPs, various studies point out that SMEs have a limited awareness of such measures and do not actively use them (Hauser and Werner 2010).

With respect to outward FDI activities, Svetličič et al. (2007) show that the highest barriers to SME investments are host-country-related factors, including high levels of political risk, unstable investment climates, a systemic lack of transparency, and general instability.

The information gap is still regarded a serious problem for SMEs, even in the current era of extensive information availability (Kumar 2012). The literature shows that SMEs that are unable to gather and use export market information exhibit a lower probability of exporting and lower export intensity (Koksal and Kettaneh 2011). Evidence based on surveys of the UK shows that the inability to contact potential overseas customers is a serious barrier to entering international markets (Crick 2007a; Kneller and Pisu 2007). Using data for Swedish manufacturing exporters, Rundh (2001, 2007) shows that difficulties in finding suitable distribution channels as well as insufficient knowledge of the procedures involved in international business are very important barriers together with competitors' control over the distribution system[32].

Combined internal and external considerations

Overall, SME decisions to engage in foreign markets depend on not just one, but a combination of internal and external factors. More innovative and productive SMEs are more likely to export, and also exhibit higher export intensity. However, the evidence of the impact of internationalisation on productivity is mixed. Learning-by-exporting occurs in specific circumstances, and while there is robust evidence that the internationalisation of SMEs has a positive impact on firm growth, there are still few studies that rigorously investigate its causal effects. A recurring finding in the empirical literature is that micro enterprises are most often not distinguished from larger SMEs. Furthermore, few studies distinguish between exports of goods and exports of services.

SME international expansion is impaired mainly by knowledge-related weaknesses and by external barriers, such as strong competition and difficult access to foreign markets due to existing business regulations and distribution channels. In order to overcome obstacles to internationalisation, the research reviewed above emphasizes the skill-related attributes of SMEs: managerial and technological expertise on the one hand, and knowledge of foreign markets, cultures, and institutional and legal frameworks on the other. SME internationalisation efforts are further stimulated by host-country characteristics such as opportunities for sales and profit growth.

With regard to ways in which the relevant barriers can be overcome, two distinct dimensions stand out. The first is the role of home-country government authorities in supporting SME internationalisation processes though a variety of measures related to export and FDI promotion policy. The main challenge underlined by various studies is that SMEs' knowledge and awareness of EPPs is still limited, which lowers their potential impact. The second dimension concerns the decision to expand into foreign markets which is increasingly dependent on ownership and control of products and resources perceived as valuable by foreign firms active in global value/supply chains. Developing relationships with large multinational customers and distributors allows SMEs to gain market and technological knowledge and, most importantly, access to further networks across national boundaries..

3.2. TRENDS IN SME EXPORT BEHAVIOUR

3.2.1. The role of firm size, industry and distance

In order to formulate effective policy strategies that support the internationalisation activities of European SMEs, a detailed empirical analysis of the characteristics of exporting behaviour and other modes of internationalisation is required. This section analyses patterns of SME export behaviour based on firm size, industry, time, and destination market using several different data sources. The main indicators are export participation and the ratio of exports to output. The firm size categories are defined as 0-9, 10-49, 50-250, and 250+ employees. The main databases[33] are the Community Innovation Survey (CIS) 2010 (based on 20 EU countries plus Norway), the Trade and Enterprise Characteristics (TEC) database, and the linked trade statistics, with the Structural Business Statistics (SBS) provided by Eurostat's Esslait project (MMD database). In addition, the Business Environment and Enterprise Performance Survey (BEEPS) data collected by the World Bank is used. The databases differ widely with respect to country coverage, coverage of micro enterprises, industry coverage, definition of exports (exports of goods or exports of both goods and services), export threshold, and available export indicators (export status and/or amounts of exports).

[32] See also Arteaga-Ortiz (2003) for Spain.

[33] See Annex Table A1 for a comparison of the data sources.

Note that the differences in the share of exporting SMEs across the databases are likely related to these factors (see Box 3.1).

Table 3.1: Export participation in EU manufacturing (goods excluding services) by firm size based on trade statistics (Intra and Extra EU) in 2010 (percent)

Firm size (employees)	Number of firms	Intra-EU exporters in percent	Extra-EU exporters in percent
0-9	1,629,538	7.9	4.4
10-49	286,738	37.5	28.1
50-249	69,443	67.0	58.4
250+	15,073	85.4	77.1
0-249	*1,985,719*	*14.3*	*9.7*
10-249	*356,181*	*43.3*	*34.0*
Total	2,000,792	14.8	10.2

Note: contains data for 23 EU countries (EU-28 excluding IE, BE, EL, HR and MT). Business enterprise sector excludes financial services, agriculture and non-business public services, NACE Rev. 2 84-99.
Source: Eurostat, TEC database, New Cronos.

Table 3.1 provides basic information on export status (of goods) by firm size for the manufacturing sector in the EU in 2010 based on the TEC database. Given that relatively few manufacturing firms export service products independently of goods exports, the TEC database can provide a fairly precise picture of the export participation of manufacturing SMEs. Among the roughly two million manufacturing SMEs (0-249 employees) in the EU-28, 14.3 per cent export goods to EU countries and 9.7 per cent do so beyond the EU. One can observe that export participation increases strongly with firm size. Meanwhile, 7.9 per cent of micro enterprises, 37.5 per cent of small firms, and 67.0 per cent of medium-sized enterprises export to internal markets, compared to 85.4 per cent of large manufacturing firms. This indicates that the export participation of large firms is about 10 times higher than that of micro enterprises. A similar pattern emerges in observing exports to non-EU countries. It is interesting to note that the difference in export participation between medium-sized and large firms is lower than between micro enterprises (less than10 employees) and the medium-sized firms (50-249 employees).

This indicates that SMEs are highly heterogeneous in their export participation behaviour, despite often being treated as one entity. One initial important finding of this chapter is that export participation rates depend significantly on the definition of SMEs (with or without micro enterprises). If micro enterprises are included, this leads to 14.3 per cent export participation rate of manufacturing SMEs, whereas excluding micro enterprises results in 43.3 per cent (both for Intra EU). Results based on two-digit industry data presented in the background report indicate that the gap in export participation between SMEs (0-249 employees) and large firms is smallest in industries characterised by a high skill and/or R&D intensity.

CIS data makes it possible to calculate export participation rates for SMEs in the service industries. In the last decade, the tradability of services increased rapidly due to the internet and other technological developments. Table 3.2 lists export participation rates across broad industry groups, distinguishing by firm size but not by destination market. For SMEs (10-249 employees), export participation is highest in manufacturing (51.7 per cent), followed by information and communication services (40.9 per cent) and transportation (36.2 per cent). An important result is that the gap in export participation between SMEs (10-249 employees) and large firms is much less pronounced in some service industries, most notably in information and communication services and in finance. When medium-sized and large firms are compared, the difference in export participation largely disappears. In summary, another important result of this analysis is that the differences in export participation between SMEs and large firms are much less pronounced in services than in manufacturing.

Box 3.1: Notes on export data

The section on the patterns in SME exporting activities relies on a number of main data sources. These include the TEC database, which incorporates the number of goods-exporting firms and the export value for intra- and extra-EU trade. Data is available for 24 EU countries (excluding IE, BE, MT and HR) and includes all industries, as well as micro enterprises for the period 2008-2010. Since the TEC database is constructed by linking trade micro data with business registers, these registers determine the size classes at hand. The trade data is taken from three different sources: In extra-EU trade, customs declarations are used, which in practice guarantees nearly comprehensive data collection. For intra-EU trade, Intrastat data on business entities that are subject to Intrastat reporting (mainly larger enterprises) is used, while VAT data is taken for the smallest traders. This also ensures nearly complete data availability at the trader level. Whether an enterprise is subject to Intrastat reporting is based purely on its trade volume, not on other criteria such as turnover. In practice, this means that there is no systematic bias (underrepresentation) of micro companies.

The second database is the Community Innovation Survey (CIS) 2010. It is a representative survey covering all main manufacturing and service industries, with about 160,000 observations based on firms with 10 or more employees. The CIS contains information by region (EU and non-EU countries, along with information on export markets) on whether firms sold goods and services abroad in the period 2008-2010. One limitation of the data set is that its industry coverage is limited to manufacturing, wholesale trade, transport, and financial and business services. Construction is also partly covered.

The third major data source is trade/VAT statistics linked with the structural business statistics collected within the ESSLait project. The resulting Micro Moments Database includes data on the exports of goods and services of firms with 10 or more employees in 12 EU countries[34] and Norway for the period 2002-2010. Information is available for manufacturing and service industries, but it does not include mining, construction and energy, water supply. Service exports are included for most of the countries (except AT, IT, NL, and NO). Each of the main data sources has its merits and shortcomings, such as industry coverage, inclusion of micro enterprises, and coverage of service exports (see Annex Table A1 for details).

Table 3.2: EU export participation of goods and services by firm size and industry 2008-2010 (in percent)

Industry groups based on NACE Rev.2	10-49	50-249	10-249	250+
Mining and quarrying	24.1	47.0	27.8	56.3
Manufacturing	45.5	77.5	51.7	88.9
Electricity, gas, water supply	14.7	12.2	14.0	16.8
Construction	4.1	11.5	4.7	39.9
Wholesale trade	34.3	46.5	35.7	47.1
Transport and storage	35.0	43.2	36.2	50.0
Information and communication	38.6	51.1	40.9	54.9
Financial, insurance activities	17.4	23.7	19.1	25.2
Professional, scientific and technical	24.2	47.6	26.7	62.9
Total	30.7	42.6	32.6	55.1

Note: Sample based on EU-20[35] plus Norway. Weighted by sample weights. Number of firm-level observations is 139,000 (unweighted). Source: CIS 2010 Eurostat, Safe Centre own calculations.

Another interesting aspect of SME internationalisation behaviour is the export participation rate of those outside the EU. Table 3.3 shows export participation rates across broad industry groups and three destination groups for SMEs based on CIS 2010 data for 20 EU countries plus Norway. The results for SMEs show that exporting to EU/EFTA/candidate countries or serving both markets are the most common ways of serving foreign markets. Interestingly, the share of SMEs that are generally present in markets outside Europe is relatively high in information and communication services at about 25.8 per cent (21.7 plus 4.1 per cent), which is close to the 30 per cent (27.9 plus 2.5 per cent) ascertained for manufacturing SMEs. Other service industries are clearly lagging behind (15.7 per cent for professional and technical services, 18.2 per cent for wholesale trade, 15.1 per cent for transportation). To sum up, results show that SMEs in ICT services are much more oriented towards worldwide markets than are other service industries.

[34] AT, DE, DK, FI, FR, IE, IT, LU, NL, SE, SI, UK

[35] BG, CY, CZ, DE, EE, ES, FR, HR, HU, IE, IT, LT, LU, LV, NL, PT, RO, SE, SI, SK

Table 3.3: EU export participation (goods and /or services) by firm size and broad industry groups 2008-2010 (in percent)

Industry groups based on NACE Rev.2	SMEs (10-249)			large firms (250+)		
	EU/EFTA/ only	non EU EFTA/only	both	EU/EFTA/ only	non EU EFTA/only	both
Mining and quarrying	14.7	2.8	10.3	12.8	5.6	38.0
Manufacturing	21.3	2.5	27.9	17.6	1.7	69.6
Electricity, gas, water supply	7.7	0.8	5.5	9.1	1.6	6.1
Construction	3.1	0.9	0.8	14.3	6.1	19.5
Wholesale trade	17.6	2.3	15.9	15.1	1.9	30.1
Transport and storage	21.2	1.8	13.3	22.8	1.6	25.6
Information and communication	15.0	4.1	21.7	16.3	2.0	36.5
Financial, insurance activities	9.2	1.0	8.9	10.9	0.9	13.3
Professional, scientific and technical	11.0	2.7	13.0	13.6	2.9	46.4
Total	14.9	2.1	15.7	15.5	3.4	36.2

Note: EU-20 plus Norway. Weighted by sample weights. See Table 3.2 for further comments.
Source: CIS 2010 Eurostat, Safe Centre own calculations.

Table 3.4: Ratio of goods exports to output in EU manufacturing by firm size in 2010 (in percent)

Firm size class	Intra-EU total	Extra-EU	total
0-9	8.5	3.8	12.3
10-49	11.2	5.9	17.2
50-249	19.7	9.5	29.2
250+	21.9	14.4	36.3
10-249	*16.6*	*8.2*	*24.7*
0-249	*15.4*	*7.5*	*22.9*

Note: Aggregate for manufacturing contains data for EU-28 excluding IE, BE, EL, LU, HR and MT).
Source: Eurostat, TEC database, Structural Business Statistics, New Cronos.

Table 3.5: Direct and indirect export participation, EU total business sector in 2008 (in percent)

	5-49	50-249	250+	SMEs (5-249)
indirect export participation	6.9	14.1	24.5	8.0
direct export participation	16.2	45.5	56.0	20.5
indirect and/or direct export participation	19.7	50.2	66.5	24.2

Note: Countries are Poland, Romania, Estonia, Czech Republic, Hungary, Latvia, Lithuania, Slovak Republic, Slovenia, Bulgaria and Croatia. Numbers are weighted using sample weights. The number of observations is 3355.
Source: BEEPS 2008.

Along with export participation, export behaviour is commonly taken as a measure of the export-to-output ratio. However, given that it is more difficult to become an exporter than it is for those already exporting to increase their exports, the export-to-output ratio is commonly seen as less important in describing the export behaviour of SMEs.

Table 3.4 presents the export-to-output shares for the EU manufacturing sector by firm size based on the TEC database. For 2010 the ratio of goods exports to turnover is 22.9 per cent for SMEs and 36.3 per cent for large firms. Again, the export-to-output-value ratio increases with firm size. However, the differences in the export-to-output ratio between micro enterprises and large firms are less pronounced than those seen in export participation. Another important result is that the group of SMEs is highly heterogeneous, with larger differences in export share between micro enterprises and medium-sized firms (17 percentage points) than between medium-sized and large firms (seven percentage points). Furthermore, it is interesting to note that the export intensity of medium-sized enterprises in the internal market is close to that of large firms (20 per cent and 22 per cent, respectively). However, the export intensity of medium-sized firms in non-EU destinations is much lower than that of large firms. This indicates that even medium-sized SMEs are at a disadvantage when serving distant markets. The analysis above focuses solely on direct exports. SMEs often start to export indirectly by supplying

Table 3.6: Exports (goods and services) to output ratio, EU-10+NO, 2003-2010 (in percent)				
Industry groups based on NACE Rev.1.1	10-19	20-49	50-249	250+
total manufacturing excluding electrical machinery	19.4	23.6	35.8	47.8
consumer goods	16.0	22.2	27.9	29.3
intermediate goods	16.6	20.8	35.0	48.6
investment goods, excluding electrical machinery	30.6	31.8	48.0	61.8
electrical machinery & post and communication services	22.0	24.9	38.8	32.9
market services excl. post and telecommunication	14.1	14.7	15.0	14.0
distribution	17.9	17.9	17.4	16.0
financial and business services excluding real estate	9.6	10.7	13.6	12.8
personal services	2.1	2.5	3.2	4.7

Note: Unweighted means. The sample includes annual data for AT, DK, FI, FR, IT, NL, NO, PL, SE, SI and UK for the period 2003-2010.
Source: ESSLait Micro Moments Database based on the trade/VAT database and Structural Business Statistics.

parts or final goods to a domestic distributor/agent or another independent domestic firm[36].

Table 3.5 displays direct and indirect export participation rates for the overall business enterprise sector which show that the total export participation of SMEs increases slightly when indirect exports are taken into account, from 20.5 to 24.2 per cent. Both indirect and direct export participation increase with firm size, indicating that these types of exporting are complementary rather than substitutable.

The findings based on the TEC database in the previous section show that the export participation (defined as exports of goods) of firms increases with firm size. Meanwhile, the export-to-output ratio for manufacturing also increases with firm size, but to a lesser extent. While there is a consistent positive relationship between export participation and firm size, the relationship between export intensity and firm size in services is less clear. The structural business statistics linked with the trade/VAT database can be used to explore the relationship between firm size and export intensity.

Table 3.6 shows the average export-to-output ratio by size classes and broad industry groups. The results for manufacturing industries show that the average export/output ratio increases with firm size. In particular, the gap in export intensity between small and large enterprises is generally larger for intermediate and investment goods than for consumer goods. Furthermore, the results for the manufacturing sector show that SMEs are a highly diverse group of enterprises, with medium-sized firms generally displaying little difference in export behaviour compared to large firms. However, there are large differences in export intensity between the smallest size class and larger SMEs. For the main service industries, however, there is no clear pattern in the relationship between firm size and export intensity. For market services as a whole, the export/output ratios for two groups of small firms are 14.1 and 14.7 per cent, respectively, while the ratios for medium-sized and large firms are 15.0 and 14.0 per cent, respectively. For business and financial services, the export intensity of large service firms is only slightly higher than that of small service firms (12.8 per cent vs. 9.6 and 10.7 per cent). The finding that the export intensity of service firms is less dependent on firm size is consistent with the empirical evidence based on data for EU countries (Gourlay et al., 2005 and Harris and Li, 2009 for UK service firms; Eickelpasch and Vogel, 2011 for German service firm; and Lejárraga and Oberhofer, 2013 for French service firms).

[36] Information on direct and indirect export participation can be calculated using firm level data from the 2008 wave of BEEPS database provided by the World Bank (or from the EFIGE dataset).

Table 3.7: Export participation (goods) by firm size and destination markets for selected EU countries (in percent)

Host country group	0-9	10-249	0-249	250+	Total
			France		
EU-28 + EFTA	1.0	18.9	2.0	61.2	2.1
North America	0.3	6.5	0.7	36.9	0.8
South and East Asia incl. China and India	0.4	7.7	0.8	41.3	0.9
China + India	0.1	4.2	0.4	30.6	0.4
			Netherlands		
EU-28 + EFTA	10.8	44.7	12.9	85.4	13.1
North America	0.3	7.8	0.8	33.9	0.8
South and East Asia incl. China and India	0.6	13.9	1.4	60.9	1.6
China + India	0.2	5.6	0.5	27.1	0.6
			Sweden		
EU-28 + EFTA	3.7	30.4	5.2	67.2	5.3
North America	0.5	9.0	0.9	40.1	1.0
South and East Asia incl. China and India	0.5	9.4	0.9	41.2	1.0
China + India	0.2	5.7	0.5	31.8	0.5

Note: Export data refers to exports of goods only. Data refers to the total business enterprise sector.
Source: Statistics France (Insee), Statistics Netherlands, Statistics Sweden. China excludes Hong Kong SAR.

A further aspect involves investigating the most important destination markets of these SMEs and the difference to those of large firms. Table 3.7 shows SME export participation in goods by destination region for three EU countries (FR, NL, and SE) by size category. Results for France, the Netherlands, and Sweden show less than 1 per cent of SMEs (0-249 employees) are exporting to China and India in 2010, compared to between 27 and 32 per cent for large firms. The corresponding numbers of SMEs with between 10-249 employees range between 4 and 6 per cent (FR 4.2 per cent, NL 5.6 per cent, and SE 5.7 percent). In particular, very few micro enterprises are exporting goods to the growth markets China and India with export participation rates between 0.1 and 0.2 per cent of the three EU countries in 2010. This indicates that the gap in exporting to growth markets between SMEs and large firms is much more pronounced for micro enterprises than for larger SMEs (10-249). Similarly, very few SMEs are exporting to whole region South and East Asia (including China and India). In contrast, the export participation of SMEs (0-249) to the EU-28/EFTA region is significantly higher, ranging between 2 and 13 percent of the three EU countries.

3.2.2. Other internationalisation activities

As mentioned earlier, the other main mode of internationalisation involves outward FDI activities. Table 3.8 presents a breakdown of SME internationalisation strategies by different categories based on data for the manufacturing sector for four EU countries based on the EFIGE dataset.[37] The different modes considered in the analysis include firms only exporting indirectly; exporting directly and indirectly; directly investing abroad; outsourcing production internationally; exporting and investing abroad; exporting and outsourcing; and exporting, investing, and outsourcing abroad. It is clear from Table 3.8 that direct exporting is the most prevalent internationalisation mode with about 48 percent. Interestingly, 3.6 percent of firms export indirectly only, followed by FDI and international outsourcing each with 0.6 percent. 2.4 percent of SMEs either export and conduct FDI, or combine export with international outsourcing. A very small proportion of SMEs engaged simultaneously in all three internationalisation modes.

[37] EFIGE dataset is based on a firm survey undertaken in seven EU member state countries; Germany, France, Italy, Spain, United Kingdom, Austria, and Hungary. The data collected from the EFIGE survey were augmented with additional balance sheet information from the Amadeus database. In this analysis, due to a limited number of observations for some of variables, it was necessary to exclude data for the United Kingdom, Austria, and Hungary.

Table 3.8: Internationalisation Activities of SMEs by mode in manufacturing in 2008 (in percent)		
	Number	**Percent**
Purely Domestic Market Traders	3,158	42.5
Indirect Exporters only	266	3.6
Direct Exporters	3,538	47.6
FDI	45	0.6
International Outsourcing	46	0.6
Exporting and FDI	176	2.4
Exporting and International Outsourcing	180	2.4
Exporting, FDI, and International Outsourcing	27	0.4
Observations	7,436	100.0

Note: Categories are mutually exclusive. Direct Exporter category includes firms which only export directly and firms which export indirectly and directly simultaneously. Based on sample of SMEs for France, Germany, Italy and Spain.
Source: Authors' analysis of the EFIGE data set.

Table 3.9: Share of SMEs with foreign affiliates abroad EU-28 total business enterprise sector in 2012			
	all destinations	**EU-28 and /or EFTA**	**non EU-28 and/or EFTA**
0-9	2.8	1.8	0.9
10-49	2.1	1.2	0.8
50-249	7.7	4.7	3.2
250+	21.4	15.2	11.4
0-249	3.1	1.9	1.2

Source: Amadeus 2013.

It is also possible to calculate the percentage of SMEs that have a foreign affiliate. Outward FDI activities are defined as firms directly or indirectly owning 10 per cent or more of the equity of affiliates abroad. The FDI status refers to the year 2012. Of the 1,814,700 SMEs (0-249 employees) in the total business enterprise sector for which data is available in the EU-28, only 52,000 have a foreign subsidiary abroad, which is equal to a share of 3.1 per cent[38] (see Table 3.9).

When comparing the share of SMEs that have a foreign affiliate abroad with those that export, one can conclude that exporting is the preferred internationalisation mode as compared to outward FDI activities. In addition, very few European SMEs have foreign affiliates in markets outside Europe. The share of SMEs with foreign affiliates outside the EU/EFTA region is 1.2. The corresponding share for large firms is 11.4

The findings so far show that export participation of SMEs is much higher than the propensity to undertake FDI by establishing a foreign affiliate. An interesting question is whether industries with a higher share of exporting SMEs are likely to have a higher share of SMEs with foreign affiliates abroad. In order to investigate the correlation across the two internationalisation modes, the FDI and the export status at the two digit manufacturing level for EU countries for which data is available is compared. Figure 3.3 shows that export participation and the decision to invest abroad go hand in hand.

3.3. DETERMINANTS OF SME EXPORT BEHAVIOUR

As outlined in section 3.1, a number of studies have investigated the determinants of SME export behaviour. These determinants can be divided into external and internal factors. External factors include home- and host-country characteristics and business regulations. Internal firm-specific factors include innovation activities, human capital, initial level of productivity, and foreign ownership. As outlined earlier, exporters are more productive, innovative, and skill-intensive than non-exporters. This is due to the fact that only the most productive and innovative SMEs can cover the entry costs associated with exporting. This section reinvestigates the role of the external and internal factors of export participation and export intensity.

[38] This number should be interpreted with caution given that micro enterprises and to lesser extent small firms are underrepresented in the Amadeus database.

Table 3.10: Correlation between export participation (Extra-EU) and business/export regulations				
		0-9	**10-249**	**0-249**
Documents to export (number) in 2009	r	-0.40	-0.34	-0.40
	p	0.04	0.09	0.04
Time to export (days) in 2009	r	-0.49	-0.24	-0.53
	p	0.01	0.23	0.00
Cost to export (US$ per container) in 2009	r	-0.28	-0.40	-0.31
	p	0.15	0.04	0.12
Cost of starting a business (% of income per capita) in 2009	r	-0.48	-0.28	-0.50
	p	0.01	0.16	0.01
Share of workers with university degree and above in % in 2009	r	0.50	0.27	0.50
	p	0.01	0.17	0.01

Note: The table reports Pearson correlation coefficients r and the corresponding p-value. Export participation refers to 2010. Business and export regulation indicators are lagged one year and refer to 2009. Countries: EU-28 excluding IE, BE, MT, HR. Source: TEC, Eurostat, Doing Business Indicators World Bank. Own calculations.[39]

3.3.1. Role of export and business regulations and export promotion

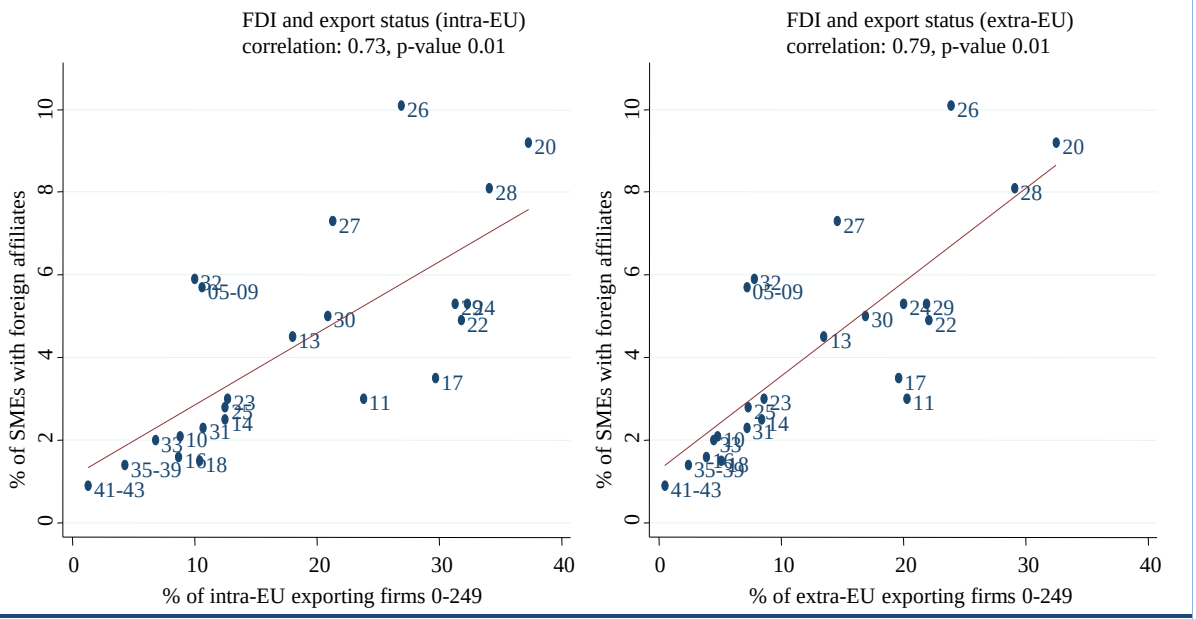
The nature of export regulations in the home market are likely to influence the export participation and export intensity of SMEs. The World Bank has introduced measures of time, costs, and the number of documents necessary for export procedures (World Bank Doing Business indicators). These indicators aim to measure the efficiency of customs regulations and domestic transport infrastructure. In 2013, the cost to export ranged between USD 1,030 per container within the EU (unweighted average across 28 EU countries) and USD 580 in China. In the EU countries, there is a high degree of variation in these indicators, with higher regulations in Southern Europe. Furthermore, other country characteristics are also likely to have an influence on the share of exporting SMEs. It is reasonable to expect that participation in international markets increases with the level of economic development and the human capital of the country at hand (ISGEP, 2008). Table 3.10 reports the correlation coefficients and the significance levels between the percentage of exporting SMEs and different types of export and business regulation indicators, as well as other country characteristics.

The correlation coefficients show that the time and number of documents needed to export are significantly and negatively related to SME (0-249 employees) export participation in non-EU countries, with correlation coefficients of -0.53 and -0.40, respectively. For micro firms, one can find similar results. When SMEs are defined as 10-249 employees the correlation for number of documents to export and export participation is still negative but only significant at the 10 percent level. The alternative measure of export barriers – the cost to export in terms of USD per container – is significant for small and medium-sized firms (10-249 employees), with a correlation of -0.40. Given the findings, EU countries should continue to reduce the costs associated with exporting.

With regard to the results of the correlations for entry regulations, one can see that the costs of starting a business are an obstacle to the export participation of micro firms in non-EU markets, with a correlation of -0.48. In contrast, the correlations between the different types of entry regulation and export participation are insignificant for SMEs with 10 to 249 employees. The correlations for the other types of business regulations, such as minimum capital requirements, number of procedures required to start a business, and time (in days) needed to start a business, are generally not significantly different from zero. Furthermore, for micro firms export participation in non-EU markets significantly increases with the share of workers with a tertiary degree (with a correlation of 0.50). The relationships can also be illustrated using scatter plots (see Figure 3.4 for the time and number of documents required to exports and Figure 3.5 for entry costs and human capital).

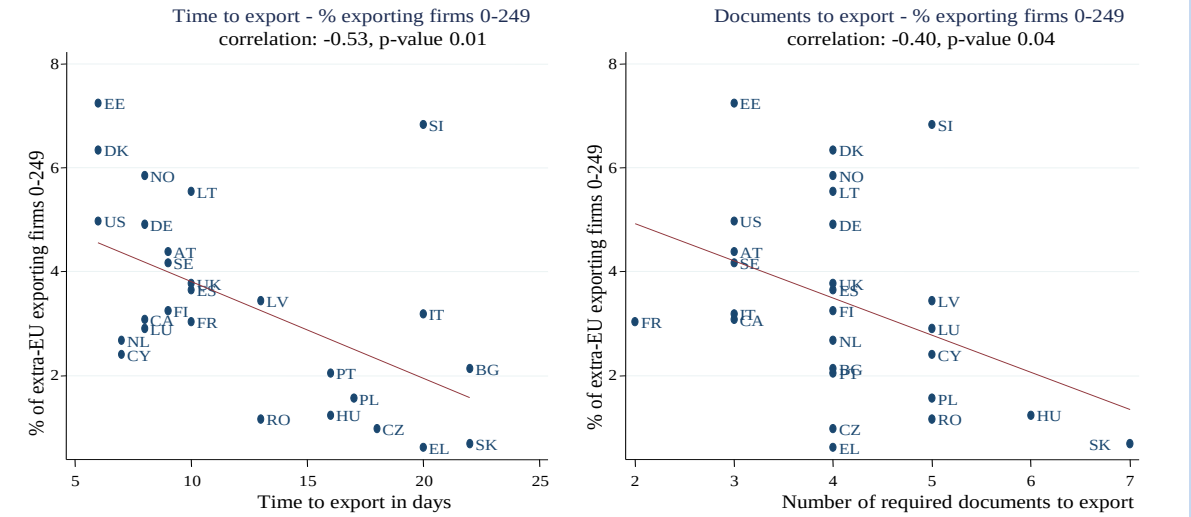
[39] The sample consists of 27 countries: 24 EU member states, the US, Canada, and Norway. Export participation is defined as the number of SMEs exporting to non-EU countries. For the remaining countries, export participation refers to all destinations.

Figure 3.3: Relation between FDI status and export status across EU manufacturing industries



Note: NACE Rev 2. Examples: 20 is chemicals, 28 machinery, 26 computer, electronic and optical products, 27 is manufacture of electrical equipment.
Source: Amadeus 2013 and TEC database.

Figure 3.4: Export regulation and the share of exporters to non-EU markets



Source: TEC, Eurostat, Doing Business Indicators World Bank, own calculations.

In summary, the results show that improving the business climate and taking export facilitation measures stimulates the exporting activities of SMEs. This holds particularly true for micro firms. Given the results, the EU countries should continue to offer better business conditions and lower export regulations for SMEs. In the last 10 years, a number of EU countries have reduced the time and costs associated with starting a business. In contrast, the cost of exporting has slightly increased in the last five years (by 14 per cent between 2008 and 2013 based on the World Bank Doing Business indicators).

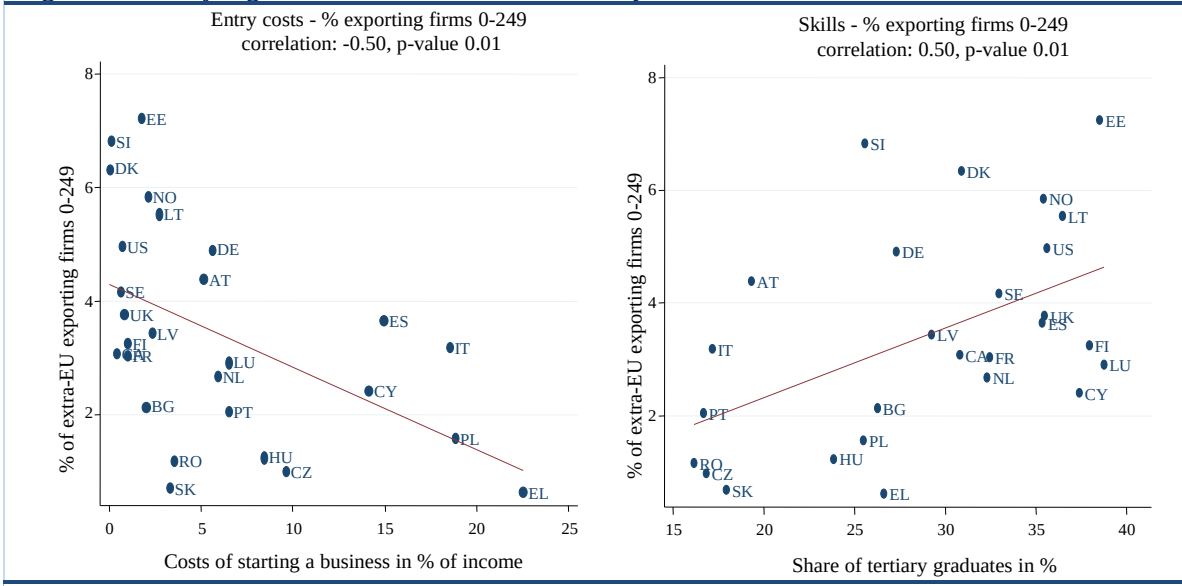
Export promotion programmes are another important measure to stimulate exports of SMEs. Figure 3.6 shows that firms benefitting either from export insurance, financial incentives to export, or intensive export credits have significantly higher export-to-output ratios than firms receiving no such support based on estimates for manufacturing SMEs four European Countries (France, Germany, Italy and Spain).[40] The difference between these two groups

[40] The effects are estimated controlling for other firm characteristics (e.g. size, productivity and innovation activities). The estimation model is the second stage of the

ranges between 9 and 22 percentage points (the regression results are presented in Annex Table A2).

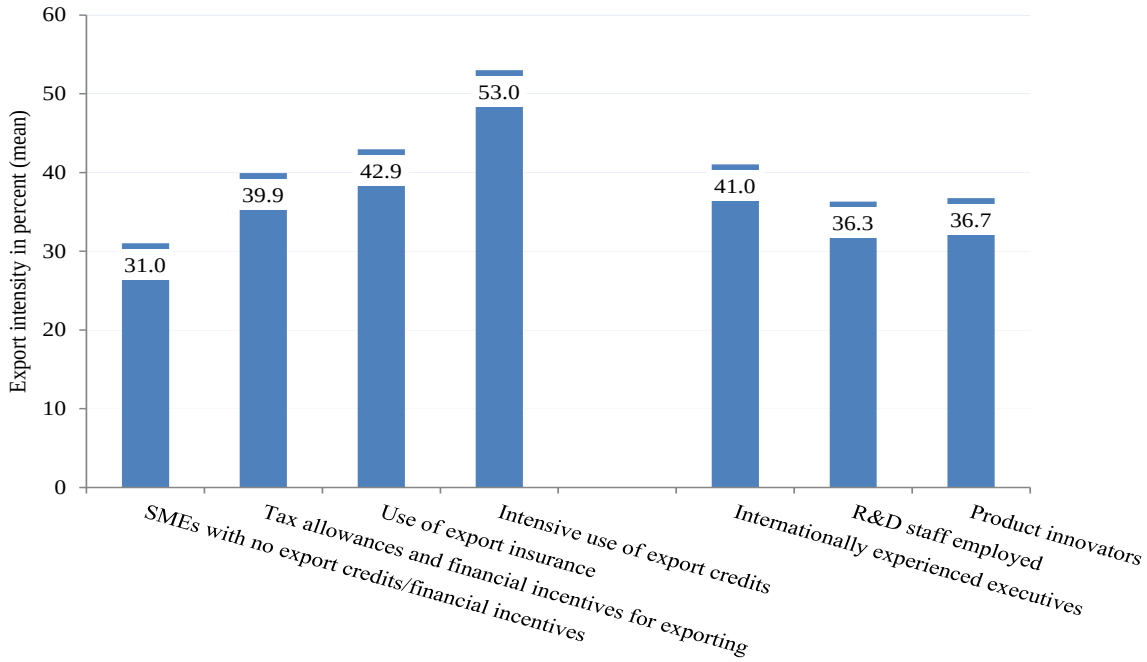
In terms of the strength of the relationships between policy variables and export intensity, the export

Figure 3.5: Entry regulation, skills and the share of exporters to non-EU markets



Source: TEC, Eurostat, Doing Business Indicators World Bank. own calculations.

Figure 3.6: Export intensity of SMEs benefiting from export promotion programmes and other factors in 2008 (in per cent)



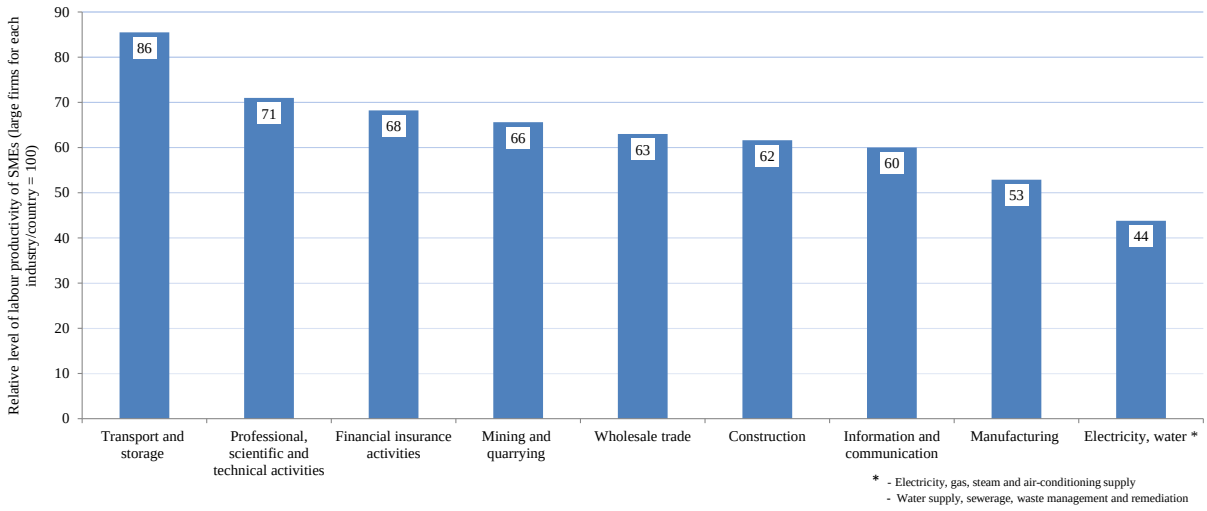
Note: Based on a sample of SMEs for France, Germany, Italy and Spain. The graph compares the export intensity of SMEs without financial incentives to those benefiting from the different export promotion programmes as well as other variables (SMEs with internationally experienced managers, product innovations and R&D activities). The effects of the variables are partial effects controlling for other firm characteristics and are based on the regression results displayed in Annex Table A2. Source: EFIGE database merged with additional data from Amadeus.

Heckman selection model estimated using data on four EU countries based on the EFIGE dataset merged with additional data from Amadeus for 2008.

credit estimate is the most pronounced, suggesting that SMEs that use export credits intensively have a 71 per cent higher export intensity than those that do not (this is equal to about 22 percentage points higher export intensity given the benchmark of the

average export intensity of 31 percent). The finding that export credits and other financial incentives to export are positively related to the export intensity of SMEs suggests that public policies designed to support exporting may be effective in raising SME export performance. The EFIGE data also includes information on firm specific advantages such as R&D activities, product innovations and international experience of managers. These factors are also important in determining the export intensity and export decision of SMEs. Figure 3.6 also shows that SMEs with internationally experienced managers have a ten percentage points higher export intensity (as compared to the benchmark value of the export intensity of 31 percent) while SMEs with product innovations and R&D facilities also have a higher export intensity.

Figure 3.7: Relative productivity level of SMEs (10-249) relative to large firms by broad industry groups in 2010 (large firms=100)



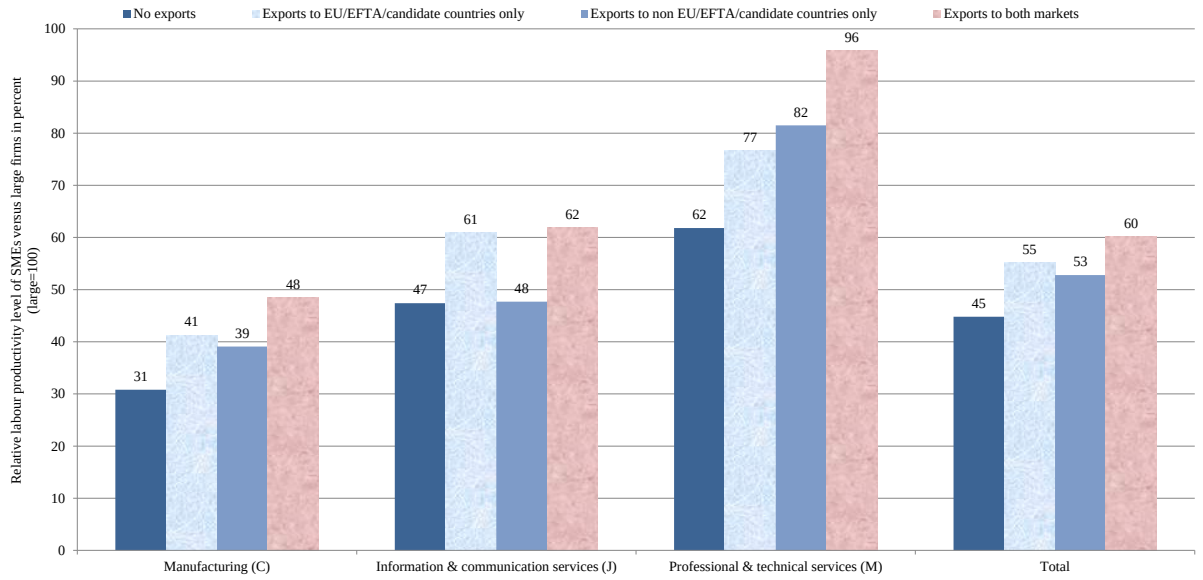
Notes: Relative labour productivity of SMEs is calculated by dividing turnover per employee of SMEs to that of large firms (mean across industry/country cells. Number of observations is 139,000. Country coverage: BG, CY, CZ, EE, ES, FR, HR, HU, IT, LT, LU, LV, NL, NO, PT, RO, SE, SI and SK
Source: CIS 2010 Safe Centre.

3.3.2. Firm-specific factors: the role of productivity, innovation, and skills

This section investigates differences in firm characteristics between exporting and non-exporting SMEs. It also focuses on investigating whether SMEs that export to EU and non-EU markets exhibit different characteristics than those that only serve the European market. In addition, the role of these factors in the export/output ratio is examined. CIS 2010 data containing information on productivity, innovation activities, and export status is taken for about 110,000 SMEs; for a subset of countries, information on skill intensity is also available. Results based on the CIS data for 2010 show that European SMEs have a lower productivity level than that of large firms. As shown in Figure 3.7, the productivity level of SMEs ranges between 44 and 86 per cent of the level of large firms, with higher values for service industries. Given the lower productivity of SMEs, it is interesting to consider the extent to which participation in international markets helps SMEs catch up with their larger counterparts.

Figure 3.8 shows the relative productivity level of SMEs by industry sector within and outside Europe. The results show that SME export participation and relative productivity level are positively related. In particular, the relative productivity level of exporting SMEs (10-249 employees) is between 10 and 15 percentage points higher than those for non-exporting SMEs As expected, the relative productivity level is higher for SMEs that are present in both markets than for those that are only present in one of the two. For the business sector as a whole, non-exporting SMEs have a relative productive level of 45 per cent, whereas those exporting to either Europe or countries outside Europe have a productivity level of 55 and 53 per cent, respectively; SMEs exporting to both markets, meanwhile, have a relative productivity level of 60 per cent. The gap in the relative productivity level between non-exporters and exporters to both markets is more pronounced for some service industries. Results presented in the background report indicate that the relationship between export participation and productivity is more pronounced for small firms than for medium-sized firms.

Figure 3.8: Relative productivity level of SMEs (10-249) by export status and destination by industry based on 20 EU countries (large firms=100)



Notes: Weighted by sample weights. Number of observations is 139,000. Source: CIS 2010 Safe Centre.
Weighted by sample weights. Number of observations is 139,000. Country coverage: BG, CY, CZ, EE, ES, FR, HR, HU, IT, LT, LU, LV, NL, NO, PT, RO, SE, SI and SK
Source: CIS 2010 Safe Centre.

Table 3.11: Robust regression estimates of the exporter productivity premium for SMEs (10-249) based on 20 EU countries

industry groups based on NACE Rev. 2	coef.	t-value	# of obs	R^2
total	0.12 ***	69.79	115741	0.13
Manufacturing	0.13 ***	57.57	53118	0.13
Distribution	0.10 ***	22.34	20010	0.11
Transportation	0.35 ***	36.16	8293	0.42
Information & communication	0.07 ***	13.10	7980	0.07
Financial sector	0.09 ***	6.82	3060	0.10
Professional, scientific and technical activities	0.12 ***	17.96	8479	0.12

Note: The table reports robust regression results of the relationship between the relative productivity level of SMEs and the export status following the specification proposed by ISGEP (2008). The percentage effect of export participation on the relative productivity level can be calculated as (exp(ß)-1) multiplied by 100 (Halvorsen and Palmquist 1980). Country dummy variables are included but not reported. Country coverage: EU-20. Source: CIS 2010 Safe Centre.

In addition to the relative productivity level, innovation activities are another important driver of export activities. Table 3.13 shows that export participation rates are higher for SMEs that introduce new market products, which holds true for all broad industry groups. The difference in export participation between innovative and non-innovative firms, measured in terms of new market products, is greatest in professional services and manufacturing (more than 30 percentage points). This clearly indicates that export participation and product innovations go hand in hand although it is not possible to distinguish between causes and effects because of the two-way dependency between exporting and innovation activities.

The next step is to investigate whether the productivity premium of exporters is significant across industries. The productivity premium of exporters – or "export premium", which can be defined as an average percentage difference in labour productivity between exporters and non-exporters – can be estimated using the specification based on ISGEP (2008) (see Box 3.1). Table 3.11 contains the results of the robust regression of the exporter productivity premium for the group of SMEs.[41]

[41] Robust regression concerns a weighted least-squares procedure that puts less weight on outliers, achieved using

Box 3.1: The link between productivity and exporting

It is generally believed that firms improve their relative productivity after they begin exporting (learning-by-exporting effects). However, there is self-selection into exporting caused by the fact that the most productive firms start to export. Following the seminal works of Clerides et al. (1998) and Bernard and Jensen (1999), a large number of studies have investigated the causal effect of exporting on productivity – the learning-by-exporting hypothesis – without reaching a consensus. Some studies find no significant effects of exporting on firm productivity after the self-selection effect is taken into account. A recent extensive review of the literature by Silva et al. (2012) suggests that learning-by-exporting occurs in limited circumstances. In particular, it is more likely to occur: a) among younger firms and new entrants in foreign markets, b) for firms highly exposed to foreign markets, c) only in certain industries, and d) mainly for firms exporting to high-income countries. The use of cross-sectional data does not allow for an investigation of the dynamic relationship between exporting and productivity, but it does make it possible to estimate the "export premium". This is defined as the percentage difference in labour productivity between exporters and non-exporters. In order to account for differences in production technology and capital intensity across countries and industries, the relative productivity level of SMEs relative to large firms is calculated. The relative productivity level is then regressed on export status, country dummy variables, and industry dummy variables:

$$RELPROD_{ijct} = \beta_0 + \beta_1 EX_{ijct,\cdot t-2} + \gamma DCO_{ijct} + \eta DSEC_{ijct} + \varepsilon_{ijct}.,$$

where *i* denotes firm, *j* industry, *c* country and *t* time. The dependent variable is the relative productivity level, RELPROD is defined as output (turnover) per employee of SMEs, Y/L^{SME}, in 2010 to that of the average large firms, Y/L^{large} in the same industry and country in 2010 (measured as the mean for each industry in a given country). EX is the export status (goods and/or services) between 2008 and 2010. DCO and DEC are country and industry dummy variables. β_1 expresses the differences in the relative labour productivity between SME exporters and non-exporters. Possible extensions could involve disaggregating export status by export participation in different destination markets. This would make it possible to investigate whether SMEs exporting both within and outside Europe have a higher productivity level than those who are present in one of the two destination regions. Note that, according to ISGEP (2008) the export premium tends to be overestimated since it is not possible to control for firm fixed effects using cross-sectional data.

Table 3.12: Robust regression estimates of the exporter productivity premium for SMEs by destination (total business enterprise sector)

	exporter coef.		t-value
exports to EU/EFTA/candidate countries only	0.08	***	36.73
exports to non EU/EFTA/candidate countries only	0.08	***	15.60
both markets	0.17	***	79.47

Note: The Table reports robust regression results of the relationship between the relative productivity level of SMEs and the (destination specific) export status. The coefficient measures the exporter productivity premium of SMEs relative to large firms in percentage points. Country coverage: EU-20. Source: CIS 2010 Safe Centre.

Table 3.12 shows the corresponding results, distinguishing export participation by destination. The dependent variable is the productivity level of SMEs relative to that of large firms (means across industry-country pairs). On average across the 20 EU countries, the productivity level of exporting SMEs is 13 percentage points higher than that of non-exporting SMEs (as compared to large firms). The highest productivity premium of exporters can be observed when SMEs are present in both markets simultaneously.

Given that there is a positive association between exporting and innovation activities, it is interesting to investigate whether this association is more pronounced for SMEs that export to both European and non-European markets. Figure 3.9 shows the share of SMEs with different types of technological innovations by destination. The results show that SMEs exporting to both markets are more innovative than those that are present in one or the other. In particular, the propensity to introduce new products is 30 percentage points higher for SMEs that export worldwide than for non-exporters (46 versus 16 per cent). In the case of new market products and process innovations, the difference is 21 percentage points.

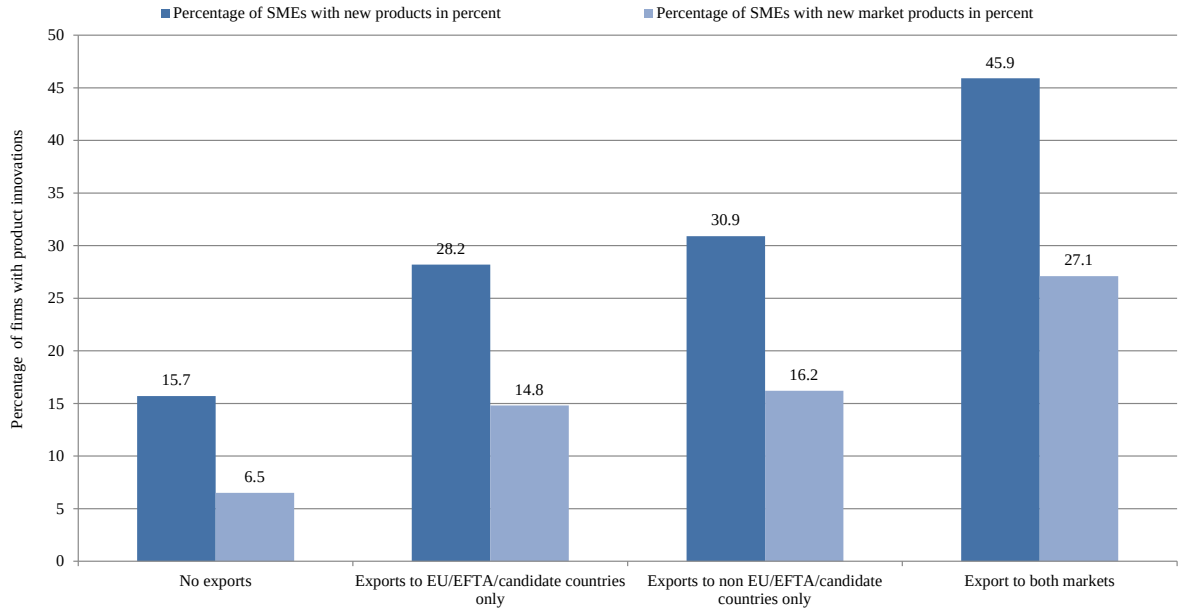
Cook's distance and then performing Huber iterations. See for example Stata (2013).

Table 3.13: Export participation of SMEs by market novelties (in percent)

	mining	manufacturing	energy	construction	wholesale trade	transport	I & C	financial sector	professional services
no new markets products	24.8	46.4	12.8	4.3	33.9	35.2	34.7	17.6	22.1
new markets products	50.3	77.7	30.1	15.1	52.8	57.9	55.0	33.4	55.0

Notes: Weighted by sample weights. Number of observations is 139,000. Country coverage: EU-20.
Source: CIS 2010 Safe Centre.

Figure 3.9: Share of SMEs with product innovations by export participation and destination market (10-249 employees)



Notes: Weighted by sample weights. Number of observations is 139,000. Country coverage: EU-20.
Source: CIS 2010 Safe Centre.

Figure 3.10 lists the shares of exporting SMEs by skill intensity. One can see that the skill intensity and export participation of SMEs go hand in hand. The relationship is more pronounced for SMEs in service industries (e.g. information and communication services, finance, and transportation) with a progressive improvement in SME export participation associated with an increased share of university-educated employees.

As mentioned earlier, SMEs are not only engaged in exporting but also in other internationalisation modes such as investing abroad and international outsourcing. Annex Table A3 shows the marginal effects of multinomial logit regression of the factors that determine the intensity with which SMEs export, engage in FDI, and outsource internationally.[42] Results show that firm-specific advantages appear to be the main drivers. However, the sign and significance differ widely across the different types of internationalisation modes. Labour productivity is significantly positively related with exporting, with a 1 per cent increase in productivity linked to a three-percentage-point increase in the probability of exporting on average. However, high labour productivity is not a prerequisite of a high probability of indirect exporting. The finding that productivity is less relevant to indirect exports than direct exports is consistent with the theoretical

[42] A multinomial logit model is used to predict the probabilities of the different potential outcomes of a categorically distributed dependent variable, given a set of independent variables. Here, the model is used to estimate how various factors influence firms' internationalisation model. See Box 3.3 for details. The results provide measures of association rather than causal effects.

Box 3.3: Determinants of SME Outward Internationalisation Modes using a multinomial logit model

The determinants of the outward internationalisation mode choices are estimated using a multinomial logit model (MNL). In this analysis, information is available for firms who deal purely with the domestic market, export indirectly, export directly, directly invest abroad, internationally outsource production, export and directly invest abroad, export and outsource abroad, and export, invest and outsource abroad. All groups are mutually exclusive. For the empirical estimation strategy, it is assumed the firm chooses the internationalisation strategy that maximises its profit. Firm profit for each internationalisation mode is expressed as follows;

$$\pi_{icm} = \alpha_{0cm} + \sum \beta_{jm} Z_{icjm} + \gamma_{cm} + \theta_{sm} + \varepsilon_{im} ,$$

where π_{icm} is the profit of firm i in country c from choosing internationalisation mode m, the firm-specific term Z_{icjm} includes a set of firm controls that are expected to influence their internationalisation mode. β_{jm} is the coefficient corresponding to each variable. γ_{cm} and θ_{sm} are country and industry specific effects which are included to control for respective compositional differences across countries and sectors that may influence firm internationalisation mode selection. Under the assumption that the error term ε_{im} follows the Weibull distribution and under the assumption that profit for the firm that supplies only the domestic market is zero, the probability of firm i in country c choosing internationalisation mode m is expressed as:

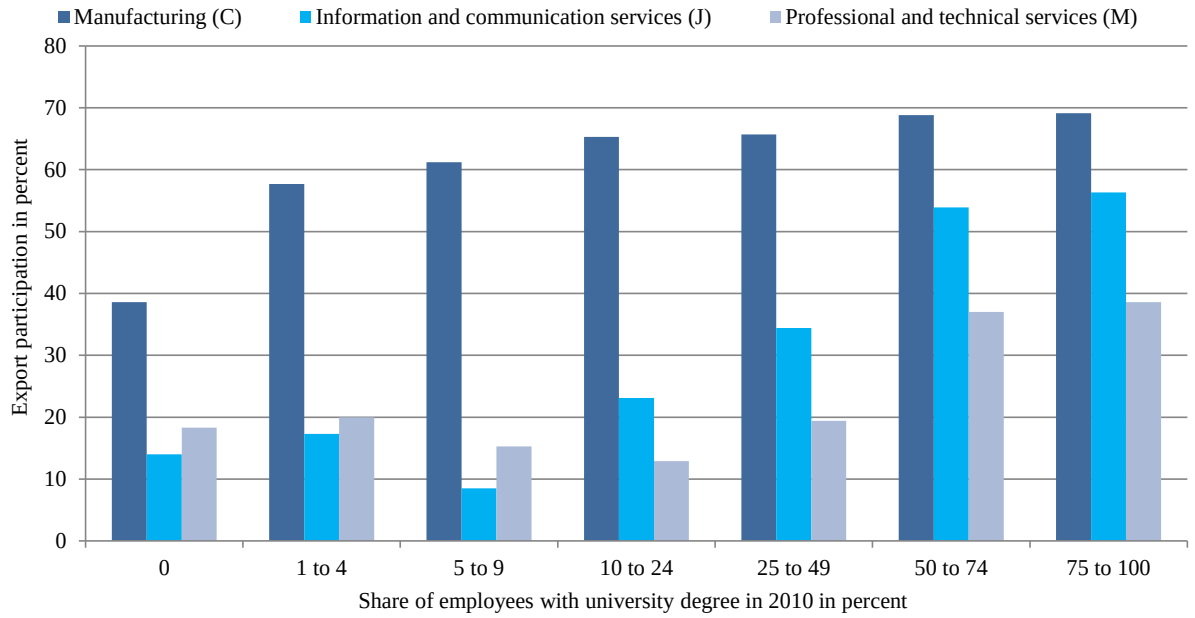
$$PR(INT_{ic} = m) = \frac{\exp\left[\hat{\alpha}_{om} + \sum \hat{\beta}_{jm} \hat{Z}_{icjm} + \hat{\gamma}_{cm} + \hat{\theta}_{sm}\right]}{1 + \sum_{m}^{7} \exp\left[\hat{\alpha}_{om} + \sum \hat{\beta}_{jm} \hat{Z}_{icjm} + \hat{\gamma}_{cm} + \hat{\theta}_{sm}\right]}$$

Multinomial logit coefficients are interpreted in terms of relative probabilities. It is necessary to compute marginal effects to reach conclusions on actual probabilities. Accordingly, the marginal effect of each variable is based on the derivative of the probability of each internationalisation mode with respect to the explanatory variable.

expectations (e.g. Ahn et al. 2011). In terms of innovative activity, firms that employ R&D workers are more likely to export directly or export. Product innovators are found to be positively associated with active engagement in exporting. Interestingly, firms that protect their intellectual property are found to export more often. Results also indicate that firms that have applied for intellectual property protection are less likely to export indirectly.

The results of the multinomial logit model also indicate that the choices of each form of internationalisation are positively related to firms that are more productive, employ R&D staff and internationally experienced managers, and engage in importing. In addition, older and larger firms are more likely to export and invest abroad, while foreign-owned firms and product innovators have a higher propensity to export. Productivity, employing R&D staff and internationally experienced managers, and importing are positively associated with the intensity of exports (measured as percentage of exports in turnover), FDI, and outsourcing. The importance of firm-specific advantages differs across the main internationalisation modes (exporting and FDI). In particular, the drivers of SME internationalisation are also different for direct and indirect exporting. Product innovations and R&D activities are only relevant to (direct) export decisions. As for the drivers of internationalisation mode intensities, labour productivity is positively associated with firms that are engaged more intensively in exporting, FDI, and international outsourcing. This indicates that the most productive firms are more likely to be internationalised irrespective of the mode of internationalisation.

Figure 3.10: Export participation of EU SMEs (10-249 employees) by firm skill intensity (in percent)



Notes: Weighted by sample weights. Number of observations is 139,000. Coverage: EU-20.
Source: CIS 2010 Safe Centre.

Box 3.4 : Modelling the determinants of export participation and export intensity

Modelling the export behaviour of SMEs involves two stages: export participation (extensive margin) and export intensity (intensive margin). The probability of exporting can be estimated by a probit or logit model. Bernard and Jensen (2004) show that size, productivity, labour quality, ownership structure, introduction of product innovations and past successes in export markets, are factors that increase the probability to export. For data that includes information on export value, two-part models or Heckman selection models can be employed. A two-part model would describe both the decision to export and the share of exporting SMEs. All explanatory variables are lagged one year in order to mitigate endogeneity problems. However, the regression results do not determine causality but rather provide measures of association. The export intensity equation is conditional on having positive values for exports and is therefore only estimated on a subset of the data. Given that the export share in the second part of the model is bound between values close to zero and one, the generalized linear model (GLM) link is used. In practice, ordinary least squares (OLS) estimation will lead to similar results. Table A2 provides results of the Heckman sample selection model. Table 3.14 provides results for the probit model of the export decision.

The findings of the analysis above show that export decisions and export intensity are significantly correlated with both productivity and innovation activities of SMEs which indicates that general framework conditions are important for success in international markets. This also suggests that the successful internationalisation of SMEs is likely to depend on a mix of direct and indirect policies rather than on a single policy instrument. For example, there are likely to be complementarities between policies that promote innovation and those that support trade; policymakers should thus seek to integrate and coordinate such policies. Improvements in framework conditions can lead to higher productivity levels through, for example, the reduction of the costs of doing business, lower mark-ups and better allocation of resources, improved utilisation of production inputs, and greater incentives to innovate.

Based on the empirical results, several policy implications can be drawn. First, policies aiming to increase the skill levels and R&D indirectly increase the export activity of SMEs. Second, the significance of skill intensity and R&D intensity indicates that SMEs need to improve the quality of their products and services in order to be successful in foreign markets. The significance of foreign ownership indicates that collaborating with large foreign firms is one way for small firms to compensate for their shortcomings in exporting.

Table 3.14: Determinants of exports decision: Probit estimations, pooled samples over time of SMEs

		AT[G]		DK		FR		IE		IT[G]		LU		NL[G]		NO[G]		PL		SE		SI		UK	
Firm has website	coef	0.11		0.00		0.09	*	0.19	***	0.24	***	0.17	**	0.01		0.23	***	0.21	***	0.21	***	0.29	**	0.28	
	t	0.55		0.00		1.83		4.27		9.32		2.40		0.09		3.20		6.05		2.96		2.04		0.52	
Employee broadband access	coef	0.07		0.06		0.13	*	n.a		0.20		-0.12		0.02		0.35	**	0.05		0.35	***	0.09		0.99	**
	t	0.29		0.71		1.79				4.52		-1.12		0.23		4.86		0.90		5.35		0.47		2.11	
Online transactions	coef	0.05		0.04		0.05		0.07		0.04		-0.06		0.03		0.06		0.06		0.07		0.14		0.41	
	t	0.33		0.52		0.75		1.52		0.85		-0.66		0.49		1.35		1.52		1.50		0.82		1.21	
ICT-intensive human capital	coef	n.a		0.79	***	0.24		n.a		n.a		n.a		n.a		0.50	**	n.a		0.50	**	n.a		2.36	**
	t			3.01		0.87										2.12				2.46				2.18	
Non-ICT intens-ive human capital	coef	n.a		0.14		0.69	***	n.a		n.a		n.a		n.a		-0.62	***	n.a		0.59	***	n.a		0.61	
	t			0.54		3.63										-3.83				3.22				0.68	
Human capital	coef	n.a		n.a		n.a		n.a		n.a		n.a		-0.14		n.a		n.a		n.a		0.08		n.a	
	t													-0.67								0.20			
Log wages	coef	0.29		n.a		n.a		0.02		0.20	***	-0.17	*	n.a		n.a		0.15	***	n.a		n.a		n.a	
	t	1.51						0.39		6.52		-1.81						4.32							
Prior exports	coef	1.39	***	2.79	***	2.43	***	1.96	***	3.29	***	2.10	***	1.18	***	1.33	***	2.11	***	2.15	***	1.98	***	1.14	**
	t	6.03		15.52		19.48		15.04		78.89		8.55		10.21		14.50		31.83		17.65		5.73		2.22	
Log labour productivity	coef	0.0002		0.0000		0.0002	**	0.0002		0.0000		0.0001		0.0000		0.0002	***	0.0001	***	0.0000	**	0.0027	***	-0.0001	
	t	0.62		0.51		2.07		1.33		0.62		-0.85		0.27		8.36		3.57		2.29		2.72		-0.18	
Log employment	coef	0.37	***	0.19	***	0.13	***	0.13	***	0.14	***	-0.09	**	0.14	***	0.27	***	0.16	***	0.13	***	0.27	***	0.31	
	t	4.09		4.47		4.55		5.21		11.04		-2.25		4.35		9.86		9.95		5.98		4.04		1.01	
Capital/labour ratio	coef	-0.0001		0.0001	**	0.0001		n.a		-0.0001		n.a		0.0013		-0.0001	***	0.0000		0.0000		0.0000		0.0009	
	t	-0.02		2.59		0.20				-1.33				1.32		-5.02		0.17		-0.88		0.00		1.18	
Age	coef	n.a		0.00		0.00		0.00	**	0.00		0.01	***	0.00		0.01	***	-0.01	***	0.00		-0.01		0.00	
	t			-0.80		-0.13		2.24		1.38		3.42		1.46		2.84		-3.77		0.10		-0.66		0.01	
Foreign ownership	coef	n.a		0.12		0.20	***	0.02		0.00		n.a		-0.01		0.39	***	0.56	***	0.22	***	0.42	**	-0.13	
	t			1.48		2.77		0.31		0.00				-0.15		6.34		12.52		3.37		2.18		-0.34	
Export spillovers	coef	2.14	***	0.29		-0.11		-0.35		0.50	***	0.76	**	1.73	***	0.66	***	-0.33	*	0.22		0.23		3.62	***
	t	4.14		0.98		-0.45		-1.40		6.21		2.22		6.30		3.27		-1.83		1.08		0.36		2.89	
constant	coef	-1.78	*	0.90		0.41		-5.49		-0.63	***	2.08	***	0.49		-1.76	***	-1.18		0.51		-1.29		5.54	
	t	-1.90		1.41		1.12		0.00		-3.69		3.72		1.40		-5.18		-6.02		1.65		-1.15		0.00	
Observations		800		5897		6486		5385		34802		4479		4923		6476		18690		9068		912		333	
Industry dummies		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	
Year dummies		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes		Yes	

*Note: All explanatory variables (except age and ownership) are lagged one year. G signifies information only available for exports of goods. ***, ** and * denotes significance at the 1, 5 and 10 per cent levels. Coverage: EU countries as indicated. The LR chi-square test shows that the model is statistically significant at the one percent level in all cases.*
Source: ESSLait PSEC dataset and own calculations.

3.3.3. The role of ICT as a facilitator of SME internationalisation

The importance of ICT in internationalisation has seldom been explored despite its obvious potential in simplifying international activities, especially for smaller firms and exports of services. In this section, the role of different ICT capacities in the internationalisation of European SMEs is investigated empirically. The ICT capacities explored are: having a website; degree of broadband internet-enabled employees; iii) conducting online sales; and proportion of schooled ICT employees.

Probit model estimates presented in Table 3.14 (and described in Box 3.4) show that ICT is significantly and positively related to the exporting activities of small and medium-sized firms in most of the countries investigated, although the specific ICT capacity that is most important varies to some extent across countries. As can be seen in the table, it appears that basic advantages such as having a website are important for export decisions in a majority of countries, while the e-sales variable remains insignificant. This indicates that even simpler ICT tools may help firms carry out a range of activities from a distance that would otherwise be more difficult and costly. A website makes a firm more visible while enabling it to establish direct contact with customers, strengthen its customer service, and build up a customer-related information system. A website may also support international advertising and make it possible for firms to tailor their online experience to customers from specific markets. These results are in line with those of Lendle et al (2012), who find that online markets potentially build trust and reduce information friction; and with Freund and Weinhold (2004), who conclude that websites are positively related to exporting activities.

In France, Italy, Norway, Sweden, and the UK, the degree of broadband internet-enabled employees is positively correlated with exporting behaviour even after controlling for firms' human capital. This result may indicate that SME employees in these countries use the internet as a resource in activities connected to exploiting opportunities in international markets, as suggested by Portugal-Perez and Wilson (2012).

Access to online transactions, or e-sales, is the third ICT variable investigated. Contrary to expectations, there is no clear evidence of a relationship between e-sales and decisions to export. This indicates that a system for online sales is not enough to support the exporting activities of SMEs. Instead, there could be a further underlying factor related to a lack of trust in online purchases. Alternatively, investments in proper and secure systems for online sales may require resources that are out of reach for certain SMEs, while this would be a lesser concern for larger firms (as indicated by the results of Eurostat, 2012). Employees trained in ICT are another potential resource. According to Schott (2004), highly skilled employees are important in determining the export activities of a firm. Specific ICT skills are also expected to complement other capacities of the firm. The results confirm a positive correlation between ICT-trained employees and export status in four out of the five countries (Denmark, Norway, Sweden, and the United Kingdom) for which data on educational achievement is available.

It is interesting to note that in Norway, Sweden, and the United Kingdom, the positive relationship between the degree of broadband internet-enabled employees and export status applies even when controlling for the proportion of ICT-trained employees. That is, if two SMEs with a similar proportion of ICT-educated employees are compared, the probability of exporting should be higher for the firm that has a larger proportion of employees with fast internet access. This result suggests that internet use creates benefits even when used by employees who are not trained in ICT.

It is likely that the importance of ICT capacities differs between manufacturing and service firms. Results show no clear pattern in the estimates across the two industry groups except for the presence of a website, which is more often related to the export decisions of service firms than those of firms in manufacturing. A similar analysis by Eurostat (2012) based on a data set including a high proportion of large firms renders fewer significant estimates for the relationship between having a website and deciding to export, while the link to online sales is more common. This suggests that the firm size might be a more crucial determinant of its decision to export than its sector.

In policy terms, continuing efforts to support fast internet access, which is indeed one of the key areas of the Digital Agenda for Europe, may still be a plausible solution – at least for countries exhibiting a lower intensity of ICT usage. This would enable small and medium-sized firms to take the first digital step into a new market by establishing a website with core information on their products and services. A natural next step would then be to introduce more advanced activities on the website, such as by allowing online transactions. That said, the difficulty of finding significant links between exporting behaviour and online sales may be related to firms still being resistant or unaccustomed to these kinds of transactions, or simply unable to afford a website with proper sales functions. A secure host platform for online sales serving smaller firms might balance the distorted competition between smaller and larger firms on the one hand and between firms in

countries with lower and higher ICT intensity respectively, on the other.

3.3.4. Market destination characteristics and export performance

The descriptive statistics presented in section 3.2 show that SMEs are at a particular disadvantage in exporting to distinct markets. While firm-specific advantages such as innovativeness and skill intensity play a key role in determining a firm's export performance, differences in exporting costs across market destinations due to geography, infrastructure, institutional, and other factors are also accepted as being particularly important. To date, there is limited empirical research that analyses the relevance of such country characteristics for SMEs in comparison to large firms.

The use of an augmented gravity model[43] makes it possible to examine whether the effect of destination market characteristics on exporting decisions and export intensity differs according to firm size.[44] These destination market characteristics include the gravity factors (size and distance), GDP per capita, business regulations, and property rights. Results suggest that market size as measured by GDP, common language and property rights protection in the destination country all are significantly positively related to the percentage of exporting SMEs in non EU markets (see Annex Table A4 for the results for France). This indicates that large destination markets, sharing a common language and a strong property rights regime attract a larger number of exporting SMEs outside Europe. SME export participation is found to decrease as the geographical distance (a proxy for transportation costs) between trading countries increases. For example, results suggest that if country A is 10 percent further away than country B to France, smaller firms will on average export 3.7 percent less to country A than to country B. There is some evidence to suggest that micro, small, and medium-sized firms are discouraged from entering distant markets as compared to large firms, but those who do overcome the higher costs of exporting across longer distances do so by exporting greater average shipments per product and firm. The results indicate that business and trade regulations in the host market have strong negative impact on export participation. It is interesting to note that stronger property rights protection and lower legal costs of contract enforcement are found to encourage micro and small French firms to begin exporting or expand their exported products..

The analysis suggests that trading partners that share a common native language are likely to experience greater export participation amongst SMEs. In terms of communication infrastructure, there is some evidence to suggest that better internet infrastructure in the destination market in question is more beneficial to the likelihood of micro firms engaging in exporting. Meanwhile, stronger property rights protection and lower legal costs of contract enforcement are found to encourage micro and small French firms to begin exporting or expand their exported products. Regarding regulatory trade barriers, the French results indicate that these barriers have a greater negative effect on the export participation of small and medium-sized firms.

Overall, the size of the export market and trade costs associated with geographic distance clearly matter, but the results suggest that a reduction in other trade costs, such as those arising from the development of better communication infrastructure, more efficient legal institutions, and lower regulatory barriers to trade may lead to relatively larger increases in the number of exporting SMEs.

3.4. THE IMPACT OF EXPORTING ON FIRM GROWTH

This section estimates the impact of exporting on the growth of SMEs. It is likely that the link between exporting and firm growth differs across specific firm characteristics, such as industry affiliation, skill intensity, and productivity level. Knowledge of the variation in the impact of exporting on firm growth is important for managers because it can help SMEs maximize the benefits of exporting. This section is based on an analysis of CIS 2010 data for 20 EU countries (described in Box 3.5) and investigates the relationship between the initial size of SMEs and subsequent growth. Gibrat (1931) suggests that a firm's growth is independent of its initial size; the probability of firm growth should thus be similar for firms of varying sizes in a given industry. More recently, Haltiwanger et al (2013) have also highlighted the importance of firm age when considering firm growth dynamics.

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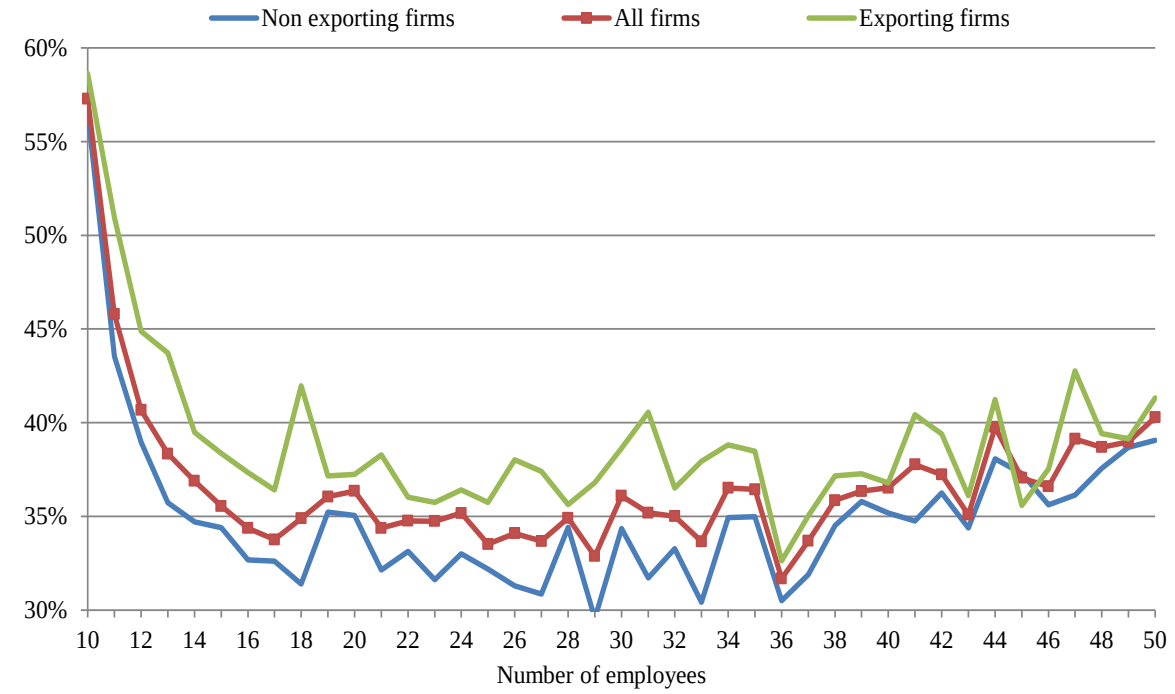
[43] The model applied to three EU countries (France, Ireland, Slovenia) for which sufficient data was available. The summary results for France are reported in Annex Table A4. Additional results are reported in the background report.

[44] The empirical approach is described in the background report. To summarise, total goods exports in a sector are decomposed into firm and product extensive margins and the product intensive margin, and are then linked to destination country characteristics using a gravity model specification. To examine if the relationship between the trade variables and the country characteristics differ across firm size groups, firm size dummies are interacted with each of the destination characteristics.

Figure 3.11: Percentage of firms with growing employment in EU-20 countries between 2008-2010 by size



Note: The number of observations range between about 3000 for firms with 10 employees to about 200 for firms with 50 employees. Size is measured as number of employees for 2008.
Source: CIS 2010. Eurostat Safe Centre.

Box 3.5: The link between exporting and SME growth

Following Bernard and Jensen (1999), the firm growth model can be augmented by a measure of initial export participation. Other control variables include size (ln Y) and size squared, innovation output activities (NEWMKT, INPS), the productivity level of SMEs relative to large firms (RELPROD), foreign ownership (FOROWN), belonging to a domestic enterprise group (GROUP), industry affiliation (DEC), and country effects (DCO):

$$\left(\ln Y_{ijct} - \ln Y_{ijct-2}\right)/2 - = \beta_0 + \beta_1 \ln Y_{ijct-2} + \beta_2 (\ln Y)^2_{ijct-2} + \beta_3 EX_{ijct,\cdot t-2} + \beta_4 NEWMKT_{ijct,\cdot t-2}$$
$$+ \beta_5 INPS_{ijct,\cdot t-2} + \beta_6 FOROWN_{ijct} + \beta_7 GROUP_{ijct} + \beta_8 RELPROD_{ijct-2} + \gamma DCO_{ijct} + \eta DSEC_{ijct} + \varepsilon_{ijct}.$$

Here *i* denotes firms, *j* industries, *c* countries, and *t* time. The dependent variable, $\Delta \ln Y = \left(\ln Y_{ijct} - \ln Y_{ijct-2}\right)/2$, measures the average annual change in turnover (or alternatively, employment) over a two-year period (2008-2010). The parameter ß$_3$ indicates the difference in firm growth between exporting and non-exporting SMEs, measured in terms of percentage points and controlling for other factors. A negative coefficient for ß$_1$ means that small firms grow faster than larger firms. A significant coefficient of the squared term of initial size means that there is a non-linear relationship between firm growth and size. The firm growth equation can be estimated using OLS with robust standard errors (alternatively with the robust regression method). Several extensions of the firm growth model are provided. The first involves dividing export status according to the respective destination markets. A further extension is to investigate whether the strength of the relationship depends on the initial level of SME productivity relative to that of large firms. The underlying hypothesis is that the relationship between exporting and firm growth is stronger for highly productive SMEs.

CSES (2012) suggests that for EU countries, the size distribution in terms of employment remains stable over time, indicating that SMEs do not grow faster than their larger counterparts. The possibility that smaller firms do grow faster than larger firms does not necessarily mean that the weight of the smaller firms in the economy grows over time, particularly if SMEs exhibit a higher exit rate at the same time. The size distribution of employment also depends on the number of firms that exit through bankruptcy or acquisition. However, smaller firms (particularly micro enterprises) are not only characterized by their growth rates, but also by a higher probability of exiting the market. This is often related to suboptimal firm size. In fact, evidence for the EU based on the structural business statistics for 2010 shows that the exit rate decreases with firm size: 12 per cent for firms with zero employees, 7 per cent for firms with 1-4 employees, 3 per cent for 5-9

employees, and 2 per cent for firms with 10 or more employees.

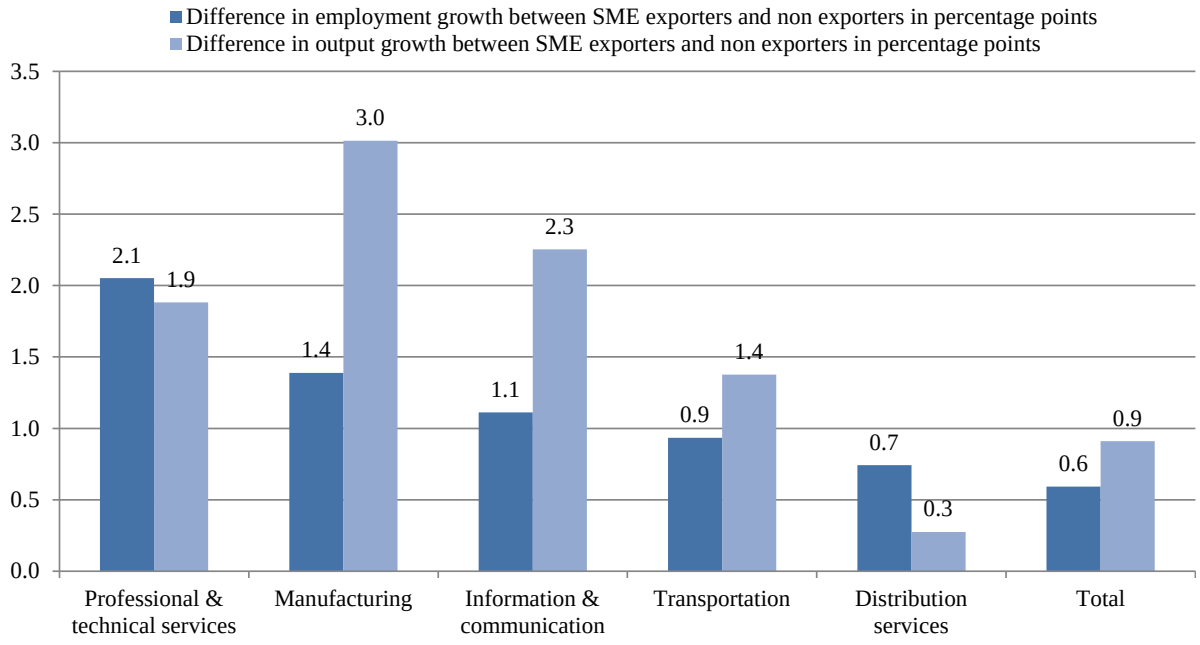
3.4.1. Export activity and SME growth

In order to gather some initial insights into the relationship between firm size and firm growth and the role of export status, the percentage of SMEs (10-50 employees) is calculated as a function of initial employment. Figure 3.11 shows that the percentage of growing firms is consistently higher among exporters than among non-exporters up to a threshold of 35 employees and that the share with growing employment is greater for small firms (those with 10-20 employees). However, for SMEs with around 20 or more employees, the share of firms with rising employment appears rather independent of initial size.

For the total sample, the annual employment growth rate of exporting SMEs is 0.5 percentage points higher on average than that of non-exporting SMEs between 2008 and 2010. The corresponding result for the difference in output growth rate is 0.9 percentage points per year. The positive relationship between SME exporting activities and firm growth is noteworthy given the time period examined in the analysis, which was characterized by economic and financial crises. This indicates that exporting SMEs recovered faster from these crises than SMEs that were only present in their domestic markets. An alternative interpretation is that the crisis induced SMEs to engage more in exporting as domestic demand was falling (European Commission, 2013).

With respect to the relationship between firm growth and firm size, the negative and statistically

Figure 3.12: Difference in firm growth between SME exporters and non-exporters between 2008-2010

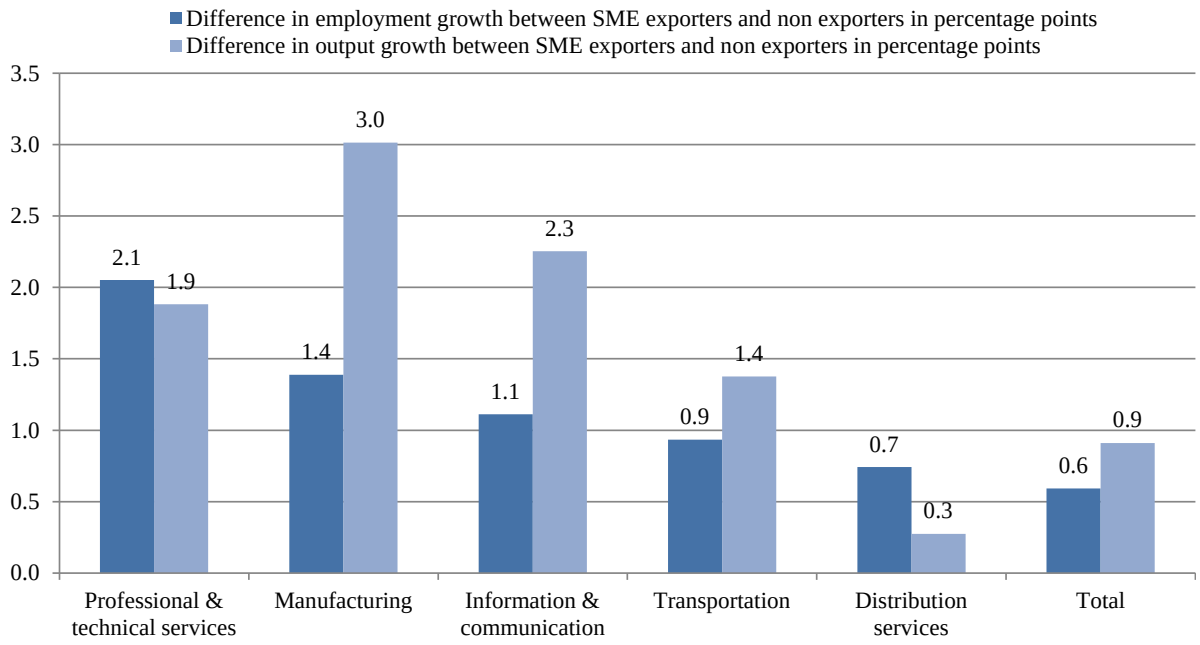


Note: Coefficients measure the difference in firm growth between exports and non-exporters in percentage points. The specification is based on Gibrat's specification and Bernard and Jensen (1999). See Box 3.5. The number of observations is 115,000, of which 51,600 are manufacturing SMEs. Source: CIS 2010. Eurostat Safe Centre.

Annex Table A5 shows the results of robust regression analysis described in Box 3.5 on the determinants of SME employment growth for the overall business enterprise sector and eight broad industry groups based on CIS 2010 data. Figure 3.12 shows the coefficient of the relationship between export status and firm growth, controlling for other enterprise characteristics and country effects by broad industry groups. The results show that exporting SMEs have a significantly higher average annual growth rate of employment for the period 2008-2010 than do non-exporting SMEs when controlling for size, innovation output, foreign ownership, industry affiliation, and country effects.

significant coefficient of firm size indicates that employment growth tends to decline with firm size, *ceteris paribus*, while the positive coefficient of the squared term suggests that employment growth tends to decrease more slowly as firms become larger. Overall, this indicates a non-linear concave relationship. However, employment growth of large firms tends to be stable over time, whereas SMEs are more unlikely to keep a positive growth path over time (Ciriaci et al, 2013).

Figure 3.13: Difference in firm growth between SME exporters and non-exporters by destination market between 2008-2010



Note: Coefficients measure the difference in firm growth between exports and non-exporters by destination in percentage points controlling for size, foreign ownership. Source: CIS 2010. Eurostat Safe Centre.

Furthermore, results for the different sub-industries show that exporting and firm growth are significantly and positively related in most industries. The link between the export status of SMEs and firm growth is particularly strong for manufacturing SMEs (and SMEs in the mining sector), with a differential of 1.4 percentage points. The association between export status and firm growth is also stronger than average for SMEs in professional and technical services (2.1 percentage points) and information and communication services (1.1 percentage points). When firm growth is measured as output growth, one can observe a similar pattern. The control variables have the expected sign, and innovative firms have higher growth rates of both employment and output.

Proceeding with an analysis of the extent to which the relationship between SME exporting activities and firm growth differs between SMEs with high and low productivity, it can be recalled that theoretical and empirical evidence suggests higher rates of productivity for exporting firms. Therefore, it is likely that the link between export status and firm growth is stronger for highly productive SMEs than for those with lower productivity. In order to test this hypothesis, an interaction term between export status and the productivity level of SMEs relative to large firms was introduced. Results presented in the background report indicate that the interaction between the relative labour productivity level and exporting is positive and significant. This indicates that the relationship between exporting and firm growth is stronger where the productivity gap between SMEs and large firms is smaller.

3.4.2. Destination markets

A further step in this analysis focuses on whether the exporting on firm growth effect differs across destination markets. It might be the case that the link between firm growth and export status is stronger when SMEs are globally present rather than in one of the two markets in question

Figure 3.13 displays the estimation results, which indicate that exporting both within and outside Europe (EU/EFTA/candidate countries) is significantly and positively related to firm growth. In general, the magnitude of the relationship between exporting and firm growth is larger for exports within than outside Europe. In information and communication services, however, results show that SMEs present in both export markets exhibited a higher growth rate of output and employment between 2008 and 2010.

Overall, the findings suggest that exporting SMEs tend to create more jobs and achieve higher output growth than non-exporting SMEs. The link between exporting and firm growth is higher in skill intensive service industries. The magnitude of this relationship increases with the productivity level of SMEs relative to large firms in a given industry and country. Results based on Swedish firm-level data presented in the background report indicate that the

exporting effect is larger for SMEs with high skill intensity.

3.5. SUMMARY AND POLICY IMPLICATIONS

Globalization and technological advances have reduced distances and the significance of national borders in various areas, and enabled the exchange of previously non-tradable goods and services. These changes have also ushered in opportunities and challenges for European SMEs. However, barriers to internationalisation are systematically higher for SMEs than for larger companies. Given the more limited resources and higher vulnerability of SMEs compared to large companies, a key question relates to the role that policymakers should play in helping SMEs internationalise, particularly with regard to the appropriate mix of targeted policies. In other words, policymakers should consider whether and to what extent they should rely on direct measures in promoting SME internationalisation and on indirect measures, such as improving framework conditions to support decisions for SMEs to export and invest abroad.

3.5.1 Main results

This chapter presents a number of new findings which may be of particular relevance when designing policies for the support of SME internationalisation. These results can be grouped under three categories: firm and management characteristics; firm specific advantages; and home and host country characteristics.

Concerning firm and management characteristics, the results show that the size of SMEs is crucial. Micro enterprises and small firms have significantly lower export participation rates compared with the other size-groups of firms. This holds particularly true for one-person businesses and young SMEs in traditional industries. New empirical findings show that the differences in both export participation and export intensity across firm size is larger within the group of SMEs than between medium-sized firms and large firms. However, for services the export to output ratio of SMEs is largely independent of firm size, unlike manufacturing. The strong size dependency can also be observed for the second most important type of internationalisation: outward FDI activities. In general, exporting is a more vital internationalisation strategy for SMEs than FDI or international outsourcing while indirect exports play a relatively minor role.

Another important result is that firm characteristics such as industry affiliation, age and destination play an important role for SME export behaviour. Export propensity of SMEs varies markedly across industry affiliations, with larger participation rates in manufacturing and in software and business services. Sectoral differences are also significant in terms of SME internationalisation via FDI. Compared with large firms, SMEs are overrepresented in European markets and underrepresented in non-European markets. SMEs have a strong disadvantage for exports beyond Europe, particularly for more distant markets such as China. Foreign ownership has a strong impact on the internationalisation inclination of SMEs: foreign-owned SMEs have a higher probability of exporting and also show a higher export to output ratio. The age of the SMEs is impacting upon the developments in their internationalisation: the older the SME, the more internationalised it is, thus the older the SME, the more likely it is to export and to invest abroad. There are some exceptions, particularly in ICT and business services where younger firms are often also internationally active.

With respect to firm-specific advantages the results show the productivity level of the SMEs, technological innovations, R&D activities, skill intensity and ICT capacities are all strongly positively related to the export participation of SMEs. In particular, productive firms are more likely to be internationalised. Export participation increases significantly with innovation, R&D activities and skill intensity. There is also a positive relationship between ICT capacities and exporting behaviour of SMEs, although which ICT capacity matters is country-specific. Finally, there is a link between the firm's decision to internationalise via FDI and between its level of productivity, innovation and the capital intensity of production. Furthermore, it is important to note that many exporting SMEs, particularly those with low productivity or low skill intensity do not realize their full growth potential. SMEs can maximize their benefits from exporting by upgrading their workforce and/or increasing their productivity level.

The analysis also provides evidence on the importance of external factors in influencing the propensity of export. Export participation of SMEs is strongly influenced by home country-characteristics, with higher export and business regulations in the home market leading to lower export participation rates. New empirical results show that export intensity of SMEs is significantly positively related with both export promotion measures and export credits. Host country level factors are also significant in SME internationalisation including market size, sharing a common language and geographical distance. SMEs are more sensitive to language differences and intellectual property rights than large firms.

3.5.1. Policy considerations

Framework conditions

The analysis presented in this chapter demonstrates that framework conditions are a critical policy tool that can be used to support SME internationalisation as these address the most important drivers and barriers. This is in line with the policies and messages contained in documents published by the European Commission which emphasize the importance of framework conditions in improving European and SME competitiveness. In a related policy update, the European Commission (2012) proposes four main elements (investment in innovation, better market conditions, access to capital and labour, and skills) to improve the framework conditions for reinforcing the growth potential of EU industry. Similarly, the European Commission (2010a) emphasizes the importance of improving framework conditions in ensuring a competitive and sustainable EU industry, especially for SMEs. The Commission and member states have taken several policy measures to support the framework conditions for firms' innovation and productivity under the Europe 2020 Strategy. These measures include policies designed to support firms' innovation activities, such as by enhancing the quantity and quality of tertiary education, encouraging smart specialisation strategies, and building a competitive business environment. Appropriate framework conditions are seen as crucial from the point of view of spreading key enabling technologies in the European Union.

An important advantage of policies that seek to improve framework conditions is their non-distortive character compared to direct, targeted policy measures with the same aims. However, certain results of the analysis presented here indicate that direct measures to support SME internationalisation are justified in some areas because they address specific market failures, which have a disproportionate effect on SMEs compared to larger firms. The analysis presented earlier suggests that framework conditions can be critical in influencing the main drivers of company-specific advantages, and thus of efforts to promote internationalisation (for example, improving productivity, technological innovation and R&D, ICT, firm size, and skill intensity). Second, given that the relationship between the exporting of SMEs and firm growth increases with the productivity level and/or skill intensity of SMEs, policy makers should not only focus on providing incentives to export, but put more emphasis on general policies (i.e. that help/induce firms to improve productivity, innovativeness and skill intensity) that are also beneficial to SMEs.

This chapter also highlights the crucial nature of external factors, particularly in the area of regulatory and bureaucratic impediments, and with specific regard to the various elements of the transaction costs of exporting and investing abroad. This may be related to the administrative burden associated with exporting (or investing abroad) or to the overall administration requirements for enterprises (entry and exit barriers, administrative efforts, etc.). The results underscore the validity of the common policy recommendations which target local business climates and can be summarized as openness, deregulation, and administrative simplification. In addition, various infrastructure considerations can be of particular importance. The evidence presented here draws attention to the importance of specific policies, such ICT initiatives, as well as policies that improve the related infrastructure. Furthermore, reducing the transaction costs of internationalisation (trade costs in a broad sense) by improving the level and quality of related infrastructure (e.g. road, ports, railways for goods and the internet for services) is also important.

Heterogeneity of SMEs

The results presented earlier also underscore various aspects of the heterogeneity of SMEs. First, they emphasize the differences compared to large companies in terms of productivity levels, and ability to deal with internationalisation requirements, especially in the area of information, operational/managerial capacities, and financial strength. Direct policies targeting SMEs can thus be justified in helping such firms overcome these difficulties during internationalisation although there is relatively little information on the evaluation of such policies[45].

Second, the link between various SME characteristics and internationalisation performance may in certain cases justify addressing various groups of SMEs directly when designing policies. For example, the underrepresentation of SMEs in non-EU markets and those outside Europe explains why informational, operational, and financial support should be especially useful for SMEs trying to establish a foothold in these markets. Differences in the strength of the link between firm size, firm age, and ownership on the one hand and internationalisation performance on the other may

[45] A study to review the internationalisation opportunities and support policies for European SMEs (EIM, 2011) found that such measures generally had a positive impact on SME performance in international markets but that there was relatively little evaluation of such policies. The most common types of support measures in the EU relate to information provision, including advisory and consulting services to organized trade fairs, seminars, matchmaking, and facilitated meetings with potential clients.

also justify differentiated support. The degree of internationalisation also differs by sector: in certain industries, SMEs may build firm-specific advantages that quickly provide a basis for internationalisation (ICT, other high-tech sectors).

Third, the heterogeneity of SMEs is connected to the link between internationalisation and firm-specific advantages such as productivity, skill intensity, innovation, specific technology, and new/unique products and services. This latter finding points to the fact that superior firm-specific advantages provide the basis for sustainable, lasting, and successful internationalisation. It also affirms the importance of improving the framework conditions that enable SMEs to gain these firm-specific advantages.

Policy implications

SMEs play a significant role in the economies of the EU member states, especially in employment, output, R&D and as suppliers to large firms but also increasingly through exports and foreign direct investment. Although the degree of internationalisation of SMEs is now proceeding at a higher speed than previously, the level of internationalisation of SMEs remains low. Instead, the majority of SMEs are still oriented towards the domestic market, particularly for micro enterprises including sole proprietorships. Given that a large number of small and micro enterprises are not exporting, further efforts should be made to increase the export participation of these firms, particularly by increasing the awareness of the benefits of internationalisation in terms of improvements in firm growth and performance.

The findings that export credits and other incentives as well as firm specific advantages stimulate export activities of SMEs suggest that successful internationalisation of SMEs depends on a mix of direct and indirect policies rather than on a single policy instrument. Creating favourable framework conditions, namely supporting innovation and R&D activities, further investments in ICT infrastructure, will help to increase the internationalisation activities of SMEs. EU member countries should continue to reduce export regulations and offer better business climate conditions for SMEs. Although EU countries have made efforts to reduce the administrative burden on SMEs and generally reduced the time and costs associated with starting a business during recent years, the cost to export has not seen the same progress. Focus on measures to improve the administration of exporting (or investing abroad), such as harmonisation of administration procedures and processing times for contact with and reporting to authorities in relation to exporting, may be useful.

Another area where improving framework conditions could be beneficial, as it indirectly affects the capacity of SMEs to internationalise, relates to certain elements of the infrastructure. Improving the ICT and internet infrastructure as well as the level and quality of trade-related infrastructure and related policies would be beneficial in indirectly promoting the internationalisation of SMEs.

Besides improving framework conditions, certain targeted policy measures may be appropriate in aiming at eliminating certain market failures hindering the internationalisation of SMEs, and addressing those SME subgroups which are hit hardest by these. The analysis presented in this chapter has also underlined the heterogeneity of SMEs in their degree of internationalisation with respect to size, age, industry affiliation, and ownership, as well as firm-specific advantages such as productivity, innovation, skills and ICT capabilities. The heterogeneity within the group suggests that less focus should be put on this cohort as a whole, but rather on small firms and medium-sized firms separately, particularly when formulating measures offering direct assistance in the form of information, financial and operational support.

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ANNEX

Table A1: Overview of the main databases on internationalisation activities of SMEs

	TEC	CIS	ESSLait MMD	BEEPS	EFIGE
Criteria	**Exports of goods**	**Exports of goods/services**	**Exports of goods/services**	**Direct & indirect exports**	**Direct & indirect exports, FDI, international outsourcing**
Export participation	yes	yes	no	yes	yes
Export intensity	yes	yes	yes	yes	yes
Exports by destination	Intra/Extra EU	Intra/Extra EU-EFTA	no	no	yes
Export threshold	no	no	partly	no	no
Firm size threshold	0	10	10	5	5
Sector coverage	A-U (here B-N excl. K)	B-M (excl. NACE Rev. 2 47, I, L)	NACE Rev 1.1 C-N (excl. D,E,F)	business enterprise	manufacturing
Country coverage	EU-24	EU-20	12 EU countries	11 EU countries	4 EU countries
Time period	2008-2010	2010	2003-2010	2008	2008

Note: MMD denotes Micro Moments Database provided by the ESSLait project. TEC denotes Trade enterprise characteristics database (TEC), CIS denotes Community Innovation Survey, EFIGE denotes European Firms In a Global Economy, BEEPS refers to the Wold Bank's Business Environment and Enterprise Performance Survey.

Table A2 : Determinants of the intensity of internationalisation mode choices of SMEs, marginal effects

	Export Intensity	Export decision	FDI Intensity	FDI decision	international outsource Intensity	international outsource decision
Intensive use of export credit	0.536***	.	0.014	.	-0.054	.
	(0.063)	.	(0.229)	.	(0.248)	.
Use Trade/export insurance	0.326***	.	-0.156	.	0.180	.
	(0.054)	.	(0.162)	.	(0.160)	.
Use export tax and financial incentives for exporting	0.253**	.	0.600**	.	0.164	.
	(0.113)	.	(0.268)	.	(0.303)	.
support from public or private institutions for FDI or international outsourcing	0.268*	.	-0.269	.	0.085	.
	(0.160)	.	(0.190)	.	(0.376)	.
financial incentives provided by the public sector	-0.057	0.043**	-0.324	-0.005	0.007	0.003
	(0.069)	(0.022)	(0.201)	(0.006)	(0.148)	(0.008)
Tax incentives	-0.015	0.001	-0.313*	-0.004	-0.393**	0.009
	(0.062)	(0.019)	(0.170)	(0.006)	(0.183)	(0.007)
Productivity (lagged)	0.078*	0.051***	0.225*	0.015***	0.343**	0.016***
	(0.043)	(0.012)	(0.117)	(0.003)	(0.139)	(0.004)
Capital intensity (lagged)	0.021	-0.005	-0.102*	-0.007***	-0.157**	-0.009***
	(0.022)	(0.006)	(0.062)	(0.002)	(0.080)	(0.002)
RD staff employed	0.158***	0.105***	-0.242	0.012**	0.343	0.021***
	(0.061)	(0.016)	(0.213)	(0.006)	(0.223)	(0.007)
Product innovators	0.170***	0.097***	0.108	0.004	0.015	-0.002
	(0.057)	(0.016)	(0.178)	(0.006)	(0.206)	(0.007)
Process innovators	-0.065	-0.004	-0.203	-0.002	-0.061	-0.004
	(0.052)	(0.016)	(0.165)	(0.005)	(0.150)	(0.006)
IP registration	0.092	0.069***	0.070	0.004	-0.214	0.033***
	(0.057)	(0.020)	(0.166)	(0.005)	(0.174)	(0.007)
Int. experienced executives	0.280***	0.066***	0.361**	0.025***	-0.032	0.016**
	(0.060)	(0.022)	(0.145)	(0.006)	(0.168)	(0.008)
Importer	0.117**	0.212***	-0.079	0.017***	0.743***	0.040***
	(0.056)	(0.015)	(0.198)	(0.006)	(0.263)	(0.007)
Production costs	0.004	-0.016	-0.354*	0.011*	0.458**	0.013**
	(0.057)	(0.017)	(0.194)	(0.006)	(0.193)	(0.007)
Product Quality	-0.111**	-0.003	0.317*	0.001	0.070	0.008
	(0.052)	(0.015)	(0.163)	(0.005)	(0.173)	(0.006)
Labour Regulation	-0.107*	-0.008	0.228	0.002	0.258	0.008
	(0.058)	(0.017)	(0.172)	(0.005)	(0.167)	(0.007)
Market demand conditions	-0.011	0.002	-0.239	-0.005	0.062	-0.008
	(0.052)	(0.015)	(0.168)	(0.005)	(0.165)	(0.006)
Scale dummy	0.072	-0.015	0.036	-0.010	0.383**	-0.013
	(0.090)	(0.024)	(0.228)	(0.007)	(0.192)	(0.010)
Domestic owned	-0.466***	-0.129***	-0.173	-0.008	-0.141	-0.013
	(0.070)	(0.027)	(0.186)	(0.006)	(0.166)	(0.009)
Age 20+	0.075	0.071***	-0.300*	0.010**	-0.383**	-0.006
	(0.052)	(0.015)	(0.177)	(0.005)	(0.162)	(0.006)
Size (lagged)	0.051	0.184***	-0.283	0.049***	0.338	0.011
	(0.041)	(0.045)	(0.336)	(0.007)	(0.239)	(0.009)
No of firms	3819		3819		3819	
λ	-0.151		0.233		-2.239	
ρ	-0.132		0.298		-0.981	
Wald test for H0: ρ=0 , (P value)	χ^2 (1) = 2.32, (0.128)		χ^2 (1) = 0.75, (0.386)		χ^2 (1) = 24.40, (0.000)	
Log-likelihood	-5594.547		-545.006		-793.4108	

*Notes: Marginal effects are based on maximum likelihood estimates for Heckman models. Robust standard errors are in parentheses. *, **, ***, denote 10%, 5%, 1% significance levels. Country, sector specific effects not shown. Test statistics based on regression output. Detailed specification of the model can be found in the background report.Country coverage: DE, ES, FR and IT. Source: Analysis based on the EFIGE data set.*

Table A3 : Determinants of the internationalisation mode choices of SMEs, marginal effects

	DOM	IEXP	DEXP	FDI	OUT	EXP, FDI	EXP,OUT	EXP, FDI, OUT
Productivity (lagged)	-0.055***	-0.008*	0.036***	0.001	0.003	0.011***	0.008**	0.004**
	(0.012)	(0.004)	(0.012)	(0.002)	(0.002)	(0.003)	(0.004)	(0.002)
Capital intensity (lagged)	0.011*	-0.002	0.006	-0.002*	-0.002**	-0.005***	-0.004**	-0.002**
	(0.006)	(0.002)	(0.007)	(0.001)	(0.001)	(0.002)	(0.002)	(0.001)
RD staff employed	-0.102***	0.007	0.075***	-0.001	0.000	0.007	0.011*	0.002
	(0.017)	(0.007)	(0.017)	(0.003)	(0.004)	(0.005)	(0.006)	(0.002)
Product innovators	-0.095***	-0.009	0.102***	-0.001	0.001	0.003	-0.004	0.003
	(0.017)	(0.007)	(0.017)	(0.004)	(0.004)	(0.005)	(0.007)	(0.002)
Process innovators	0.004	0.006	-0.001	0.000	-0.002	-0.001	-0.004	-0.002
	(0.016)	(0.007)	(0.016)	(0.002)	(0.003)	(0.004)	(0.006)	(0.002)
IP registration	-0.068***	-0.019***	0.038*	0.005	0.005	-0.001	0.039***	0.002
	(0.021)	(0.006)	(0.021)	(0.004)	(0.005)	(0.005)	(0.009)	(0.002)
Int. experienced executives	-0.073***	-0.004	0.026	0.005	0.012*	0.022***	0.006	0.006
	(0.023)	(0.009)	(0.023)	(0.004)	(0.007)	(0.007)	(0.008)	(0.004)
Importer	-0.228***	0.015**	0.161***	0.004	0.002	0.011**	0.030***	0.006***
	(0.017)	(0.007)	(0.017)	(0.003)	(0.003)	(0.005)	(0.005)	(0.002)
Product quality	0.012	-0.009	-0.017	-0.003	0.002	0.005	0.013**	-0.003
	(0.016)	(0.007)	(0.016)	(0.003)	(0.003)	(0.004)	(0.005)	(0.003)
Production costs	0.017	-0.009	-0.029*	-0.003	0.003	0.014***	0.006	0.001
	(0.017)	(0.007)	(0.018)	(0.003)	(0.003)	(0.004)	(0.006)	(0.002)
Labour Regulation	-0.004	0.008	-0.010	-0.001	-0.002	0.003	0.008	-0.002
	(0.017)	(0.007)	(0.018)	(0.003)	(0.003)	(0.005)	(0.006)	(0.002)
Size (lagged)	-0.160***	-0.010	0.106**	0.008***	0.001	0.034***	0.016	0.005*
	(0.045)	(0.016)	(0.044)	(0.003)	(0.009)	(0.005)	(0.012)	(0.003)
Scale dummy	0.035	-0.013	0.003	-0.010	-0.008	-0.003	-0.003	-0.001
	(0.024)	(0.010)	(0.025)	(0.007)	(0.008)	(0.007)	(0.009)	(0.004)
Market conditions	-0.003	0.010	0.009	-0.001	0.001	-0.010**	-0.009	0.002
	(0.015)	(0.006)	(0.016)	(0.002)	(0.003)	(0.004)	(0.006)	(0.002)
Domestic owned	0.125***	0.011	-0.114***	-0.012*	-0.002	-0.001	-0.007	-0.001
	(0.025)	(0.009)	(0.027)	(0.006)	(0.005)	(0.006)	(0.010)	(0.003)
Age 20+	-0.055***	-0.003	0.059***	0.002	-0.006	0.005	-0.008	0.005***
	(0.015)	(0.006)	(0.016)	(0.003)	(0.003)	(0.004)	(0.006)	(0.002)
financial incentives public sector	-0.043**	0.017*	0.021	-0.004	-0.001	-0.004	0.011	0.002
	(0.022)	(0.010)	(0.022)	(0.003)	(0.004)	(0.005)	(0.009)	(0.003)
Tax incentives	0.009	-0.004	-0.000	-0.004*	0.005	-0.001	-0.002	-0.001
	(0.020)	(0.007)	(0.020)	(0.002)	(0.005)	(0.005)	(0.006)	(0.002)

*Note: Analysis based on the EFIGE data set. Marginal effects are based on multinomial model estimates. Robust standard errors are in parentheses. *, **, ***, denote 10%, 5%, 1% significance levels Country, sector specific effects not shown. Test statistics based on regression output. Number of observation is 3847 and the Pseudo R^2 is 0.19. Country coverage: DE, ES; FR and IT. Source: EFIGE dataset.*

Table A4 : Augmented gravity model of the percentage of exporting firms (French firms to non-EU destinations)

		Large		Medium		Small		Micro	
ln GDP const prices in destination country	coef.	0.34	***	0.42	***	0.45	***	0.35	***
	t	13.26		16.66		20.06		13.99	
Common language	coef.	0.77	***	1.19	***	1.47	***	1.33	***
	t	13.41		17.88		25.20		15.84	
Cost of legal enforcement of contracts (0-10)	coef.	0.00		-0.02		-0.05	***	-0.07	***
	t	0.08		-1.79		-4.56		-5.58	
Geographical distance	coef.	-0.27	***	-0.34	***	-0.37	***	-0.31	***
	t	-10.65		-9.74		-11.23		-10.98	
Phone network	coef.	0.06	***	0.08	***	0.05		-0.03	
	t	3.16		2.77		1.63		-1.21	
Tariff index	coef.	0.00		0.01	***	0.01		0.01	
	t	-0.19		3.12		1.36		0.98	
Regulatory trade barriers	coef.	-0.07	***	-0.10	***	-0.11	***	-0.03	
	t	-5.39		-7.06		-5.63		-1.62	
Property rights protection (0 to 10 strongest)	coef.	0.06	***	0.08	***	0.11	***	0.13	***
	t	6.91		10.86		14.49		13.84	

Note: Dependent variable is the logarithm of the number of exporting firms. The specifications are estimated using OLS. Industry fixed effects and year effects are included in the models. T-values are based on robust standard errors. The number of observations is 35,968. The adjusted R^2 is 0.64. Analysis is conducted over the period 2000-2007.
Source: Customs data and BRN Ministry of Finance

Table A5 : Robust regression method of the relationship between EU SME exporting and employment growth

	Total sample			Mining		
	coef.		**t**	**coef.**		**t**
ln employment 2008	-0.204	***	-107.79	-0.139	***	-7.39
ln employment 2008 squared	0.023	***	87.11	0.014	***	5.26
export status 2008-2010	0.006	***	8.25	0.025	***	3.60
new market products 2008-2010	0.014	***	13.47	0.006		0.44
process innovations	0.016	***	18.54	0.015	*	1.94
foreign ownership 2010	0.011	***	8.67	0.014		1.34
domestic group 2010	0.078	***	6.78	0.012		1.52
country dummies	yes			yes		
constant	0.417	***	109.96	0.30	***	8.33
# of observations	113674			1312		
	Manufacturing			**Energy and water supply**		
	coef.		**t**	**coef.**		**t**
ln employment 2008	-0.143	***	-50.54	-0.088	***	-11.73
ln employment 2008 squared	0.014	***	37.16	0.009	***	9.08
export status 2008-2010	0.014	***	13.08	0.005		1.41
new market products 2008-2010	0.012	***	8.85	0.016	***	3.02
process innovations	0.015	***	13.24	0.009	***	2.81
foreign ownership 2010	0.015	***	7.99	0.010	*	1.95
domestic group 2010	0.013	***	9.10	0.006	*	1.74
country dummies	yes			yes		
constant	0.303	***	54.14	0.196		13.91
# of observations	51633			4367		
	Construction			**Distribution**		
	coef.		**t**	**coef.**		**t**
ln employment 2008	-0.300	***	-36.20	-0.274	***	-62.34
ln employment 2008 squared	0.036	***	30.43	0.034	***	52.86
export status 2008-2010	0.026	***	5.20	0.007	***	4.36
new market products 2008-2010	0.010		1.49	0.011	***	3.57
process innovations	0.024	***	5.97	0.010	***	4.54
foreign ownership 2010	0.004		0.34	0.002		0.83
domestic group 2010	0.009	**	2.14	0.003		1.30
country dummies	yes			yes		
constant	0.560	***	34.72	0.522	***	45.11
# of observations	8593			19761		
	Transportation			**Information & communication**		
	coef.		**t**	**coef.**		**t**
ln employment 2008	-0.266	***	-39.59	-0.497	***	-61.39
ln employment 2008 squared	0.031	***	32.68	0.062	***	52.84
export status 2008-2010	0.009	***	3.38	0.011	***	3.31
new market products 2008-2010	0.010		1.35	0.019	***	4.95
process innovations	0.023	***	5.61	0.017	***	4.68
foreign ownership 2010	-0.003		-0.50	0.015	***	2.84
domestic group 2010	0.005		1.41	0.010	**	2.55
country dummies	yes			yes		
constant	0.541	***	39.49	0.940	***	59.28
# of observations	8377			7596		
	Financial sector			**Professional & technical scvs**		
	coef.		**t**	**coef.**		**t**
ln employment 2008	-0.136	***	-15.13	-0.369	***	-50.67
ln employment 2008 squared	0.015	***	12.13	0.046	***	43.01
export status 2008-2010	0.007		1.39	0.021	***	7.38
new market products 2008-2010	0.007		1.25	0.020	***	5.45
process innovations	0.014	***	3.17	0.018	***	5.96
foreign ownership 2010	-0.004		-0.85	0.013	***	2.69
domestic group 2010	-0.014	***	-3.17	0.013	***	4.27
country dummies	yes			yes		
constant	0.29	***	15.31	0.686	***	51.95
# of observations	3255			8706		

*Note: *p<0.1, ** p<0.05, ***p<0.01. Two tailed -t-test. The dependent variable is the average annual growth of employment between the period 2008-2010. The coefficient on the export dummy measures the differential in the employment growth between exporters and non-exporters. The percentage effect of export participation on the relative productivity level can be calculated as (exp(ß)-1) multiplied by 100 (Halvorsen and Palmquist 1980). Country coverage: EU-20.*
Source: CIS 2010. Eurostat Safe Centre.

Chapter 4.

THE EFFICIENCY OF EU PUBLIC ADMINISTRATIONS IN HELPING FIRMS GROW

It is becoming widely accepted that efficient EU public administrations (hereinafter PA) is an important driver of the EU's competitiveness. Throughout their lifecycle, from their market entry to their closure, firms interact frequently with PA on a variety of occasions, e.g. when applying for licences, paying taxes or engaging in legal disputes. These interactions are costly for firms, which either have their employees dealing with burdensome bureaucratic tasks instead of pursuing productive activities, or have to pay external advisers to do so. Ultimately, in both cases, internal resources necessary for investment and firms' growth are reduced. The European Commission has stressed the importance of an efficient, effective and transparent PA in the Europe 2020 strategy and has already taken several measures to reduce the costs incurred by firms when dealing with PA. Initiatives in this area involve, among others, the Small Business Act,[46] the Services Directive[47], the Action Programme for Reducing Administrative Burdens in the European Union[48]. While the first two initiatives refer to more general targets with respect to PA, the third provides recommendations for particular dimensions of PA. Furthermore, the Annual Growth Survey 2013[49] sets out the economic and social priorities for the EU and outlines particular measures for the modernization of the PA in the Member States, in a way that can promote growth. The industrial competitiveness and economic growth currently seem to be hindered by inefficient public administrations, corruption, ineffective justice systems and legal uncertainty in a considerable number of EU Member States.

The objective of this chapter is to model and analyse empirically the contribution of PA quality to firms' productivity and growth. The quality of PA emerges as a multidimensional concept, comprising both 'internal' efficiency, i.e. efficiency in the employment and management of PA internal resources in the course of producing PA services, and 'external' efficiency, i.e. how easy it is for firms to interact with PA in terms of the resources and time needed. This study will focus on the links between PA efficiency and firms' growth and will complement a previous EC study[50] (Pitlik et al., 2012), which examined the conceptual linkages between the quality of PA and firm performance and reviewed available indicators reflecting the quality of PA.[51] The empirical analysis in the current study moves beyond descriptive frameworks and uses innovative methods in a multifaceted approach in order to provide novel empirical evidences in the discussed nexus.

Understanding the links between PA and firms' growth is critical from a policy perspective. On the one hand, the current crisis has highlighted significant heterogeneity in the functioning of PA across EU Member States. Frequently, problems in PA occur in countries (or regions) that underperform economically. On the other hand, improving the quality of PA is seen as a key lever for governments seeking to improve the business environment. Even in times of fiscal consolidation, measures to make PA more business-friendly remain feasible, or even desirable, as such measures potentially support fiscal consolidation efforts. This study, however, moves beyond a public finance context and analyses, within a micro-economy framework, the relationship between the efficiency of PA and firms' growth in three innovative and complementary ways making two particular contributions. First, it makes a methodological contribution to the (field) literature on the links between PA and firms' performance and, secondly, it provides new evidences for policy consideration.

The methodological approach reflects the fact that any naïve econometric specifications relating firms' growth to indicators of the quality of PA is prone to omitted variable bias, i.e. the omission of a wide range of potentially unobserved factors that are correlated both with PA quality and firms' growth. Such factors are likely to be country-specific and to vary over time which implies that country fixed effects are not sufficient to remove such bias. In

46 COM (2008) 394 final.
47 Official Journal of the European Union (2006), L 376/36.
48 SWD (2012) 423 final.
49 COM (2012)750 final.

50 Link:http://ec.europa.eu/enterprise/policies/industrial-competitiveness/monitoring-member-states/improving-public-administration/index_en.htm.
51 The study takes also stock of the conclusions of the EU High-level Conference on: 'The Path to Growth: Achieving Excellence in Business Friendly Public Administration' held in October 2013 in Brussels, and builds on the analysis in *Member States Competitiveness Performance and Implementation of EU Industrial Policy 2013*.

Section 4.1, these issues are discussed in greater detail. It is therefore unsurprising that research on the links between PA and firm performance and growth at the microeconomic level, is still in its infancy. For instance, it is unclear how efficient PA affect competitiveness[52], let alone firm growth (Djankov, 2009). Consequently, recommendations for policy reforms often lack supporting empirical evidence or are rather ambiguous (Rothstein and Teorell, 2008).

Methodologically, the chapter is structured in three core tasks whose main research questions can be summarised in the following way:

- Are there indicators of PA quality that can be related to the share of high growth firms and employment growth? Which dimensions of PA affect firm growth and through which channels does this occur?
- What are the costs resulting from PA as an intermediate input in different economic sectors?
- What are the costs of PA as an intermediate input to private production of firms? Considering different dimensions of PA, which are the most impeding dimensions for firm growth and how is the relative performance assessed along these dimensions across Member States?
    - This chapter approaches the effects of PA efficiency both from the firm profits as well as the firm costs perspective. In summary, the first section analyses empirically the impact of PA efficiency on the share of high-growth firms and employment growth, the second section analyses public services as inputs to economic sectors and as sources of costs for firms and the third section, evaluates and compares the costs that different dimensions of PA impose on firms, mitigating the biases in business perception information.

In more details, *Section 4.1* primarily examines empirically the effects of quality in various dimensions of PA on the share of high-growth firms or employment growth within industries and countries. It solves the econometric issues in a compelling way: it builds on and extends the well-known approach by Rajan and Zingales (1998) which allows controlling for any unobserved country-specific factors that may bias the results. This section therefore, aims to analyse the impact of the quality of PA on firm growth. The study in this section concludes that the quality of PA has an impact on the rate of high-growth firms and employment growth at the NACE 2-digit industry level. Higher PA quality induces greater rates of fast-growing firms, in particular by increasing firm turnover and net entry. This holds especially for general indicators of PA quality that measure the overall quality of the governance system, including the presence of an independent judiciary and freedom from corruption. The results from the NACE Rev. 2 sample are weaker than those from NACE Rev. 1.1, especially when employment growth is the output indicator. In the former, it is likely that the effects of the economic crisis overshadow the effects of PA;

Rather than estimating the effects on firms' growth, *Section 4.2* looks at the cost of PA. In particular, using Input-Output tables, it compares the costs of PA as an intermediate input to industries using the World Input-Output Database (WIOD), which comprises international Input-Output tables recently compiled (see Timmer 2012). The advantage of this approach is that it avoids econometric problems altogether by considering the costs of PA only. The results shed light on one specific dimension of PA quality from the perspective of firms, i.e. services that are provided by PA at a cost rather than free of charge (otherwise they would not be recorded in input-output tables). The study findings in this section show that PA services as intermediate inputs are relatively minor. This implies first that most public services are provided merely 'free of charge' (being financed out of the general tax pool) and secondly, that by concentrating on intermediate flows only, a considerable part of the potential supply-side benefits of public services will be left out.

Section 4.3 also examines the costs imposed on firms by PA but, contrary to *Section 4.2*, it uses business perceptions to discuss the relative costs imposed on firms by various dimensions of PA. The business perceptions are especially pertinent to this analysis and the methodology is developed in a way that mitigates existing biases and measurement problems. The analysis is based on firm-level data drawn from the World Bank Enterprise Surveys. The analysis in this section takes an innovative approach to measure costs which firms incur while dealing with PA and takes into account biases that may be inherent to perception data. *Section 4.3* finds that *tax administration*, *corruption* and *ineffective justice systems* are considered the factors most impeding firm growth in virtually all countries in the sample of analysis. These findings recur across the time period under consideration, indicating clear room for improvement in Member States with respect to these

[52] The European Commission study: *'The Puzzle of the missing Greek exports'* (Economic Papers 518, June 2014), is a recent one in the empirical discussion at a macro level. The study concludes that Greece's poor exports performance can be attributed at a large extend to the weak institutional quality.

dimensions of PA. Based on cross-country rankings along a particular dimension of PA, the analysis shows that the country performing best or worst with respect to one constraint also performs very well or poorly, respectively, across several other dimensions of PA.

Section 4.4 synthesises the information obtained from these approaches and summarises policy relevant considerations that can be drawn from the empirical findings.

4.1. HIGH GROWTH FIRMS AND THE QUALITY OF PA

Enterprise dynamics differ across countries and regions, and are important indicators for an economy's ability to reallocate resources to novel and more productive uses. In recent years, fast-growing firms have attracted increasing attention from both policymakers and academics. Fast-growing firms are seen as important bearers of economic dynamics, diffusion of innovations and employment generation (for a survey, see Henrekson and Johansson, 2010 and Coad et al., 2014). Only few studies compare firm growth dynamics across time. From these studies (e.g. Bravo-Biosca, 2010), a picture emerges that shows that European economies have a larger share of stable firms relative to the US, where both fast-growing and fast-shrinking firms are more prevalent than in Europe. These differences may reflect unused growth potential in the European Union.

At the same time, it is well known that the quality of the PA in its interaction with other factors of production such as capital, labour and knowledge is a key element that determines aggregate economic performance. Empirical studies (e.g. Méon and Weill, 2005) conclude that government efficiency is the aspect of governance that has the most robust effect in this respect. In this section, novel empirical evidence is provided on the interaction of PA quality and firms' growth. The research question is whether PA quality affects the number of high-growth firms and industry employment growth. Enterprises interact with the PA in many very different ways. For example, they pay taxes, have contract disputes that are most efficiently settled by impartial judges, require licences or have public procurement contracts.

This section is divided into three parts. First, a literature review provides the background by identifying channels through which the PA can possibly affect firm growth. Second, the data section selects indicators that measure the share of high growth firms as well as quantify PA quality, serving as the basis to explore the impact of PA quality on the share of high growth firms and industry employment growth. Third, the method and the results are presented. The chosen econometric approach identifies whether a higher quality of PA affects the business environment in a way that facilitates the reallocation of market shares, and thereby increases the share of high growth firms. The identification relies on a sophisticated econometric estimation technique that allows identifying the impact of PA quality via a pre-specified policy channel. The results of this exploratory analysis show that PA quality is as an important determinant of the number of high growth firms and employment growth at the industry level. Moreover, the results were used to predict the impact of a hypothetical policy reform. The magnitude varies across policy dimensions. Furthermore, the scope for improvement in the PA varies across countries and the industry of interest.

Background

Firms' growth and decline is at the core of economic dynamics. The special interest in high-growth firms is partly due to the fact that they are perceived as important drivers of economic dynamics, diffusion of innovations and employment generation. Surveys of empirical evidence by Henrekson and Johansson (2010) and Coad et al. (2014) show some remarkably robust stylised facts. For instance, high-growth firms do not necessarily cluster in specific industries. If anything, there appear to be more high-growth firms in service industries than in other sectors. A small number create a large proportion of new jobs. These firms tend to be small and young, but a significant subset of high- growth firms is also large and old (Henrekson and Johannsson, 2010). It is very difficult to predict which firms will grow fast, and most high-growth firms do not persistently display high growth rates (Coad, 2007; Coad and Hölzl, 2009). The findings of Hölzl (2014) suggest that most high-growth firms experience high growth only once, and are thus akin to 'one-hit-wonders'. However, Coad et al. (2014) emphasise that there are still significant controversial issues concerning the importance of high-growth firms, especially with regard to the aggregate implications of having a larger share of high-growth firms in an economy. Only a few studies look at the presence of high-growth firms across countries. An important finding of Bravo-Biosca (2010) is that the share of high-growth firms varies across countries and that countries with a more dynamic growth distribution (more high-growth and high-decline firms) have higher productivity growth (see also Bravo-Biosca et al., 2013).

Firms' growth takes place in a specific business environment shaped *inter alia* by the quality of the PA (see Box 4.1 for a survey on the relationship between e-government and firm performance). While there is ample evidence of the impact of

regulation (e.g. entry regulation, labour regulation, financial regulation) on firm performance (e.g. Klapper et al., 2006; Haltiwanger et al., 2008; Laeven and Woodruff, 2007), there is not much on the impact of PA quality on firms' growth. Cuaresma et al. (2014) use the World Bank Business Environment and Enterprise Performance Survey data. They find that the general institutional environment is an important driver and that the fastest growing firms appear to be most affected by a poor business environment. In a recent OECD working paper, Bravo-Biosca et al. (2013) provide evidence that financial development, banking competition, and institutions that foster better contract enforcement are associated with a more dynamic growth distribution and a higher share of high growth firms.

Box 4.1: E-government and firm competitiveness

E-government affects firm performance through the transaction cost channel. E-government services reduce information costs as a variety of information such as announcements of new public sector projects, information on law and legislation and the publication of reports become available to firms at a much lower information cost. Hirst and Norton (1998) emphasise that e-government often changes the relational connections between firms and the PA as the launch of e-government services is often accompanied by organisational reforms. Often horizontal and vertical tasks are merged in the provision, so that e-government applications provide services as one-stop shops. A third effect also emphasised by Hirst and Norton (1998) is that the online provision grants timely and geographical flexibility to the user of the services.

In addition, e-government may facilitate the democratic attributes of regulatory procedures by enabling inclusiveness through more efficient consultations through electronic forums, focus groups or other forms of discussions (OECD, 2011). Digital applications are also seen to improve the transparency of decision-making, and make corruption as well as rent seeking less likely (Pitlik et al., 2012). For these reasons e-government is often considered to provide an effective tool to enhance good governance (Andersen, 2009; Shim and Eom, 2009).

Srivastava and Teo (2007) show that there is an association between the extent of e-government service provision and public resource spending or administrative efficiency that seems to translate also into higher GDP per capita. Furthermore, the study finds a smaller social divide due to e-government. Evidence on the impact of e-governance on firm performance is rare, let alone firm growth. Some evidence of direct impacts of e-government on firm performance is provided by the studies of Thompson et al. (2005), Badri and Alshare (2008) and Cegarra-Navarro et al. (2007). Thompson et al. (2005) provide evidence from a survey of 100 firms in three US states that technology-oriented firms are more prone to use e-government services as part of their market intelligence and that those firms are also more profitable in comparison to other firms. Thompson et al. (2005) argue that the effect of e-government on profitability is mediated by the attribute of being a technology oriented firm. Badri and Alshare (2008) use survey data from firms in Dubai to study the effects of the use of e-government. They find that e-government use leads to intelligence generation, new business development, and time savings. This leads in turn to revenue gains. The findings confirm largely the results by Thompson et al. (2005) that the benefits from e-government services depend on a firm's ability to expand its business, and its ability to increase efficiency. Cegarra-Navarro et al. (2007) provide a detailed study of the determinants of the use of e-government in Spain and find that broadband access is an important precondition, as well as firm size and the general ICT orientation of the firm. This result emphasises that the extent of use of e-government services depends on the e-readiness of firms.

The basic proposition that emerges from this literature survey is that PA quality is expected to reduce barriers to the reallocation of market shares by fostering investment incentives for more efficient firms, thereby lowering barriers to firm mobility and reallocation dynamism. The quality of PA should lead to an excessive heterogeneity in firm-level performance that in turn negatively affects aggregate economic outcomes. This hypothesis is directly related to findings that cross-country differences in economic performance are associated with within-differences in the dispersion of performance across firms (e.g. Hsieh and Klenow, 2009; Bartelman et al., 2013). Firms' growth enters this consideration because a larger share of high-growth firms may indicate greater economic dynamism and market share reallocation. If the reallocation is directed towards increasing the market shares of more efficient firms at the expense of less efficient firms, then higher economic dynamism is associated with better aggregate performance.

4.1.1. Data

The effects of PA quality on firm performance are multidimensional, and could be channelled via a variety of links. For this exploratory study, of the impact of PA-quality on firm growth, seven different conceptual links are examined by 12 different indicators of PA quality. Table 4.1 provides a detailed overview of the links and the associated

Table 4.1: Indicators of PA quality

Public Administration Link	Indicator name	Indicator values	Data source
A) General governance	Government effectiveness	Index range -2.5 to +2.5, higher values indicate better performance	World Bank Worldwide Governance Indicators
	Regulatory Quality	Index range -2.5 to +2.5, higher values indicate better performance	World Bank Worldwide Governance Indicators
B) E-government	Availability of E-Government services	% of total of 8 services	EC E-Government Benchmarking Reports
C) Corruption and fraud[54]	Freedom from corruption	Index on a scale from 0 (high corruption) to 100 (low corruption)	Heritage Foundation, Index of Economic Freedom
D) Starting a business and licensing	Time required to start-up a company	number of calendar days	World Bank – Doing Business
	Cost to start-up a company	% of income per capita	World Bank – Doing Business
E) Public Payment morale	Average delay in payments from public authorities	Days of delay	Intrum Justitia European Payment Index
F) Tax compliance and tax administration	Time to prepare and file tax returns and to pay taxes	Hours per year	World Bank Paying Taxes
G) Efficiency of civil justice[55]	Enforcing contracts: Time	Calendar days	World Bank – Doing Business
	Enforcing contracts: Cost	Percentage of claim	World Bank – Doing Business
	Resolving insolvency: Time	Calendar days	World Bank – Doing Business
	Independent judiciary	Index from 1 to 7 high values indicate independence	WEF Global Competitiveness Report

Source: WIFO.

indicators that are used in the empirical analysis.[53] The links from PA quality to firm performance (measured in the present study as share of high growth firms and employment growth in NACE 2-digit industries) range from very general attributes of PA quality such as general and economy-wide governance quality to very specific links that measure PA quality in terms of time or cost of specific operational procedures such as starting a business or resolving insolvency.

The share of high-growth firms and industry growth indicators were averaged for the periods for which data are available. The NACE Rev. 1.1 sample covered 2004-07 and NACE Rev. 2 was available for 2008-10. This averaging smooths out fluctuations, thereby reducing the impact of outliers and making a more structural analysis feasible. Accordingly, the PA-quality indicators were averaged in order to match the time periods for which firm-growth data are available. This explains why it was not feasible to use more recent data and more indicators (e.g. those included in the European Public Sector Innovation Scoreboard) in the study.

Three general links are distinguished, which cover quite broad influences that affect the quality of the PA and its relation to the business environment, namely Government effectiveness, E-government, and Corruption and fraud. Government effectiveness

[53] The selection of the indicators was restricted by availability, quality, country coverage, time coverage and representativeness (see Misch et al., 2014 for more details).

[54] Important information on the corruption and fraud in the EU Member States is provided in the two recent Eurobarometer studies on corruption: Special Eurobarometer 397, '*Corruption*', March 2014 and, Flash Eurobarometer 374, *'Business' Attitudes Towards Corruption in the EU'*, February 2014.

[55] Important information on the Justice in the EU is provided in the Flash Eurobarometer 385, *'Justice in the EU'*, November 2013. Also, since 2013 the European Commission publishes the annual EU Justice Scoreboard with data on the functioning of the national justice systems in the EU.

reflects the multidimensional concept of administration quality. E-government indicators stand for the tools of administrative modernisation and should somehow summarise the use of instruments to enhance the capacities of the administration and the sophistication of service provision. Corruption and fraud presents assessments of the extent to which the powers of government and administration are exercised for private gain.

Four further specific links can be distinguished, covering issues relating to starting a business, public payment morale, tax compliance, and efficiency of civil justice. These links explicitly relate the quality of a PA to processes of firms' growth and capture the most important interactions between PA and enterprises. They have been selected with the intention of drawing a broad, yet concise picture of the impact of specific aspects of quality of PA on firms' growth.

The use of such a variety of indicators reflects the multidimensional nature of the interaction between PA quality and firms' performance, but also the exploratory character of the empirical study. Empirical work on microeconomic links between economic performance and PA quality is still in its infancy and only partially explored (Djankov, 2009). It is largely unclear through which specific channels PA quality affects industrial dynamics and firms' performance. Most of the available evidence comes from the macroeconomic studies.

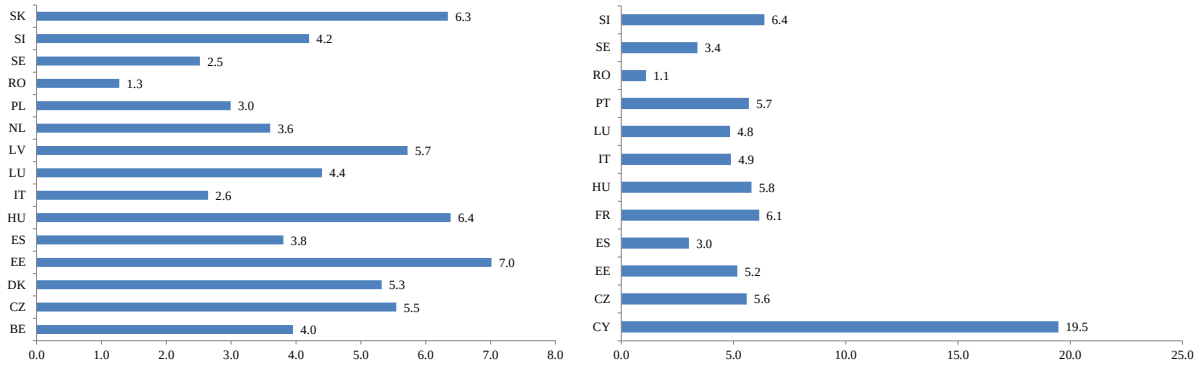
The data on the share of high growth firms was extracted from Eurostat and draws on the definition proposed by the Eurostat-OECD Manual on Business Demography Statistics (Eurostat-OECD, 2007), which is used by all European statistical offices and the OECD in their statistics on fast-growing firms. High-growth firms are defined as those that achieve an annualised growth rate of at least 20 % over a three-year period and have at least 10 employees at the beginning of that period. Growth can be measured by turnover or by the number of employees. The share of high-growth firms is calculated as a percentage of the total population of active enterprises with at least 10 employees. Figure 4.1 show average high-growth shares at country level. Unfortunately, the dataset on high-growth firms that was compiled using the NACE 1.1 and the NACE 2 industry classification does not cover all Member States and the two datasets do not even cover the same set of countries. Nevertheless, it is clear that the differences across countries are substantial.

It is important to note that firms' growth is quite a novel indicator for assessing the competitiveness of economies. The basic reason for using such an indicator is that economic dynamism (the share of high-growth firms) is related to economic performance. Processes of creative destruction, selection and learning are central for aggregate employment and productivity growth (Bartelsman et al., 2004; Restuccia and Rogerson, 2008) and the literature on firms' heterogeneity suggests that cross-country differences in economic performance may be related to within-differences in the productivity dispersion across firms (e.g. Hsieh and Klenow, 2009; Bartelsman et al., 2013). Then again, not much is known about the reasons for these cross-country differences and differences in the number of high growth firms across countries. Deeper knowledge about the interaction of institutional characteristics (e.g. corruption, regulatory quality) or economic policy variables (e.g. availability of e-government, time to start up a business) with indicators for high growth firms would help to understand what kind of institutional support is most appropriate for a dynamic growing economy populated by high- growth firms.

4.1.2. Methodology and results

It is very difficult to identify a causal link between PA quality and firms' growth. Indicators of PA quality are available only at the macroeconomic

Figure 4.1: Share % of high growth firms, mean, NACE Rev 1.1 (left) / NACE Rev. 2 (right)



Source: Eurostat, WIFO calculations.

level and are highly correlated to other institutional factors and the level of economic development. Moreover, the short time series mean that it is impossible to determine the impact of changes in PA quality on firm growth over time. PA indicators reflect structures and regulation that change only slowly, whereas the share of high-growth firms across countries and industries shows much wider variance. This renders the identification of the effect at microeconomic level unfeasible, a challenge that can be overcome at least partially by using an appropriate econometric methodology. These difficulties of estimating the impact of PA quality on firm performance can also be seen from the illustration of the impact of e-government services on firm performance in Box 4.1.

The methodology used in this paper was proposed originally by Rajan and Zingales (1998) to study the importance of the development of financial systems for economic growth for a large number of countries. This methodology uses a quite simple idea that allows identifying the effects of PA quality on firm growth. The idea is that there are theoretical links through which PA quality affects firm growth. For instance, good start-up procedures facilitate start-ups, which may lead to better firm performance. These conceptual links do not affect industries uniformly. Their impact depends on observable industry characteristics. Thus, the central element is to find a set of industry characteristics that affect the share of high growth firms in an industry. Five industry-specific characteristics are used in the study; firm turnover rate, net entry rate, average firm size, gross value added growth, capital intensity. [56]

It is expected that high-growth firms are more prevalent in industries with greater firm dynamics, as these allow a greater reallocation of market shares towards more productive firms. If PA quality affects firm dynamism, it can be expected that industries with a high turnover rate and/or firm net entry rate are affected more by low PA quality than industries with low firm dynamics. Average firm size is used as an indicator of the minimum efficient scale of operations in an industry. This may reflect structural entry barriers. Here the expectation is that administrative burdens affect primarily smaller firms. Thus industries with a low average firm size may benefit more from higher PA quality (and an efficient provision of services accompanied by lower administrative burdens). However, there may also be a link to incentives to invest, as a higher average firm size often also reflects economies of scale. An effect of regulation quality on investment incentives has been documented by Alesina et al. (2005) for investment and by Bassanini and Ernst (2002) for R&D. This channel can be captured via general PA quality indicators focusing primarily on government effectiveness, regulatory quality, freedom from corruption and independent judiciary. In this case, regulatory quality is expected to be more advantageous for growth in industries with a higher average firm size. The administrative burden channel should be more important for specific regulations measured in terms of time and cost. In order to test this relationship, capital intensity is included as an additional indicator, as it is often associated with a larger average firm size in an industry, whereas incentives to invest are more important for high-growth firms in capital-intensive industry. The last indicator used is average gross value added growth. This should reflect industries' growth potential. Here the assumption is that poor service quality in the PA affects firms' growth in industries with high growth potential to a larger extent than in stagnating industries. Table 4.3 summarises the expected signs.

The second critical ingredient of the estimation technique is the selection of benchmark countries. The idea behind this analysis setting is that countries that exhibit the highest values of PA indicators display no (or at least fewer) distortions with regard to the PA inefficiency. For this reason the industry characteristics of benchmark countries instead of the observed industry characteristics in the singly countries; are used in the regression analysis. The analysis uses Denmark and Sweden as benchmark countries, as they can be considered to have the highest-ranking PAs according to a large number of rankings (see Table A4.1 for country rankings of selected indicators). In the analysis these benchmark countries were held constant, even if in some cases they do not exhibit the highest values of PA quality in specific indicators. However, the chosen benchmarking countries rank high in all indicators (see Table A4.1). Thus, the equation estimated is:

$$FG_{c,i} = \alpha + \beta\,(PA_c \times IND_i) + \mu_c + \mu_i + \varepsilon_{ci} \qquad (4.1)$$

where *FG* is the firm growth indicator (share of high growth firms or employment growth at the country-industry level). *PA* denotes a national PA quality indicator and *IND* denotes the appropriate industry characteristic of the benchmark country providing a differential link between the PA indicator and the dependent variable. i indexes industries and c countries; μ_c and μ_i are country and industry-specific effects respectively, and $\varepsilon_{c,i}$ is an i.i.d. error term.

In order to identify long-term relationships, the data are expressed in longer time averages and only cross-section is taken into account. This is more relevant for the firm growth indicators, which show

[56] For details see Misch et al., 2014.

Box 4.2: Identifying the impact of PA quality on firm growth

Cross-sectional regressions indicate a positive relationship between PA quality and the shares of fast growing firms. However, these estimations are not identified, especially because there may be omitted variables. Also, the data structure aggravates the causality problem. For example, available time series are short and PA quality measures change slowly over time. To overcome these issues, an estimator that adds the industry dimension was implemented (Rajan and Zingales, 1998). The idea is that industries are affected differently by different PA quality measures. For instance, the sound provision of entry-exit regulations is likely to play a greater role in industries with higher firm turnover. The interaction of these two indicators is then assumed to drive aggregate firm growth.

The method follows a stepwise approach:

i. a conceptual link is made that is reflected by industry characteristics (such as firm-turnover rates); these moderate the effect of PA quality on firm growth (such as entry-exit related services);
ii. the conceptual link is assumed not to vary across countries, but the industry characteristics observed across countries are affected by national policies and framework conditions; this is addressed by using a benchmarking country (or country group) to represent a (largely) 'frictionless' economy;
iii. the share of high-growth firms (HGFs) at country-industry level is regressed on the interaction of the PA quality indicator at country level and the industry-specific characteristics of the benchmark country, controlling for country and industry-specific effects as shown in equation 4.1.; and
iv. the instrumental variable estimator is controlled for possible bias due to the choice of benchmarking countries (Ciccone and Papaioannou, 2007; 2010).

The proposed methodology is a two-step approach:

i. the 'least squares' prediction is computed for the industry indicators (*IND*) based on a regression on country and industry-specific effects, as well as the interaction of the respective country-level PA-quality indicator with industry effects. This prediction is given by the equation:

$$IND_{c,i}=\alpha+\beta_1\ \mu_c+\beta_2\ \mu_i+\beta_3\ PA_c\ \mu_i+\epsilon_{c,i} \qquad (4.2)$$

Where, μ_c are country fixed effects and μ_i are industry-specific effects additionally interacted with country-specific PA quality measures (PA_c). This regression serves as a bias control. The benchmarking countries are not used in this estimation in order to avoid predictions capturing specific effects from them; and

ii. the instrumental variable used in the estimation, is generated by predicting the industry characteristics for the values of the benchmark countries. This variable is equal to the estimated industry-fixed effect plus the benchmarking country value of the PA quality variable, multiplied by its industry-specific coefficient.

This econometric methodology allows identifying the impact of PA quality. The estimates reflect variations in the differential effect of the policy in specific sectors if moving from a country with low values to countries with a high value for that particular PA impact. It should be noted that this does not allow identifying specific sectoral impacts, but only the impact at national level (Bravo-Biosca et al., 2013).

The estimated coefficient indicates whether industries that are more reliant on the quality dimension of public services exhibit relatively more fast-growing firms. For instance, industries with a greater firm turnover rate are expected to generate more HGFs. This effect is moderated by a better (more efficient) overall governance system. In other words, industries with low firm-turnover rates in a poor governance environment will perform worse than industries with high firm-turnover rates in countries with a good governance environment. In this case, the expected sign of the coefficient will be positive.

more time variation than the PA indicators. In addition, this research used an instrumental variable estimator proposed by Ciccone and Papaioannou (2007) to estimate the consistent coefficients. Ciccone and Papaioannou (2007) argue that the industry indicator of the benchmark country needs to be 'purged' of country-specific effects. Therefore, the proposed technique constructs an instrument that is correlated with the global component of the benchmarking country's industry values, but not with the specific component of the benchmarking country. Box 4.2 provides a short overview of the identification scheme.

The regression analysis covers two time periods because of a break in the industrial sector classification. The NACE Rev. 1.1 industry classification was used for 2003-07 and the NACE Rev. 2 industry classification for 2008-10. Results in the Annex Tables A4.3-A4.6 provide the detailed regression results for the PA quality indicators *government effectiveness, regulatory quality, corruption and fraud, time required to enforce contract, insolvency resolution* and *judicial impartiality*.

A total of 280 regressions were estimated using the share of high growth firms (as an indicator of firm growth) and industry employment growth (as an indicator of industry growth). 50 statistically significant results were obtained, of which five, do not confirm expectations in that they carried an unexpected sign against the background of the initially posed hypotheses. Interestingly, these results cluster to some extent, as three of the unexpected results in the employment growth regressions were obtained for the PA indicator *time required to start a company*.[57] Industry and country specific effects only serve as control variables here.

Table 4.3: Sign of the effects (regression results)

		HGF										Employment growth									
		NACE 1.1 2004 - 2007					NACE 2 2008 -2010					NACE 1.1 2004 - 2007					NACE 2 2008 -2010				
PALink	Indicator	Turnover	Net entry	Avg. firm size	GVA growth	Capital intensity	Turnover	Net entry	Avg. firm size	GVA growth	Capital intensity	Turnover	Net entry	Avg. firm size	GVA growth	Capital intensity	Turnover	Net entry	Avg. firm size	GVA growth	Capital intensity
A) General governance	Government effectiveness	+	+				+	+	+			+		+		+					
	Regulatory Quality	+	+					+	+			+		+		+					
B) E-government	Availability of E-Government services																				
C) Corruption and fraud	Freedom from corruption	+	+					+	+			+		+		+					
D) Starting a business and licensing	Time required to start-up a company	-	-										+	-	-	-					
	Cost to start-up a company																				
E) Public Payment morale	Average delay in payments from public authorities																				
F) Tax compliance and tax administra-tion	Time to prepare and file tax returns and to pay taxes	-	-	+																	
G) Efficiency of civil justice	Enforcing contracts: Cost		-	+	+	+						-	-	+							
	Enforcing contracts: Time						+														
	Resolving insolvency: Time	-	-									-									
	Independent judiciary	+	+				+	+	+			+		+		+					

Note: only statistically significant results are reported.
Source: WIFO calculations.

[57] The Chapter 5 of the background study (Misch et al., 2014) discusses the results for all specifications in great detail, and also provides a country ranking of the PA quality indicators for both samples.

Table 4.2: Conceptual links between PA quality and industry characteristics

		Expected sign of coefficient		
National PA quality indicator	**Industry link**	**high values = high efficiency**	**low values = high efficiency**	**Motivation**
A) General governance	Average Firm Size	Positive		Good governance affects incentives to invest
	Dynamism: Turnover of firms, net entry, growth potential	Positive		Industry dynamism and good governance reinforce each other
	Capital Intensity	Positive		Good governance affects incentives to invest
B) Availability of e-government	Average firm size	Negative		Small firms benefit relatively more from e-government than large firms
	Dynamism: Turnover of firms, net entry, growth potential	Positive		E-government and industry dynamism are reinforcing each other
	Capital Intensity	Negative		E-government has a larger impact on low capital-intensive industries
C) Corruption and fraud	Average Firm Size	Positive		Corruption affects incentives to invest negatively
	Dynamism: Turnover of firms, net entry, growth potential	Positive		Dynamic industries benefit from a corruption free environment
	Capital Intensity	Positive		Corruption affects incentives to invest negatively
D) Starting a business and licensing	Average Firm Size		Positive	Industries with a high share of small firms are negatively affected by higher start-up costs and time
	Dynamism: Turnover of firms, net entry, growth potential		Negative	Industries with greater dynamism are negatively affected by higher start-up costs and time
	Capital Intensity		Positive	HGF in capital-intensive industries are less affected by high start-up costs
E) Public procurement	Average Firm Size		Positive	Delays in public procurement hamper firm growth, especially in small firms
	Dynamism: Turnover of firms, net entry, growth potential		Negative	Dynamic industries are negatively affected by inefficiencies in public procurement
	Capital Intensity		Positive	Capital intensive industries are less affected by poor public payment morale
F) Tax compliance and tax administration	Average firm size		Positive	Large firms and inefficient tax administration negatively affect firm dynamism
	Dynamism: Turnover of firms, net entry, growth potential		Negative	Industrial dynamism is hampered by an inefficient tax administration
	Capital Intensity		Positive	Industries with larger firms are less affected by an inefficient tax administration
G1) Efficiency of civil justice, operations related	Average Firm Size		Positive	Large firms are less negatively affected by higher transaction costs
	Dynamism: Turnover of firms, net entry, growth potential		Negative	Higher transaction costs hamper firm dynamics
	Capital intensity		Positive	SME channel
G2) Efficiency of civil justice, independent judiciary	Average Firm Size	Positive		Industries with smaller firms are affected by an inefficient justice system / impartial justice affects investment incentives
	Dynamism: Turnover of firms, net entry, growth potential	Positive		Industries with high firm dynamics are affected more by inefficient and impartial justice systems
	Capital Intensity	Positive		Industries with smaller firms are affected by an inefficient justice system / impartial justice affects investment incentives

Source: WIFO elaboration.

Box 4.3: Predicted Impact of Policy Reform

The term of the estimated regression β ($PA_c \times IND_i$) can be used to predict the impact of policy reform on the share of high growth firms (see equation 4.1). Two interlinked predictions are presented. First, the effects of policy reforms on high-growth firms are quantified. It is assumed that a country improves its country-specific PA-quality ranking so that it matches benchmarking countries that lead the PA-quality rankings. Second, such predictions of the impact of reforms are based on an average industry. Putting these findings into perspective, the cross-industry range of the predicted impact of policy reform is predicted.

First, Table 4.4 presents the results of the prediction at the country level. It shows the impact of reforms that assume an improvement in the country-specific level quality of the PA to the level of countries that lead the PA quality rankings. The impact is computed as the difference between the predicted value for HGFs in countries that lead in PA quality (best-practice countries) and countries that rank lower. In other words, the share of HGFs will improve if countries implemented a PA reform that made them achieve the PA quality of frontrunner countries. The magnitude of this effect on HGFs is predicted. The results differ across countries with the scope for improvements in PA quality. The two other variables of the term, the estimated coefficients (β) and the mean industry turnover (*IND*), were held constant.

The used coefficients were obtained from the estimates for the entire sample (see Tables A 4.2-A 4.6 in the Annex). The chosen industry characteristic was the firm-turnover rate, since the results for this characteristic have shown to be among the most robust. Following Bravo-Biosca (2013), industry and country specific effects were held constant. A mean firm turnover rate for the benchmarking countries of 14.3% was used to rule out variance with respect to industries (see equation 4.1) The PA quality indicators used, follow Table 4.1, and the absolute PA quality values of the countries in the sample for the time period used can be found in the Annex (see Table A4.1).

Second and in addition to holding the conceptual channel *firm turnover rate* constant (at its mean value), the between industry variance of the policy-reform impact can be shown by using the 10th and 90th percentile of the distribution of the turnover indicator in the benchmarking country (see Figure 4.2). The 10th percentile industry is: "Manufacture of machinery and equipment n.e.c." (NACE Rev. 1.1: DK29); the firm-turnover-rate at the 10th percentile is: 9.6%. The 90th percentile industry is: "Air transport" (NACE Rev. 1.1: I62) with a firm-turnover-rate of 20.6%. Other than predicting the reform-impact at the country level, a hypothetical country was created by using the average values of three highest and lowest ranked countries of the respective indicator.

The relatively low number of statistically significant results in Table 4.3 should not surprise. For the exploratory analysis, five industry characteristics were used as potential links even in cases where the relationship can be expected to be quite weak. The selected indicators cover both *general governance* and *specific, operational aspects* of firms' interactions with the PA. One could assign the indicators government effectiveness, regulatory quality, freedom from corruption and fraud and an independent judiciary as general indicators for the PA. These are general in that they describe the economy-wide impact of the PA and do not refer to individual interactions between firms and the PA. Indicators relating to more operational aspects include *starting a business*, *resolving insolvency*, *the cost and time to pay taxes* or *the public payment morale*. It is important to note that the dichotomy of general and operational indicators is conceptual, and assigning the indicators to one group or the other is necessarily debatable. Indicators on specific operational aspects of firms' operations show weaker effects than the *general governance* indicators. However, a shorter time to resolve insolvencies and the quality of the tax administration can also be linked to greater rates of high-growth firms via the firm dynamism channels.

Overall, the results in Table 4.3 are in line with the expected direction of the impact of PA quality on firm growth. A higher PA quality leads — all other things being equal — to a higher share of fast-growing firms. The most important links through which PA quality affects the share of high-growth

firms are the firm dynamics indicators, i.e. *firm turnover* and *net entry*. This holds especially for general indicators that measure the overall governance system, including the existence of an independent judiciary system and freedom from corruption. These indicators are relatively general and are related to the quality of institutions and general (also political) governance at country level.

This raises the question about the magnitude of the impact of policy reform, which differs with the policy dimension chosen, the scope for improvement in the PA and the industry of interest (see Box 4.3 below). Table 4.4 illustrates the impacts of a change in PA quality at the country level. This analysis is based on a hypothetical policy-reform scenario and illustrates the impact on the share of high growth firms if a country was to switch to a PA quality level that corresponds to the *best practice* value measured in the sample. The numbers in Table 4.4 report the associated changes in the share of high growth firms as percentage points. The results used stem from the estimated regression coefficients for the firm turnover-rate channel (see Annex Table A4.2 to

Table 4.4: The impact of PA-reforms on the share of high-growth firms

	General governance	Regulatory quality	Freedom from corruption	Time to resolve insolvency	Independent judiciary
Belgium	0.71	1.13	1.42	b.p.	1.23
Czech Republic	2.06	1.47	3.10	3.27	2.68
Denmark	b.p.	b.p.	b.p.	0.59	b.p.
Estonia	1.90	0.99	2.04	1.02	1.19
Spain	1.59	1.33	1.60	0.25	2.83
Hungary	2.33	1.52	2.70	0.51	2.44
Italy	2.84	2.03	2.77	0.41	3.10
Luxemburg	0.62	0.13	0.52	0.51	0.64
Latvia	2.70	1.93	3.28	1.02	3.01
Netherlands	0.45	b.p.	0.33	b.p.	b.p.
Poland	2.86	2.26	3.37	1.02	2.95
Romania	4.24	3.27	3.92	1.50	3.90
Sweden	b.p.	0.37	b.p.	0.51	0.27
Slovenia	1.98	2.32	2.06	0.51	2.55
Slovakia	2.33	1.71	3.25	1.68	3.58

Note: The results show the differential share of HGFs of best-practice (b.p.) countries and the respective countries. They are based on the estimated coefficients provided in the regression tables in the Annex, the respective PA quality indicator and the mean turnover rate of Denmark and Sweden as benchmarking countries. The reforms were simulated for selected policy fields for statistically significant results of the NACE Rev. 1.1 industry classification (2003-2007).
Source: WIFO calculations.

A4.6). Countries with best practice quality indicators are identified as b.p. in the Table 4.4.

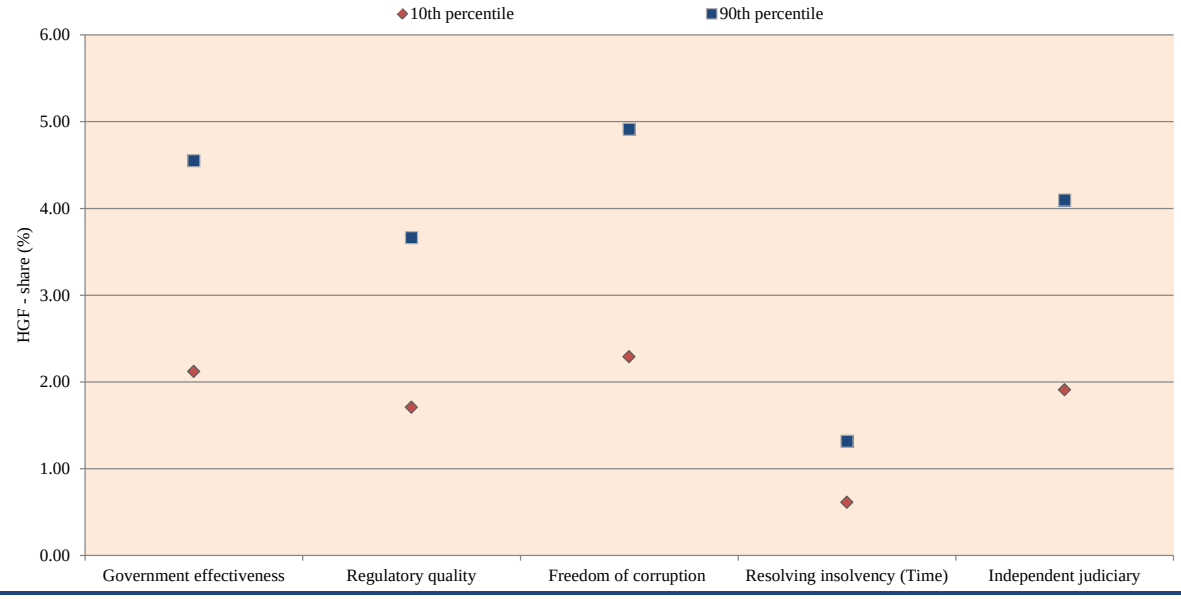
The predictions show that PA quality has a substantial impact on the share of high growth firms. The general indicators of PA quality (*government effectiveness*, *regulatory quality*, *freedom from corruption* and *independent judiciary*), have a greater impact than the specific link with *time to resolve insolvency*. The impact should not be added across indicators, as the general indicators of PA quality are highly correlated.

The impact of policy reforms is heterogeneous not only across countries, but also across sectors. In the predictions illustrated in Table 4.4, the impact of policy reform was held constant across industries, whereas country-specific effects were emphasised. The following contrasts this perspective, and explores the impact across industries, holding the country-variance constant by using the average effect across countries. The industry variance is sketched by the lower and upper bound of the effect. It is illustrated by taking into account the distribution of the industry-specific characteristics of the benchmarking countries. To estimate the lower bound of the effect, the 10^{th} percentile industry of the firm turnover rate was selected. Accordingly, the 90^{th} percentile industry was used to calculate the upper bound of the effect. The magnitude of the reform was obtained by the assumed achievement of the PA quality indicators of the three best ranked countries in the three worst ranked countries. It is important to note that the set of countries used differs across indicators, even though the countries that rank high in the PA-quality are often overlapping (see Box 4.3).

The illustration in the Figure 4.2 is based on the same underlying regression results (see Tables A 4.2-A 4.6 in the Annex) for the same five indicators (*government effectiveness*, *regulatory quality*, *freedom from corruption*, *the time to resolve insolvency* and the presence of an *independent judiciary)*. Again, the findings tend to show a stronger impact of the general indicators of PA quality.

More generally, the results show that PA quality has a positive impact on the share of high growth firms. This result is robust. In addition to the reported bias control by Ciccone and Papaioannou (2007), the initial method by Rajan and Zingales (1998) showed similar results. These results remain unreported to fit the scope of this study. Moreover, the wealth of the used PA quality indicators, the alternative indicator *employment growth* and the estimations for both NACE Rev. 1.1 and NACE Rev. 2 pose further robustness checks.

Figure 4.2: Cross industry variance of the impact of PA reform on the share of high-growth firms



Note: The results show the differential impact of policy reform in the 10th and 90th percentile industry via the firm turnover channel. The assumed reform simulates the improvement in the PA quality indicators from the average value of the three worst performing to the average value of the three best performing countries. They are based on the estimated coefficients provided in the regression tables in the Annex, the respective PA quality indicator and the distribution of the turnover rate. The reforms were simulated for selected policy fields for statistically significant results of the NACE Rev. 1.1 industry classification (2003-2007).
Source: WIFO calculations.

While the results for NACE Rev.1.1 show similar patterns with the results for the NACE Rev. 2 sample, the NACE Rev. 2 findings are generally weaker than the findings for the NACE Rev. 1.1 sample, especially when employment growth is the output indicator. It is likely also that the economic crisis overshadows the impact of the PA quality. The identified patterns in addition, suggest that firm-growth and employment-growth are not identical processes. PA quality also, has an impact on industry employment growth, especially via investment-related channels such as capital intensity. While PA quality affects firm growth primarily through the *firms' turnover rate* and the *net entry rate*, the differential links that are more relevant for industry employment growth are *average firm size*, *growth potential* (average value added growth) and *capital intensity*. Only a minority of the statistical significant results remain the same across the share of HGF and the employment growth regressions tested. However, even in the statistically insignificant results, the signs often point into the same direction. Improving PA quality is therefore, not expected to generate trade-offs with regard to the share of high growth firms and industry employment growth.

The reported results are novel and suggest strongly that improvements in PA quality will also have an impact on the share of high-growth firms and firms' growth in general. The results are comparable with those obtained by Bravo-Biosca et al. (2013), who use a slightly different dataset and focus on a different set of institutions not directly related to PA quality. The results thus suggest that relatively broad concepts of PA as regards quality and governance are very important in shaping the environment for high-growth firms. In addition, the present findings are largely confirmed by firm-level evidence from the EFIGE database (see Box 4.4).

4.2. PUBLIC SERVICES AS INPUTS TO THE ECONOMIC SECTORS AND AS COSTS FOR FIRMS

The public sector contributes to the manufacturing sector's competitiveness, and hence output, mostly via the provision of services. Many of these are provided via publicly financed infrastructure in areas like health, education, transport, etc. Even though they are indispensable in modern economies and much effort is invested in improving public infrastructure in order to enhance present and future growth prospects, their specific economic contributions are hard to measure.

In this section, a system of interlinked international input-output tables (WIOD) is used to measure the economic contribution of public services. In input-output tables, these contributions correspond to direct and indirect deliveries of PA services to other sectors inside and outside the domestic economy. The analysis relies on the assumption that the relevance of the services increases with the extent of

Box 4.4: Some firm-level evidence from the EFIGE dataset

Information about 14,759 firms in eleven sectors was used to explore whether high growth firms perceived '*bureaucratic and legislative obstacles to firm growth'* in a different way compared to firms using the firm level data from the EU-EFIGE/Bruegel-Unicredit dataset (Altomonte and Aquilante, 2012). The OECD-Eurostat definition of high growth firms was implemented for the period: 2005-2008 by using matched data from the AMADEUS dataset provided by the Bureau van Dijk. Seven countries are covered with varying sample sizes: Austria (443), France (2,793), Germany (2,935), Hungary (488), Italy (3,021), Spain (2,832) and the UK (2,067). Identifying the characteristics of a high growth firm (HGF) in country '*c'* and industry '*i'*, the following Probit baseline regression was estimated:

$$HGF_{c,i} = \alpha + \beta_1 PA_{c,i} + \beta_2 size_{c,i} + \beta_3 age1_{c,i} + \beta_4 age1\ \mu_i + \epsilon_{c,i} \quad (4.3)$$

'PA' denotes the responses to the question on the bureaucratic and legislative obstacles, '*size*' measures the number of employees in the base year, '*age1'* denotes firms that are younger than 6 years whereas, *'age2*' denotes firms that are older than 15 years and *'ϵ'* stands for the error term. This specification is expanded in a stepwise approach. In a second regression, a series of additional obstacles relatively to the perceptions about the general business environment, is included. Third, the competitive situation is captured by the responses provided on whether the firm is: a global exporter, a part of a foreign group or it competes internationally. Eventually, sector and industry dummies are added. The analysis is conducted at the country-sector level. In the OLS regressions, the share of high growth firms (*HGF*) is associated with; the PA quality-related information (*PA*), the mean of all reported obstacles as a proxy for the general business environments (*OBST*) and the share of global exporters as a proxy for the sector's degree of internationalisation (*EXP*). The share of high growth firms is found to be negatively related to the fraction of firms that perceive '*legislative or bureaucratic restrictions*' as a growth hampering factor. Let '*c*' denote countries , '*s*' sectors and '*ϵ'* the error term, the estimated regression can then be written as:

$$HGF_{c,s} = \alpha + \beta_1 PA_{c,s} + \beta_2 OBST_{c,s} + \beta_3 EXP_{c,s} + \epsilon_{c,s} \quad (4.4)$$

The results in Table 4.5 and 4.6 show a weak, but statistically significant evidence that perceived '*bureaucratic and legislative obstacles to firm growth*' are negatively associated with firm growth rates for the period: 2005-2008. In other words, high growth firms report bureaucratic and legislative obstacles less than other firms in the sample. The relationship is robust at both firm and country-sector level. However, it loses its statistical significance when country effects are added. This emphasises the country-specific nature of PA as also reflected by the low within-country variance of the indicator. These findings are largely in line with Cuaresma et al. (2014) who estimated the effect for transition economies. However, it is important to note that uncertainty remains as to the directionality of these relationships.

The PA-quality is embedded in the perceptions about the overall business environment. Descriptive statistics rank the perceived quality of the PA as a hampering factor to growth below other aspects such as '*lack of demand'* and '*financial constraints'*. However, attempts to link other obstacles to firm growth did not obtain statistically significant results.

their inter-sectoral and international linkages. Accordingly, it concentrates on measuring these linkages by applying different input-output indicators against the hypothesis that intermediate flows of PA services are equally important as those originating from other services as well as manufacturing and industries.

4.2.1. Background

At least two types of difficulties have to be borne in mind when interpreting results derived from applying input-output techniques to the research question of this section:

– First, public services are provided by various economic sectors; these comprise PA and defence as the core sector accounting for public services, but also, education and health, transport and other types of services sectors which include both private business and government activities that cannot be separated from each other.

– Secondly, the most tantalising restriction one faces, however, concerns the basic arrangement of data within input-output tables. Within input-output tables public sector services appear both as a final demand category (general government consumption) as well as sectors / commodities in the make and intermediate use tables. Deliveries of the commodity "PA services" to other economic sectors are included in the intermediate use table only if service payments are due. In that case the actual payment for the service is reported as intermediate (public) consumption (of PA) while the rest of the cost is reported as final consumption expenditures of the general government (see Eurostat Manual of Supply, Use and Input-Output Tables, 2008, p. 149).

Table 4.5: Probit regression results, HGF (2005-2008) at the firm level

	High growth firms, firm level			
VARIABLES	(1)	(2)	(3)	(4)
Public Administration	-0.01	-0.01**	-0.01**	-0.01*
	(0.006)	(0.006)	(0.006)	(0.007)
Size base year	0.00	0.00	0.00	0.00
	(0.00)	(0.00)	(0.00)	(0.00)
Age < 6 years	0.03	0.03	0.03	0.03
	(0.02)	(0.021)	(0.021)	(0.021)
Age > 15 years	-0.03***	-0.03***	-0.03***	-0.03***
	(0.007)	(0.007)	(0.007)	(0.007)
Financially constr.		0.01	0.01	0.01
		(0.006)	(0.006)	(0.006)
Labour market constr.		0.01	0.01	0.01
		(0.009)	(0.009)	(0.009)
Lack of man. resources		0	0	0.01
		(0.008)	(0.008)	(0.008)
Lack of demand		-0.01	-0.01	0
		(0.006)	(0.006)	(0.006)
Other Obstacles		0.00	0.00	0.00
		(0.007)	(0.007)	(0.007)
International Competition			0.00	0.00
			(0.006)	(0.006)
Part of foreign group			0.01	0.01
			(0.01)	(0.011)
Global exporter			0.01**	0.02**
			(0.007)	(0.007)
Country dummies	No	No	No	Yes
Industry dummies	No	No	No	Yes
Pavitt dummies	-	-	-	-
Observations	3,444	3,298	3,298	3,298
Pseudo R^2	0.0349	0.0404	0.0462	0.0658

*Note: Standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*
Source: EFIGE, WIFO calculations.

Notwithstanding these restrictions, an attempt is made to analyse the economic contribution of public services and their role as a 'lubricant' to the working of the economy as a whole. The input-output analysis will pursue two avenues in order to mitigate the second restriction:

- input-output tables themselves are analysed with a focus not only on intermediate public services, but also on public consumption (as included in the final demand section of the tables); and
- the tables are transformed into an input-output model (which also includes the international trade linkages) using standard assumptions; on the basis of this international IO table, multiplier matrices are then derived and calculated in order to compute linkage measures which provide insights into direct and indirect flows of public services across sectors and countries. The input-output model will be applied to these tables focusing on PA as intermediated inputs to other sectors of the economy.

Finally, the linkage measures are set against quality indicators of public services, thereby statistically examining the possible relationship between a high density of linkages and the accruing benefits.

Table 4.6: Regression results, HGF (2005-2008) at the country-sector level			
Country-Sector fraction of HGF (OLS)	(1)	(2)	(3)
Public Administration, average	-0.06**	-0.05*	0.03
	(0.023)	(0.025)	(0.092)
Constraints, average	0.04	0.06	0.04
	(0.051)	(0.050)	(0.138)
Global exporter, average	0.06*	0.03	0.11*
	(0.033)	(0.039)	(0.055)
Country dummies	No	No	Yes
Industry dummies	-	-	-
Pavitt dummies	No	Yes	Yes
Observations	74	69	69
Pseudo R^2	0.052	0.033	0.248

*Note: Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1*
Source: EFIGE, WIFO calculations.

4.2.2. Methodology and data

The World Input-Output Database (WIOD) on which the input-output analysis is based combines detailed information on national production activities and international trade data. For each country, tables are used that reflect how much of 59 products is produced and used by 35 industries. By linking these tables to trade data, it is estimated, for example, how many dollars of Belgian fabricated metal products are used by the French transport equipment industry. This type of information is available in the WIOD database for 40 countries (EU-27 countries and 13 major other countries), along with estimates for the rest of the world for 1995-2007 (plus estimates for 2008 and 2009). Tables used here are in current prices.

National supply and use tables (SUTs) are the basis for the analysis. SUTs are usually non-square and allow for secondary production, better reflecting reality. A supply table provides information on how much of each product is produced by each domestic industry. A use table indicates the use of each product (combining domestically produced and imported products) by each of the industries and final-use categories (e.g. consumption by households and government, investments and gross exports). Both types of table are thus based on 'product-by-industry'. Because national SUTs are only infrequently available and are often not harmonised over time, they have been benchmarked on consistent time series from national accounts statistics (NAS).

The analysis here will be based on symmetrical input-output tables from WIOD by sectors and countries. Therefore, the number of activities is the same across all 40 countries and final demand does not include exports; rather, these are part of the intermediate use table.

The equation defining an input-output model to be derived from a table as described above is the following:

$$Ax + f = x \qquad (4.5)$$

As in the technology matrix; each column includes the sectoral shares of intermediate inputs from domestic and foreign sources (by countries) in total production. It is of dimension (sector*country) x (sector*country). *'x'* is the total value of production both by sector and country. *'f'* is the vector of total final demand aggregated across all final demand categories; its dimension corresponds to that of vector *'x'*.

Rearranging this equation leads to the equation of the input-output model that can be applied analytically:

$$x = (I - A)^{-1} f \qquad (4.6)$$

Here, *'I'* refers to the identity matrix. $(I - A)^{-1}$ refers to the so called Leontief-inverse; the column sum of that matrix is the value of the additional output if final demand for the output of the corresponding sector is increased by 1 (say 1 Dollar). The additional output includes both direct effects and indirect effects which are generated by the chain of intermediate deliveries across sectors and countries. Elements on the main diagonal are always greater than 1 since direct effects (increase of sectoral output by one unit) are included. Elements off the main diagonal are less than 1 and indicate the additional output of a specific sector located in a specific country induced by the increase in final demand. Premultiplying the Leontief inverse by

value added or employment coefficients (i.e. value added or employment per unit of production value) delivers the impact in terms of value added or employment.

The Leontief-matrix is a natural first step in exploring the economic contribution of intermediate public services. The columns contain the economic impacts generated by final demand for the commodities provided by a sector in a specific country on all sectors in all countries; the column sum indicates the total economic impact resulting from that demand 'shock'. Summing across rows attains the so called *'forward linkages'* as an indicator for how much of a sector's output is used in the production processes of other sectors. Since the focus here lies on PA services and their contribution to the functioning of other sectors, most attention will be paid to forward linkages with respect to the PA sector.

4.2.3. Results

Input-Output Linkages of PA services[58]

As a first step in analysing the WIOD system of international input-output tables, selected structural information was extracted for all countries included in WIOD and the rest of the world in 1995 to 2011. This includes:

- indicators on the importance of foreign trade,
- the ratio of government consumption expenditures (CG) to total value added,
- the share of sector 'L' (PA) in total value added, and
- the share of sector PA's output in government consumption expenditures.

The results can be summarised as follows:

- exports became more important in 1995-2011, both for EU Member States and non-EU countries. In the EU, exports account for a larger proportion of VA than in non-EU countries. This is mostly due to a size effect.
- on average, Member States exhibit markedly higher ratios of government consumption (CG)[59] to total value added: around 24% in the pre-crisis year against the non-EU countries' 15-16%. Also, the response to the crisis was much more pronounced in the EU: the CG share jumped up by almost 2.5 points in the two years after the onset of the crisis; outside the EU, the increase was more moderate, at 1.5 points; and
- the output of the PA sector is mostly delivered to government consumption as part of final demand: in EU and non-EU countries alike, this share is around 88%, with a slightly decreasing trend. Conversely — and in line with the low share of PA in total intermediate inputs — the value of PA services consumed as intermediate demand by other sectors in the total value of PA services is low, though on a rising trend: since 1995, it has gained about 1 percentage point to reach an average of 7.5% in the EU and 5.4% in regions outside Europe. Manufacturing sectors directly consume around 1% of the PA sector's output.

As intermediate PA services are rather insignificant as compared with other commodities used by intermediate demand, attempts to measure the effects of government services on the working of the economy in general should not be restricted to analysing those inputs alone but expanded to activities such as those included in government consumption. However, since input-output models treat government consumption as an exogenous variable, the scope of the analysis is somewhat limited in that respect.

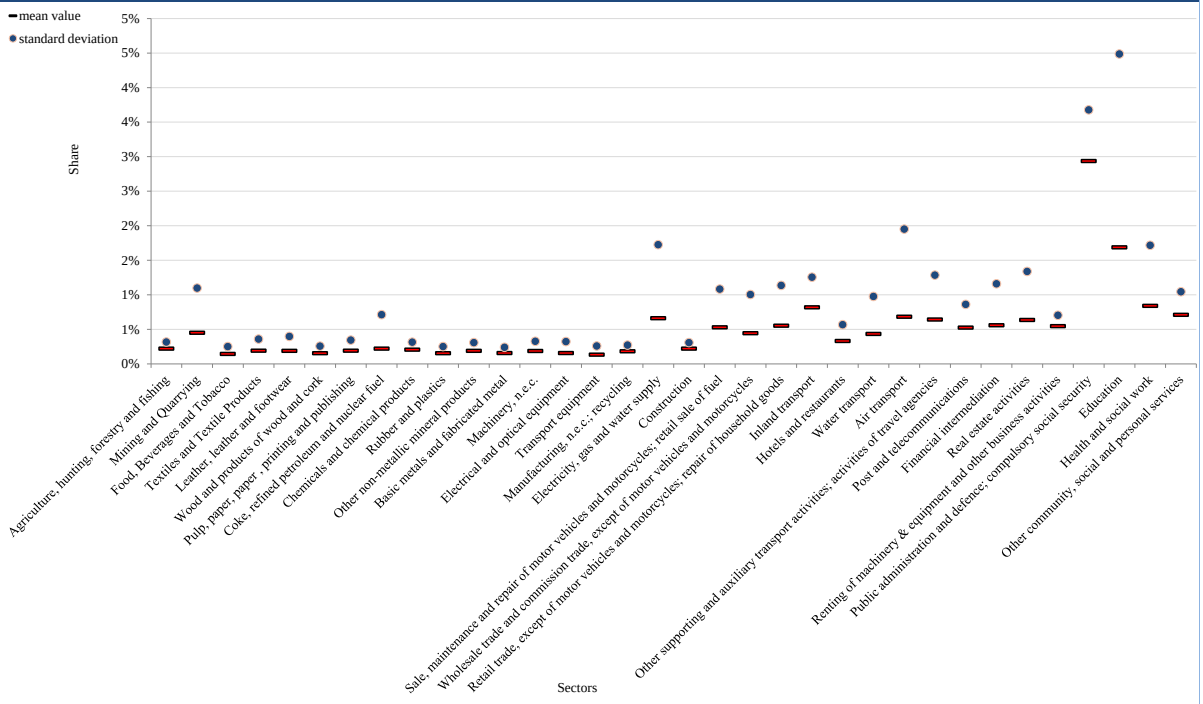
Figure 4.3 shows the share of PA services in total intermediate input by sector for the 40 WIOD countries.[60] The figure shows that for most sectors and most countries, the relevance of PA as a direct input is significantly lower for the manufacturing industries compared to the service industries. The PA share is also low in construction services (since government fees for construction permits should mostly be accounted for in real estate services), but higher for the energy producing sector. However, differences in mean shares between manufacturing and service sectors seem to be driven by a higher cross-country variation for most service industries. In general, the standard deviation with respect to these shares is much higher for service industries in comparison to manufacturing industries. Within services, the highest variation is found for the PA sector itself and the education sector.

[58] For the detailed analysis refer to the study: Misch et al. (2014).

[59] Sector 'L' (Public administration), together with sectors 'M' and 'N' (Health and Education, respectively), makes up the bulk of government consumption.

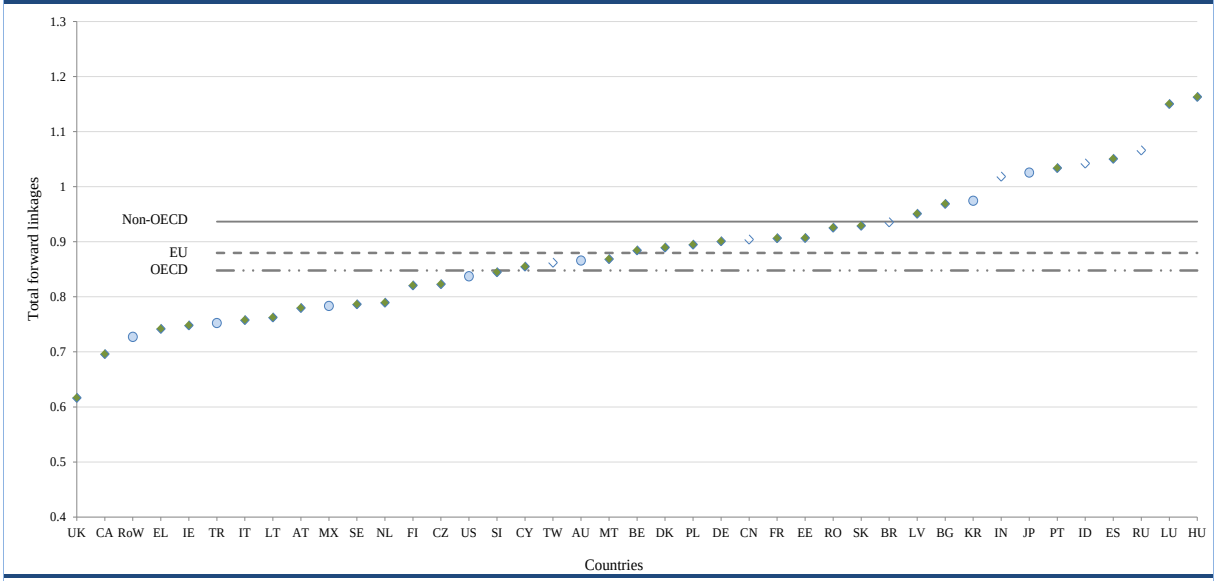
[60] A country-level analysis could not add to the discussion here.

Figure 4.3: Shares of intermediate PA services in Total Intermediate Inputs by sector (mean of 1995-2011)



Source: WIOD calculations

Figure 4.4: Total Forward Linkages of PA by country / region (mean of 1995-2011)



Source: WIOD calculations.

Note: The figure illustrates the Shares of Intermediate PA Services in Total Intermediate Inputs by Country/Region

More insights into the inter-industrial linkages of PA services can be gained by further exploiting the inter-country intermediate use table derived from the WIOD system. For that purpose, a Leontief multiplier matrix was calculated and then premultiplied with the sectoral share of value added in output. The resulting matrix thus includes value-added multipliers by sector and country. The multiplier values express how much value added, differentiated by sectors and countries, is directly and indirectly generated when final demand for the product/service of a certain sector in a certain country is increased by one unit (in monetary terms).

Based on this value-added Leontief matrix, *forward linkages* of PA services by country are analysed to arrive at an indicator for the importance of the PA sector as a provider of inputs to other sectors in the economy. Higher values of this indicator imply greater importance. The values of the indicator range from 0.6 to almost 1.2, with neither country size nor region seemingly influencing the size of the *forward*

linkages (see Figure 4.4). The average values for the EU Member States, OECD- and non-OECD countries do not differ significantly. However, countries with higher *forward linkages* of the PA sector may have a higher share of fee-based services than those with lower *forward linkages*.

A comparison across sectors reveals that the *forward linkages* emanating from PA rank close to the median over all sectors. Sectors ranked behind PA include mainly those concentrated on the production of investment or consumption goods (which both show up in the final demand section of the tables). At the top of the list, one can find many service goods but also manufacturing commodities needed for production in many other sectors. *Forward linkages* of intermediate PA services, however, are highly concentrated on the PA sector as the receiving entity, i.e. most of the intermediate public services are inputs in the production of the PA sector itself. This implies once more that, for other sectors, fee-based public service deliveries do not play a significant role as inputs to production — at least in terms of the monetary value of the fees included in the intermediate use tables (which may not correspond to the actual value of the public service as received by the demanding sector). Since those fees need not cover the whole cost that accrues in the production of the services, their true benefits to the companies using them remains unclear and may very well be underestimated by looking at the forward linkage or other input-output related indicators only. This problem is further addressed below in the examination of indicators of the quality of public services.

Total forward linkages can be broken down into *domestic* and *foreign linkages*.

Foreign linkages show which share of the public services produced and delivered in one country ends up as inputs to sectors located abroad via indirect input-output linkages. The linkages ranked by size and assigned to the respective country produce three different groups of countries: A first group with foreign *forward linkages* between 0.01 and 0.07; another group (with Cyprus in between those groups) with 0.2 and 0.28; and finally a group of three countries (China, Indonesia and Luxemburg) with values of *foreign linkages* above 0.38. [61] The countries within the groups are quite heterogeneous with respect to size and geographic location. Higher *forward foreign linkages* imply that domestic sectors receiving PA services are closely linked to foreign economies (e.g. directly through exports or indirectly through deliveries to domestic exporting sectors).

[61] See Figure 2.15 in background study (Misch et al., 2014).

Input-output linkages of PA and the quality of governance[62]

Observed structural differences between countries with respect to PA services (as derived from the input-output analysis) are contrasted with export performance on the one hand (as an indicator of "competitiveness", a component of which is assumed to be influenced by the level and quality of public services) and indicators of efficiency, transparency and accountability of the public sector on the other hand (as an indication of the quality of public services). Both the level of the variables (2006-11 average) and developments in 1995-2011 (measured as mean annual changes) are considered. In all instances, correlation diagrams for the variable under consideration include:

- the ratio of exports to total value added; and
- the ratio of exports to imports; for both X-related indicators, mean annual changes are applied instead of levels, to correct for country size.

Seven indicators describe the quality of PA:

- governance;
- tools for administrative modernisation;
- corruption;
- starting a business;
- procurement;
- tax compliance and tax administration; and
- effective civil justice.

Correlations are identified, but causalities (either from the variables under consideration to the set of indicators, or *vice versa*) cannot be inferred. The results can be summarised as follows:

- The correlation between CG/VA[63] and the development of external trade is nil. As for the other indicators, correlation seems to be present: the larger government consumption relative to total value added, the better a country's achievement in all seven quality indicators. However, this positive correlation seems to be driven by the position of four countries in particular: the Scandinavians (Denmark, Sweden and Finland) and the Netherlands (DFNS), countries with a large government sector and efficient administration — if these are taken out of the sample, the correlations vanish or even turn slightly negative.

[62] For the detailed analysis refer to Misch et al. (2014)

[63] CG/VA is an indicator of the size of government i.e. the more goods and services the government demands relative to the size of the economy (this measured as value added), the larger the government sector is.

- For quality indicators and mean annual changes in CG/VA, most correlations vanish.
- The correlation is reversed when the share of sector PA in total value added (in levels) is used. Whereas the relative amount of government spending was positively correlated with the quality indicators (thanks to DFNS), the relative size of PA is (slightly) negatively correlated with administrative quality;
- When looking at annual changes, countries with an expanding public sector seem to be those with lower rankings in the quality indicators. As before, two countries significantly affect this correlation. Exclusion of these two countries (Bulgaria and Romania) however, does not cause the correlations to break down; they merely become less pronounced.
- Calculating correlations using the share of government consumption accounted for by the PA sector, both in levels and in annual changes, reveals similarities to the PA/VA-correlations; in this case, Bulgaria and Slovakia are driving correlations.

Another way of shedding light on the relationship between the quality of PA and the characteristics of the sector, as shown by the input-output analysis, involves:

i. contrasting the share of value added by the PA sector with the share of its output delivered to intermediate use; and
ii. (using a broader definition of the public sector), relating the shares of value added by sectors 'L', 'M' and 'N' (PA, Education, Health & Social Work) to the shares of their output going to intermediate use.

On the basis of these shares, countries are classified according to the following four groups:

- Countries with above-average VA-share ("large government") and above-average share of intermediate use ("fee-based government", Quadrant I);
- Countries with below-average VA-share ("small government") and above-average share of intermediate use ("fee-based government", Quadrant II);
- Countries with below-average VA-share ("small government") and below-average share of intermediate use ("tax-based government", Quadrant III);
- Countries with above-average VA-share ("large government") and below-average share of intermediate use ("tax-based government", Quadrant IV).

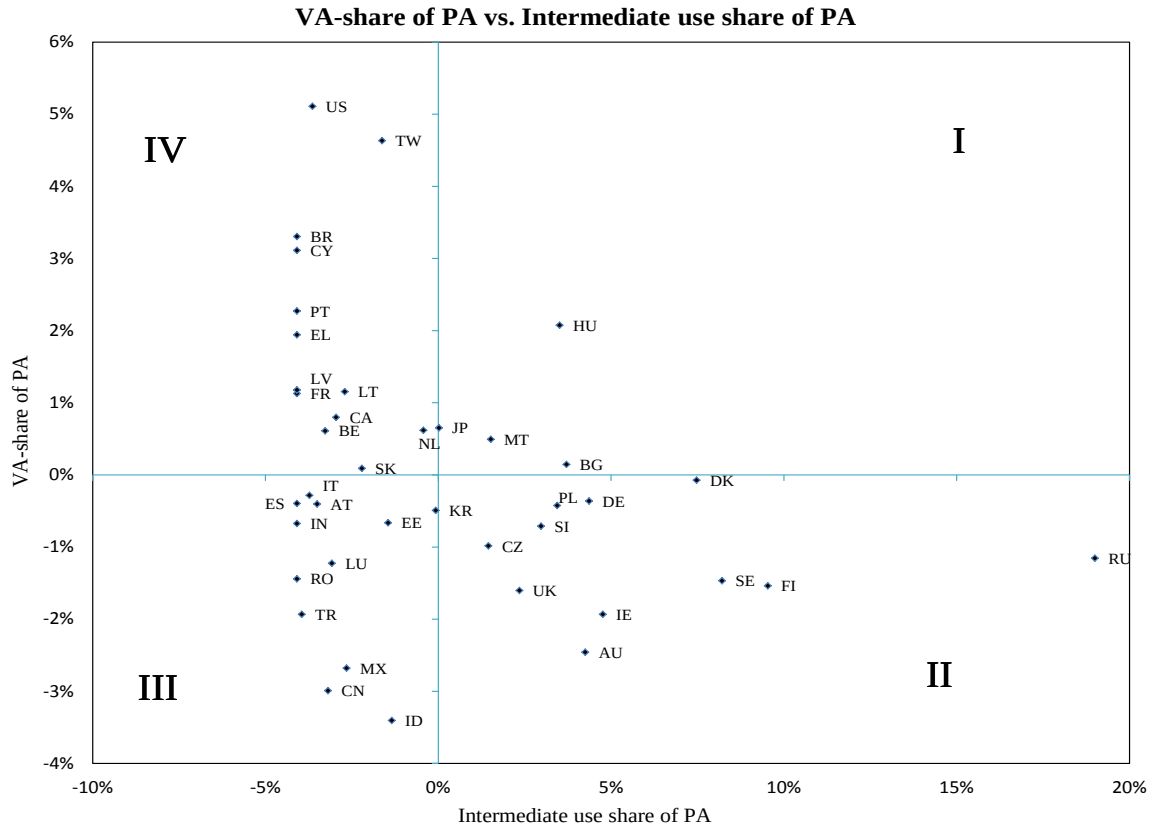
Figure 4.5 shows the positioning of 40 countries along these two dimensions. The first diagram is based on a narrow definition of government — only sector PA is included. The diagram underneath takes an aggregate of sectors: PA, Education, Health & Social Work, i.e. a broader definition of the government sector, as its starting point. Interestingly enough, quite a few countries switch quadrants depending on the definition of the public sector applied (see Misch et al., 2014).

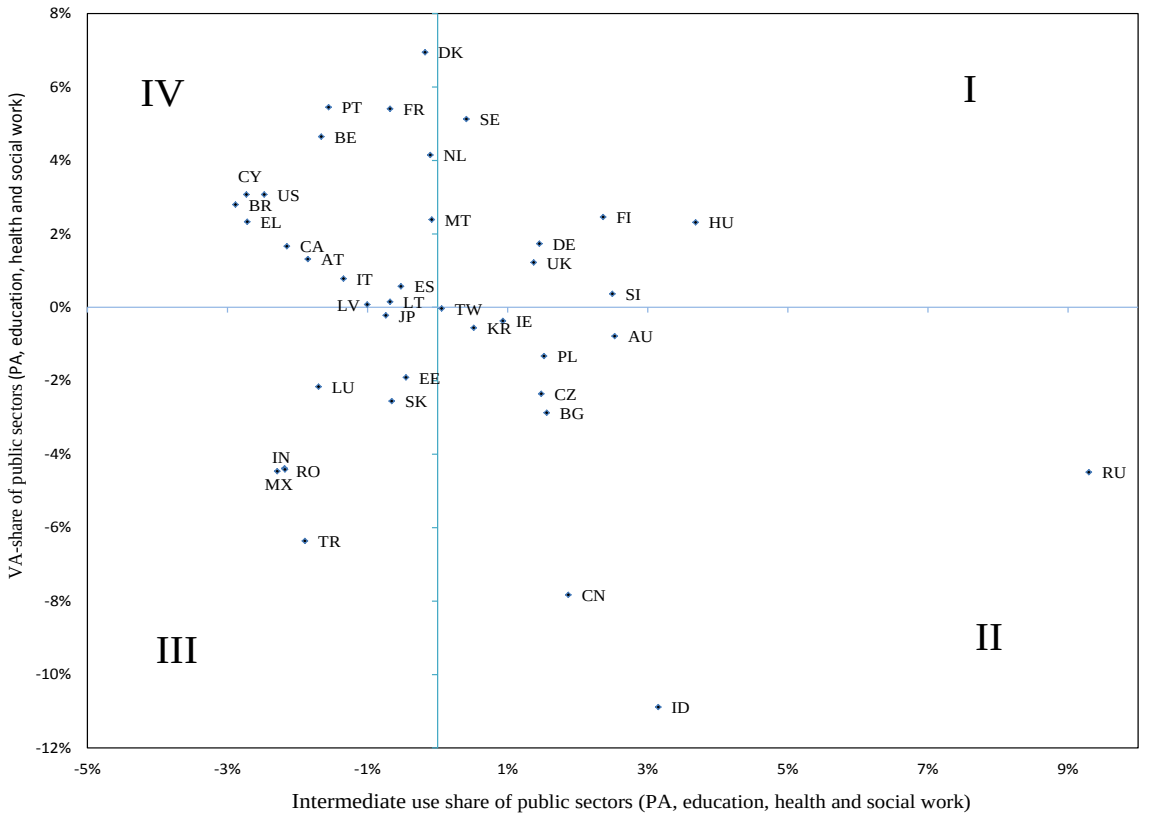
The main findings indicate that input-output analysis does not support the hypothesis that intermediate linkages of the PA sector can play a particularly important role in the overall economy; rather, PA services appear in the final demand category 'government consumption' (this implies that most public services are provided more or less 'free of charge'). As such, they exert considerable demand impacts on other sectors of the economy but their supply-side effects remain unclear in an input-output framework. Moreover, observed differences across countries with respect to input-output linkages do not lead to clear-cut conclusions and may merely reflect differences in accounting standards and national institutional features of the public sector. Furthermore, no consistent patterns emerge from analysing the statistical correlation between the size of the public sector, its intermediate linkages and indicators of the quality of PA services. However, when countries are classified according to the significance of two sets of government revenue-raising activities (i.e. taxes versus fees) and to the extent of government activities (i.e. 'large' vs 'small' government), some evidence appears that systems that rely more on fees than on taxes may be characterised by higher quality public services.

4.3. BUSINESS PERCEPTIONS AND THE COST OF PUBLIC ADMINISTRATION

Given the limited political capital and administrative capacity in Member States, identifying and prioritising those dimensions of PA that most impede firms' operations, is crucial. To this end, the objective of this section is to propose an innovative approach to measuring the severity of obstacles arising from particular dimensions of PA, thereby providing a valuable policy tool that will allow more targeted policy recommendations to complement existing measures taken by the European Commission, such as the Small Business Act, the

Figure 4.5: Share of Public services in Total Value Added vs. Share of Public Services used in Intermediate Demand





Source: WIOD calculations.

Services Directive and the Action Programme for Reducing Administrative Burdens in the European Union.

This section uses business perceptions to assess whether and to what extent various dimensions of PA constrain firms in their operations and therefore, ultimately in their growth. In particular, the objective is to improve the assessment using two innovative methodologies and to compare the costs that inefficiencies in PA impose on firms across different dimensions of PA and across different countries.

Business perceptions are a powerful source of information to help policymakers understand the extent to which PA constrains firms. In particular, using business perceptions has several advantages: they can be interpreted as measures of the costs that PA imposes on firms and are comparable indicators of these costs, as different obstacles are measured on a single scale. However, despite these strengths, business perceptions are often not sufficiently appreciated due to concerns about their credibility and representativeness leading to biases (e.g. Bertrand and Mullainathan, 2001).

Using two novel empirical methodologies, biases in perception data are tested and corrected for:

- with the first approach, proposed by Carlin et al. (2010), raw business perceptions of PA-related obstacles are corrected for differences in firm characteristics by regressing firm-level perceptions on indicators of the sector, the level of employment, ownership and export status of the firm;
- the second approach controls for the individual firm's overall tendency to complain by expressing the perception of particular PA-related constraints relative to the average level of complaint, thereby cancelling out idiosyncratic factors of the individual respondent.

Using the findings from both approaches, the results sub-section provides rankings of different dimensions of PA both across and within countries. The latter shows which dimension of PA is considered as most costly for firms in a particular country, whereas the former shows how a particular country ranks internationally in a particular dimension of PA. When used for within-country analysis, both methodologies identify *tax administration*, *corruption* and *ineffective justice systems* as the most severe obstacles to firm growth. These results are highly robust and show only little variation over time during the period under consideration.

4.3.1. Background

Business perceptions are subjective assessments by leading managers of firms and are now routinely included in various business surveys, in particular the World Bank Enterprise Surveys, where respondents are asked: 'Is [dimension of PA] no obstacle, a minor, a moderate, a major or a very severe obstacle to the current operations of this establishment?'. The responses were recorded on a 0-4 scale; no obstacle (0), minor obstacle (1), moderate obstacle (2), major obstacle (3), and very severe obstacle (4).

Given the formulation of the survey question, business perceptions in essence measure the costs that PA imposes on firms, as Carlin et al. (2010) argue. Intuitively, survey responses can be regarded as showing the difference in firm profits between the hypothetical state in which PA poses no obstacle to firms' operations and the actual state. Inherent to this is the idea of PA being a public input to private production. If a particular obstacle is rated as more severe than other obstacles, this means that it affects profits more adversely and hence increases costs more than other dimensions. Through its impact on costs, this particular dimension then also creates an adverse impact on firms' growth.

Furthermore, while the rating scale does not provide a basis for inferring the absolute magnitude of costs, it does reflect costs in relative terms. This is sufficient for identifying the bottleneck with respect to PA. Ultimately, it is therefore the relative costs which policymakers need to understand. Governments face a wide range of options when it comes to forms of intervention and policy reform, all of which supposedly help to promote firms' performance and growth. In addition, other indicators of PA do not assess the relative importance or relevance of a particular public service or good for the private sector. Business perceptions, on the contrary, may reflect the relevance of respective dimensions of PA for the private sector and may therefore complement existing objective indicators (Carlin et al., 2013).

While business perceptions have key advantages over other measures of PA costs, they also have weaknesses. In particular, their subjectivity imposes challenges in terms of correct interpretation.

First, there is a concern that business perceptions are dependent on the subjective views of individual managers, which are driven by idiosyncratic factors. This may, in turn, render raw perceptions incomparable between different entities. This becomes especially evident in the case of corruption (Veenhoven, 2002), e.g. it is likely that the evaluation of corrupt practices differs within, as well as, between countries. Even if two respondents

consider the same practice to stem from corruption, their assessment in terms of severity may still differ. Consequently, on the basis of the same set of information, the PA may be assessed as highly corrupt by some individuals and only moderately corrupt by others.

Second, there is the concern that business perceptions are driven by firms' characteristics in the sense that performance, industry and size determine which issues are seen as obstacles. In other words, they may be demand-driven in the sense that firms' demand for different PA services differs according to their characteristics, which in turn affects whether and to what extent they see a particular issue as an obstacle. Hence, firm performance and other characteristics may be closely correlated with the way potential obstacles, including those relating to PA, are perceived. One firm may argue that low-quality internet access is a severe obstacle, while another may report the opposite as its business does not rely on internet access. Simply aggregating answers from all firms in the sample would therefore not provide conclusive information about the quality of internet access in that particular country. It would rather identify the share of firms that rely on well-functioning internet access. Consequently, it is necessary to control for firm characteristics in a given country when making cross-country comparisons.

4.3.2. Data

The primary data source for the analysis of business perceptions comes from the World Bank's Enterprise Surveys (World Bank, 2014) covering 11 Member States, four candidate countries, one applicant country and one country that is neither a candidate nor an applicant. The first main wave of the survey was implemented in 2002 and the latest in 2013.[64] Enterprise Surveys comprise business perceptions for up to 15 different dimensions of the business environment: *compulsory certification*, *corruption*, *ineffective justice systems*, *crime and disorder*, *customs and trade*, *electricity*, *competition from the informal sector*, *business inspections*, *labour regulation*, *access to land*, *permits and licensing*, *tax administration*, *tax rates*, *telecommunications* and *transport*.

Perceptions for each dimension are collected using an identical scale of measurement and an identical survey question. This is crucial for the common interpretation of survey responses in terms of units of foregone profit. Evidently, not all the dimensions mentioned above relate to PA. For instance, tax rates refer exclusively to legislation and do not reflect the quality of PA. The same applies to crime and disorder, and competition from the informal sector, although both are to some extent influenced by the quality of PA. Hence, these dimensions are not part of the analysis. Similarly, electricity, telecommunications and access to land, are also left out of the analysis.

4.3.3. Methodology

The analysis in the previous sub-sections pointed out that accounting for country- and firm-specific characteristics is necessary to construct perception-based measures of PA quality that are comparable across firms and countries. This requires a dedicated methodology. Two such methodologies are used in this section:

i. the '*benchmarking approach*', which is the main and more formal approach; and
ii. the less complex '*mean correction approach*'.

Both approaches will propose procedures to obtain bias-free measures of business perceptions of PA that allow for relative performance to be assessed both within and across countries.

Benchmarking approach

The benchmarking approach, based on Carlin, et al. (2010), tackles issues relating to perception data. It is well suited to the purposes of this section, in particular to addressing the problem of business perceptions depending on firms' characteristics. The proposed framework differs from the usual approaches applied in the economic literature in that, rather than augmenting existing specifications by adding a further regressor containing business perceptions, the perceptions are used as a dependent variable in the econometric analysis. Given the advantages of perception data discussed above, this approach then provides a more accurate measure of the costs that firms incur from PA and ultimately their impact on performance.

In order to deal with the dependence of survey responses on firms' characteristics, the approach proposes controlling for several dimensions: the number of employees, the sector a particular firm operates in, the type of ownership, the share of foreign ownership and the share of sales accounted for by exports. The characteristics are codified as dummy variables of zero or one. The benchmark firm across all countries corresponds to the case when all dummy variables are set to '0' and serves as a basis for a bias-free measure of the costs that firms incur when dealing with PA.

Initially, the definition of the dummy variables will closely follow Carlin et al. (2013) and define the

[64] Detailed information about country and time coverage can be found in Table A 4.7 in the Annex.

benchmark firm as having 30 employees, operating in the manufacturing sector, being privately owned, exhibiting a share of less than 10% foreign ownership and a share of less than 10% of sales accounted for by exports. In the subsequent analysis, these assumptions will be varied in order to check the robustness of the results. First, individual firm perceptions are regressed on these dummy variables according to equation (4.7), in order to obtain an assessment unaffected by firm characteristics.

$$perception_{jict} = \beta_1\, empl_{ict} + \beta_2\, sector_{ict} + \beta_3\, own_{ict} + \beta_4\, foreign_{ict} + \beta_5\, exports_{ict} + \eta_{jc} + \epsilon_{jict} \quad (4.7)$$

Here, $perception_{jict}$ refers to the individual assessment with respect to the administrative dimension *(j)*, of firm *(i)*, in country *(c)*, at time *(t)*. The variables $empl_{ict}$ to $exports_{ict}$ refer to the respective firm characteristics codified as dummy variables. η_{jc} refers to a country fixed effect and captures unobserved, but time-constant, heterogeneity at the country level. ϵ_{jict} denotes the idiosyncratic and firm-specific error term.

Assessments unaffected by firm characteristics are obtained by setting the dummy variables equal to zero following the definition of the benchmark firm. Given this calibration, η_{jc} would not only capture unobserved heterogeneity, but could also be interpreted as the assessment by a typical or benchmark firm in country c with respect to dimension j of PA. As explained above, these assessments can then be interpreted as country-specific costs of the administrative dimension j used as public input to private production and measured in relative units of forgone profits. On the basis of the estimation results, reported relative costs $(\hat{rc}_{jict})$ are calculated according to equation (4.8). Given the independence from firm characteristics, results can then be used to rank the relative importance of PA dimensions within a country and to identify the factor most impeding firms' growth.

$$\hat{rc}_{jict} = \hat{\eta}_{jc} + \hat{\varepsilon}_{jict} \quad (4.8)$$

The robustness of the general methodology is tested as follows:

i. assumptions with respect to the definition of the benchmark firm, e.g. number of employees, are adapted;
ii. checks are carried out as to whether firm age may also influence perceptions with respect to costs imposed on firms by PA. Assessments may differ simply because, with increasing age and size, firms are more likely to have dedicated departments dealing with administrative tasks. This would reduce the perceived burden of PA;
iii. a proxy for firm productivity is also included; this is defined as sales per employee, with sales deflated and measured in US dollars for all countries in the sample. Given these robustness checks, the estimation equation is altered.[65]

$$perception_{jict} = \beta_1\, empl_{ict} + \beta_2\, sector_{ict} + \beta_3\, own_{ict} + \beta_4\, foreign_{ict} + \beta_5\, exports_{ict} + \beta_6\, age_{ict} + \beta_7\, productivity_{ict} + \eta_{jc} + \epsilon_{jict} \quad (4.9)$$

Mean-Correction approach

Mean correction is another way of correcting business perceptions for their dependence on firms' characteristics. Rather than taking particular characteristics explicitly into account, this approach tries to capture the firm's individual tendency to complain in the survey. This is achieved by calculating the mean across all dimensions of PA for each firm according to equation (4.10):

$$\overline{tc}_{ict} = \frac{1}{J}\sum_{j=1}^{J} perception_{jict} \quad (4.10)$$

This kind of approach does not only control for potential dependence on firms' characteristics, but could also takes into account the mood of the respondent at the time of the survey, which again could be independent of firm characteristics. The tendency to complain $(\overline{tc}_{ict})$ is then used to correct individual assessments of every administrative dimension following equation (4.11). Subsequently, these adjusted firm-specific perceptions are used to calculate a country-specific mean according to equation (4.12).

$$\widetilde{perception}_{jict} = \frac{perception_{jict}}{\overline{tc}_{ict}} \quad (4.11)$$

$$\tilde{rc}_{jct} = \frac{1}{N}\sum_{i=1}^{N} \widetilde{perception}_{jict} \quad (4.12)$$

4.3.4. Results

Results using the benchmarking approach

Results are obtained using the least squares dummy variables estimation approach. Regressions are executed separately for every dimension of PA and included up to 20,026 firm-level observations. Table 4.7 summarises the results for all covered dimensions of PA.

For perceptions of ineffective justice system, the estimation included 19,424 firm-level observations. Except for one case, all coefficients exhibit a statistically significant impact on individual

[65] Further technical details on the methodology are provided in the Annex.

Table 4.7: Estimation results of the baseline specification

	(1) Corruption	(2) Ineffective justice systems	(3) Customs	(4) Inspections	(5) Permits	(6) Tax Administration	(7) Transport
Exports	0.0484	0.0806	0.389	0.000778	0.0614	0.0880	0.0375
	[2.12]**	[3.74]***	[19.45]***	[0.02]	[3.03]***	[4.25]***	[1.95]*
Employment	0.00218	0.0438	0.0250	0.0436	0.0311	-0.00256	0.0388
	[0.35]	[7.43]***	[4.57]***	[4.18]***	[5.62]***	[0.44]	[7.33]***
Foreign ownership	-0.141	-0.0513	0.160	-0.0210	-0.0241	-0.0789	-0.00632
	[-4.90]***	[-1.87]*	[6.02]***	[-0.43]	[-0.93]	[-2.98]***	[-0.25]
Private ownership	-0.390	-0.138	-0.127	-0.205	-0.194	-0.251	-0.245
	[-11.84]***	[-4.54]***	[-4.43]***	[-2.55]**	[-6.46]***	[-8.02]***	[-8.99]***
Sector	-0.0170	-0.0472	-0.0817	0.0171	-0.0131	-0.0953	-0.0408
	[-0.79]	[-2.34]**	[-4.52]***	[0.51]	[-0.71]	[-4.91]***	[-2.29]**
AL	2.095	1.607	1.356	0.878	1.105	1.638	1.060
	[43.11]***	[31.73]***	[27.42]***	[6.21]***	[24.41]***	[35.37]***	[22.51]***
BG	1.680	1.318	0.549	1.008	0.999	1.325	0.769
	[49.57]***	[41.27]***	[22.01]***	[15.04]***	[33.59]***	[44.66]***	[26.60]***
BA	1.676	1.176	0.929	0.665	0.966	1.473	0.816
	[35.13]***	[28.39]***	[24.22]***	[10.61]***	[25.87]***	[36.69]***	[23.17]***
CZ	1.337	1.367	0.990	1.314	1.091	1.947	1.076
	[28.68]***	[29.89]***	[24.27]***	[17.40]***	[27.26]***	[46.78]***	[23.69]***
EE	0.734	0.516	0.469	0.509	0.673	0.658	0.652
	[17.16]***	[14.23]***	[12.08]***	[8.65]***	[16.03]***	[16.49]***	[14.46]***
HR	1.195	1.263	0.561	0.825	0.732	1.301	0.590
	[30.83]***	[33.04]***	[18.45]***	[7.25]***	[23.55]***	[35.22]***	[20.12]***
HU	0.978	0.629	0.592	0.403	0.849	1.562	0.534
	[25.09]***	[19.75]***	[18.17]***	[7.00]***	[24.40]***	[39.41]***	[17.96]***
LT	1.491	1.224	0.611	1.322	1.007	1.609	0.725
	[27.34]***	[24.16]***	[13.85]***	[17.13]***	[20.72]***	[33.63]***	[15.63]***
LV	1.263	0.924	0.750	1.197	0.949	1.852	0.896
	[22.35]***	[18.18]***	[16.24]***	[15.21]***	[19.39]***	[36.60]***	[17.33]***
FYROM	1.279	1.260	0.776	0.702	0.850	1.115	0.679
	[27.75]***	[26.83]***	[19.88]***	[11.16]***	[21.19]***	[27.48]***	[19.25]***
ME	0.503	0.452	0.650	0.558	0.551	0.916	0.566
	[9.19]***	[8.66]***	[11.78]***	[6.54]***	[10.24]***	[15.19]***	[10.86]***
PL	1.410	1.478	1.105	1.547	1.094	1.951	0.739
	[42.76]***	[47.23]***	[35.09]***	[23.53]***	[36.79]***	[65.59]***	[26.64]***
RO	1.918	1.623	1.069	1.319	1.542	2.088	0.936
	[50.32]***	[44.86]***	[29.10]***	[21.29]***	[43.81]***	[59.93]***	[26.91]***
RS	1.446	1.202	0.865	0.831	0.846	1.469	0.692
	[32.83]***	[29.44]***	[23.26]***	[12.72]***	[24.00]***	[37.22]***	[21.44]***
SK	1.443	1.359	0.681	1.153	0.947	1.147	0.835
	[26.96]***	[26.71]***	[15.00]***	[15.97]***	[21.46]***	[25.15]***	[18.11]***
SI	0.751	0.985	0.380	0.955	0.573	1.115	0.578
	[17.66]***	[22.50]***	[11.59]***	[12.69]***	[16.01]***	[27.53]***	[16.02]***
TR	1.864	1.361	0.942	0.463	1.327	1.853	0.936
	[62.93]***	[49.85]***	[37.17]***	[14.13]***	[50.22]***	[71.18]***	[39.17]***
N	19,402	19,424	18,798	5,492	19,560	20,017	20,026
R-sq	0.571	0.515	0.431	0.463	0.463	0.628	0.331

*Note (1): Least squares dummy variables approach applied in all specifications, cluster-robust t-statistics at the firm level are reported * p<0.10, ** p<0.05, *** p<0.001.*
Note (2): Firm controls are coded as dummy variables (0 - 1), coefficients indicate a deviation from the benchmark case (dummy switching from 0 to 1).
Source: ZEW calculations.

assessments at the 1% or 5% levels. Based on the results for this particular dimension, increasing proportions of export sales are on average associated with more severe assessments of the costs associated with the ineffective justice system.

A similar effect on individual assessments can be observed if firm size deviates from the benchmark case. On average, the severity of assessments diminishes with increasing shares of foreign ownership. Results point in the same direction if the main sector of operations differs from manufacturing, i.e. the benchmark case.

These results may be explained by the following arguments: An increasing share of export sales may lead to more complex lawsuits as these may more frequently involve firms located abroad. Two different arguments may explain the sign of the coefficient in the case of employment. A deviation from the benchmark case either means a reduction or an increase in firm size. A negative sign for smaller firms could be attributed to a potential lack of capacities and experience in dealing with ineffective justice systems or lawsuits. This is less likely to hold for larger firms. Increases in size are likely to be associated with increasing sales and therefore, potentially with more frequent lawsuits.

Belonging to a sector other than manufacturing may reduce the frequency of lawsuits as firms in sectors such as wholesale or services tend to exhibit a lower probability of lawsuits.

Country-specific assessments independent from firm characteristics are given by the respective country codes in Table 4.7. The scale of these estimated coefficients is equivalent to that of raw perceptions. Consequently, on average and throughout all time periods covered in the sample, firms in Romania assess the level of effectiveness of the justice system as being a minor to moderate obstacle to firm growth. In the case of Estonia, the level of effectiveness of the justice system is perceived to be no or only a minor obstacle to firms' growth.

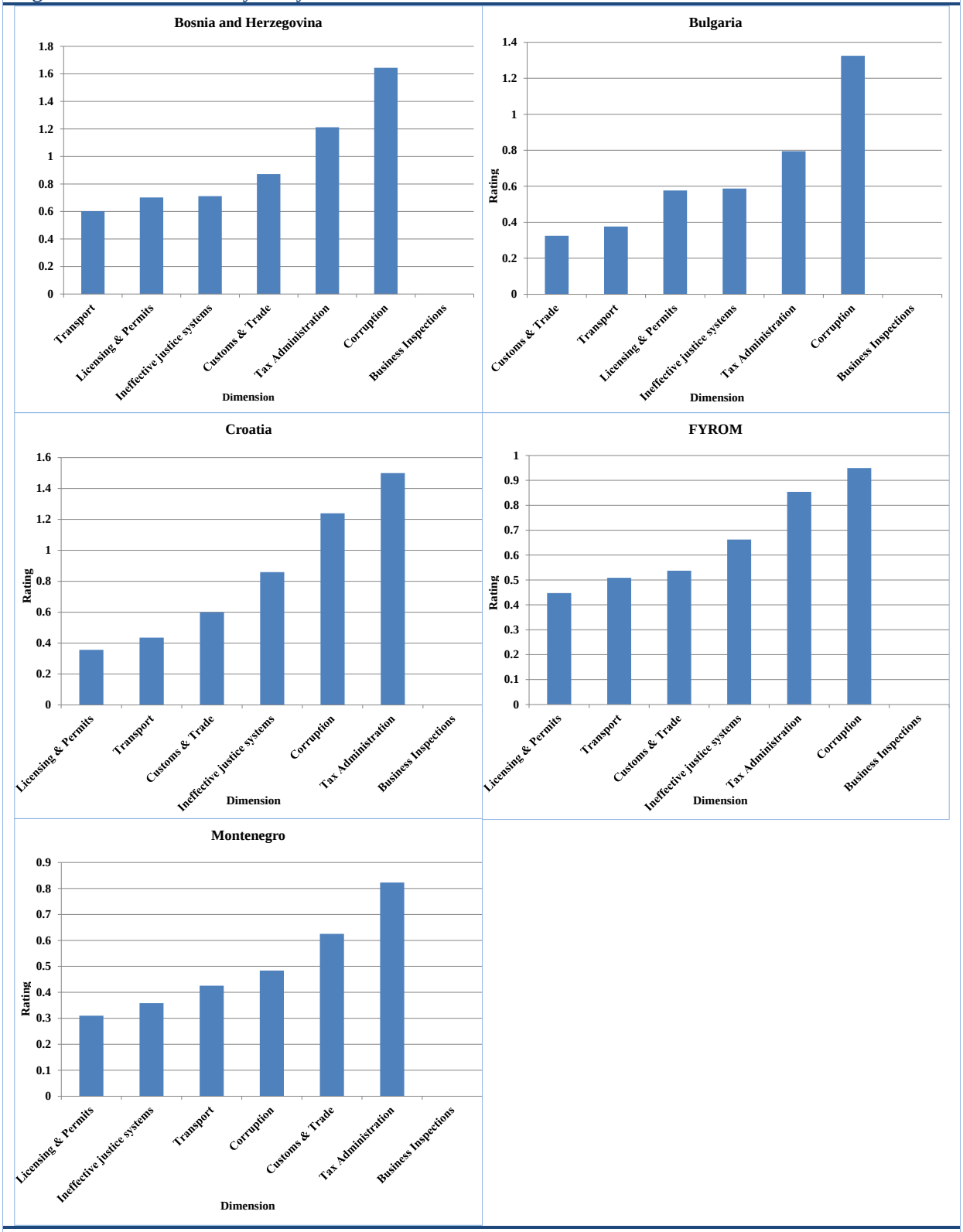
On the basis of the estimation results for all dimensions of PA covered, it is possible to carry out country-specific analyses identifying the factor most impeding firms' growth. Figure 4.6 summarises the results for countries for which 2013 data are available.

As shown in Figure 4.6, assessments of the severity of the impact of particular dimensions of PA on firms' growth vary widely. *Tax administration* or *corruption* are perceived as the factor most impeding firms' growth.[66] According to the scale of measurement, managers assess tax administration or corruption as a moderate obstacle to firms' growth, but also as the most pressing in relative terms. The lowest ratings are assigned to licensing & permits and customs and trade. Both dimensions of PA are perceived to be no, or only a minor, obstacle to firm growth.

Table 4.8 summarises the factors impeding firms' growth least and most in individual countries. It also illustrates variation over time and documents changes in the dimensions perceived as the source of the most and least binding constraints. The factors impeding firms' growth most are *tax administration*, *corruption and ineffective justice systems*. These results show very little variation over time, which is not the case for the least severe obstacle to firms' growth. In the first two waves covered in the dataset, this shows little variation over time, but this changes when one takes the waves after 2008 into account. While transport is seen as the least impeding factor in virtually all countries in the sample in the first two waves of the survey, this changes in 2008, when customs and trade, and business inspections come to the fore.

[66] The background study (Misch et al., 2014) also provides results for 2008 with wider country coverage.

Figure 4.6: Within-country analysis for 2013



Source: ZEW calculations.

Table 4.8: Summary of the least and most impeding factors for firm growth (baseline specification)

	2002		2005		2008		2009		2013	
	least	most	least	most	least	most	least	most	least	most
AL	Licensing & Permits	Corruption	Transport	Corruption	Customs & Trade	Corruption	.	.	.	.
BG	Transport	Corruption	Transport	Corruption	Customs & Trade	Corruption	.	.	Customs & Trade	Corruption
BA	Transport	Corruption	Transport	Corruption	Business Inspections	Corruption	Business Inspections	Tax Administration	Transport	Corruption
CZ	Transport	Tax Administration	Transport	Tax Administration	Customs & Trade	Ineffective justice systems	Customs & Trade	Transport	.	.
EE	Customs & Trade	Licensing & Permits	Transport	Corruption	Ineffective justice systems	Transport	.	.	.	.
HR	Transport	Ineffective justice systems	Transport	Ineffective justice systems	Customs & Trade	Ineffective justice systems	Customs & Trade	Tax Administration	Licensing & Permits	Tax Administration
HU	Transport	Tax Administration	Transport	Tax Administration	Customs & Trade	Tax Administration	.	.	.	.
LT	Transport	Tax Administration	Transport	Tax Administration	Customs & Trade	Corruption	Customs & Trade	Tax Administration	.	.
LV	Transport	Tax Administration	Customs & Trade	Tax Administration	Customs & Trade	Tax Administration	.	.	.	.
FYROM	Transport	Ineffective justice systems	Transport	Corruption	Business Inspections	Ineffective justice systems	.	.	Licensing & Permits	Corruption
ME	Corruption	Customs & Trade	Transport	Tax Administration	Ineffective justice systems	Tax Administration	Licensing & Permits	Tax Administration	Licensing & Permits	Tax Administration
PL	Transport	Tax Administration	Transport	Tax Administration	Customs & Trade	Tax Administration	Customs & Trade	Tax Administration	.	.
RO	Transport	Corruption	Transport	Tax Administration	Customs & Trade	Tax Administration	.	.	.	.
RS	Transport	Tax Administration	Transport	Ineffective justice systems	Business Inspections	Corruption	.	.	Transport	Tax Administration
SK	Transport	Corruption	Customs & Trade	Ineffective justice systems	Customs & Trade	Corruption	Customs & Trade	Transport	.	.
SI	Transport	Ineffective justice systems	Transport	Tax Administration	Customs & Trade	Transport	Customs & Trade	Ineffective justice systems	Customs & Trade	Tax Administration
TR	Transport	Tax Administration	Transport	Tax Administration	Business Inspections	Corruption	.	.	.	.

Note: To improve readability, results for 2007 are omitted. '.' indicate missing data for respective countries. In the year 2009, HU and FYROM are excluded from the ranking due to the very low number of observations.
Source: ZEW calculations.

Table 4.9: Summary of the worst and best performing countries for all covered dimensions of PA

	2002		2005		2008		2009		2013	
	lowest	highest	lowest	highest	lowest	highest	lowest	highest	lowest	highest
Corruption	ME	AL	SI	TR	ME	RO	ME	LT	ME	BA
Ineffective justice systems	ME	AL	EE	TR	EE	HR	ME	HR	ME	SI
Customs & Trade	SI	AL	SK	AL	EE	RO	SK	HR	BG	BA
Business Inspections	.	.	.	.	HU	PL	ME	LT	.	.
Licensing& Permits	SI	RO	SK	TR	EE	RO	ME	PL	ME	BA
Tax Administration	SI	PL	EE	CZ	EE	RO	SK	HR	BG	HR
Transport	SI	AL	SI	TR	HU	CZ	ME	CZ	BG	BA

Note: To improve readability, results for 2007 are omitted. '.' indicate missing data for respective dimensions of PA. In the year 2009, HU and FYROM are excluded from the ranking due to the very low number of observations.
Source: ZEW calculations

Table 4.9 summarises the results for every dimension of PA included in the analysis. It depicts respective countries with the highest and lowest perceived costs for a particular dimension of PA. Furthermore, Table 4.9 also allows the identification of shifts in the relative performance of countries over time.

One striking result in the table above is the high correlation in terms of performance between different dimensions of PA in a particular country. In 2002, for instance, Albania exhibits the highest reported costs in four out of six dimensions of PA. The same pattern can be observed as regards the lowest costs. Here, Slovenia performs best in four out of six dimensions. A substantial shift occurs in 2005 with respect to the worst performing countries. Here, Turkey exhibits the highest perceived costs in four out of six dimensions of PA. A similar change in results can be observed in 2008. Here, Romania exhibits the highest costs in four out of seven dimensions. In case of the best performing countries, Estonia stands out and exhibits the lowest costs in four out of seven dimensions of PA.

Beside the within-country analysis, results from the benchmarking approach also allow for a between country evaluation. This permits the identification of the best and worst performing country for a particular dimension of PA. Figure 4.7 serves as a showcase, it illustrates the results for tax administration in 2008 and the substantial heterogeneity among the Member States covered in the sample. Estonia and Slovenia exhibit the lowest perceived costs and firm managers assess the tax administration to be no or just a minor obstacle to firm growth in 2008. Romania as well as Hungary exhibit the highest reported costs. Here, firms perceive tax administration to be a moderate to major obstacle for firm growth. The majority of Member States' reported costs range between 1 and 2 and is equivalent to a minor to moderate obstacle to firm growth.

Figure 4.7: Between-country analysis for Tax Administration in 2008

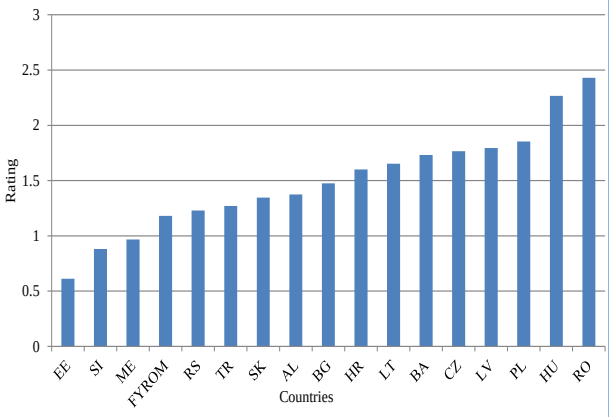
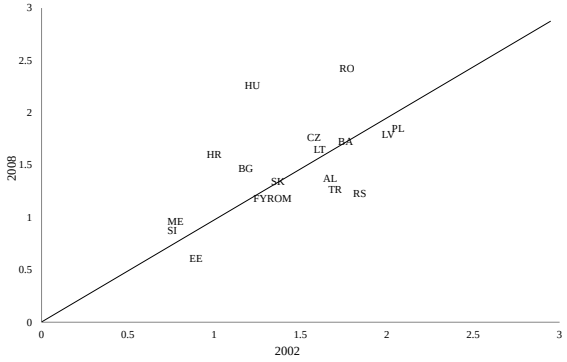


Figure 4.8: Scatterplot of between-country comparisons with respect to Tax Administration



Note: Scores for 2002 and 2008 are compared, as this maximises the country coverage for this particular type of analysis.
Source: ZEW calculations.

Figure 4.8 depicts the variation of country-specific results over time, not limited to the best and worst performing countries. Reported costs are compared between 2002 and 2008 for perceptions of tax administration. Figure 4.8 again serves as a showcase. While results below the bisecting line indicate improvements in country-specific perceived costs with respect to tax administration, results above it indicate deterioration. Results on the bisecting line denote an identical assessment in 2002 and 2008. Seven countries in the sample exhibited an increase in perceived costs associated with tax administration on firms. Seven exhibited a reduction. For three countries, assessments remained virtually the same. The largest increase in perceived costs was in Hungary, Romania and Croatia. Here, the growth was up to 1, i.e. a complete step on the scale of measurement. The remaining countries exhibited an increase of up to 0.5 in their assessment. The usual improvements in country-specific perceived costs were up to 0.5 as well. Here, Serbia exhibited the largest reduction in perceived costs incurred by firms from tax administration between 2002 and 2008.

Performing the same type of analysis using raw perceptions data, suggests that firm-specific assessments might indeed suffer from biases described above. Qualitatively, many results appear to be robust, but quantitatively, deviations of the specific numerical results point to differences of up to 15-20% with respect to the size of the obtained coefficients. In the majority of cases, the ranking of the constraints is not much affected. However, given the size of changes, this cannot be taken for granted. In fact, in case of the within-country analysis alone, rankings are altered in 13% of the cases. For instance, in Lithuania or the Former Yugoslavian Republic of Macedonia, the most impeding factor for firm growth would change if raw perception data was not corrected for the biases. In two additional cases, the analysis using raw perceptions data does not allow to unambiguously identify the most impeding factor for firm growth. The same problems arise when raw business perceptions are used for the between-country analysis. In particular, the positions of low performing countries are altered relatively frequently.

Furthermore, the results using the benchmarking approach are also confirmed in the robustness checks.[67] In cases where differences to the results of the baseline specifications occur, virtually always the second most or second least impeding factor for firm growth changed positions with the former first ranked dimension. In addition, a striking pattern emerges with respect to *transport* which is the least impeding factors for firm growth. In the first survey wave after accession, the least impeding factor for firm growth switches to *customs* and *trade* potentially reflecting the benefits for firms associated with the accession to the EU.

Results using the Mean-Correction Approach

As pointed out in sub-section 4.3.3, business perceptions can also be corrected for their dependence on firm characteristics using the mean correction approach. The findings[68] are quite similar to the baseline results from the benchmarking approach. The absolute majority of identified least and most impeding factors are identical. Again, *tax administration*, *corruption* and *ineffective justice systems* are among the three most frequent dimensions of PA identified as the most severe obstacle to firms' growth. Where the most impeding factor deviates from the results of the benchmarking approach, the mean-correction approach identifies tax administration instead. The clear-cut difference between the first two and the subsequent waves as regards the least impeding factor can be observed here as well.

Summarizing, the results in both approaches show that *tax administration*, *corruption* and *ineffective justice systems* are considered to be the most impeding factors for firm growth in virtually all countries in the sample of analysis. These findings are recurring across the time period under consideration and indicate that there seems to be room for improvement in Member States with respect to these dimensions of PA. [69]

4.4. SUMMARY AND POLICY IMPLICATIONS

The efficiency of the EU public administrations is believed to be an important factor for firms' productivity and growth, as already discussed from a

[67] Estimation results of the robustness checks can be found in the Annex of the study Misch et al. (2014).

[68] Refer to Table 3.42, Misch et al., 2014.

[69] Quality, independence and efficiency are the key components of an effective justice system. Well-functioning justice systems are an important structural condition on which Member States base their sustainable growth and social stability policies. Since 2012, the improvement of the quality, independence and efficiency of judicial systems has been a priority for the European Semester. Since 2013, the EU Justice Scoreboard [http://ec.europa.eu/justice/effective-justice/scoreboard/index_en.htm, COM (2013)160final&COM (2014)], provide reliable, comparable and objective data on the functioning of National justice systems, constituting an important information tool that will allow the rigorous empirical analysis of the efficiency of justice systems at the EU and Member States level. Extended references of the work undertaken up to now in the EC in order to prove the impact that effective justice systems have on the economy, can be found on page 4 of the COM(2014) 155 final.

conceptual perspective in the latest literature.[70] Firms very frequently interact with PA in a variety of ways. Such interaction can be costly, but also important as regards the quality of service/input to the business world. From a microeconomic and policy perspective, understanding these links is critical and goes beyond public finance considerations. The calls for efficient EU PA call for sound empirical evidence to support or rebutt business perceptions, which are currently the available source of feedback on the link between PA efficiency and business performance. While the need for increased efficiency in EU PA can be reasonably argued and empirically supported on macroeconomic grounds, assessing EU PA efficiency via micro economy channels, with a view to providing 'hard evidence', is a real challenge. Such empirical evidence could also be important in the attempt to select and benchmark the most appropriate PA efficiency indicators that will facilitate the monitoring of progress on EU PA efficiency so as to promote a prosperous business environment.

This chapter provides three sets of considerations that are relevant for policymaking:

- **Novel empirical evidences with respect to policy priorities and implications**
  The study provides new empirical evidences on the nexus between the quality of PA and firms' growth and productivity. It discusses empirically, models and evaluates existing patterns of the contribution of PA to firms' growth.
- **Methodology**
  The study develops and employs novel methodologies to circumvent the existing data constraints, to model and analyse the interactions between the EU PA and firms' growth.
- **Data issues**
  The study highlights particular data constraints in the econometric analysis in this area. The case for constructing and maintaining comprehensive EU MS-level micro-data becomes compelling when the aim is to optimise MS PA efficiency in order to facilitate *doing business* in the EU.

With respect to the empirical findings, the econometric analysis of *Section 4.1,* revealed that a higher quality of PA is conducive to both firms' and overall employment growth, even though these occur via different transmission channels. This finding shows that firms' growth and industry growth are not identical processes. The most important links for increasing the *share of high-growth firms* are those based on indicators of firm dynamics, while for *employment growth,* the investment-related channels (e.g. capital intensity, average firm size, etc.) proved to be more relevant. The findings in this section also show that improving PA quality is not expected to generate trade-offs with regard to the share of high-growth firms and industry employment growth, which is an additional important message for policymaking. These empirical findings could help with the compilation and benchmarking of the most appropriate indicators of MS PA performance in a way that will provide a more prosperous business environment.

In *Section 4.2,* a system of interlinked international input-output tables (WIOD), is used to measure the economic contribution of PA. Input-output modelling, though based on some rather restrictive assumptions, is an appropriate and widely used tool for analysing economic impacts from changes in final demand and intermediate sectoral linkages, which represent an important structural feature of an economic system. When applied to PA services and their contribution to the economic well-being of other economic sectors, the analysis needs to focus on the latter, assuming thereby that any intermediate deliveries by the public sector are an appropriate indicator for the wider benefits of these services. This first implies that most public services are provided merely free of charge (being financed out of the general tax pool) and secondly, that by concentrating on intermediate flows only, which the application of an Input-Output modelling tool implicitly requires, a considerable part of the potential supply-side benefits of public services will be left out. Moreover, observed differences across countries with respect to the Input-Output linkages do not lead to clear-cut conclusions with respect to observed national differences. It is highly likely that resulting country patterns merely reflect differences in accounting standards and institutional features of the public sector. However, even within the standardized national accounting standards at EU level, such differences still play a role and this is definitely the case when countries and regions outside the EU are considered.

In general, the business-perceptions based analysis in *Section 4.3,* within the framework of the considerable data constraints for the majority of the EU MS, produced results with plausible policy implications. Analysis here showed that in within country rankings, tax administration, corruption and ineffective justice systems are considered most frequently as the most important constraints in virtually all countries. This result is robust across all years covered in the analysis and indicates the scope for further improvements in these areas. In addition,

[70] See Pitlik et al. (2012).

a striking pattern emerges with respect to the factors least impeding firms' growth. While prior to the EU accession of the eastern European Member States, transport is considered as the least impeding factor in virtually all countries in the sample, in the first survey wave after accession, there is a switch to customs and trade, potentially reflecting benefits for firms affected by EU enlargement.

In Estonia, contrary to most other countries, transport is still seen as a central constraint relative to the other constraints; this may be a reflection of its location at the periphery of the EU. In cross-country rankings of business perceptions of particular dimensions of PA, Estonia often performs reasonably well, whereas Romania often performs poorly; this corresponds to anecdotal evidence on the quality of PA in both countries. The results show a strong correlation across different dimensions of PA. Typically, the best or worst performing country with respect to one constraint also performs very well or poorly, respectively, across several other dimensions.

With respect to the methodology, this is developed in a way that circumvents many of the existing data shortcomings (for the studied countries) and provides with econometrically robust models. On the one hand, establishing causality patterns is difficult, i.e. to provide evidences on the causal effects of the quality of PA rather than to provide evidences on simple correlations with no policy implications. The analysis in *Section 4.1* argues that 'naïve' regressions suffer from omitted variable bias, thereby seriously undermining the 'value' of the results for policymaking, or even resulting in misleading or plainly wrong policy implications. On the other hand, linking and measuring the quality of PA in a doing business framework is challenging. There is no single or ideal approach that solves all difficulties simultaneously. The empirical analysis in this chapter has therefore been based on three different approaches and nevertheless makes significant progress in this respect. The econometric approach selected at each stage responds to the particular research question.

Where the policy focus is on the impact of PA efficiency on firms' and industry growth, the regression-based evidences using the empirical specifications of *Section 4.1* are most suitable. In particular, the innovative methodology applied in *Section 4.1* circumvents (for the selected sample of countries) existing econometric difficulties and may also serve as a benchmark in similar exercises in future.

Similarly, business perceptions may be used if the policy interest relates to a country's relative performance in particular dimensions of PA. However, the analysis in *Section 4.3* indicates that business perceptions must be used with caution and should be corrected for inherent biases and subjectivity. The 'filtered' business perceptions may then be used to arrive at within-country and cross-country rankings of obstacles for firms' growth, including those that relate to PA.

By contrast, the Input-Output table-based analysis in *Section 4.2* showed that it may not be a suitable framework for addressing convincingly the research questions in this chapter. One reason is that only fee-based public services are considered as *'intermediate deliveries of the public sector'*, so the amount of fees charged may be fairly small for services delivered by PA. This means that observed differences in shares of PA as an input to production across countries mainly reflect variations in whether public services are fee or tax-financed. As a result, any input-based measures of public services are likely to seriously underestimate their role for industrial production.

With respect to observed data issues, this chapter has revealed several key constraints and gaps in the availability of comparable EU-wide data at industry and firm level. This is worrying, as policy measures to promote firms' growth should ideally be based on rigorous empirical analysis. The quality of such analysis relies on the quality of the underlying data.

First, available industry data suffer from various shortcomings, and their time and country coverage is problematic. With respect to the proportion of high-growth firms by industry, data for key EU MS are missing and data availability for recent years is limited (e.g. no data are available for the years after 2010).

Second, there is no freely accessible *firm-level survey* with a panel dimension available for all, or at least the majority of the EU Member States, like the *Enterprise Surveys* (the latter are available only for selected years and countries). Such data would facilitate analysis of firm growth issues at EU level. On a related point, existing *business perception data* are fragmented across different types of data which again are not available for all Member States. Alleviating these data constraints will require the maintenance of comprehensive industry and firm-level data bases updated with data collected and provided at MS level, so as to support evidence-based policymaking in this area.

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ANNEX

Section 4.1

Table A4.1: PA quality rankings

Country	Government Effectiveness	Regulatory Quality	Freedom from corruption	Time to resolve insolvency	Independent judiciary
BE	1.71	1.31	71.10	0.90	7.17
CZ	0.97	1.17	44.40	7.44	5.09
DK	2.22	1.83	94.80	2.16	8.99
EE	1.06	1.38	61.20	3.00	7.23
ES	1.23	1.23	68.20	1.50	4.87
HU	0.82	1.15	50.70	2.00	5.43
IT	0.54	0.93	49.60	1.80	4.48
LU	1.77	1.75	85.40	2.00	8.02
LV	0.62	0.97	41.50	3.00	4.62
NL	1.86	1.77	88.40	1.10	8.89
PL	0.53	0.83	40.20	3.00	4.70
RO	-0.23	0.39	31.40	3.95	3.33
SE	1.99	1.64	92.40	2.00	8.56
SI	1.02	0.80	61.00	2.00	5.27
SK	0.82	1.07	42.00	4.30	3.79

Source: WIFO illustration.
Note: The indicators of PA quality are referred in Table 4.1.

Table A4.2: Government effectiveness

HGF; NACE Rev. 1.1

General governance	(1) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) Capital intensity
Coefficient	0.1268**	0.2075**	0.0005	4.4774	0.8273
Standard errors	(0.042)	(0.071)	(0.001)	(5.247)	(1.049)
Observations	322	322	188	322	322
R-squared	0.603	0.601	0.574	0.591	0.592

HGF; NACE Rev. 2.0

General governance	(6) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) Capital intensity
Coefficient	0.1583+	0.3407**	0.1042**	10.7090	-0.7111
Standard errors	(0.091)	(0.099)	(0.037)	(7.073)	(2.392)
Observations	193	193	193	193	193
R-squared	0.873	0.881	0.878	0.872	0.87

EMPLOYMENT GROWTH; NACE Rev. 1.1

General governance	(1) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) Capital intensity
Coefficient	0.0020*	-0.002	0.0000+	0.1044	0.0327+
Standard errors	(0.001)	(0.003)	(0.000)	(0.103)	(0.018)
Observations	322	322	188	322	322
R-squared	0.332	0.326	0.361	0.326	0.333

EMPLOYMENT GROWTH; NACE Rev. 2.0

General governance	(6) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) Capital intensity
Coefficient	0.0163	0.0092	0.0046	-0.1488	-0.2510
Standard errors	(0.013)	(0.007)	(0.004)	(0.172)	(0.255)
Observations	193	193	193	193	193
R-squared	0.236	0.222	0.226	0.218	0.221

*Note: ** p<0.01, * p<0.05, + p<0.1*
Source: WIFO calculations.

Table A4.3: Regulatory Quality					
HGF; NACE Rev. 1.1					
Regulatory Quality	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.1617*	0.3009**	0.0005	6.0303	0.9492
Standard errors	(0.071)	(0.116)	(0.001)	(8.299)	(1.681)
Observations	322	322	188	322	322
R-squared	0.598	0.599	0.572	0.591	0.591
HGF; NACE Rev. 2.0					
Regulatory Quality	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.1135	0.4762**	0.1417+	12.0861	1.6652
Standard errors	(0.197)	(0.172)	(0.074)	(12.459)	(4.172)
Observations	193	193	193	193	193
R-squared	0.870	0.877	0.875	0.871	0.870
EMPLOYMENT GROWTH; NACE Rev. 1.1					
Regulatory Quality	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.0028+	-0.0038	0.0001*	0.3409	0.0830+
Standard errors	(0.002)	(0.005)	(0.000)	(0.222)	(0.043)
Observations	322	322	188	322	322
R-squared	0.330	0.327	0.386	0.333	0.344
EMPLOYMENT GROWTH; NACE Rev. 2.0					
Regulatory Quality	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.0265	0.0144	0.0082	-0.2518	-0.4044
Standard errors	(0.022)	(0.012)	(0.008)	(0.307)	(0.404)
Observations	193	193	193	193	193
R-squared	0.235	0.221	0.226	0.218	0.220

*Note: ** p<0.01, * p<0.05, + p<0.*
Source: WIFO calculations.

Table A4.4: Freedom from corruption

HGF; NACE Rev. 1.1					
FREECORR	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.0044**	0.0075**	0.0000	0.1149	0.0240
Standard errors	(0.001)	(0.002)	(0.000)	(0.181)	(0.036)
Observations	322	322	188	322	322
R-squared	0.608	0.605	0.574	0.591	0.592
HGF; NACE Rev. 2.0					
FREECORR	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.0044	0.0095**	0.0027*	0.2516	-0.0292
Standard errors	(0.003)	(0.003)	(0.001)	(0.210)	(0.078)
Observations	193	193	193	193	193
R-squared	0.872	0.876	0.874	0.871	0.870
EMPLOYMENT GROWTH; NACE Rev. 1.1					
FREECORR	**(1)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.0001*	-0.0000	0.0000**	0.0031	0.0010*
Standard errors	(0.000)	(0.000)	(0.000)	(0.003)	(0.000)
Observations	322	322	188	322	322
R-squared	0.332	0.325	0.362	0.326	0.334
EMPLOYMENT GROWTH; NACE Rev. 2.0					
FREECORR	**(6)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**Capital intensity**
Coefficient	0.0002	0.0002	0.0000	-0.0039	-0.0025
Standard errors	(0.000)	(0.000)	(0.000)	(0.005)	(0.005)
Observations	193	193	193	193	193
R-squared	0.220	0.219	0.219	0.218	0.218

*Note: ** p<0.01, * p<0.05, + p<0.*
Source: WIFO calculations.

Table A4.5: Time to resolve insolvency

HGF; NACE Rev. 1.1

RI_T	(1) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) Capital intensity
Coefficient	-0.0355*	-0.0490*	0.0003	1.7909	0.3135
Standard errors	(0.014)	(0.022)	(0.000)	(2.045)	(0.335)
Observations	322	322	188	322	322
R-squared	0.598	0.595	0.578	0.592	0.593

HGF; NACE Rev. 2.0

RI_T	(6) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) Capital intensity
Coefficient	-0.0248	-0.0638	-0.0153	-2.6054	0.2493
Standard errors	(0.032)	(0.040)	(0.014)	(2.658)	(1.102)
Observations	193	193	193	193	193
R-squared	0.871	0.873	0.871	0.871	0.870

EMPLOYMENT GROWTH; NACE Rev. 1.1

RI_T	(1) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) Capital intensity
Coefficient	-0.0006**	0.0002	-0.0000	0.0120	-0.0031
Standard errors	(0.000)	(0.001)	(0.000)	(0.028)	(0.006)
Observations	322	322	188	322	322
R-squared	0.330	0.324	0.344	0.324	0.325

EMPLOYMENT GROWTH; NACE Rev. 2.0

RI_T	(6) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) Capital intensity
Coefficient	-0.0048	-0.0035	-0.0015	-0.0166	0.0596
Standard errors	(0.005)	(0.003)	(0.002)	(0.071)	(0.098)
Observations	193	193	193	193	193
R-squared	0.233	0.223	0.226	0.218	0.219

*Note: ** p<0.01, * p<0.05, + p<0.1*
Source: WIFO calculations.

Table A4.6: Independent judiciary

HGF; NACE Rev. 1.1

INDJUS	(1) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) Capital intensity
Coefficient	0.0485**	0.0807**	0.0001	1.4692	0.1936
Standard errors	(0.013)	(0.023)	(0.000)	(1.802)	(0.363)
Observations	322	322	188	322	322
R-squared	0.609	0.605	0.573	0.591	0.591

HGF; NACE Rev. 2.0

INDJUS	(6) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) Capital intensity
Coefficient	0.0604+	0.1325**	0.0457**	3.5778	-0.1401
Standard errors	(0.034)	(0.048)	(0.016)	(2.997)	(0.951)
Observations	193	193	193	193	193
R-squared	0.873	0.881	0.881	0.871	0.870

EMPLOYMENT GROWTH; NACE Rev. 1.1

INDJUS	(1) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) Capital intensity
Coefficient	0.0005*	-0.0008	0.0000*	0.0503	0.0132*
Standard errors	(0.000)	(0.001)	(0.000)	(0.033)	(0.006)
Observations	322	322	188	322	322
R-squared	0.329	0.327	0.374	0.329	0.338

EMPLOYMENT GROWTH; NACE Rev. 2.0

INDJUS	(6) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) Capital intensity
Coefficient	0.0084	0.0041	0.0026	-0.0555	-0.1356
Standard errors	(0.007)	(0.004)	(0.002)	(0.078)	(0.130)
Observations	193	193	193	193	193
R-squared	0.252	0.223	0.235	0.218	0.224

*Note: ** p<0.01, * p<0.05, + p<0.1*
Source: WIFO calculations.

Section 4.3

Table A4.7: Country and time coverage of the dataset

	Year of Survey						
	2002	**2005**	**2007**	**2008**	**2009**	**2013**	**Total**
Albania	170	204	304	54	0	0	732
Bosnia and Herzegovina	182	200	0	347	14	360	1103
Bulgaria	250	300	1015	288	0	293	2146
Croatia	187	236	633	55	49	360	1520
Czech Republic	268	343	0	80	170	0	861
Estonia	170	219	0	273	0	0	662
Hungary	250	610	0	289	2	0	1151
Latvia	176	205	0	271	0	0	652
Lithuania	200	205	0	159	117	0	681
FYROM	170	200	0	361	5	360	1096
Montenegro	20	18	0	90	26	150	304
Poland	500	975	0	185	270	0	1930
Romania	255	600	0	541	0	0	1396
Serbia	230	282	0	388	0	360	1260
Slovak Republic	170	220	0	266	9	0	665
Slovenia	188	223	0	153	123	270	957
Turkey	514	1880	0	1152	0	0	3546

Source: ZEW calculations based on Enterprise Surveys (World Bank, 2014).

Further information on the methodology of Section 4.3

The component $\hat{\eta}_{jc}$ is the crucial element of the estimated reported costs $\hat{rc}_{jict}$, since it is interpreted as the quantification of costs arising from PA independent of biases due to firm characteristics. By definition, however, it captures only a time-constant country-specific impact of PA on firms' growth. Its particular value, while unique for every country in the sample of analysis, will be constant over time and identical for every year covered. Consequently, variation over time in estimated costs from PA used as public input to private production exclusively arises from the firm-specific error term $\hat{\varepsilon}_{jict}$.

In principle, it would be possible to include time variation in a more formal way, given the framework used by Carlin et al. (2010). This could be achieved by including time-fixed effects, which would capture time-specific unobserved heterogeneity, assuming simultaneously that this heterogeneity is identical for every country in the sample. However, given the general framework of the benchmarking approach, this would be at odds with its conceptual idea. The key idea of the benchmarking approach is to control for firm- and country-specific factors that may determine the assessments made by firms. Time-fixed effects, however, would introduce country-unspecific common time trends and therefore contradict the idea of filtering out country- and sample-specific factors. Thus, the analysis will not include time-fixed effects. It would still be possible to incorporate country-specific time-fixed effects. However, while technically feasible, this would cancel out all variation in the data except for variation at firm level. This would render subsequent steps of analysis of the benchmarking approach impossible, so country-specific time-fixed effects will not be included either.

Apart from these aspects, it is important to shed further light on the error term $\hat{\varepsilon}_{jict}$. While it is the main source of time variation in the analysis, it also incorporates the impact of all variables not taken explicitly into account in the econometric specification. A key variable among these factors is firms' productivity. This cannot be observed directly in the data and is therefore only part of the error term. To capture its potential impact in a more systematic way, robustness checks will include a proxy for firms' productivity.

In principle, it would be possible to control for unobserved time-constant heterogeneity at firm level in a more formal way using firm-fixed effects. However, as in the case of time-fixed effects, their inclusion would not be technically feasible. This is due to the mechanics of the benchmarking approach. To quantify the unbiased costs from PA, the approach relies on the numerical estimation of every single firm-specific effect. This is a crucial difference between the benchmarking approach and a standard econometric estimation including firm-fixed effects. This would result in a situation in which more than 10,000 coefficients would have to be estimated in a single regression, which, in turn, would cause a significant drop in the degrees of freedom of the estimation and ultimately result in a significant loss of precision. Hence, the analysis does not include firm-fixed effects.

Chapter 5.

FIRM GROWTH, INNOVATION AND THE BUSINESS CYCLE

The economic crisis that started in 2008 and is still ongoing in many European countries has significantly affected the ability of the EU economy to innovate, grow and create jobs. Overcoming the crisis and ensuring long-term competitiveness and growth are key challenges for EU.

EU Policy regards innovation as an important driver for the firms' competitiveness, economic growth and job creation. It has been placed at the heart of Europe 2020, the EU strategy for smart, sustainable and inclusive growth and job creation. Within Europe 2020, the flagship initiative focused on innovation aims to foster an innovation-friendly environment and to ensure that innovative ideas can be turned into products and services that create growth and jobs. In addition, many other initiatives and programmes support innovation in specific areas. This policy support for innovation is based on the expectation that innovation plays an important role in promoting output and employment growth.

While the positive effect of innovation on output growth is well documented, the effects on employment growth have been subject to considerable debate in the economic literature. This debate is driven by the fact that different types of innovations have different effects. The introduction of new products and processes can create jobs due to additional demand, but it can also destroy jobs by reducing demand for old products and by increasing labour productivity, which enables firms to produce the same output with less labour. The total effect is unclear *a priori* and has to be determined empirically. Understanding and quantifying the effects of different types of innovation and the total effect is very important for the design of policies aimed at supporting job creation and innovation.

An open question is whether innovation has different employment effects in different phases of the business cycle. It is likely that the extent to which innovation can stimulate demand and the extent to which process innovations are used to reduce costs vary over the course of the business cycle, with important implications for employment. Previous studies on this topic have focused mainly of the relationship between business cycle and the firms' innovation behaviour and found that innovation is pro-cyclical (Himmelberg and Petersen, 1994; Barlevy, 2007; OECD, 2012). One of the few studies that examined how the business cycle affects employment effects of innovation found that product innovation has a positive effect on employment mainly in upswings, while process innovation has a negative effect only in downswings (Lucchese and Pianta, 2012). The findings that innovation has different employment effects in different phases of the business cycle may have important implications for the design of policies aiming to increase employment in the current economic climate.

A related question is whether the employment effects of innovation depend on firm, sector and country characteristics. These characteristics may affect firm technology and the market structure in which the firm operates, which in turn, may affect employment outcomes of innovation.

This chapter aims to provide empirical evidence to help understand better the relationship between employment growth and innovation and the factors that affect it. It addresses the following research questions:

- how do product, process and organisational innovation affect employment growth? Do they have different effects?
- does innovation have different employment effects in different phases of the business cycle? Does product innovation create more employment in booms and upturns? Are the labour-saving effects of process innovation larger in downturns and recessions?
- do the employment outcomes of innovation in different phases of the business cycle depend on firms' characteristics, such as sector of activity, size, ownership structure and geographical location?

The empirical analysis is based on five waves of Community Innovation Survey (CIS), including the latest available wave (CIS2010). This dataset provides internationally harmonised firm level data for 26 European countries, in manufacturing and service sectors, for the period 1998-2010.

The main contribution of the chapter is examining how business cycles and firm characteristics affect employment effects of innovation at firm level. There is a large literature on employment effects of innovation, but most studies do not examine possible sources of variation of these effects or focus on one source of variation (Lucchese and Pianta, 2012; Dachs and Peters, 2014). Another important

contribution of this study is that it uses a very comprehensive firm level dataset, which covers almost all EU Member States, Iceland and Norway, manufacturing and services sectors and a long time period, which includes the recent economic crisis. While there is evidence on how the economic crisis affected firms' innovation activities (Paunov, 2012; Rammer, 2012; Archibugi et al., 2013), not much is known about how it affected the employment effects of innovation.

The results suggest that product innovation has a positive and large effect on employment growth in all phases of the business cycle, in both manufacturing and service sectors, and for almost all types of firms considered. The effects of process and organisational innovation on employment growth tend to be negative, but they are often small in magnitude and statistically insignificant. Product innovation contributes most to employment growth during boom and upturn phases of the business cycle, but in recessions it plays an important role in limiting job losses. While product innovation has a positive effect on employment for all types of firms considered, the size of these effects varies with technological intensity of the sectors, size, ownership structure and geographical location.

An important caveat to this analysis is that it examined the effects of innovation on employment growth at firm level. The results cannot be generalised to the aggregate level, as firm-level estimates do not take into account the innovation effects on firms' exist and entry and the effects on other firms, for instance, on firms' competitors and suppliers.

Despite this limitation, the results are very informative for policy. They suggest that innovation is vital for increasing and preserving employment at firm level, in all phases of the business cycle. Product innovation plays a particularly important role in recessions, when it continues to support employment growth or at least reduces job losses. These results underline the importance of continuing to make innovation support a policy priority, including during crisis, when firm investment in innovation tends to decrease.

The chapter is structured as follows. Section 5.1 reviews the literature on the relationship between innovation, employment and business cycles. Section 5.2 describes the data used. Section 5.3 presents trends in innovation and employment over the business cycle. Section 5.4 explains the econometrical model. Section 5.5 presents the main results and sections 5.6 to 5.10 examine how these results vary for different types of firms and section 5.11 provides conclusions and policy implications.

5.1. INNOVATION AND EMPLOYMENT: THE MAIN RELATIONSHIPS

The effects of innovation on employment growth have been the focus of intense debate in economic literature. Different forms of innovation may have different effects on employment and disentangling and quantifying them is a challenging task.

To analyse these effects, it is useful to make a distinction between *product, process* and *organisational innovation*. *Product innovation* is the introduction of a product that is new to the firm (OECD, 2005). *Process innovation* is the implementation of new processes for the production of products (OECD, 2005). *Organisational innovations* are new ways of organising work, including introduction of new business processes (Edquist et al. 2001). While analytically it is important to distinguish between these types of innovations, empirically, it is difficult to fully disentangle them and their effects, as there might be important complementarities between different types of innovations (Van Beveren and Vandenbussche, 2010).

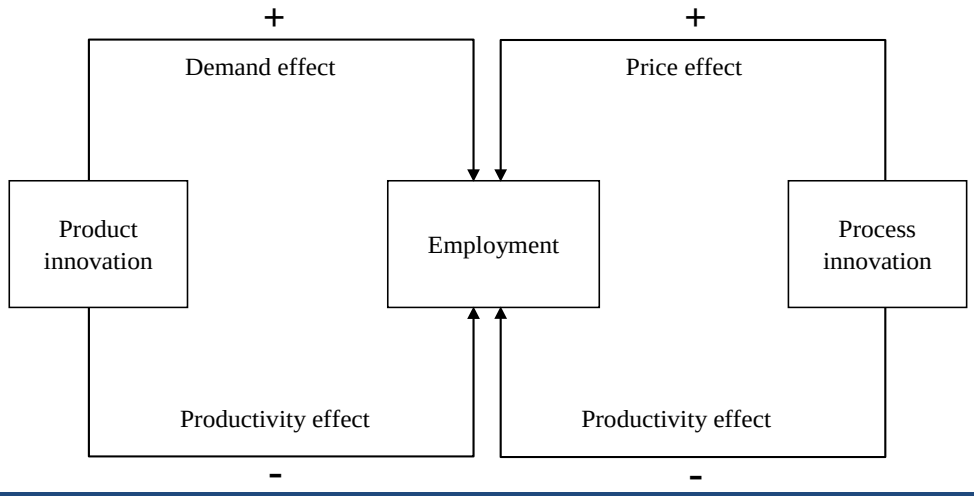
A new product introduced to the market provides higher utility for consumers, and creates new demand for the firm (see Figure 5.1). For the firm producing the new product, this *demand effect of product innovation* can result either in an overall market expansion, which has a positive effect on labour demand, or in a decrease in the demand for old products produced by the firm and in this case the net effect on labour demand is unclear. However, most empirical studies have found that the demand effect of product innovation is positive (Vivarelli, 2012). The magnitude of this effect depends on the degree of competition, demand elasticity, the existence of substitutes, the reactions of competitors and the timing of these reactions (see Garcia et al., 2002). In addition to this main effect, product innovation can lead to a negative *productivity effect* on employment if the new product can be produced with less labour than the old product. The total effect of product innovation comprises both the demand and productivity effects of the introduction of a new product and its sign is ambiguous *a priori*.

In general, the *process innovations* are closely related to productivity improvements[71], which allow firms to produce the same amount of output with fewer inputs, including labour, and, thus, to lower unit costs (*productivity effect of process innovation*). As a consequence, if output remains constant,

[71] However, introduction of process innovations may have other purposes than reducing labor costs. They may be introduced to comply with new regulation or to improve the quality of the product.

process innovations that lead to productivity improvements have negative effects on employment. The size of this negative effect depends on the current production technology and, thus, on the rate of substitution between input factors, and on the direction of the technological change. The reduction in unit costs caused by the productivity effect of process innovation allows the innovative firm to lower its product price, leading to higher sales, which may lead to higher employment. The magnitude of this *price effect* depends on the size of the price reduction, the price elasticity of demand, the degree of competition as well as on the behaviour and relative strength of different agents such as managers and unions within the firm (Garcia et al., 2002). The total effect of process innovation on employment depends on the magnitude of these two (price and productivity) effects, which have opposite signs and, it is unclear *a priori*. Organisational innovation affects employment through the same channels as process innovation.

Figure 5.1: Effects of product and process innovation on employment



Source: Harrison et al. (2014, p. 37), own illustration.

There is a large empirical literature on the employment effects of innovation, recently reviewed by Vivarelli (2012). The majority of empirical studies have found a positive relationship between product innovation and employment growth in manufacturing (Entorf and Pohlmeier, 1990; König et al., 1995; van Reenen, 1997; Blechinger et al., 1998; Rottmann and Ruschinski, 1998; Smolny, 1998; Greenan and Guellec, 2000; Garcia et al., 2002; Smolny, 2002; Hall et al., 2008; Harrison et al., 2014) and in services (Harrison et al., 2014; Peters et al., 2013).

Empirical evidence on the employment effects of process innovations is less clear. Van Reenen (1997), Entorf and Pohlmeier (1990) and Hall et al. (2008) found that the effect of process innovation on employment was a small or statistically insignificant. Evangelista and Vezzani (2011) found that process innovation had a statistically insignificant productivity effect and a positive price effect. König et al. (1995), Smolny (2002), Greenan and Guellec (2000) or Lachenmaier and Rottmann (2011) found a significant positive effect of process innovation on employment growth. In contrast, Blechinger and Pfeiffer (1999) found evidence of labour displacement by process innovation, the effect being more pronounced in larger firms. Furthermore, there is only weak evidence on the employment effect of process innovation in European service firms and mixed results for the organisational innovation (Peters et al., 2013).

Innovation tends to be pro-cyclical (Himmelberg and Petersen, 1994; Barlevy, 2007, OECD, 2012; Arvanitis and Wörter, 2013). The literature explains this on the basis of more favourable conditions for innovation during upturns and booms, such as: higher extra-normal, monopolistic profits due to innovation (Schumpeter, 1911), higher capacity of markets for absorbing new products (Judd 1985, Lucchese and Pianta, 2012), higher confidence in future demand growth (Cohen 1995, 2010) and larger internal cash flows and easier access to external finance (Himmelberg and Petersen, 1994, Aghion et al., 2012). However, during recessions, the incentives to introduce certain types of innovations may increase because the opportunity cost of introducing them (forgone sales and profits) is lower (Aghion and Saint-Paul, 1998).

The pro-cyclicality of innovation activity may have implications for its employment effects. During upturns and boom periods, greater willingness of the consumers to buy new products, higher potential for demand expansion and higher extra-normal profits are likely to lead to a stronger *demand effect of product innovation* on employment growth. In

addition, it is possible that these conditions could encourage firms to introduce products new to the market and not only new to the firm, which are associated with higher employment effects (Falk, 1999). In downturns and recessions, the lack of demand may decrease this effect and may induce firms to postpone introduction of products new to the market and instead focus on products new to the firm, which may increase demand by less and hence have a lower effect on employment. This may result in higher demand effects of product innovation on employment in upturns and booms than in downturns and recessions.

The *productivity effect of process innovations* on employment may also vary over the business cycle. In a growing market in upswings, firms may use process innovations primarily to expand production capacity to meet the increasing demand, rather than to cut costs. In contrast, in downswings, the stronger competition pressures in shrinking markets may force firms to focus their innovation efforts on rationalisation and reducing costs, including labour costs, leading to larger job losses. Therefore, the productivity effect of process innovation is likely to be larger in downturns and recessions than in upturns and boom periods.

So far, the effect of business cycle on employment effects of innovation was examined at aggregate level by Lucchese and Pianta (2012), who found evidence from 21 manufacturing sectors in six European countries in line with the hypotheses described above. Overall, both the theory and existing empirical evidence suggest that product innovation might have a larger positive effect on employment growth in booms and upturns and process innovation might have a larger negative effect in downturns and recessions.

As, discussed above the magnitude of the employment effects of different types innovation may depend on several factors (Garcia et al., 2002), which could be linked to characteristics of the firm and of the economic and technological environment in which the firm develops its activity. There are few empirical studies that analysed how firm level characteristics affect employment effects of innovation. An important exception is Dachs and Peters (2014), who found evidence that product innovation has a stronger positive effect and process innovation has a stronger negative effect on employment growth for foreign firms than for domestic firms.

5.2. DATA

The two main data sources for the empirical analysis in this chapter are the Community Innovation Survey (CIS) and the Mannheim Innovation Panel (MIP).

CIS collects information on innovation activities at the firm level. It is based on a common questionnaire administered by Eurostat and national statistical offices in all EU Member States, Iceland and Norway. The methodology of CIS is based on the in the OECD Oslo Manual (latest edition: OECD, 2005). This dataset was accessed at the SAFE centre at EUROSTAT.

The analysis uses five waves of CIS data covering the years 1998-2000 (CIS3), 2002-2004 (CIS4), 2004-2006 (CIS2006), 2006-2008 (CIS2008) and 2008-2010 (CIS2010). The target population of CIS covers all legally independent enterprises with at least 10 employees. The dataset contains data for firms in 26 European countries[72], which provided access to their micro-data at the SAFE centre at EUROSTAT. However, only 12 countries provided data for all five waves. The differences in the firm coverage within a given country between different waves have been addressed by using weighting factors throughout the analysis. The differences in the country coverage between waves were partly addressed by estimating the regressions for groups of countries and for specific countries (Germany, France and Spain[73]). The survey covers firms in manufacturing and selected services sectors[74]. In total, the dataset contains 414,474 observations, of which more than 50% are in manufacturing sector.

Each CIS wave contains a cross section of firms and information about employment and sales in a given year *t* and year *t*-2; this allows to calculate employment and sales growth at firm level. CIS includes numerous innovation indicators, such as whether a firm has introduced new products, processes and organisational innovations and the proportion of sales due to new products.

The empirical analysis requires identifying the phases of the business cycle. As CIS data cover

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[72] Belgium, Bulgaria, Cyprus, Czech Republic, Germany, Denmark, Estonia, Spain, Finland, France, Greece, Croatia, Hungary, Iceland, Italy, Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Portugal, Romania, Sweden, Slovenia, Slovakia. Data for UK, Ireland, Austria and Poland were not available at SAFE center at Eurostat, or had missing data for important variables.

[73] The estimations for France and Spain are not included in this report.

[74] The sectors and the corresponding NACE Rev. 2 codes are: Food / beverages / tobacco (10-12), Textile / wearing apparel / leather (13-15), Wood / paper / printing (16-18), Chemicals (20, 21), Rubber / plastics (22), Non-metallic mineral products (23), Basic and fabricated metals (24, 25), Machinery(28, 33), Electrical engineering (26, 27), Vehicles (29, 30), n.e.c (31, 32), Wholesale trade (46), Transport/storage/post (49-53), Telecommunications / computer programming / information services (61-63), Banks / insurances (64-66), Technical services (71-72), Consultancies (69, 70, 73), Other business related services (74, 78, 80-82), media (58-60).

three-year periods (e.g. CIS 2010 covers 2008-2010), a two-year GDP growth rate is used. For example, for CIS 2010, the growth rate is calculated for the period between 2008 and 2010. We distinguish four business cycle phases[75]:

- *upturn*: GDP growth is positive and increasing;
- *boom*: GDP growth is positive and increasing and it is the last period of increasing growth before downturn;
- *downturn*: GDP growth is positive but decreasing; and
- *recession*: GDP growth is negative.

It is important to notice that the recession observations occur only in the period 2008-2010. Thus, all the results for recession phase refer to the economic crisis, which started in 2008.

One of the main disadvantages of CIS is that it does not allow tracing firms over time, which imposes limitations on the empirical methods used. To overcome these limitations, the main analysis is complemented with a panel data analysis using Mannheim Innovation Panel (MIP), a German firm level dataset, which allows tracing firms over time. Like CIS, MIP is based on a written survey and it follows the definition of innovation variables and the recommendations on the survey methodology in the Oslo manual. An additional advantage of MIP is that it covers firms with between 5 and 10 employees, not covered by CIS.

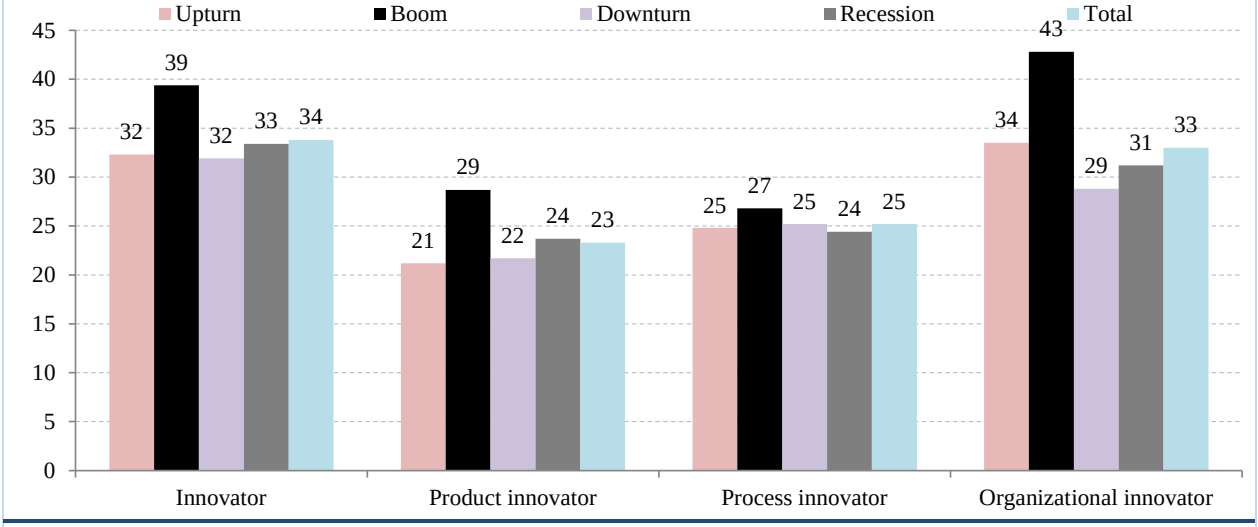
5.3. TRENDS IN EMPLOYMENT AND PRODUCTIVITY GROWTH FOR INNOVATIVE AND NON-INNOVATIVE FIRMS OVER THE BUSINESS CYCLE

In this section, we provide preliminary evidence on the relationship between innovation, employment growth and business cycles.

Figure 5.2 shows the proportion of firms that introduced innovations in each phase of the business cycle in Europe in between 1998 and 2010.

The figure shows that all three types of innovation considered – product, process and organisational innovation – were by far most frequent in boom periods. In this phase of the business cycle, demand expectations, willingness of consumers to buy new products and opportunities to finance innovations are highest (Himmelberg and Petersen, 1994; Barlevy, 2007; OECD, 2012). In other phases, different types of innovations display different patterns. In recessions, product and organisational innovations behave counter-cyclically, while process innovations behave pro-cyclically. In downturns and upturns, similar shares of firms introduced product and process innovations, but more firms introduced organisational innovations in upturns than in downturns. Overall, process innovation shows the lowest fluctuation over the business cycle, while organisational innovation shows the largest.

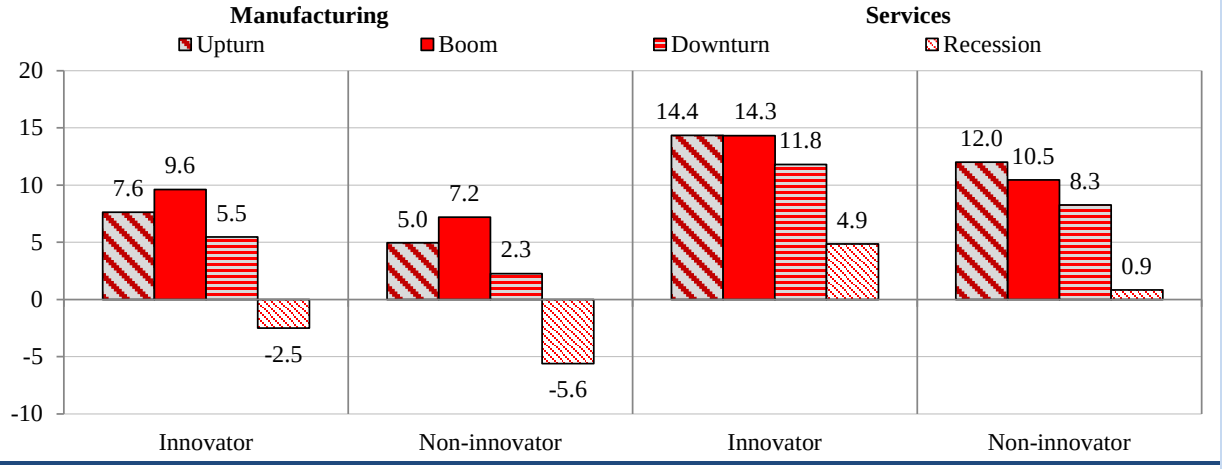
Figure 5.2: Innovator shares over the business cycle (in %), 1998-2010



Note: Innovator shares are weighted. Weights are provided by Eurostat.
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

[75] The background study also uses an alternative definition of the business cycle, based on the country level two-year GDP growth. It distinguishes between negative, low (between 0 and 4%) and high growth (above 4%).

Figure 5.3: Employment growth in different phases of the business cycle by innovation status, manufacturing and services, 1998-2010



Note: Weighted figures. Depicted are average two-year employment growth rates. Accordingly, the business cycle phases are defined using two-year GDP growth rates.
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

As stated above we expect, in general, innovation to be conducive to employment growth, but with varying intensity over the course of the business cycle. Figure 5.3 presents the mean employment growth for innovating and non-innovating firms[76] in manufacturing and service sectors, in each phase of the business cycle for the period 1998-2010[77].

Innovating firms exhibit higher employment growth (or lower employment losses) than non-innovating firms in all stages of the business cycle, in both manufacturing and service sectors. The differences in the employment growth between innovators and non-innovators are largest in recessions.

The figure also shows important differences in the employment growth between firms in manufacturing and service sectors. Employment growth was higher in service sector in all phases of the business cycle, which is line with the macroeconomic evidence indicating that, since the 1980s, employment in Europe has grown mainly in services (Rubalcaba et al., 2008). Another important difference between firms in manufacturing and in service sectors is that in service sector, employment growth remained positive even in recessions. This could indicate either that service sector was less affected by the crisis or that, during recessions, labour hoarding was higher in this sector, possibly due to a more labour intensive production technology and/or higher search and training costs.

Innovators and non-innovators also differ in their productivity growth[78]. Figure 5.4 shows that innovators have higher productivity growth than non-innovators in all stages of the business cycle, in both manufacturing and service sectors and that non-innovators' productivity gap is particularly wide in recessions. Interestingly, in manufacturing, the productivity gap is the smallest in boom periods, when there is almost no productivity gap between innovators and non-innovators. This may suggest that innovators do not use all opportunities for productivity growth in this phase of the business cycle due to weaker competitive pressure.

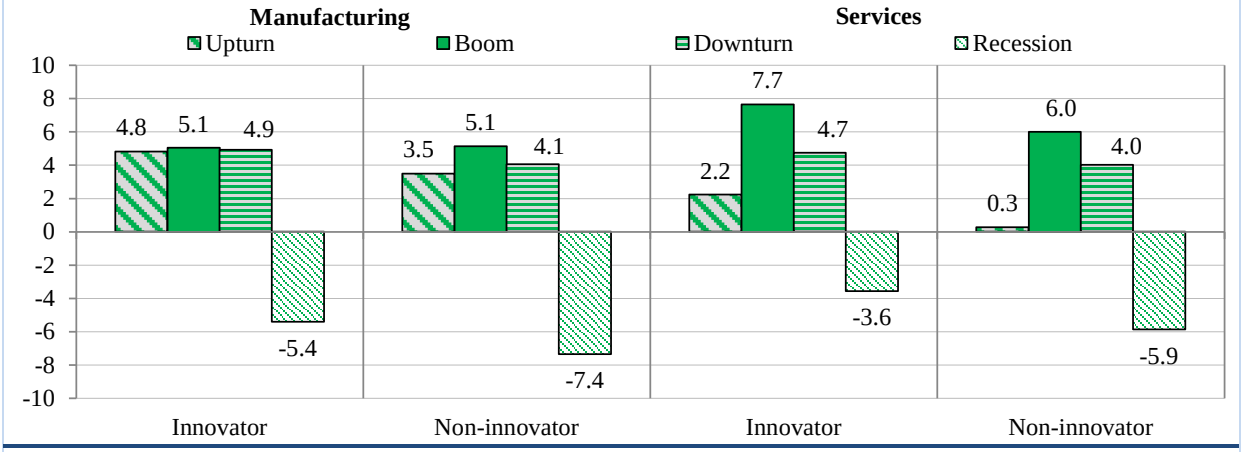
To investigate the role of product innovation in different stages of the business cycle in more detail, we examine graphically the sales growth due to new and old products. Both are key variables in the empirical model relating product innovation to employment growth (see section 5.4). Average nominal sales growth due to new and old products for all four phases of the business cycle is displayed in Figure 5.5.

[76] Innovators/innovative firms are defined as the firms who introduced at least one product, process or organisational innovation, while non-innovators are firms that did not introduce any of these types of innovations.

[77] These employment growth figures are averages for all service and manufacturing firms in the respective phases of the business cycle. They are *not* directly comparable to employment growth figures published by statistical agencies for several reasons. First, the numbers reported here do not include employment changes due to firm entry and exit. Second, only firms with more than 10 employees are included. Third, the observation with the highest and lowest employment growth have been dropped and finally the employment growth is averaged across firms, rather than taking the ratio of the sum of changes in employment for all firms to the sum of employed personnel.

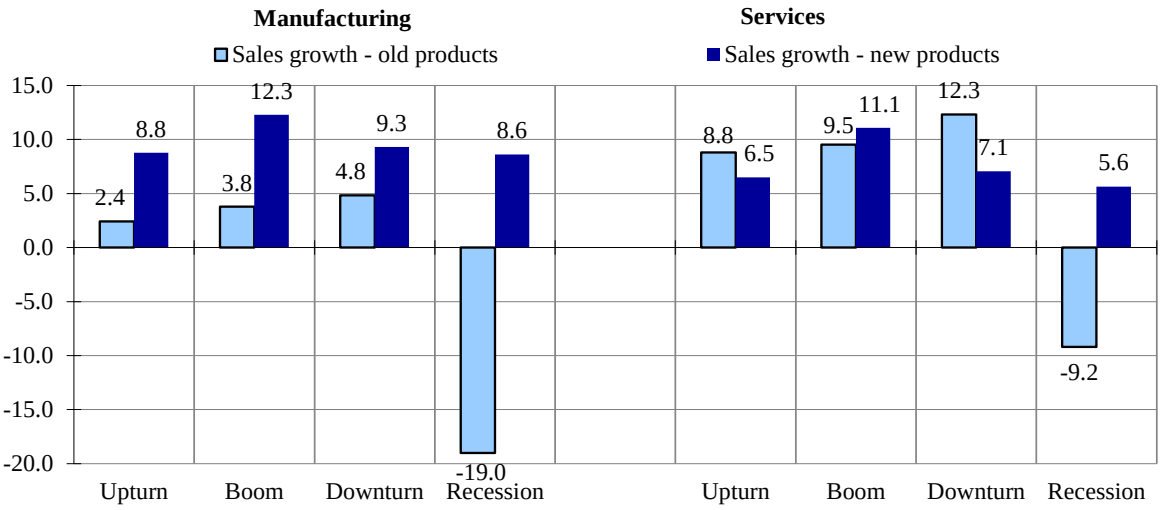
[78] Productivity growth is measured by growth in labour productivity (ratio of sales to employment) in real terms. CIS data do not include information on capital, which would be essential to calculate total factor productivity.

Figure 5.4: Productivity growth in different phases of the business cycle, manufacturing and services, 1998-2010



Note: Weighted figures. Depicted are average two-year real productivity growth rates. Accordingly, the business cycle phases are defined using two-year GDP growth rates.
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculation.

Figure 5.5: Sales growth due to new and old products in European firms in different phases of the business cycle



Note: Weighted figures. Depicted are average two-year nominal sales growth rates due to new and old products respectively. Accordingly, the business cycle phases are defined using two-year GDP growth rates.
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

The figure shows that, in manufacturing, the sales growth due to new products is larger than the sales growth due to old products in all phases of the business cycle and the difference between the two is particularly large in recessions. In service sector, the evidence is more mixed, but the difference in sales growth due to new and old products is also largest in recessions. Another important difference between growths in sales due to new and old products is that although both follow pro-cyclical paths, the sales growth due to new products is considerably *less affected by the business cycle*. Even in recession, in both sectors it remains positive and large (above 8% in manufacturing and above 5% in services). In contrast, sales growth due to old products is much more affected by the business cycle and, during recessions, it declines sharply. This decline is particularly strong in manufacturing (almost 20%). Taken together the robustness of sales due to new products and the higher employment growth of innovators than non-innovators, suggest an important way in which product innovation may affect employment growth.

5.4. EMPIRICAL MODEL

To investigate econometrically the effects of innovation on employment growth, we follow the approach developed by Harrison et al. (2014), who proposed an empirical model based on the theoretical relationship between employment growth and different types of innovation at the firm level. Several studies have used this model to study

employment effects of innovation: Harrison et al. (2014) for UK, Spain, France and Germany, Hall et al. (2008) for Italy, Benavente and Lauterbach (2007) for Chile, Mairesse et al. (2011) and Mairesse and Wu (2014) for China, Crespi and Tacsir (2013) for Latin America.

In this model, it is assumed that a firm can produce different products.[79] Firms are observed at two points in time *t* (= 1, 2). At the beginning of the references period, in *t*=1, the firm produces a set of products which are aggregated to one product and labelled as the 'old product' or 'existing product'. During the reference period, between *t*=1 and *t*=2, the firm can decide to introduce one or more, new or significantly improved, products. The new product can (partially or fully) replace the old one, if it substitutes it, or enhance the demand of the old product, if it complements it. Thus, at the end of the reference period, the firm will produce either only old products, only new products, or a combination of old and new products. Based on these assumptions, Harrison et al. (2014) derive a model that relates overall employment growth to three factors:

- changes in efficiency in the production of the old product due to:
  - process innovation,
  - organisational innovation and
  - non-innovation related efficiency gains.
- changes in the real output of the old product.
- changes in sales due to new products. This effect depends on the differences in the production technologies of the two goods and on the real output growth due to new products.

Non-innovation related efficiency gains captures employment effects of training, improvements in the human capital endowment, corporate restructuring, acquisitions of firms, and productivity effects of spillovers, among others. Changes in the real output of old product may be due firm's own new product, the induced change being negative for substitutes (cannibalization effect) and positive for complements. It also accounts for demand shifts for old products due to new products introduced by rivals (business stealing), price reductions following own process innovations (compensation effects of process innovation), general business cycle effects (as long as we do not separately control for them), changes in consumer preferences or new products in upstream or in downstream firms.

[79] In the following, the term product covers both goods and/or services unless stated otherwise.

Equation (5.1) describes the relationship between employment growth (*l*), changes in the real output due to the old products (g_1-π_1), efficiency gains due to non-innovation related efficiency gains (α_0), process (*pc*) and organisational innovation (*orga*) and sales growth due to new products (g_2):

$$l-\left(g_1-\tilde{\pi}_1\right)=\alpha_0+\alpha_1 pc+\alpha_2 orga+\beta g_2+v \qquad (5.1)$$

The derivation of this model is provided in Harrison et al. (2014). A detailed definition of variables used in the theoretical and in the empirical models is given in Table 5.1.

In the estimation, non-innovation related types of efficiency gains (α_0) are assumed to depend on the country, sector, size and ownership structure of the firm.

In the empirical model, *pc* is measured as a dummy variable that takes the value 1 if the firm has introduced *process innovations and no product innovations* and 0 otherwise. This definition ensures that the model identifies the effect of efficiency improvements in the production of old products. For firms that introduced product and process innovations, the effect of process innovations with respect to an increase in efficiency in the production of old products cannot be separately identified in CIS data.

The dataset does not contain information on the real sales growth rates due to new and old products, but only on the nominal sales growth rates. Price growth rate for old products between *t* and *t-2* is measured using producer price indices at the country-industry level (for more details see Table 5.1). However, the difference between average country – industry price changes and firm level price changes is included in the error term. In addition, there is no data on firm-level price changes for new products; therefore, these changes are also captured by the error term.

Since these price changes are captured by the error term, it is likely that *sales growth rate due to new products* (g_2) is correlated with the error term *v*, which may lead to biased estimates. To address this endogeneity problem, equation (5.1) is estimated using instrumental variables. The variables used as instruments should be correlated with sales growth due to new products, but uncorrelated with the error term and in particular they should be uncorrelated with relative price difference of new and old products. The following instruments were used. The first instrument is a dummy variable that indicates whether product innovation was aimed at increasing the product range. The second and third instrument used are two dummy variables that indicate whether the firm carried out R&D continuously (for services) and whether firms have cooperated in innovation

projects with other agents (for manufacturing). The first two instruments have been used in previous studies (Peters, 2008; Hall et al., 2009; Dachs and Peters, 2014; Peters et al., 2013; Harrison et al., 2014). Instrument validity and non-weakness has been carefully tested using tests on over-identifying restrictions and on weak instruments. The results of these tests are reported in Peters et al. (2014), the background study for this chapter.

Equation 5.1 is estimated separately for firms in manufacturing and service sectors in each phase of the business cycle[80], and for different types of firms defined based on technological intensity of the sector, size, ownership and geographical location.

The econometric analysis is complemented by a decomposition analysis, which allows quantifying the absolute *contribution of different sources to employment growth for different types of firms*. The analysis follows the methodology developed by Harrison et al. (2014). Equation (5.2) describes the decomposition of employment growth:

$$l = \underbrace{\hat{\alpha}_0}_{1} + \underbrace{\hat{\alpha}_1\, pc}_{2} + \underbrace{\hat{\alpha}_2\, orga}_{3} + \underbrace{\left[1 - I(g_2 > 0)\right](g_1 - \tilde{\pi}_1)}_{4} + \underbrace{I(g_2 > 0)(g_1 - \tilde{\pi}_1)}_{5a} + \underbrace{I(g_2 > 0)\hat{\beta}\, g_2}_{5b} + \hat{v} \qquad (5.2)$$

In this equation, the $\hat{\alpha}_0, \hat{\alpha}_1, \hat{\alpha}_2,$ and $\hat{\beta}$ are the coefficients obtained from the estimation of equation (5.1), *I(.)* indicates whether the sales due to new products are positive. This equation shows how change in employment is decomposes, in line with the theoretical model into the contributions of: *general trend in productivity* in the production of *old products* to employment growth, term (1) in equation 5.2), *process innovation* applied in the production of *old* products, term (2); *organisational innovation*, term (3); *real growth of output in old products for firms that do not introduce any new products*, term (4); *net contribution of product innovation*, which is equal to the sum of increases in the demand for new products (5a) and changes in demand for the old product due to the introduction of new products (5b). The decomposition of the average employment growth is estimated by inserting in equation (5.2) the coefficients obtained from the estimation of equation (5.1), the average shares of non-innovators, process, organizational and product innovators and employment, price and sales growth rates (for the corresponding group of firms). The residual is zero by definition.

5.5. EMPLOYMENT EFFECTS OF INNOVATION OVER THE BUSINESS CYCLE

The results of the estimation of equation (5.1) are presented in Table 5.2. The key variables are sales growth rate due to new products (SGR_NEWPD in the estimation, g_2 in equation 5.1), process innovation (PCONLY in the estimation, *pc* in equation 5.1) and organisational innovation (ORGA in the estimation, *orga* in equation 5.1).

The coefficient of the variable SGR_NEWPD indicates that product innovation is associated with significantly higher employment growth in all four phases of the business cycle, both in manufacturing and service sectors. The differences in the coefficients of SGR_NEWPD in different phases of the business cycle are not statistically significant, suggesting that the growth due to sales of new products has the same gross effect in all phases of the business cycle. An increase in sales growth due to new products of 1% leads to an increase in gross employment by 1%. The net effect, which takes into consideration the fact than new products may replace old ones, is given in the decomposition analysis below.

The coefficients of process innovation (PCONLY) [81] and organisational innovation (ORGA) are negative and statistically significant only in upturns and downturns and, in the case of process innovation, only for firms in manufacturing sector. These results indicate that, in upturns and downturns, firms that introduced these innovations experienced lower employment growth than firms that did not introduce such innovations. A possible explanation for these results could be different motives of firms to introduce process and organisational innovations in different phases of the business cycle. In boom periods, when demand is high and growing, firms may use process innovations mainly to expand production capacity to meet the increasing demand, rather than to cut costs. In downturns, when demand decreases, firms may use these innovations to reduce costs, including labour costs, which might have reached high levels during the boom period. In recessions, however, firms may have already reached a relatively low level of employment and may not need to use process and organisational innovations to reduce labour costs further or they may adjust employment by other means.

Overall, the results suggest that product innovation has a positive effect on employment growth in all phases of the business cycle and in all sectors.

[80] In the background study, equation one was also estimated separately for periods of negative, low and high economic growth. The results are in line with those obtained for four phase definition of the business cycle.

[81] Some effects of process innovation may also be reflected by the product innovation variable, since, for firms reporting both product and process innovation, it is not known whether the process innovation is related to the old or new product.

Process and organisational innovations tend to have negative, but often statistically insignificant effects. These results confirm the results of previous studies reviewed in section 5.1 who also found mainly positive results for product innovation, but mixed and often insignificant results for process and organisational innovation.

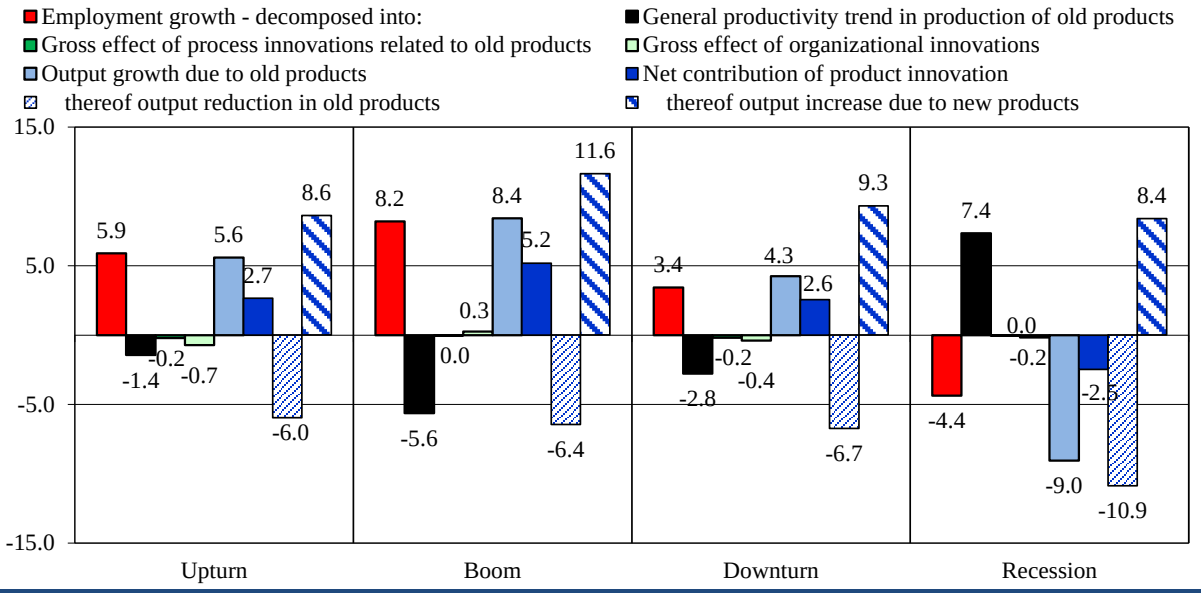
Figure 5.6 provides the decomposition of employment growth for firms in manufacturing sectors based on equation (5.2). It shows employment growth (red bar) broken-down into employment growth due to: general productivity trend in production of old products (black bar), process (dark green bar) and organisational innovation (light green bar), output growth due to old products (light blue bar) and the net contribution of product innovation (dark blue bar). The graph further splits the net contribution of product innovation into contribution of the demand for new products and changes in demand for the old product (both blue stripes).

The figure reveals that the net contribution of *product innovation* (dark blue bar) is particularly large in booms and upturns. This is in line with the hypothesis that higher market acceptance for new products, potential for demand expansion and extra-normal profits lead to a higher *demand effect* and higher employment growth due to product innovation in these phases of the business cycle. During recessions, the net contribution of product innovation becomes negative. Nevertheless, in recessions, the job losses of product innovators due to the net contribution of product innovation (dark blue bar) are much smaller than job losses due decreases in sales of old products for firms that did not introduce new products (light blue bar). The smaller employment losses for product innovators are due the sales of new products partly compensating for the decrease in sales of old products. In this sense, product innovation has a stabilising effect on employment in recessions. Figure 5.6 also reveals that the contributions of *process and organisational innovations* are negative, but minor and almost constant over the different phases of business cycle. For firms that did not introduce product innovations, *sales of old products* are a major source of employment growth during upturns, booms and downturns, but also the main source of job losses during recessions. In upturns, booms and downturns, the contribution of general productivity trend is negative, indicating that rising productivity slows down employment growth during these phases of the business cycle. In recessions, however, the contribution of general productivity trend becomes positive suggesting that during this phase lower productivity limits job losses. This implies that employment destruction would have been even larger if firms had not been willing to accept a worsening of productivity – for instance as a result of labour hoarding.

Figure 5.7 depicts the employment growth decomposition analysis for firms in service sector.

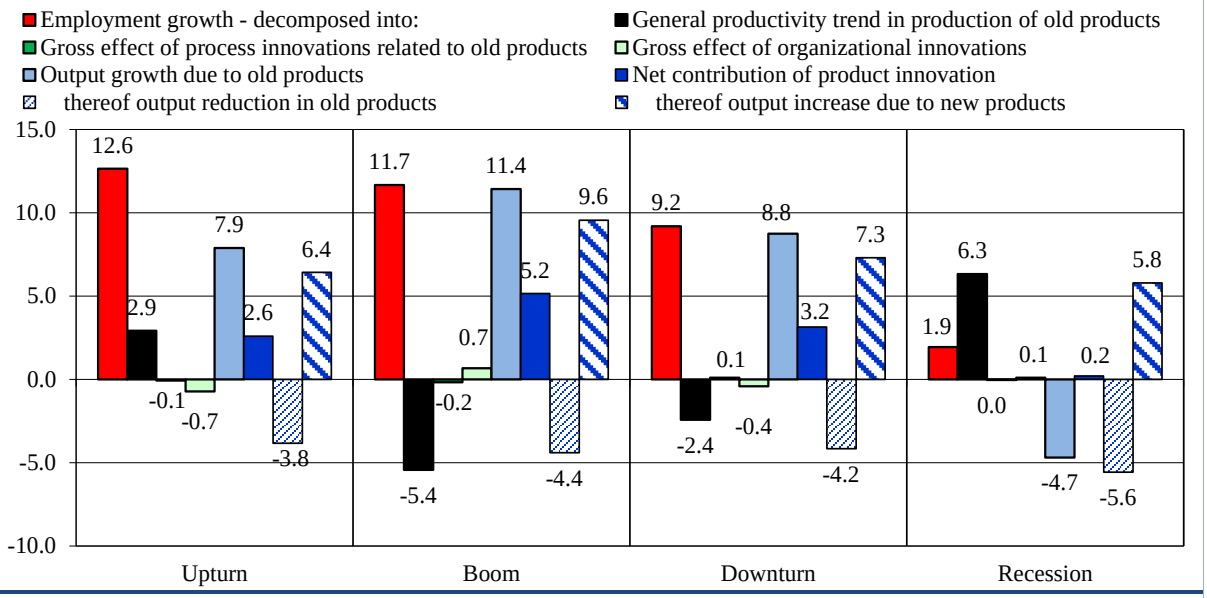
The results of the decomposition are similar to those obtained for manufacturing sector. However, employment growth and the contributions of different forms of innovation are higher than in manufacturing sector. Another important difference is that, in recessions, the net contribution of product

Figure 5.6: Contribution of innovation to employment growth over the business cycle, manufacturing, 1998-2010



Note: Decomposition is based on regressions (1) to (4) of Table 5.2.
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculation.

Figure 5.7: Contribution of innovation to employment growth over the business cycle, services, 1998-2010



Note: Decomposition is based on regressions (5) to (8) of Table 5.2.
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

innovation remains positive in service sectors unlike in manufacturing, where it becomes negative.

Overall, the results show that product innovation has an important contribution to employment growth. In line with our hypothesis and with previous studies (Lucchese and Pianta, 2012), the results show that the contribution of product innovation is larger in upturns and booms than in downturns and recessions. Furthermore, these results provide evidence on its important role during recessions in preserving employment. Process and organisational innovations have minor contributions to employment growth and these contributions show limited variation over the business cycle.

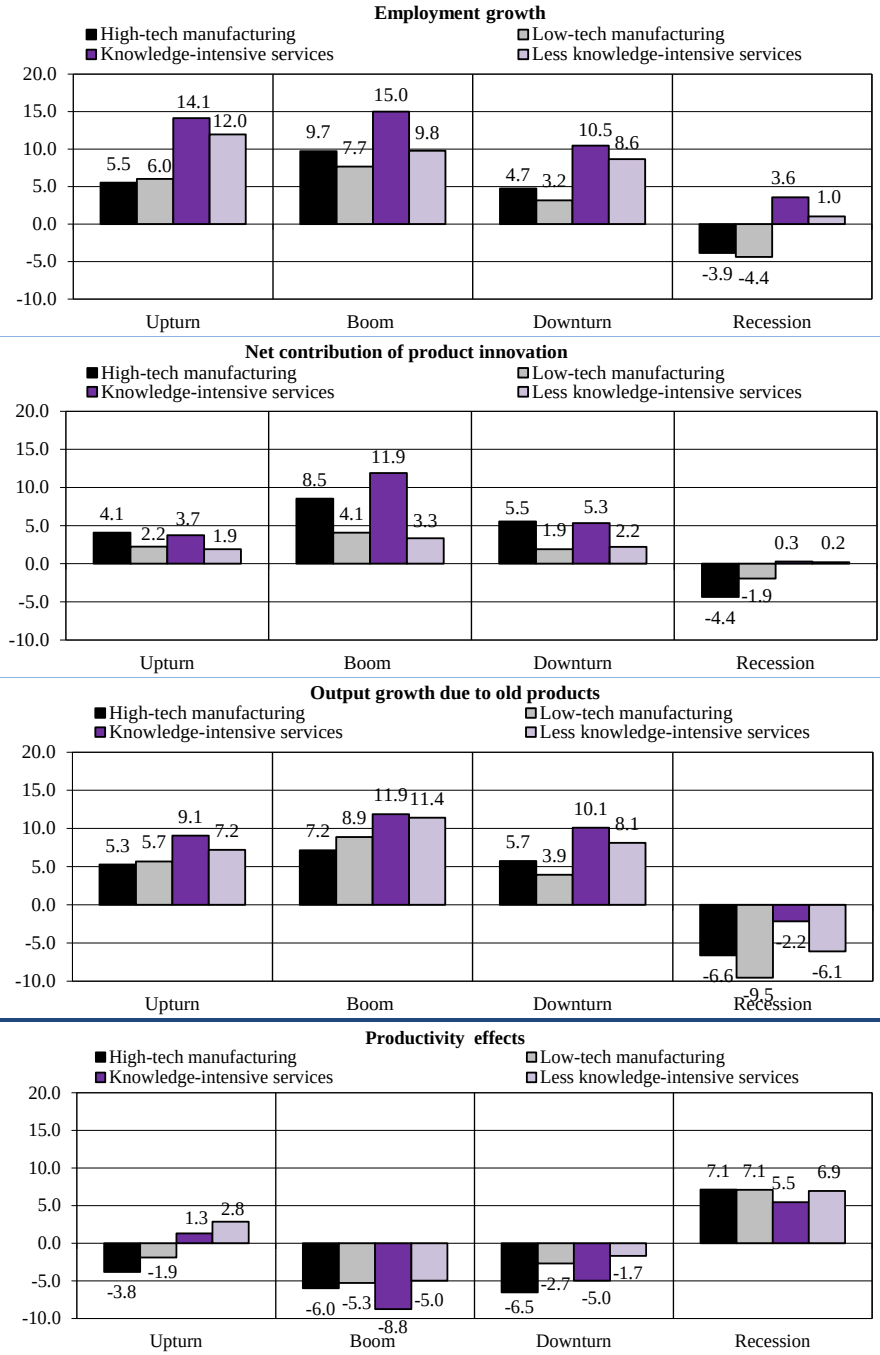
The results presented so far indicate the average effects for firms in manufacturing and service sectors. The following sections will examine whether these effects depend on technology intensity of the sector, size, ownership and geographical location of firms. In these sections, for expositional reasons we will aggregate all general productivity trend and the productivity effects of process and organisational innovations in one category: productivity effects.

5.6. SECTOR DIFFERENCES

Sectors differ considerably in terms of their technology intensity[82] and innovativeness, which can be explained by differences in demand expectations, in technological opportunity, and in appropriability conditions (Cohen, 1995, 2010). These factors may also influence the employment creation from innovation. Recently, high-technology sectors experienced the fastest growth (Rincon-Aznar et al., 2009) and higher growth in the past may lead to expectations of higher growth in the future. These expectations may result in faster employment growth in upswings and less employment losses in downswings. Faster technological change may lead to more opportunities for innovation in high-technology sectors compared to other sectors, which may result in a higher contribution of innovation to employment growth. A high level of appropriability, which is the ability of a firm to avoid involuntary spillovers of new knowledge to competitors, allows firms to reap more profits from an innovation and, hence, it is favourable to both innovation and employment growth based on innovation. High-technology sectors typically have higher appropriability conditions. Overall, these sector differences suggest that employment effects of innovation, especially those related to product innovation, are likely to be higher in high technology sectors and that the

[82] In addition, the background study examines differences in employment effects of innovation across sectors with different business cycle sensitivity.

Figure 5.8: Comparison of employment effects across sectors, 1998-2010



Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

business cycle may have different effects in sectors with different technology intensity.

This study distinguishes between high-tech manufacturing (HIGH), low-tech manufacturing (LOW), knowledge-intensive services (KIS) and less knowledge-intensive services (LKIS). This classification is based on the Eurostat classification of sectors according to their technology intensity[83].

The Figure 5.8 depicts employment growth (first panel) and the sources of employment growth: net contribution of product innovation (second panel), output growth due to old products (third panel) and productivity effects (forth panel) in each business cycle phase and for each of the four sector groups.

[83] For manufacturing sectors, high-technology and medium-high-technology manufacturing groups in the Eurostat classification are aggregated in the group high-tech manufacturing (HIGH). Similarly low-technology and medium-low-technology manufacturing groups are aggregated in the category low-technology manufacturing (LOW).

Figure 5.8 shows that employment growth in high-tech manufacturing and in knowledge-intensive services is generally higher (or less negative) than in low-tech manufacturing and less knowledge-intensive services, respectively. This can already point towards differences in the innovation-employment link across industries related to technology or knowledge intensity.

The net contribution of product innovation (second panel) is higher in high-technology/knowledge intensive sectors than in low-technology/ less knowledge intensive sectors, in all phases of the business cycle except recessions. The effect of product innovation in high-tech manufacturing and knowledge-intensive services is highly pro-cyclical. Employment growth due to product innovation nearly doubles in boom periods compared to upturns or downturns in these sectors. Sales growth due to old products (third panel) have an important contribution to employment growth in upturns and downturns phases, in high-technology/knowledge intensive sectors and in all phases of the business cycle, in low tech manufacturing and less knowledge-intensive services.

In recessions (forth column in Figure 5.8), in both service sectors, product innovation creates new employment, although its contribution is relatively small. In contrast, in both manufacturing sectors, the net effect is negative. Interestingly, the negative contribution of net product innovation is larger in high technology manufacturing than in low tech manufacturing. More detailed results reported in Peters et al. (2014), indicate that this result is driven by a larger decrease in the sales of old products due to the introduction of new products in high-tech manufacturing. This could be linked to shorter product cycles in high-tech manufacturing (Milgrom and Roberts, 1990). However, the job losses due to the net contribution of product innovation are considerably smaller than those due to reductions in demand for old products for firms that did not introduce product innovations (third panel). This holds for all sectors, but, interestingly, these differences are particularly large for firms in low-technology manufacturing, which experience a very large decrease in demand for old products. This result highlights the importance of the product innovation in limiting job losses in recessions, and it shows that this effect is not limited to high-technology/knowledge intensive sectors.

5.7. DIFFERENCES AMONG SMALL, MEDIUM-SIZE AND LARGE FIRMS

Firm size may affect the relationship between innovation and employment growth. Large firms have several advantages in introducing innovations and benefiting from them, such as, easier access to finance necessary for funding innovation projects and higher product diversification, which facilitates managing innovation related risks and increases the number of potential applications of innovation (Rosenberg, 1990). However, small and medium-sized enterprises (SMEs) are more dynamic and have greater flexibility, which enables them to react faster to new opportunities (Archibugi et al., 2013). There is also evidence that SMEs are more sensitive to the business cycle than larger firms and that this is particularly true for SMEs' innovation activities (Paunov, 2012; Rammer, 2012; Archibugi et al., 2013) and employment growth (Fort et al., 2013). These may have implications for the employment effects of innovation in different phases of the business cycle.

Figure 5.9 depicts employment growth and sources of employment growth for small and medium firms (10-249 employees) and large firms (more than 250 employees) in manufacturing (M) and services (S).

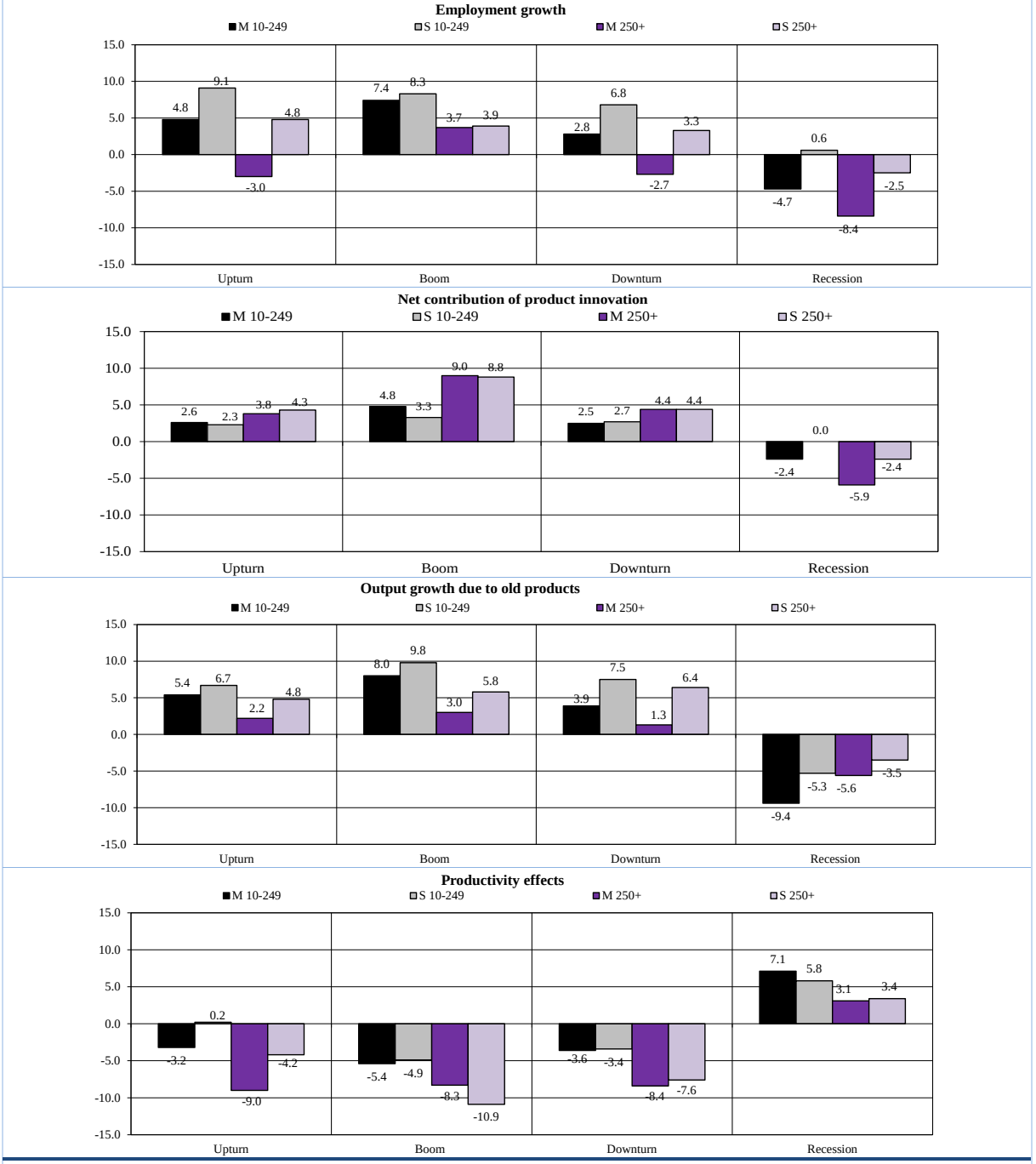
Figure 5.9 shows that SMEs grew faster (or had lower employment losses) than large firms in all stages of the business cycle, in both manufacturing and service sectors (first panel). Large manufacturing firms, on average, did not grow at all except in boom times.

The net contribution of product innovation to employment growth (second panel) is higher for large firms than for SMEs in both sectors and in all phases of the business cycle except recession. However, in recessions, this contribution is negative and it leads to higher employment losses in large firms than in SMEs in both sectors. This larger negative contribution is due mainly to decreases in sales of old products due to the introduction of new ones.

In both sectors, the contribution of old products to employment growth is much larger for SMEs. Consequently, in recessions, SMEs also suffer much higher losses than large firms due to the decline in sales of old products.

Productivity effects (forth panel) contribute more to employment changes in large firms than in SMEs and their contribution is particularly high for large firms in manufacturing sector. Peters et al. (2014) show that these productivity effects are only marginally driven by process and an organisational innovation, whose contributions are minor. They are mainly due to general productivity trends, which could be related to higher capital intensity, larger economies of scale, or better management practices. All these factors are associated with higher productivity, but could not be accounted for separately in the model. For large firms, the large negative productivity effects offset the large

Figure 5.9: Comparison of employment effects across size classes, 1998-2010



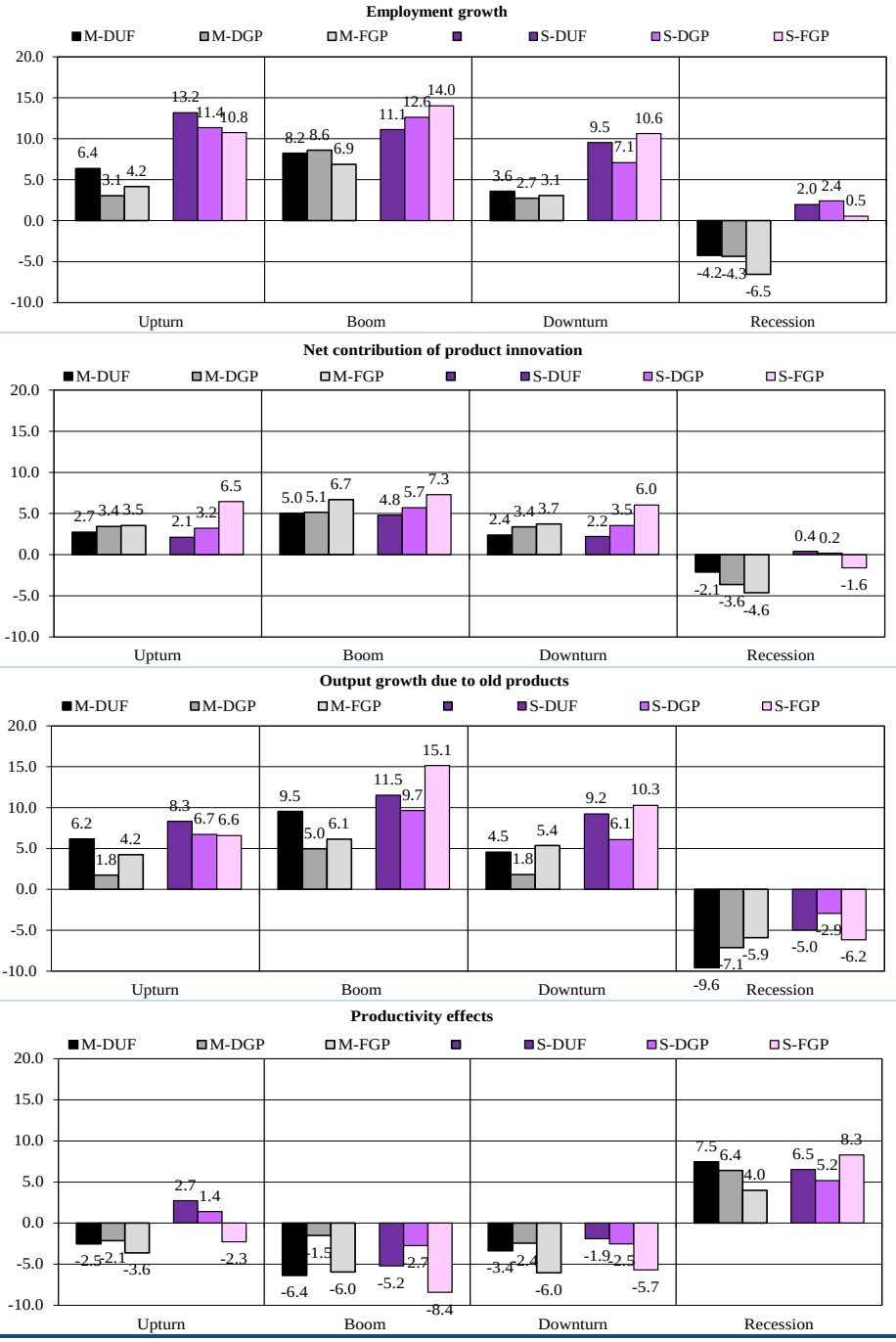
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

employment growth due to product innovation, leading to low employment growth and, in manufacturing sector, to almost jobless growth.

5.8. DIFFERENCES AMONG DOMESTIC AND FOREIGN-OWNED FIRMS

Foreign-owned firms have access to superior firm-specific assets of their parent MNEs, such as innovations of the parent MNEs and its experience with introducing innovations, and technology, brands, and distribution channels developed by the parent MNEs (Dachs and Peters, 2014). Access to these assets facilitates the successful introduction of innovations. Foreign firms also tend to be larger than domestic firms and, hence, they benefit from all the advantages associated with size reviewed in section 5.7. These differences between domestic and foreign firms may affect not only innovation success, but also employment effects of innovation. Dachs and Peters (2014) found evidence that the demand effect of product innovation has a larger positive effect and the productivity effect of process

Figure 5.10: Sources of employment growth by firm ownership, 1998-2010



Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

innovation has a larger negative effect for foreign firms. In a business cycle perspective, these results may imply that a higher demand effect of product innovation in upturns and booms and a higher productivity effect in downturns and recessions for foreign-owned firms than for domestic firms.

This study classifies the firms in three groups based on their ownership: domestic firms unaffiliated to a firm group (DUF), domestic firms affiliated to a firm group with a domestic headquarter (DGP), and foreign-owned firms (FGP). In addition, firms are split based on their sector of activity in manufacturing (M) and services (S). Figure 5.10 shows the employment growth and sources of employment growth for the six groups of firms.

The first panel of Figure 5.10 shows that, in manufacturing, foreign-owned firms grow less in upturns, booms and downturns, which may in part be explained by the fact that foreign-owned firms are larger on average than domestic firms. It also shows that foreign firms cut more jobs during

recessions than both types of domestic firms. The results for firms in service sectors are more mixed.

In both sectors, the net contribution of product innovation (second panel in Figure 5.10) is larger for foreign firms than for domestic firms in upturns, booms and downturns. The difference in the net contribution of product innovation between foreign and domestic firms is particularly large in service sector. In recessions, the negative net contribution of product innovation is larger in foreign-owned firms than in domestic firms. More detailed results in Peters et al. (2014) show that foreign-owned firms create more employment than domestic firms from increases in output of product innovation during the recession, but also lose more employment than domestic firms due to substitution effects leading to a lower net contribution of product innovation.

In most phases of the business cycle, all firms experience negative productivity effects and these effects are particularly large for foreign firms. These large negative productivity effects are the main reason foreign firms experienced lower employment growth, despite the large employment effect of product innovation. In recessions, however, these effects become positive, suggesting labour hoarding. In manufacturing, the positive effect of productivity is considerably smaller for foreign-owned firms leading to a larger decline in employment during recessions. A larger negative net contribution of product innovation and less labour hoarding firms (as indicated by lower contributions of the productivity effects) explain the higher employment losses for foreign-owned firms during recessions.

5.9. COUNTRY DIFFERENCES

Innovation strategies vary between firms from different regions in Europe. Peters et al. (2014) provide descriptive evidence based on CIS data that the proportion of innovators is on average higher in countries in North and Western Europe, than in Eastern and Southern Europe. An obvious question raised by this pattern is whether and to what extent this behaviour affects firm growth.

CIS data provided at Eurostat's SAFE centre do not allow performing a comparative analysis at country level *for all countries* since not all countries are observed in all business cycle stages. As an alternative, the countries studied are grouped based on their geographical location in three groups:

- *Eastern Europe*: Czech Republic, Estonia, Latvia, Lithuania, Slovakia, Slovenia, Romania, Hungary, Bulgaria and Croatia.
- *North-western Europe*: Belgium, Germany, Denmark, France, Finland, Ireland, Luxemburg, the Netherlands, Sweden, Iceland and Norway.
- *Southern Europe*: Cyprus, Spain, Greece, Italy, Malta and Portugal.

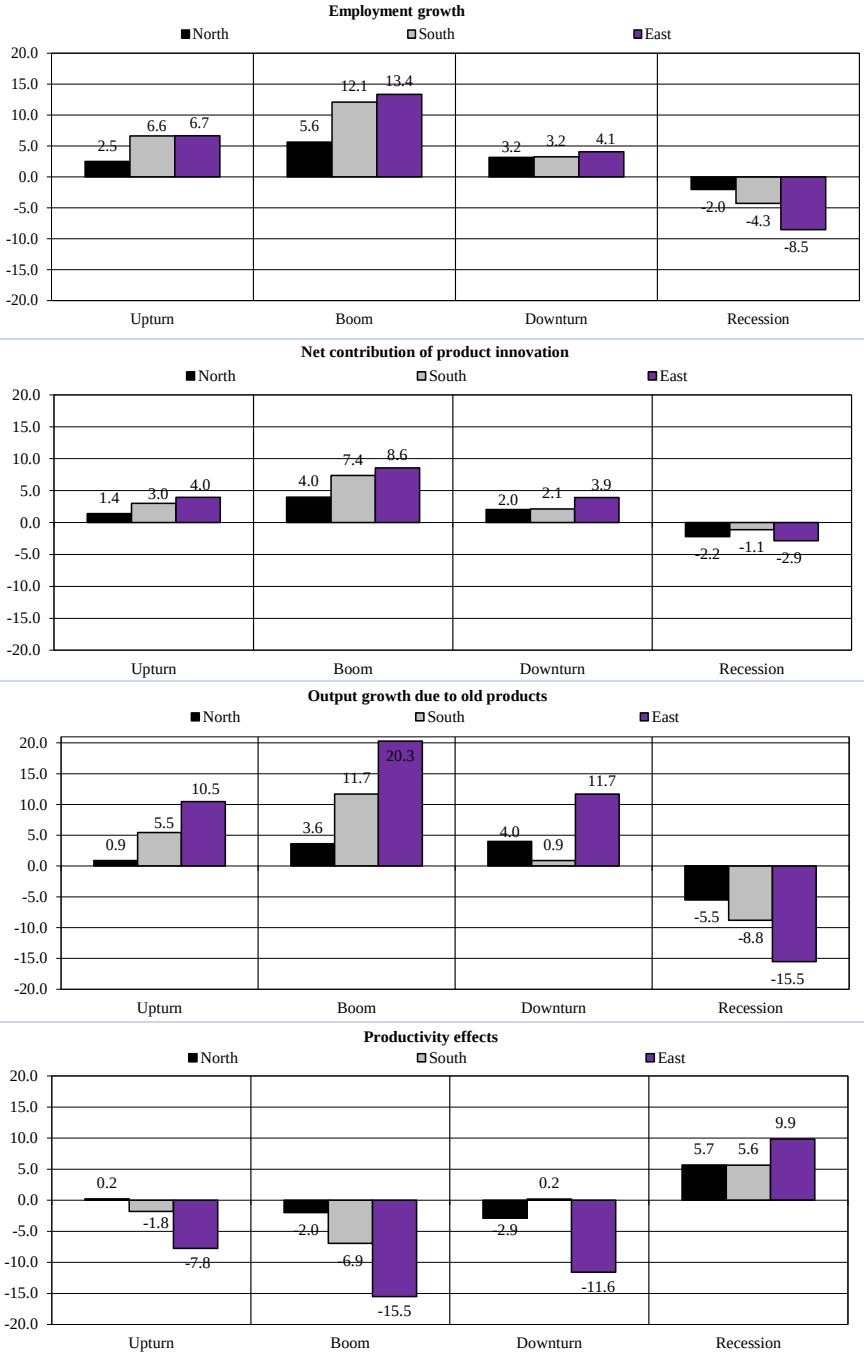
The first panel in Figure 5.11 shows the average two-year employment growth rates for manufacturing firms from these groups of countries between 1998 and 2010. In all groups, employment growth follows a pro-cyclical pattern but this pattern is much more pronounced in countries in Eastern and Southern Europe. Compared to firms in North-Western Europe, employment growth in firms in Eastern and Southern Europe was on average 2.5 times higher, during upturns and booms, and employment losses were between 2.5 and 4.5 times larger, during recessions. This may be indicative of higher labour intensity of firms in these regions.

The decomposition of employment growth reveals that during upturns, booms and downturns, the net contribution of product innovation to employment growth is positive in all three regions, but it is largest in Eastern Europe. The lower net contribution of product innovation to employment for firms in North-western Europe is driven by the higher efficiency in the production of new products compared to the old products in most phases of the business cycle. In recession, net contribution of product innovation is negative in all regions, but this negative contribution is much larger for firms in Eastern and Southern Europe than for firms in North-western Europe.

Despite the large net contribution of product innovation to employment growth in Eastern and Southern Europe, sales of old products (third panel) remain the main driver of employment changes in these regions. They play a less important role in North-Western Europe, where the contribution of product innovation is the main driver of employment growth. The high importance of old products for employment growth in Eastern and in Southern Europe is also the main reason for larger employment losses in these regions during recessions. Though the net contribution of product innovation was negative in recessions, these employment losses were lower than the losses due to decreases in sales of old products for firms that did not introduce product innovation (third panel, column four). In this sense product innovation has a stabilising effect in recessions in all three regions.

In upturn, boom and downturn periods, employment effects of productivity increases are negative in all countries and they were particularly large in Eastern and Southern Europe. In all regions these effects are

Figure 5.11: Comparison of employment effects across regional aggregates, manufacturing, 1998-2010



Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

driven mainly by non-innovation related productivity gains. However, in Eastern and Southern Europe, organisational innovations also play an important role. In recessions, productivity effects were positive in all three regions, suggesting labour hoarding effects.

5.10. PANEL DATA EVIDENCE

CIS data do not allow tracking firms over time and, hence, controlling for firms-specific individual heterogeneity. To confirm the robustness of the main findings of the chapter, we complement the main analysis with a panel data analysis based on the Mannheim Innovation Panel (MIP), a German firm level panel dataset. This dataset allows tracking firms over time and, hence, using econometric methods that take into account firm-specific individual heterogeneity. The analysis based on MIP

data extends the main analysis based on CIS data in several ways[84].

First, the panel structure of the data allows using econometric methods that control for unobserved firm heterogeneity. Unobserved firm heterogeneity could be an important determinant of firm growth. For instance, in the German sample, about 45% of the total variance in the employment growth is explained by individual effects. Despite the importance of individual heterogeneity, the results for the innovation variables confirm the main results obtained for the pooled cross-sectional sample of firms from CIS (see Table 5.3).

Second, using MIP data, we are able to examine the employment effects of innovation for very small firms with between 5 and 9 employees, which are not covered by the CIS. The inclusion of these firms has the potential to affect the estimation results considerably, because changes in the labour force in these firms may result in large growth rates due to their small size. Despite the potential large effect of these firms, the estimation results, reported in the background study, indicate that their inclusion changes the results only marginally.

Third, the fact that firms can be tracked over time allows to study whether innovation affects employment growth over a period of time longer than three years, while using CIS data we could estimate only employment effects of innovation within a three-year period (or less). Innovation may affect employment growth over a longer period. While it is sensible to assume that displacement effects of process or product innovations will not be lagging much from the time of their introduction, compensation effects of product and process innovations may take place with a certain delay. In this case, the employment creation effects of innovation are underestimated. The hypothesis of long-term effects of innovation on employment growth is tested by including 2-year or 3-year lags of sales growth due to new products and process innovation[85]. The results reported in Table 5.3 indicate that introduction of new products has long-run effects on employment growth, though the size of these effects decreases over time, and that there are no significant long-run effects of process innovations.

In conclusion, the results obtained using the MIP data for Germany, confirm the main results of the study. They suggest that the main results are robust to controlling for firm unobserved heterogeneity, inclusion of very small firms and long term effects of the innovation.

5.11. SUMMARY AND POLICY IMPLICATIONS

EU policy regards innovation as an engine for output and employment growth. Measures aiming to encourage the development and diffusion of new products and processes are seen as suitable instruments to promote employment in Europe.

While the positive effect of innovation on output growth is well documented, the empirical evidence on its effect on employment is mixed. Introduction of new products and processes may lead to increases in demand for firm output and increases in employment, but it may also lead to decreases in demand for old products and to increases in productivity, which enable firms to produce the same output with less labour. In addition, there is limited evidence on the factors that might affect the employment effects of innovation, such as business-cycle phases and firms' characteristics.

This chapter has studied the relationship between employment growth and innovation and how this relationship is affected by the business cycle and by firms' characteristics, such as sector of activity, firm size, ownership structure and geographical location. It used a large sample of firms in manufacturing and service sectors, in 26 European countries, over a large time period (1998-2010), which includes the recent economic crisis. The effect of innovation on employment has been estimated econometrically using pooled-cross sectional firm level data for 26 European countries from Community Innovation Survey using methods that took into account endogeneity of the innovation variables. The main findings were further confirmed by the results of the estimations using panel data from the Mannheim Innovation Panel. These estimations, in addition to accounting for endogeneity of innovation variables, also, account for firm specific individual heterogeneity and possible long-run effects of innovation.

The results suggest that product innovation has a positive and large effect on employment growth in all phases of the business cycle, in both manufacturing and service sectors, and for almost all types of firms considered. The contribution of product innovation to employment growth is largest in upturns and boom periods, when favourable economic conditions and high demand growth expectations lead to higher demand effects. However, during recessions product innovation

[84] In addition, the background study also examined non-linear effects of product innovation on employment growth, but found no evidence of such effects.

[85] For both variables, the *t*-2 or *t*-3 lags are included. Note that for example the sales growth due to new products in year *t*-2 actually measures the sales growth rate due to new products between year *t*-4 and *t*-2.

plays an important role in limiting job losses. The effects of process and organisational innovation on employment growth tend to be negative, but often small in magnitude and statistically insignificant.

The size of the contribution of product innovation to employment growth varies with technological intensity of the sectors, size, foreign-ownership and geographical location. Product innovation has a larger effect on employment growth in high-technology and knowledge-intensive sectors, than in low-technology and less knowledge-intensive sectors. It also tends to have a higher contribution to employment growth in large and foreign-owned firms, compared to SMEs and domestic firms. However, for both large and foreign firms the contribution of product innovation to employment growth is partly, and in some cases, fully offset by employment losses due to higher productivity effects, leading to mostly jobless growth. Employment effects of innovation also differ between firms in different regions. The net contribution of product innovation is largest for firms in Eastern and Southern Europe. Despite the high contribution of product innovations, sales of old products remain the most important source of employment growth in for firms in these regions, and only for firms in countries in North-Western Europe product innovation is the main source of employment growth.

The findings of this chapter have various implications for policy. Generally, the results imply that innovation is vital for employment growth or at least employment preservation in all phases of the business cycle, including in recessions. They underline the importance of supporting innovation, which could be pursued through measures aimed at supporting investment in R&D and other innovation related activities, facilitating access to finance, necessary for innovation projects, ensuring that labour supply has the necessary scientific, technical and business skills to create new products and processes and to market them successfully and measures helping firms to bring new products to markets faster, among others.

To achieve better employment outcomes, the policy could focus on product innovation, which is associated with higher employment growth (or lower employment losses) for all types of firms and in all business cycle phases. In contrast, the results for process and organisational innovations suggest that their employment effects are often statistically insignificant and their contribution to net employment growth is minor. However, these types of innovations are very important for productivity growth, firm competitiveness and even for product innovation. In this context, our results suggest that policy support for these innovations should not be affected by fears of possible negative employment effects.

The results for different phases of the business cycle suggest that innovation, and in particular product innovation, contributes to employment growth in all phases of the business cycle. While its contribution is largest in boom periods it plays an important role in creating and preserving jobs during recessions. These results highlight the importance of continuing to make innovation support a policy priority in all phases of the business cycle, including during recessions. These results, together with the results of Peters et al. (2014) showing that firms tend to decrease investment in innovation during recessions, suggest that support for R&D and other innovation activities could be a candidate for smart fiscal consolidation. During recession, when credit constraints can limit firms' investment in innovative activities, policy could also aim to facilitate access to finance, especially for SMEs, which are more likely to be credit-constrained. In addition, short-term measures complementing the existing policies that support long-term development of research, development and innovation capacities could also be considered.

Support for innovation should take into consideration firm heterogeneity. It could focus on product innovation in SMEs, because for SMEs the employment effects of product innovation are not offset by negative productivity effects, as it happens in large firms. The results for sectors suggest different possible focuses. While the employment effects of innovation are highest in high-tech/knowledge intensive sectors during booms, product innovation plays a very important in limiting job losses in all sectors during recessions. The different results for firms in different regions in Europe highlight the importance of taking into account the specific characteristics of different regions. Of particular importance is the finding that in Eastern and Southern Europe, old products remain the main driver of employment changes, despite a large net contribution of product innovation for firms that introduced new products. Policy could aim to support more product innovation in these regions.

Overall, the results imply that innovation and, especially, product innovation plays an important role in creating jobs in most phases of the business cycle and preserving jobs during recessions. They confirm the approach of the European Union to foster employment by promoting innovation and highlight the importance of this policy during the crisis.

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ANNEX

Table 5.1: Variable definitions

Variables	Theoretical model	Description
Dependent variable		
EMP	$l-(g_1-\tilde{\pi}_1)$	According to the theoretical model, EMP is defined as follows:
EMPGR	l	Employment growth rate in head counts between *t* and *t-2*. Information for both years comes from the same CIS survey.
SGR_OLDPD	g_1	Sales growth rate due to old products between t and t-2. It can be calculated as total sales growth rate *g* between *t* and *t-2* minus the sales growth rate due to new products g_2 (see below).
PRICEGR	$\tilde{\pi}_1$	Price growth rate for existing products between *t* and *t-2*. Price growth is measured using producer price indices at the country-industry level (2-digit NACE rev. 1.1 for CIS 3, CIS4 and CIS2006 and NACE rev. 2 for CIS2008 and CIS2010). In services, information on producer prices is not available for all industries over the whole period. If producer price deflators are unavailable, we have used the harmonized consumer price index instead country level.
Explanatory variables		
SGR_NEWPD	g_2	Sales growth rate between *t* and *t-2* due to new products. It has been calculated by multiplying the share of sales in *t* due to new products introduced between *t* and *t-2* with the ratio of sales in *t* and *t-2*. Note: A new product (product innovation) is a product (incl. services) whose components or basic characteristics (technical features, components, integrated software, applications, user friendliness, availability) are either new or significantly improved. A product innovation must be new to the enterprise, but it does not need to be new to the market. A firm is called a product innovator if it has introduced at least one product innovation in the period *t-2* to *t* (PD).
PCONLY	pc	Dummy variable = 1 if a firm has introduced at least one process innovation but no product innovation in the period *t-2* to *t* and zero otherwise. Note: A process innovation is the implementation of a new or significantly improved production process, distribution method, or support activity for goods or services within the three-year period *t-2* to *t* (PC). This includes significant changes in techniques, equipment and/or software used to produce goods or services. Process innovations can be intended to decrease unit costs of production or delivery, to increase quality, or it can be a by-product of the introduction of new products.
ORGA	$orga$	Dummy variable = 1 if a firm has undertaken at least one organisational innovation in the period *t-2* to *t* and zero otherwise. Note: Organisational innovation encompasses the occurrence of at least one of the following events in the three-year period: the introduction of a new organisational method in a firm's enterprise business processes, the introduction of a new workplace organisation or the implementation of new external relations that has not been previously used in the enterprise or new methods of organizing external relations with other firms or public institutions.
DUF / DGP / FGP		A set of dummy variables for ownership in year *t*. We distinguish between unaffiliated firms (DUF; reference) and firms that belong to a company group which has a domestic (DGP) and foreign headquarter (FGP), respectively.
SMALL / MEDIUM / LARGE		A set of dummy variables for each size class in year t-2. We distinguish between firms with 10-49 (SMALL; reference), 50-249 (MEDIUM) and 250 and more employees (LARGE).
GDPGR		Country-level real GDP growth rates between year *t-2* and *t*.
COUNTRY		A set of dummy variables for each country in the sample.
INDUSTRY		A set of dummy variables for each industry.
Instrumental variables		
RANGE		Variable that indicates whether the product innovation was aimed at increasing the product range (0/1) in the period *t-2* to *t*.
RD		Dummy variable = 1 if the firm carries out R&D continuously in the period *t-2* to *t*.
COOP		Dummy variable = 1 if the firm has cooperated in innovation projects with other agents in the period *t-2* to *t*.
CLIENT		Dummy variable that equals 1 if clients have been a high-to-medium important information source for innovation in the period *t-2* to *t* (not available in CIS 2010 and therefore only used for a few some sub-samples if one of the other instruments turned out to be invalid).

Table 5.2: Impact of innovation on employment growth in different stages of the business cycle, manufacturing and services, 1998-2010

	Manufacturing				Services			
	Upturn	Boom	Downturn	Recession	Upturn	Boom	Downturn	Recession
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
SGR_NEWPD	0.984***	0.965***	1.002***	0.976***	0.988***	0.845***	1.036***	1.026***
	(0.024)	(0.029)	(0.025)	(0.026)	(0.051)	(0.119)	(0.046)	(0.036)
PCONLY	-1.747**	-0.268	-1.835*	-0.367	-0.524	-1.831	1.224	-0.255
	(0.853)	(1.391)	(0.941)	(1.027)	(1.463)	(4.295)	(1.097)	(0.882)
ORGA	-2.207***	0.601	-1.373**	-0.567	-2.034**	1.501	-1.390*	0.338
	(0.467)	(0.738)	(0.617)	(0.490)	(0.793)	(1.970)	(0.825)	(0.565)
GDPGR	3.641***	2.816	-0.600***	-0.017	1.694	-3.500*	-0.631***	0.846***
	(0.556)	(1.811)	(0.175)	(0.278)	(2.084)	(2.008)	(0.220)	(0.256)
MEDIUM	-3.080***	-0.006	-1.255**	-2.019***	-4.640***	-1.045	-3.376***	-4.197***
	(0.460)	(0.865)	(0.596)	(0.496)	(0.942)	(1.720)	(0.646)	(0.581)
LARGE	-4.718***	-3.542***	-1.351*	-3.979***	-4.890***	-4.085**	-5.868***	-4.922***
	(0.609)	(1.284)	(0.787)	(0.659)	(1.531)	(1.914)	(1.174)	(1.058)
DGP	-1.472*	3.213***	0.567	1.290*	-1.169	0.346	0.119	0.380
	(0.791)	(1.163)	(0.648)	(0.661)	(1.094)	(1.578)	(0.631)	(0.609)
FGP	-1.130	1.034	0.124	-1.805***	-5.169***	-1.844	0.118	0.462
	(0.804)	(1.147)	(0.659)	(0.631)	(1.359)	(2.202)	(0.801)	(0.830)
Constant	-67.186***	-33.372**	-15.091***	3.049*	-32.862	18.939	-6.139*	15.404***
	(7.291)	(15.808)	(2.647)	(1.654)	(25.674)	(17.056)	(3.585)	(1.221)

*Note: Method: Weighted instrumental variables estimation. ***, ** and * indicate significance at the 1%, 5% and 10% level. Reported are only the main variables of interest. Additionally included but not reported: Dummies for industries countries and time. Full results including specification tests are given the background report.*
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

Table 5.3: Impact of innovation on employment growth : accounting for individual heterogeneity, endogeneity, non-linear and long-term effects, German manufacturing and service firms, 1994-2012

	Manufacturing				Services				Manufacturing	
	OLS	**FE**	**IV**	**IVFE**	**OLS**	**FE**	**IV**	**IVFE**	**IVFE**	**IVFE**
SGR_NEWPD	0.803***	0.732***	.951***	.930***	.864***	.797***	.864***	.912***	.040***	.132***
PCONLY	-1.878	-0.435	0.015	.546	3.191***	2.171	2.946***	1.094	1.938	0.853
GDPGR_D	-5.145***	-6.253***	5.312***	4.858***	1.228**	1.552*	1.516**	1.711**	5.930***	7.613***
GDPGR_U	-9.711***	-11.228***	10.431***	11.268***	2.299***	2.843***	4.540***	3.991***	13.316***	13.751***
GDPGR_B	-9.826***	-11.225***	10.983***	12.161***	0.869	0.486	1.540*	0.126	13.582***	13.526***
SGR_NEWPD	0.071***	0.091***	.016	0.032	.001	.017	.053	.087	-	-
x GDPGR_D										
SGR_NEWPD	0.099***	0.111***	.016	0.018	.050**	.075*	.101*	.048	-	-
x GDPGR_U										
SGR_NEWPD	0.092***	0.070**	.089	.027	0.025	.003	.051	0.020	-	-
x GDPGR_B										
PCONLY	-3.089**	-3.930*	3.236*	4.761**	.391	.057	.886	.185	-	-
x GDPGR_D										
PCONLY	0.303	-1.204	0.210	2.415	.187	.270	.867**	.247	-	-
x GDPGR_U										
PCONLY	-0.883	-0.431	0.476	0.064	.855	0.811	.695	0.583	-	-
x GDPGR_B										
SGR_NEWPD^2	-	-	-	-	-	-	-	-	-	
SGR_NEWPD_{t-2}	-	-	-	-	-	-	-	-	.094***	
SGR_NEWPD_{t-3}	-	-	-	-	-	-	-	-		.083***
$PCONLY_{t-2}$	-	-	-	-	-	-	-	-	.163	
$PCONLY_{t-3}$	-	-	-	-	-	-	-	-	-	.910
Obs	27,908	27,908	22,394	18,369	21,163	21,163	18,290	14,252	7,303	5,524

*Notes: Methods: OLS, Fixed Effects (FE), Instrumental variables (IV) and Instrumental variables with fixed effects (IVFE) estimations. ***, ** and * indicate significance at the 1%, 5% and 10% level. Reported are only the main variables of interest. Source: Mannheim Innovation Panel, own calculation*

Chapter 6.
ENERGY COSTS AND EU INDUSTRIAL COMPETITIVENESS

Energy costs of production are primarily determined by two factors: they grow with energy prices, but can be mitigated by efficiency improvements, as measured by changes in energy intensity. This chapter analyses all these elements in a common framework in order to study the impact of energy costs on the competitiveness of EU manufacturing industries.

The issue of energy costs and their impact on industrial competitiveness have become central for EU policy making in the context of the EU ambitious climate and environmental objectives and against the challenge of growing competitive pressures from emerging economies. This is all the more important given the slow recovery of the EU industrial output and employment after the crisis.

Climate change policies and rising fuel prices have made energy efficiency improvements a fundamental step of the shift toward low-carbon economy. The Europe 2020 strategy[86] explicitly stipulates a 20% improvement of energy efficiency in the EU as one of its objectives, together with a greenhouse gas emission reduction target of 20% with respect to 1990 levels, as well as an increase of renewable energy in final energy consumption to 20%. In 2012, the new industrial policy strategy called for re-industrialization of Europe, setting a target of 20% share of EU manufacturing in GDP. Moreover, in January 2014, the European Commission adopted a proposal for a new energy and climate policy framework for the period to 2030.[87] The 2030 Framework includes EU targets for reducing greenhouse gas emissions by 40% with respect to 1990 levels, increasing renewable energy to 27% in final energy consumption and improving energy efficiency to 30% in 2030. In tandem with the new energy and climate policy framework, in January 2014, the Commission adopted its industrial policy communication, calling for mainstreaming of industrial competitiveness in all other policy areas and reinforcing the course to re-industrialization.[88] The political crisis in Ukraine added a new dimension to the energy policy debate, the security of supply, which led to the adoption in May 2014 of the energy security strategy.[89]

Against this background, the issue of energy prices and costs and their impact on industrial competitiveness has moved high in the policy debate. Concerns about the external competitiveness of European industry have been particularly reinforced by the recent 'shale gas revolution' in the United States, which resulted in plunging prices of natural gas and electricity, benefiting in particular energy-intensive industries such as metals and chemicals, and leading to a revival of manufacturing in the United States. According to a 2013 Commission's Green paper, 'one of the fundamental objectives of EU energy policy is to ensure that the energy system contributes to the competitiveness of the EU economy by ensuring competitive domestic and international energy markets and prices which are internationally competitive and represent affordable energy for final consumers' (European Commission 2013b). Furthermore, in May 2013 the European Council called on the Commission 'to present an analysis of the composition and drivers of energy prices and costs in Member States before the end of 2013, with a particular focus on the impact on households, SMEs and energy intensive industries, and looking more widely at the EU's competitiveness vis-à-vis its global economic counterparts'.

This chapter builds on the recent analytical work undertaken by the Commission in response to the Council requests. The 2012 ECR (European Commission, 2012c) showed that the relative weight of energy in manufacturing inputs in the EU experienced an overall decrease over the past decade, mostly due to continuous technical improvements. Two recent Commission studies (European Commission (2014a, 2014b) document the rise of energy prices in the EU and show that growing network costs and energy taxes are among the main drivers of this increase, even though in some countries price development also reflect environment and climate policy objectives. Several sectoral studies, focusing on energy intensive industries (like steel, aluminium, ceramic, glass), show that their competitiveness may be particularly at risk because of high energy costs (CEPS 2013a, 2013b, 2014a, 2014b).

[86] http://ec.europa.eu/europe2020/index_en.htm
[87] See http://ec.europa.eu/clima/policies/2030/index_en.htm
[88] http://ec.europa.eu/enterprise/policies/industrial-competitiveness/industrial-policy/communication-2014/index_en.htm
[89] http://ec.europa.eu/energy/security_of_supply_en.htm

This chapter builds on and complements the findings of the previous studies analysing in more depth whether energy investments in energy saving technology have been sufficient to maintain competitiveness against the backdrop of rising prices. In that, it contributes as well to the growing academic debate about the role of energy costs and prices on industrial competitiveness (Rennings and Rexhäuser, 2011; Christiansen and Haveman, 1981; Gollop and Roberts, 1983; Greenstone, 2002; Jaffe et al.,1995; Riker, 2012; Eichhammer and Walz, 2011).

The chapter is organised as follows. It starts examining trends in energy prices (Section 6.1), energy intensity and the related energy cost developments (Section 6.2) in the last two decades, using data from WIOD and the International Energy Agency (IEA). The analysis confirms that energy prices have been growing and that energy intensity has been decreasing across most industries both in the EU and for our major competitors. This is consistent with previous findings, including the ECR 2012. However, the analysis shows that energy costs have grown. This trend is especially relevant for energy-intensive industries, where the costs shares are significantly higher than for the rest of the economy. This suggests that energy efficiency gains may not have been sufficient to offset growing energy prices. Section 6.3 verifies this hypothesis through an econometric model, estimating the price elasticities of energy intensities by sector. The estimates range between -0.3 and -1.5, with most of them being less than unity. This result confirms that efficiency gains did not fully compensate for the increase in energy prices. Starting from this observation, Section 6.4 goes further by examining measures of export competitiveness - as export volumes and RCA - to assess if and how they are affected by the growing energy costs. The analysis finds that higher energy costs tend to reduce exports: 1 percentage point increase in the cost share of electricity results in about 1.6 % decline in exports. The result holds over a number of robustness checks. Finally, Section 6.5 concludes and draws the relevant policy implications.

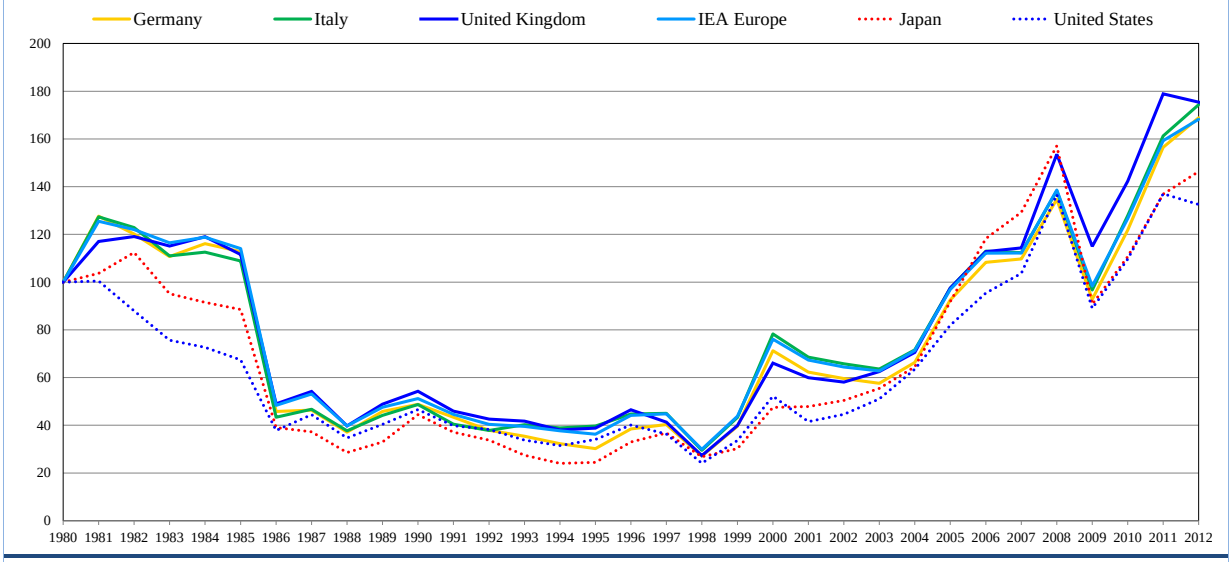
6.1. ENERGY PRICE DEVELOPMENTS

This section provides a short comparative analysis of oil, gas and electricity prices across EU Member States, over time, and in comparison with the EU's major external competitors: the United States, Japan, China and Russia. The analysis is based on end-user prices for industrial consumers, excluding VAT, using data from the IEA and Eurostat. International comparisons are made using PPIs rates. See the background study to this report for more results and for a complete description of the methodology. See also European Commission (2014a, 2014b) for a comprehensive analysis of energy prices, which includes also an investigation of household prices.

6.1.1. Oil prices

The dynamics of gas and electricity end-user prices for industry in the countries and regions covered by the present chapter have been affected to varying degrees by the dynamics of global oil prices. After the two oil 'price shocks' in the 1970s, the world oil price declined substantially in the mid-1980s and remained at generally low levels until the end of the

Figure 6.1: Real crude oil import price, real index 1980=100



Note: Deflated with PPI. IEA Europe is OECD Europe without Estonia, Iceland and Slovenia.
Source: IEA and national statistics.

1990s (see Figure 6.1). However, it surged dramatically in 2000-08, partly reflecting supply bottlenecks in the face of persistently growing oil demand (especially from emerging economies such as China) and geopolitical conflicts in the oil-rich areas such as Iraq, but also increasing speculation in the global oil markets – particularly in the run-up to the 2008 financial crisis. As a result, by mid-2008 the oil price climbed to some USD 130-140 per barrel. Initially, the global financial and economic crisis resulted in sharply falling oil prices (to levels below USD 30 per barrel by early 2009). However, they soon resumed their upward trend, arguably fuelled not least by the ultra-loose monetary policy of the US Federal Reserve which contributed to abundant global liquidity conditions. Over the past three years, the price of Brent oil – the benchmark oil blend traded in Europe – has hovered around or exceeded USD 100 per barrel. The impact of global oil price dynamics varied across individual countries and regions, depending on exchange rate movements *vis-a-vis* the US dollar. For instance, the trend of appreciation of the euro against the US dollar in the pre-crisis years cushioned the impact of rising oil prices on Europe, while in Japan the surge in oil prices (traded in US dollars) was on the contrary magnified by the depreciation of the yen against the US dollar (Morgan and Emoto, 2007).

However, the **pass-through** from oil to end-user gas and electricity prices has been highly uneven – both across countries/regions and over time. The pass-through to gas prices has been generally greater than that to electricity prices (Figure 6.2). This is explained by the fact that oil and gas can often be used as substitutes, whereas electricity production represents the next stage in the value chain where other inputs also play a role. In addition, electricity can be generated from a number of sources other than oil and gas, such as coal, hydro and nuclear power. Important cross-country differences with respect to the magnitude of this pass-through can be observed (see background report to this study for a detailed analysis). This partly reflects different market structures and the degree of price regulation at various stages of the value chain, but is also due to specific pricing mechanisms which, in some cases, link by contract the prices of oil and gas.

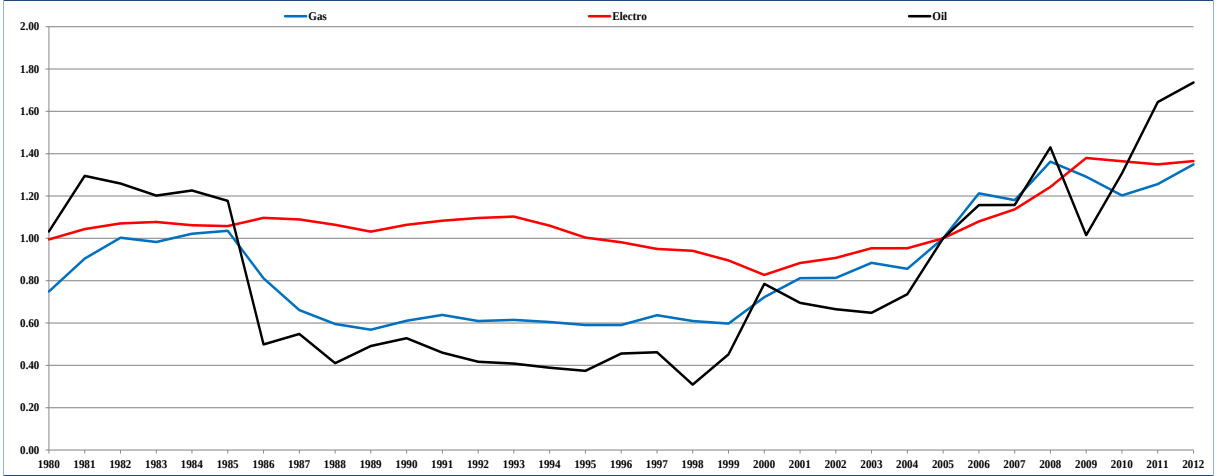
6.1.2. Natural gas prices

In continental Europe, the dynamics of upstream gas prices have until recently broadly followed oil price dynamics. This is not surprising given that the region is heavily dependent on gas imports and import contracts typically link the price of gas to that of oil. Historically, most of natural gas imports have come from three major external suppliers: Russia (in the past, the Soviet Union), Norway, and Algeria, largely via pipelines. Currently, imported gas accounts for around half the EU's gas consumption, with half of those imports coming from Russia.

The bulk of gas imports to continental Europe are made under long-term contracts which typically stipulate supply volumes for years in advance and contain a formula linking the gas price to the price of oil/oil products so that swings in global oil prices translate into changes in gas import prices in Europe after a short delay.

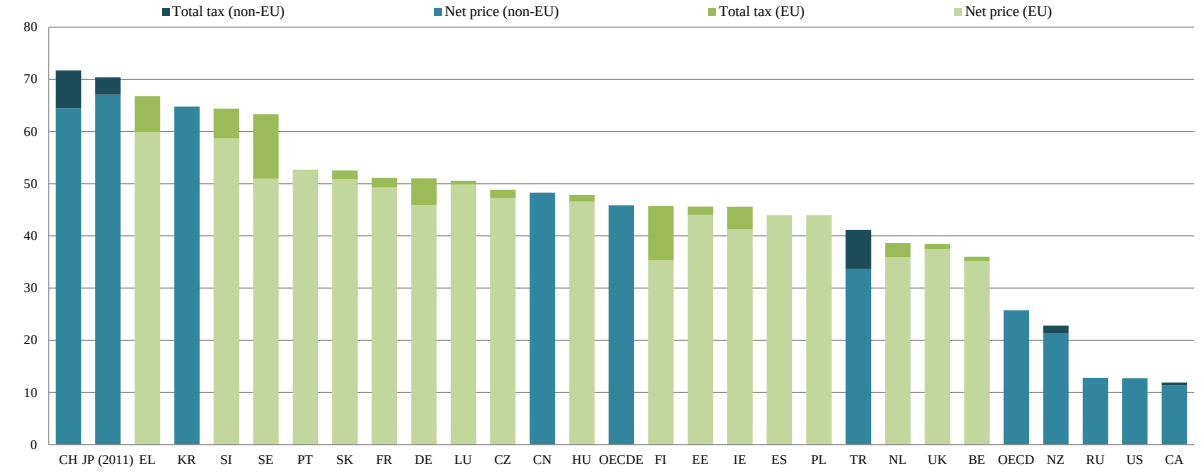
But the pass-through to end-user prices for industry has been generally cushioned by other (less volatile) end-price components such as transport and distribution costs and margins, which are typically regulated. In particular, regulated gas transport costs, which are usually relatively stable, account for a significant share of the final price. As a result, although the price paid for gas by final consumers often increased as much as upstream prices in

Figure 6.2: Oil, gas and electricity prices in OECD Europe, 1980-2012, real index, 2005=100



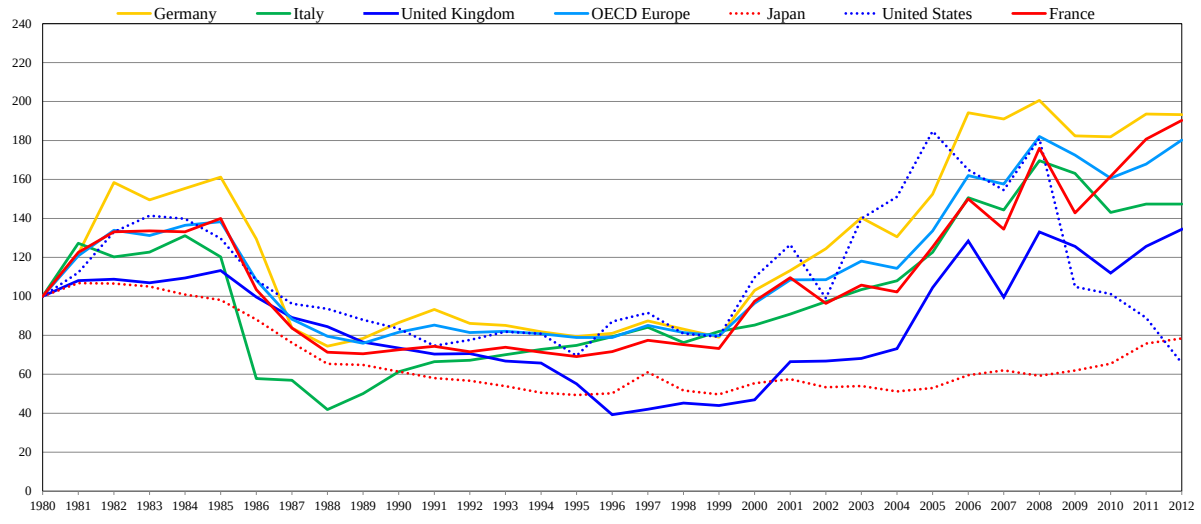
Note: Deflated with PPI. Oil price is crude oil import price for IEA Europe (OECD Europe without Estonia, Iceland and Slovenia); gas and electricity prices are end-user prices for industry.
Source: wiiw calculations based on IEA data.

Figure 6.3: End-user gas price for industry and its components in 2012 by country, in USD/MWh



Source: IEA, national statistics

Figure 6.4: Real gas end-user price for industry, real index 1980 = 100



Note: Deflated with PPI.
Source: own calculations based on IEA data.

absolute terms, the increase in percentage terms has generally been much smaller (Morgan and Emoto, 2007). In addition, the excise taxes on gas which are levied in many Member States have in some cases provided an extra cushion to end-user prices. Since excise taxes are typically specified in volume rather than value terms, an increase in the pre-tax price led to a less-than-proportional increase in the final price – unless the excise tax rate itself was adjusted upwards accordingly (as was the case in Germany). A decomposition of gas prices per country is showed in Figure 6.3.

From 2009 onwards, gas prices in continental Europe de-coupled somewhat from oil prices and initially fell (Figure 6.4). This was caused by the combined effect of weak gas demand in Europe and the shale gas 'revolution' in the United States, as a result of which the country has become almost self-sufficient in terms of gas supply. As a consequence, liquefied natural gas (LNG) shipments from third countries (such as Qatar), which previously targeted the US market, have been re-oriented to markets elsewhere, notably Europe and the Asian-Pacific area. Spot prices paid for LNG have generally been lower than for natural gas shipped through pipelines, putting pressure on traditional gas suppliers such as Russia and Norway, and contributing to the overall downward trend in gas prices in Europe. This pressure resulted in numerous re-negotiations of long-term gas supply contracts in favour of buyers. However, more recently the gas price decline has come to a halt and has even reversed in a number of countries, as LNG's share in European markets

started to fall again due to it being diverted to more lucrative markets in the Asian-Pacific basin.

Unlike in continental Europe, in the United States and the UK the link between oil and gas prices is generally less pronounced. To the extent that it existed historically, it primarily reflected substitution possibilities between oil and gas rather than contractual price links. Upstream gas prices in both the United States and the UK are largely determined by the interplay of supply and demand in the wholesale gas market, with LNG imports playing a relatively important role. This pricing mechanism makes upstream gas prices in these two countries much more volatile than in continental Europe (see for example Corbeau, 2010; Biermann, 2008).[90] In addition, in the United States there is a strong link between wholesale and end-user gas prices. This is partly due to low taxation: unlike in European countries (including the UK), there is no federal excise tax on gas in the United States.[91]

Between 2000 and 2006, gas prices for industry in the United States rose quite fast, largely due to the supply constraints following the 2005 hurricane and a surge in gas demand, as several new gas-fired power stations came on-stream. However, from 2006 they started to fall relative to oil prices, and since 2009 have been falling rapidly also in absolute terms thanks to the steep growth in shale gas supplies. As can be seen from Figure 6.4, the resulting drop in real gas prices for industry in the United States has been dramatic and un-mirrored in other countries and regions (see for example Kefferpütz, 2010). The increased gas supplies in the United States have also been helped by export restrictions: in order to export natural gas, producers need to obtain an export licence from the regulatory authorities. As a result, gas prices for the US industry currently stand at around a quarter of the OECD-Europe average. Restrictions are likely to be relaxed somewhat in the near term and increased exports are expected to boost US gas prices. However, a sizeable price gap will most likely remain vis-a'-vis Europe and Japan (IEA, 2013).

In Japan, the increase in gas prices during the pre-crisis years was much less pronounced than in other countries and regions covered by the present study, largely because of 'in-built' price caps in the formula linking the price of imported LNG to the oil price. However, the price of imported gas nearly doubled in Japan in the post-crisis years after the coal-fired power generation capacities had been largely destroyed in areas hit by the 2007 earthquake and the suspension of nuclear power generation following the 2011 Fukushima disaster (IEA 2013). In addition, the very high level of end-user gas prices for industry in Japan is also due to the absence of tariff differentiation between industrial and residential users, implying a de facto cross-subsidisation of households by industry (Yuying et al., 2013).

Finally, domestic gas tariffs in China and Russia have historically been set with little regard to international energy price developments. In China, gas prices continue to be heavily regulated, with upstream prices and transport tariffs being set by central government and end-user prices by provincial authorities. However, since 2006 the country has become a net gas importer, with more expensive imported gas putting the traditional 'cost-plus' formula under increasing pressure. As with Japan, the high level of gas prices for industry in China also partly reflects the continuing cross-subsidisation between industrial and residential users – the latter generally pay much less than industry.

In Russia, the low gas prices paid by industry help offset the negative impact of poor energy efficiency on industrial competitiveness, particularly in energy-intensive branches which are prominent. To great extent, this low level of tariffs reflects the cross-subsidisation of domestic customers by Russia's state-owned gas monopolist Gazprom at the expense of export shipments (largely to Europe, which is the main export market and where prices are the highest). Although Russia has, since 2006, pursued a programme of gradual domestic tariff hikes, not least because of its WTO-accession commitments, the initial targets have been repeatedly postponed. As a result, the real gas price for domestic industrial users in Russia has increased only moderately in recent years.

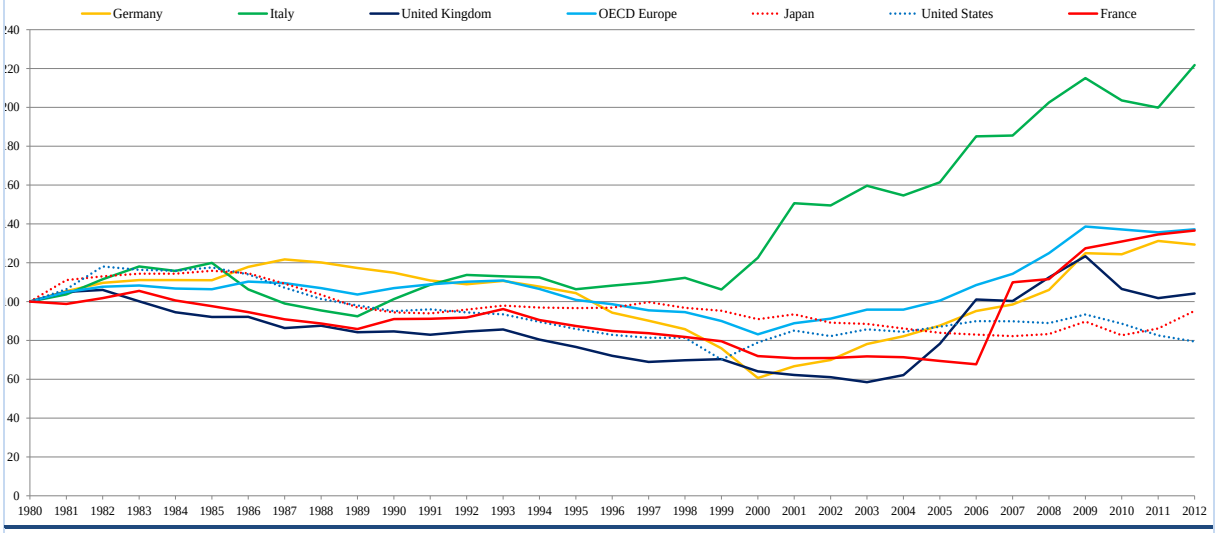
6.1.3. Electricity prices

Between the mid-1980s and the beginning of the 2000s, trends in real industrial end-user prices for electricity in the EU, the United States and Japan were largely similar, showing an overall declining trend (Figure 6.5). From 2000, industrial electricity prices started to rise in the EU, China and the United States, while they continued to fall in Japan. In the EU, the price rise was tremendous, with prices in 2012 some 40% above the 1980 level, and differences between Member States growing considerably. In the United States, instead, electricity prices rose only modestly and started to fall in 2010 as a result of the boom in the production

[90] This price volatility has a high-frequency nature (monthly and even daily) and therefore cannot be seen from Figure 2.4 which is based on annual data.

[91] However, some US states impose taxes on oil and gas production (often called 'severance' or 'conservation' taxes), which are sometimes paid by the gas purchaser. As of 2012, 31 US states levied such taxes (National Conference of State Legislatures, 2012).

Figure 6.5: Real electricity end-user price for industry, real index 1980=100



Note: Deflated with PPI.
Source: IEA.

of shale gas, which has increasingly been replacing coal in power generation. By 2012, real electricity prices in the United States were some 20% below the 1980 level, whereas in Japan they were nearly as high as in 1980.

As a result of these developments, electricity price differences across the world regions have widened over the past 12 years. While nominal electricity prices are highest in Japan and lowest in Russia, the gap between Europe and China on the one hand and the United States on the other hand, has widened dramatically. In 2012, European electricity prices stood on average at USD 147 per MWh – one quarter below Japan's level but some 30% higher than in China and double the US and Russian level. Interestingly, the wider price gap between Europe and the United States can be attributed only partly to the recent shale gas revolution, which did not take effect until the end of the 2000s: the bulk of the gap dates back to the pre-crisis years and is due to price growth in Europe. The most likely explanation for this gap is the sharp increase of network costs (+21% for industrial consumers in the period 2008-2011) and electricity taxation (+67%) in the EU, as documented in European Commission (2014a, 2014b), with end-user prices increasing more than wholesale prices. Table 6.1 shows price changes for each component at the Member State level.

In its *New Policies Scenario of the World Energy Outlook 2013*, IEA projects that the gap in industrial electricity prices between the United States on the one hand and the EU and China on the other hand will continue to widen modestly (IEA, 2013). By 2035, electricity prices in the EU are projected to increase by 24% and become the highest among the major industrialised countries.

Figure 6.6 shows a wide variation in electricity prices for industry not only between the European Union and other major economies, but also within the EU, with the highest prices observed in Cyprus, Malta and Italy, and the lowest in Sweden, Finland, Estonia, Bulgaria and Romania. For instance, electricity prices in Cyprus are three times higher than those in Sweden. The figure also shows that in most EU Member States, energy and supply prices are the most important component of electricity end-user price for industry. However, network costs make up almost 60% of the price in Lithuania and the Czech Republic, and about 50% in Slovakia, Denmark and Latvia. Finally, national taxes and levies are highest in Germany and Italy, accounting for 32% and 30%, respectively, of the electricity price. By contrast, no taxes and levies for industrial electricity consumers are charged in Lithuania, Malta, Latvia and Romania.

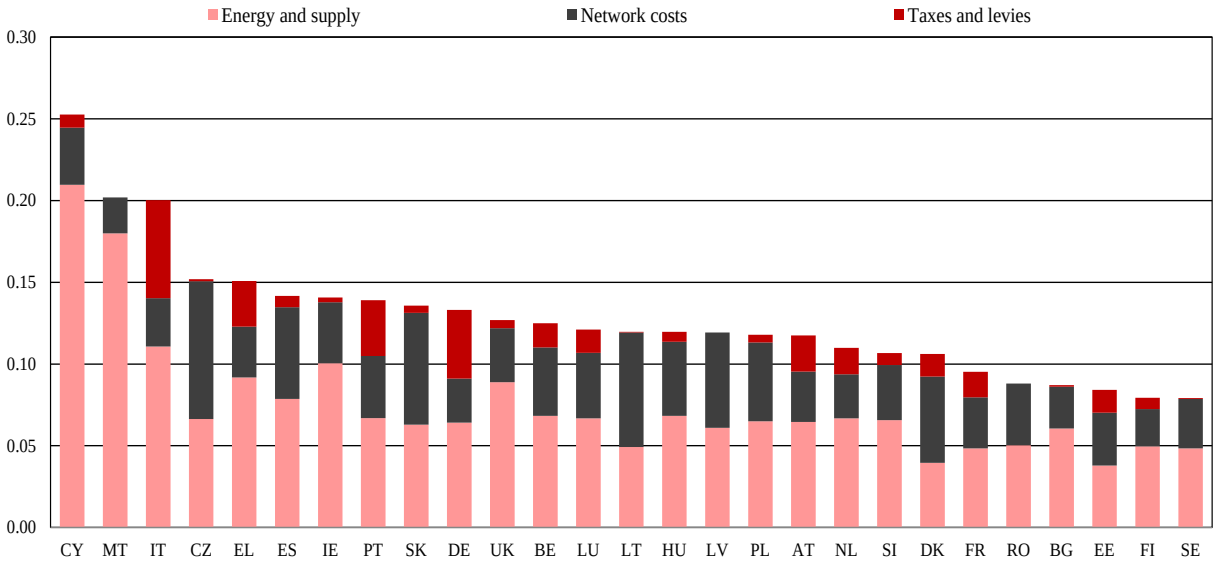
Overall, industrial electricity prices increased between 2008 and 2012 in most EU Member States, with the exception of Romania, Slovenia, Hungary, Denmark and the Netherlands. Price increases were lowest in Slovakia and Sweden with 2% and 4%, respectively, but reached about 17% in Germany, and were even higher in Latvia and Estonia (30%). Table 6.1 demonstrates that these price increases were driven largely by the sharply rising network costs and taxes and levies, while energy and supply costs even went down in a number of countries. For instance, energy and supply costs in Germany fell by

Table 6.1: Electricity price developments in the EU countries, 2008-2012, cumulative % change

	Energy and supply	Network costs	Taxes and levies	Total Price
Austria	-8.4	28.7	48.1	8.4
Belgium	-13.2	33.0	9.4	4.2
Bulgaria	16.2	42.8	100.0	23.8
Cyprus [1]	38.7	0.9	1.3	30.0
Czech Republic	-14.6	39.5	-8.3	8.3
Denmark	-40.7	81.7	3.0	-2.5
Estonia	32.3	5.0	174.5	30.9
Finland	3.9	24.2	169.2	16.1
Germany	-10.4	3.4	204.2	17.2
Greece [2]	20.9	-7.3	157.4	26.2
Hungary	-17.8	-7.9	158.3	-11.1
Ireland [2]	11.5	-5.1	540.0	8.0
Italy	1.7	18.4	143.0	26.6
Latvia	12.7	60.8	0.0	32.0
Lithuania [1]	6.5	15.4	-91.3	7.3
Luxembourg [3]	2.0	2.3	-2.3	1.9
Malta	15.3	0.0	0.0	13.4
Netherlands	-15.3	32.2	18.4	-1.7
Poland	29.9	-1.2	-15.8	12.9
Portugal	17.5	46.7	30.3	27.6
Romania	-15.6	-17.1	0.0	-16.3
Slovakia	-18.9	22.6	528.6	2.0
Slovenia	-19.7	-6.4	102.9	-12.0
Estonia	-2.6	85.8	24.6	23.9
Sweden	-11.7	34.0	20.0	3.8
UK	9.5	42.5	17.8	17.1

Note: Consumption band IB: 20 MWh < Consumption < 500 MWh. 1) 2010-2010.- 2) 2009-2012.- 3) 2007-2011.
Source: Eurostat.

Figure 6.6: Weighted average electricity price for industrial consumers in EU Member States 2012, EUR/kWh



Note: Weighted average electricity price based on the electricity consumption data from WIOD (2007/2008) weighted by the number of enterprises taken from Eurostat.
Source: Eurostat, WIOD and wiiw calculations.

10%, while network costs increased by 3%, and taxes and levies by as much as 204% over this period. However, in the absence of a harmonised reporting methodology for breaking down electricity prices into individual cost components any cross-country comparisons should be treated with caution.

One important factor explaining the absolute levels and dynamics of electricity prices is the **generation mix**. Although this is quite diverse across the EU, with coal (25%), gas (24%), nuclear power (27%) and renewables (21%) each providing about a quarter of total supply, the average figure masks large differences among Member States (Figure 6.7). In some countries, electricity generation is dominated by just one fuel: petroleum products in Cyprus and Malta (100%), coal in Estonia and Poland (about 86%), nuclear power in France (75%), whereas in Germany, Denmark, Spain, Finland, Hungary, Romania and Slovenia, for example, the electricity generation mix is much more diversified.

These differences in the generation mix affect several components of the electricity price. For instance, energy and supply costs are determined by the variable costs of electricity generation, which are nearly negligible for renewables, but higher for nuclear power, followed by coal, natural gas, and petroleum products. The high level of industrial electricity prices in Cyprus and Malta is entirely explained by the use of petroleum products in electricity generation, which drives energy and supply costs upwards. In contrast, countries such as France or Denmark, which derive the bulk of their electricity from nuclear power and renewables, respectively, have correspondingly low energy and supply costs. The renewables boom in Denmark in recent years also explains the impressive drop in its costs of energy and supply (by 40% between 2008 and 2012, see Table 6.1).

The growing role of **renewables** has been to a large extent facilitated by targeted EU support schemes such as 'feed-in tariffs', which guarantee preferential rates for renewable electricity provided to the grid and represent long-term contracts, e.g. 20 years in the case of Germany. The tariffs are usually paid by electricity consumers and linked to their consumption. The costs of support for renewables are added to the electricity price either in the form of network charges (i.e. Denmark) or through taxes and levies (e.g. in the UK or Austria), often compensating the low energy and supply costs associated with renewables used for electricity generation. Thus, the net price effect for the electricity end-user depends on who bears the costs of support for renewables and may differ across EU Member States. For instance, in Germany energy-intensive industries pay sharply reduced renewable surcharge rates, while self-generation is exempted altogether (Folkers-Landau, 2013). For these industries, renewable energy may therefore well be cheaper than energy from fossil fuels (Sensfuß, 2011; Kubat and Kennedy, 2011). Renda (2013) compared support costs for the aluminium industry in selected countries and found that in 2012 aluminium smelters in Italy paid twice as much for electricity as those in Germany, France, Greece or Slovakia (see also Section 6.1.4).

In addition, the EU **Emissions Trading Scheme** (EU ETS) might lead to higher costs – both direct and indirect (through higher energy prices) – for energy-intensive sectors. However, there is no compelling evidence so far of this having resulted to any "carbon leakage", i.e. increase in the carbon emissions of a non-EU country due to relocation of production activities outside the EU. Protective measures that have been put in place, free allocation, and the allowed use of cheaper international credits, have proven to be effective. There is also the possibility for Member States to provide state aid to compensate for the indirect carbon cost for the most electro intensive sectors (European Commission, 2012a).

If not matched by corresponding gaps in energy intensity levels, cross-country differences in energy prices may have significant repercussions on production costs and industrial competitiveness. For instance, cheap energy in the United States, particularly when it comes to natural gas, more than compensates for the relatively high energy intensity of US manufacturing (which is only about 20% higher than in the EU – see Section 6.2.2) and potentially represents an important competitive advantage for US producers, particularly in energy-intensive branches. With respect to EU's other major competitors, energy cost competitiveness is likely to be less of an issue. In Russia, cheap energy is compensated by the very high energy intensity of production, whereas in both China and Japan energy prices are at least as high as in the EU and, in the case of China, are coupled with a much higher energy intensity of manufacturing.[92] At the same time, the potential energy cost disadvantages to Chinese industrial producers are probably counteracted by other cost factors such as cheap labour.

6.1.4. Sub-sectoral analysis

The data sources used for the analysis above do not allow for a granular analysis of specific industries. Even the 2-digits NACE classification used in most of the following sections hide a high level of

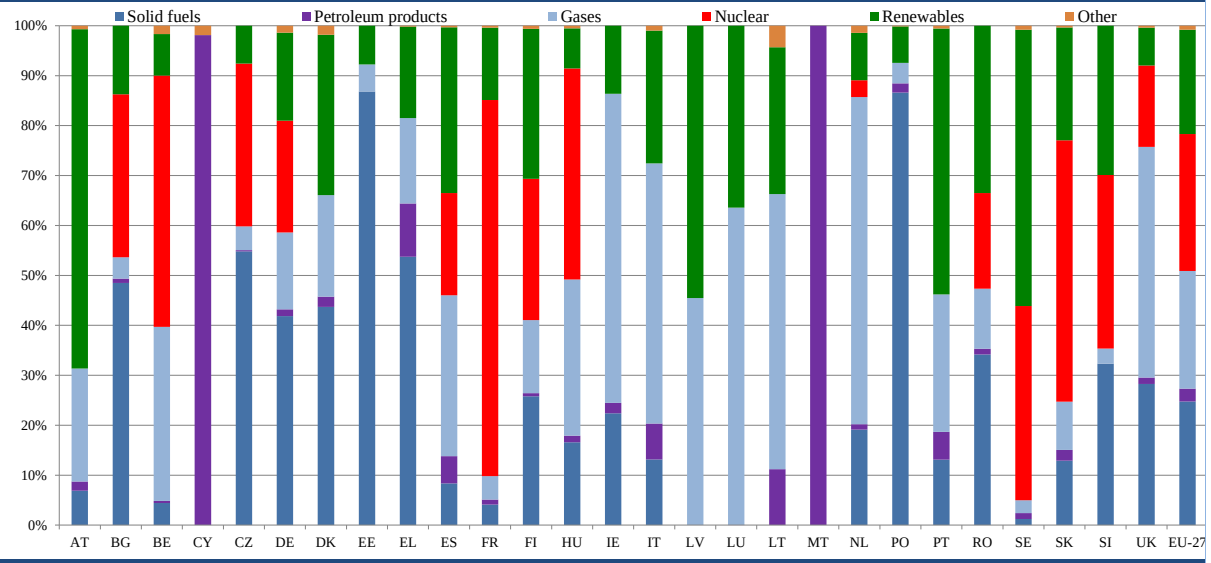
[92] Excluding NACE Rev. 1 23 (coke, refined petroleum and nuclear fuel).

heterogeneity within sectors. In particular, the price of energy products is a crucial variable for the competitiveness of energy intensive industries, which deserve a more detailed analysis. Data extracted from CEPS (2013a, 2013b, 2014a, 2014b) show that industrial energy prices are highly influenced by one-to-one bargaining between facilities and energy suppliers. The actual prices paid vary on the basis of many factors, like the duration of the procurement contract and the consumption level of the facility.

Table 6.2 shows the energy prices faced by the surveyed industries for the year 2012 highlighting a large heterogeneity across sectors. Looking at the price growth between 2010 and 2012, though, we can see that almost all sectors experienced a price increase above 30% for their dominant energy source, either natural gas or electricity (dominant source indicated by a star).

Interestingly, there is also large heterogeneity within sectors. The case of aluminium producers is an interesting example (See CEPS, 2013a). As shown above, aluminium production relies on electricity as its main energy source (it accounts for 30% of total production costs). In Figure 6.8, facilities are classified according to their sensitiveness to energy market conditions. A first, highly sensitive group

Figure 6.7: Electricity generation mix in the EU Member States, 2010



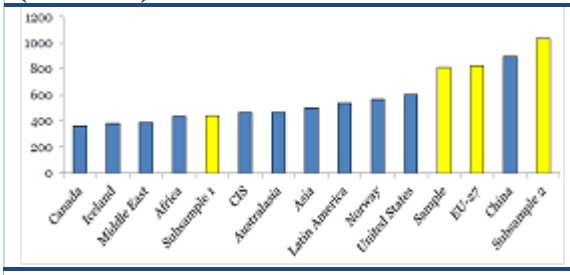
Source: European Commission Energy-Country Factsheets 2012.

Table 6.2: Energy prices for selected Energy Intensive Industries (2012)

Industry	Electricity price (€/MWh)	Growth (2010-2012)	Natural gas price (€/MWh)	Growth (2010-2012)
Basic Metals				
Aluminium	-		-	
Steel	71.4*	32%	32.2	7%
Chemicals				
Ammonia	71.1	11%	31.2*	41%
Chlorine	56.4*	-5%	-	-
Other Non-Metals and Mineral Products				
Bricks and Roof Tiles	102.4	13%	39.5*	30%
Wall and Floor Tiles	97.6	21%	31.7*	27%

*Note: Growth refers to the period 2010-2012. * indicates the main energy source for the industry*
Source: Data extracted from CEPS (2013a, 2013b, 2014a, 2014b).

Figure 6.8: Power costs per tonne of aluminium (USD 2012)



Source: CEPS (2013a).

Table 6.3: Energy cost shares in basic prices (in % of gross output)

	Total economy				Manufacturing				Manufacturing*			
	1995	*2000*	*2007*	*2011*	*1995*	*2000*	*2007*	*2011*	*1995*	*2000*	*2007*	*2011*
EU-27	3.0	3.2	4.1	4.6	3.8	4.8	6.3	7.5	2.3	2.2	2.8	3.0
China	5.2	5.9	7.7	7.7	6.2	7.0	7.8	8.1	4.4	4.7	5.7	5.9
Japan	2.8	3.3	4.8	5.1	3.4	4.6	7.3	8.0	2.9	3.3	4.6	5.4
US	2.8	3.6	4.6	4.6	4.8	6.5	10.2	11.3	2.3	2.8	3.1	2.9

*Note: * not including NACE Rev. 1 23 coke, refined petroleum and nuclear fuel.*
Source: WIOD; wiiw calculations.

can be defined that meets its demand entirely via the market but is not on long term arrangements with electricity suppliers. This is labelled as Subsample 2 in the figure. A second, less sensitive group procures electricity through long-term contracts or relies on self-generation (labelled as Subsample 1). The first group suffers particularly high costs compared to the second, paying prices that can be as high as twice those paid by the second group. When compared with international competitors, we can see that such price difference produces very different rankings for the two types of facilities: plants with long-term procurement contracts are comparable to the cheapest power cost countries, whereas plants with short-term contracts show the highest power costs among international competitors.

6.2. ENERGY COST SHARES AND ENERGY INTENSITIES

6.2.1. The relevance of energy cost shares and other input factors

The purpose of this section is to provide a comparative analysis, at country and industry level, of the relevance of energy costs in production and the patterns of energy efficiency across countries and over time. The first step is to compare energy cost shares in gross output relying on the national supply and use tables, which provide information on inputs by energy product: coal (CPA 10); crude oil and natural gas (CPA 11); coke, refined petroleum and nuclear fuels (CPA 23); and electrical energy, gas, steam and hot water (CPA 40). Data are available from the WIOD project (www.wiod.org). Though these comparisons highlight an important aspect of cost competitiveness, it should be stressed that several other dimensions can affect the international performance of firms, including the quality of products, product differentiation, etc. These aspects are strictly related to the quality of the workforce and their skills and training, but also to provisions of high-quality intermediates and geographic factors such as proximity to consumers.

Table 6.3 shows **energy cost shares** for the EU-27 and other major economies over the period 1995-2011. The cost shares are reported for the total economy, the manufacturing industries and the manufacturing industries excluding the sector Coke, refined petroleum, and nuclear fuel (NACE Rev. 1 23). The analysis excluding this sector is interesting because the bulk of energy inputs are used in it as feedstock rather than energy source. The cost shares are calculated in basic prices, thus excluding taxes and margins.[93] These figures reveal some important points. For the EU-27, the energy cost share in 2011 stood at 4.6% for the total economy. This is broadly in line with Japan (5.1%) and the United States (4.6%). Only China shows a higher energy cost share with 7.7%. However, for manufacturing the energy cost share in the EU-27 (7.5%) is more in line with Japan (8.0%) and China (8.1%), while the United States shows a much higher share of 11.3%. Energy cost shares in manufacturing (NACE Rev. 1 15-37) tend to be higher as compared with the total economy due to the generally low energy intensity of the services sectors (although the transport industry, for example, is energy-intensive). In nearly all cases, energy cost shares have been on the rise over the time period considered. It is also worth noting that, in manufacturing, energy cost shares increased in the United States (+6.5 pps) and Japan (+ 4.6 pps) more than in the EU-27 (+ 3.7 pps) and China (+ 1.9 pps).

However, these results are quite sensitive to the inclusion of the sector Coke, refined petroleum and nuclear fuel (NACE Rev. 1 23). When excluding it, the energy cost shares drop to about 3% in the EU-27 and 2.9% in the United States, but are higher in China (5.9%) and Japan (5.4%). Also in this case, energy cost shares have increased over time, although much less than when the production of coke, refined petroleum and nuclear fuel is included.

At the level of aggregation used for this analysis, energy costs are smaller than other industrial inputs but comparable in size to, for instance, agricultural inputs or transport and communication (Table 6.4). Cost shares would be somewhat different when using purchaser prices: shares tend to be higher, with

[93] This allows for a better international comparison, since not all countries report data in purchaser prices (i.e. including domestic tax and trade and transport margins, see Timmer et al., 2012, for details).

differences of 1-2 percentage points on average: for example, the energy cost shares for the EU-27 were 5.6% in 1995 and 7% in 2011 for the total economy and about 4% in both years in manufacturing (not including NACE Rev. 1 23).[94]

Chemicals and chemical products). Japan and China show much higher energy cost shares in Chemicals and chemical products (NACE Rev. 1 24), Other non-metallic mineral (NACE Rev. 1 26), and Basic and fabricated metals (NACE Rev. 1 27-28). Not

Table 6.4: Structure of production costs for Manufacturing industries (excl. NACE Rev. 1 23), in % of gross output by type of input, 2011

	Energy	Agriculture etc.	Mining and utilities	Low- tech	Medium-low-tech	Medium-high- and high-tech	Construction	Non tradable market services	Transport and communication	Business services	Non-market services	Value added
EU-27	3.0	3.2	0.9	6.7	13.7	14.9	0.4	12.2	3.4	9.2	0.3	32.1
China	5.9	5.7	3.2	12.3	17.4	23.8	0.0	4.3	2.5	3.2	0.3	21.3
Japan	5.4	3.1	0.7	6.2	17.1	19.9	0.5	8.2	2.6	5.6	0.1	30.6
US	2.9	5.3	0.7	7.8	11.2	14.7	0.4	7.6	2.7	10.3	0.1	36.5

Source: WIOD; wiiw calculations.

Table 6.5: Energy cost shares by manufacturing industry in basic prices (in % of gross output)

	EU-27		China		Japan		US	
	1995	*2011*	*1995*	*2011*	*1995*	*2011*	*1995*	*2011*
Food, Beverages and Tobacco	1.7	2.5	1.3	1.5	1.5	2.3	1.8	2.0
Textiles and Textile Products	2.2	3.1	1.2	2.2	2.2	3.3	1.7	2.2
Leather, Leather and Footwear	1.1	1.4	0.5	1.2	1.6	2.0	1.2	0.8
Wood and Products of Wood and Cork	2.0	2.8	3.1	3.1	1.9	2.5	2.1	3.1
Pulp, Paper, Printing and Publishing	2.5	3.2	3.8	3.6	3.4	4.8	2.4	3.2
Coke, Refined Petroleum and Nuclear Fuel	47.8	62.0	56.9	72.2	20.8	47.0	62.2	67.9
Chemicals and Chemical Products	4.4	7.4	9.9	18.9	6.8	13.1	5.9	7.8
Rubber and Plastics	2.5	3.5	2.8	3.3	3.1	3.3	3.0	2.5
Other Non-Metallic Mineral	5.6	7.4	10.5	15.5	9.2	16.8	4.6	5.8
Basic Metals and Fabricated Metal	3.7	4.1	7.7	9.8	4.4	10.2	3.3	4.2
Machinery, n.e.c.	1.2	1.3	2.8	3.5	1.2	1.5	1.1	1.0
Electrical and Optical Equipment	1.0	1.1	1.3	1.4	1.6	2.2	1.3	0.5
Transport Equipment	1.2	1.1	1.8	1.6	1.2	1.6	0.7	0.8
Manufacturing, n.e.c.; Recycling	1.4	2.1	1.9	1.9	2.0	3.0	1.2	0.8

Source: WIOD; wiiw calculations.

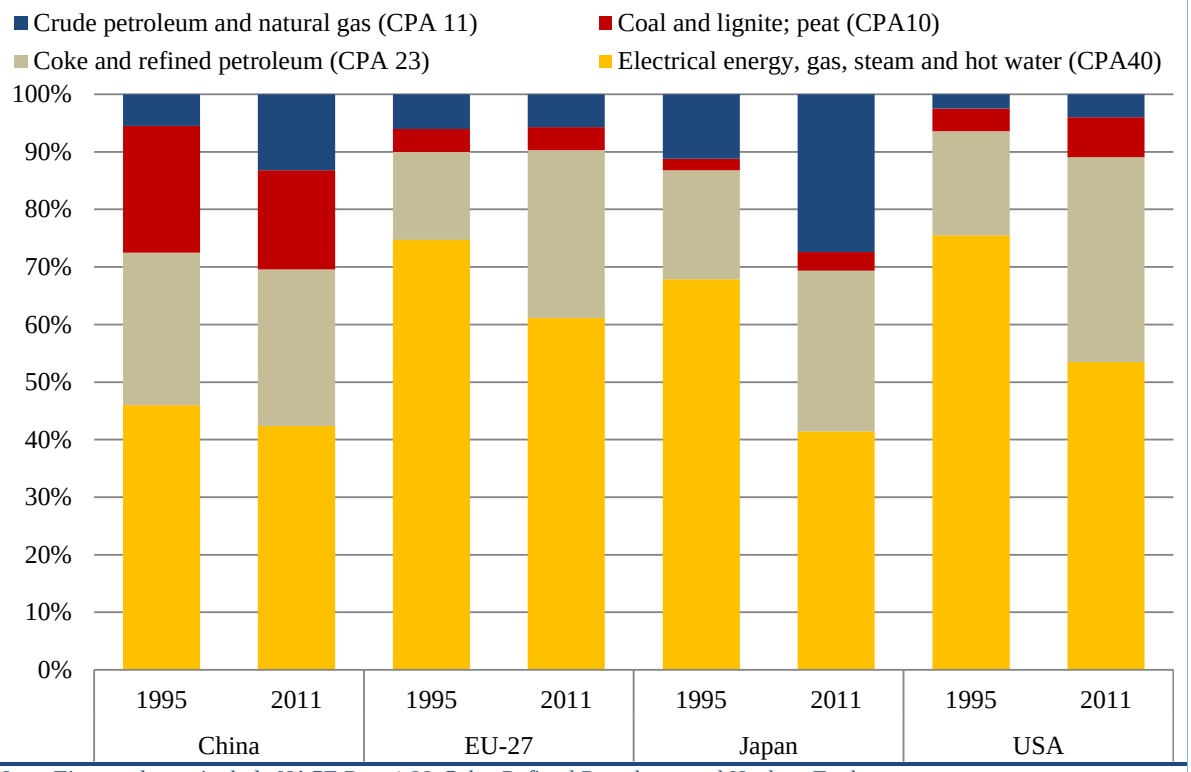
There are large sectoral differences beyond these aggregate numbers. Table 6.5 shows energy **cost shares by industry** at the 2-digit level of sectoral aggregation in NACE Rev 1 for the EU and its major competitors. In the EU-27, cost shares range between about 1% in Transport equipment, Electrical and optical equipment and Machinery and 7% in Chemicals and Other non-metallic mineral products. In the United States, energy cost shares are lower than in the EU-27 in almost all industries (important exceptions are NACE Rev. 1 20, Wood and products of wood; and NACE Rev. 1 24, surprisingly, industry NACE 23 (Coke, refined petroleum and nuclear fuels) has a much larger energy cost share, ranging from 47% in Japan to more than 70% in China. The EU-27 (62%) has a lower share than the United States (68%).

An analysis of the evolution of **Real Unit Energy Costs** (RUEC) for these fourteen manufacturing subsectors (European Commission 2014a) confirms the existence of substantial heterogeneity both across subsectors and Member States. The sectors with the highest RUEC are Coke, refined petrol and nuclear fuel, Chemicals, Other non-metallic minerals, Basic metals and Rubber and plastics. The sector Coke, refined petroleum and nuclear fuel is characterized by high RUEC also in comparison to other countries and its growth rate is among the

[94] Note that for the US data are only available in basic prices (see Timmer et al., 2012 for details).

highest ones. For Chemicals, Other non-metallic minerals, Basic metals and Rubber and plastics, RUEC levels in the EU are generally comparable here (EU-27, Japan and United States), though they generally increased over time. Looking at manufacturing (NACE Rev. 1 15-37) only, the energy cost shares are higher, though this depends

Figure 6.9: Structure of energy costs by CPA categories in manufacturing (excl. NACE Rev. 1 23) in the major economies. Costs in % of total energy costs, 1995-2011



Note: Figures do not include NACE Rev. 1 23 Coke, Refined Petroleum and Nuclear Fuel.
Source: WIOD; wiiw calculations.

with those of Japan, but are higher than the US. In other sectors, the EU RUEC fares better on an international level. For example in the wood and wood product sector, the RUEC is the second lowest in 2009 (after Japan).

Countries also differ with respect to the structure of energy cost shares according to the four CPA categories used here (Figure 6.9). In the EU-27, the largest, but decreasing cost share is due to Electrical energy, gas, steam and hot water (CPA 40) followed by Coke and refined petroleum (CPA 23), whose share is, instead, increasing. The other two categories account for only 4% (Coal) and 5.7% (Crude oil and gas). This pattern is rather similar in other advanced countries, as the United States and Canada, which have a higher share of coke. Japan is different, with the share of Electrical energy, gas, steam and hot water (CPA 40) standing at about 40%, and those of Crude oil and gas (CPA 11) and Coke and refined petroleum (CPA 23) at about 27%.

Summing up, at the level of large sectoral aggregates, energy cost shares are smaller than other industrial inputs, standing at slightly less than 5% of gross output in the advanced countries considered heavily on the inclusion of coke, petroleum and nuclear fuel (NACE Rev. 1 23). Excluding this industry from manufacturing reduces overall energy cost shares to about 3%, which is even less than the energy cost share for the total economy. However, a more disaggregated analysis would reveal that some industries and firms face much larger energy costs (see, for example, Renda, 2013; Riker, 2012).

6.2.2. Energy intensities

This section focuses on changes in energy intensity, i.e. energy use divided by value added, over time and across countries. As well as supply-use and input-output tables, the WIOD provides energy accounts, i.e. energy flows (gross energy use) in terajoules (TJ), with the same country and industrial coverage from 1995 to 2009. This enables us not only to describe general patterns, but also to study the changes in energy efficiency by means of decomposition analysis. The aim is to disentangle changes in energy usage per unit of output into an energy intensity effect, i.e. changes in energy intensity at constant industrial structures, and a structural change effect, i.e. changes in overall intensity due to structural shifts.

Energy intensity is measured as terajoules divided by value added in constant 2005 prices, and converted with PPP rates for 2005. The figures are, to a certain extent, sensitive to measurement issues, particularly for countries like China. First, calculating energy intensity as a ratio to gross output tends to indicate lower energy intensities in China due to the relatively lower share of value added in gross output, (see Table 6.4). Secondly, in this chapter, PPPs rather than exchange rates have been used to convert value added to a common currency, since the Chinese exchange rate is strongly undervalued.[95] It should be noted, however, that the choice between exchange rates and PPPs does not affect the results of the decomposition analysis reported below.

in the EU-27 and up to 34.6 in the United States. This is not surprising as manufacturing industries tend to be more intensive in energy use than services (with the exception of transport services). As for the total economy, these levels have decreased substantially since 1995. Considering manufacturing without Coke, refined petroleum and nuclear fuel industry, the energy intensity levels are only slightly higher than for the total economy, with the same patterns and dynamics observable.

Surprisingly, in manufacturing (including NACE Rev. 1 23) China's energy intensity is even lower than that of more advanced countries due to a much lower energy intensity in NACE Rev. 1 23. However, when considering manufacturing without this sector, the energy intensity in China is higher

Table 6.6: Energy intensities (TJ per million USD of value added in PPPs 2005), 1995 and 2009

	Total economy		Manufacturing		Manufacturing*	
	1995	2009	1995	2009	1995	2009
EU-27	10.4	7.8	31.1	24.6	12.2	9.1
EU-15	9.8	7.6	30.1	25.9	11.0	9.4
EU-12	15.8	9.7	39.1	18.7	23.4	7.8
China	20.4	13.6	38.3	20.4	26.4	13.3
Japan	9.5	8.3	25.0	22.9	11.2	9.9
US	13.1	9.0	46.7	34.6	16.4	11.1

*Note: * not including NACE Rev. 1 23 coke, refined petroleum and nuclear fuel.*
Source: WIOD; wiiw calculations.

As with cost shares, there are substantial differences when considering the manufacturing sector only and depending on whether NACE Rev. 1 23 (Coke, refined petroleum and nuclear fuel) is included. Table 6.6 shows energy intensities for the total economy, manufacturing and manufacturing excluding NACE Rev. 1 23, now also differentiating between EU-15 and EU-12 countries. At the total economy level, energy intensities in 2009 were the lowest in the EU-15 and the EU-12, while in Japan and the United States they were above the EU-27 level by 6% and 15%, respectively. China shows a level almost double that of the EU-27. Notably, energy intensity decreased in all regions and countries considered, particularly so in the EU-12 (from 15.8 to 9.7 TJ per million USD) and China (from 20.4 to 13.6 TJ per USD million). Considering manufacturing only, in 2009 energy intensity levels are much higher, ranging from around 20 TJ per USD million in the EU-12, China and Japan, to 25.9

than in the more advanced countries. Similarly, the energy intensity of manufacturing in the EU-12 is lower than in the EU-15. The higher energy intensity in US manufacturing as compared with the EU-27 is explained by the larger share of industry NACE Rev. 1 23 in the United States (about 10% versus 3% in the EU-27). However, even without this industry, the energy intensity of manufacturing in the EU-27 is still lower than in the US, which also holds for almost all individual sectors.

As seen above, energy intensities have tended to converge across countries and within the EU-27 in particular. Such convergence can be driven simultaneously by two factors: first, energy intensities in each industry might decline; second, the structure of the economy may shift towards less energy-intensive activities or industries. To analyse this in more depth, the **log mean Divisia index** is applied (see Ang, 2004; Mulder and deGroot, 2012) whereby changes in energy use per unit of output

[95] The ratio of exchange rate to PPP (defined as USD per national currency unit) in China in 2005 stood at 0.42. A sensitivity analysis is provided in the background study to this chapter. European Commission (2014a) provides results using market exchange rates. A more appropriate choice would be to use sectoral PPPs, which are however not available. Lacking better data, neither of these choices is perfect, so the results have to be interpreted with caution given these statistical shortcomings.

Table 6.7: Results from decomposition analysis of changes in energy intensity

Annualised growth rates in %, 1995-2009

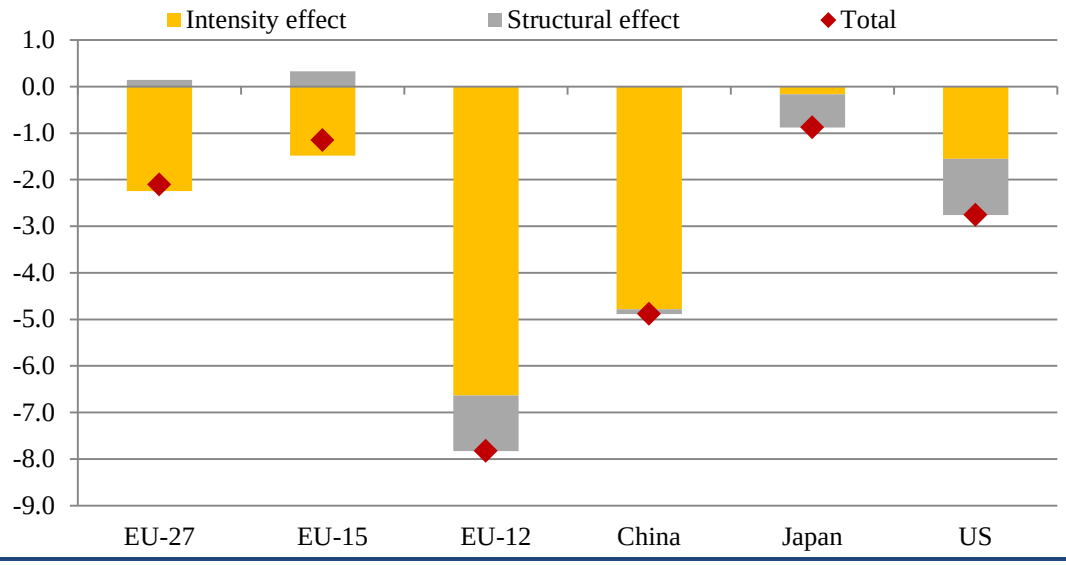
	Total economy			Manufacturing			Manufacturing*		
	Total	Intensity effect	Structural effect	Total	Intensity effect	Structural effect	Total	Intensity effect	Structural effect
EU-27	-2.1	-0.5	-1.5	-1.7	-0.5	-1.2	-2.1	-2.2	0.1
EU-15	-1.9	-0.7	-1.1	-1.1	-0.8	-0.3	-1.2	-1.5	0.3
EU-12	-3.5	-0.8	-2.7	-5.3	-1.5	-3.8	-7.8	-6.6	-1.2
China	-2.9	-4.0	1.1	-4.5	-4.3	-0.2	-4.9	-4.8	-0.1
Japan	-1.0	0.2	-1.1	-0.6	1.1	-1.7	-0.9	-0.2	-0.7
US	-2.6	-3.0	0.4	-2.1	-5.3	3.2	-2.8	-1.5	-1.2

*Note: * not including NACE Rev. 1 23 Coke, Refined Petroleum and Nuclear Fuel.*
Source: WIOD; wiiw calculations.

can be split into **intensity** and **structural** effect. The numbers in Table 6.7 indicate the average annual changes in percentage terms.[96] The analysis shows that for China and the US, the intensity effect is stronger relative to the structural effect across all sample specifications. For all other countries, the structural effect dominates for the total economy. Looking at manufacturing only, in the EU the decline was mainly driven by the EU-12 Member States, with the structural effect being relatively more important.

However, the relative importance of the structural versus the intensity effect is sensitive to the inclusion of the most energy-intensive sector NACE Rev. 1 23 (Coke, refined petroleum and nuclear fuel), which is characterised by declining shares in value added, thus giving more weight to the structural effect. This is highlighted in Figure 6.10 (based on results reported in Table 6.7). For all countries and regions, an increase in overall energy efficiency has been observed. In this case, the intensity effect dominates in all countries except Japan. The structural effect in the EU-15 and EU-27 points towards a shift towards more energy intensive activities, in particular the chemical industry. In the EU-12, Japan and the United States the negative contribution of the structural effect is mostly explained by a strong shift towards higher-tech industries such as Electrical and optical equipment and Transport equipment. Surprisingly, structural shifts relative to intensity reductions are negligible

Figure 6.10: Results from decomposition analysis for manufacturing industries excl. NACE Rev. 1 23
Annualised growth rates in %, 1995-2009

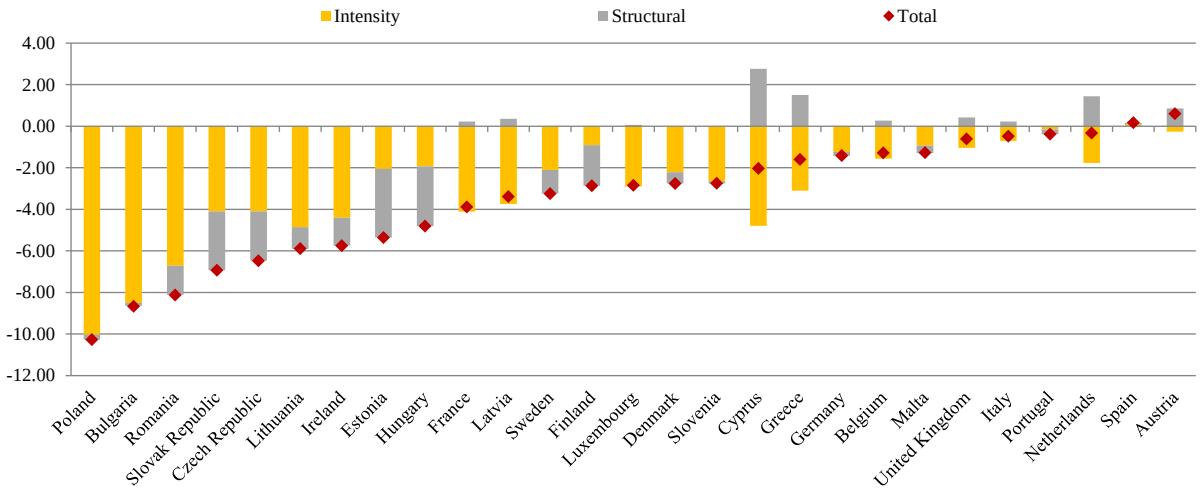


Note: Figures do not include NACE Rev. 1 23 Coke, Refined Petroleum and Nuclear Fuel.
Source: WIOD; wiiw calculations.

[96] European Commission (2014a, 2014b) performed a similar analysis based on real unit energy costs, using the shift-share methodology.

in China. The reason for this is that the initial energy intensity of this industry was rather high, despite a significant shift towards the Electrical and optical equipment sector over this period. For this reason,

Figure 6.11: Results from decomposition analysis for manufacturing industries excl. NACE 23 in EU Member States. Annualised growth rates in %, 1995-2009



Source: WIOD; wiiw calculations.

efficiency gains in China were easier to achieve, and this explains the declining energy intensity that we see in the data.

Energy intensity changes over time have also been down for individual Member States – see Figure 6.11 for the results for manufacturing (excluding NACE Rev.1 23). As hinted at also by Table 6.7, energy intensity in manufacturing dropped further in eastern European countries, most notably Poland (-10%) and Slovakia (-8.6%), with the declines in most other countries ranging between -7.2% (Estonia) and -5.2% (Latvia). Only Slovenia showed a lower decline of energy intensity of -2.8% per annum. In most east European countries, the intensity effect dominated, though the structural effect also played an important role due to the shift to the higher-tech industries. Exceptions are Poland, Bulgaria and Latvia, where only the intensity effect mattered. In Poland this is because, despite a structural shift away from Textiles and towards Transport equipment, initial energy intensity levels were rather similar, so that the structural shift did not show up in a change in overall energy intensity. Similarly, in Bulgaria the structural shifts were strong but generally between sectors with initially similar levels of energy intensity. In **western European** countries, the changes in the overall energy intensity of manufacturing (excluding NACE Rev. 1 23) were generally less pronounced, up to about -3% with the exception of France and Ireland, with some MS slightly increasing their energy intensity.The intensity effect broadly dominated Western Europe, with the exceptions of Finland and Sweden. In Cyprus, Greece and the Netherlands, the structural effect was even positive. In Cyprus and Greece, there was a strong structural shift towards non-metallic mineral products (and basic and fabricated metals in the case of Greece) which have a relatively high energy intensity. In the Netherlands, a shift towards chemicals and chemical products drove the positive structural effect.

Summarizing, the analysis shows that a strong convergence process has taken place across the major economies and particularly within Europe, where the EU-12 countries have been successful in decreasing their energy intensities (or increasing energy efficiency). For the manufacturing industries excluding NACE Rev. 1 23 (coke, refined petroleum and nuclear fuel), this process has been driven mostly by a technological reduction of energy intensities, although a structural shift towards higher-tech industries has also played a role, particularly in the EU-12 countries. By contrast, in the EU-15 a structural shift towards chemicals and chemical products (NACE Rev. 1 24) has constrained the scope of energy intensity reduction, which has been driven exclusively by technological improvements.

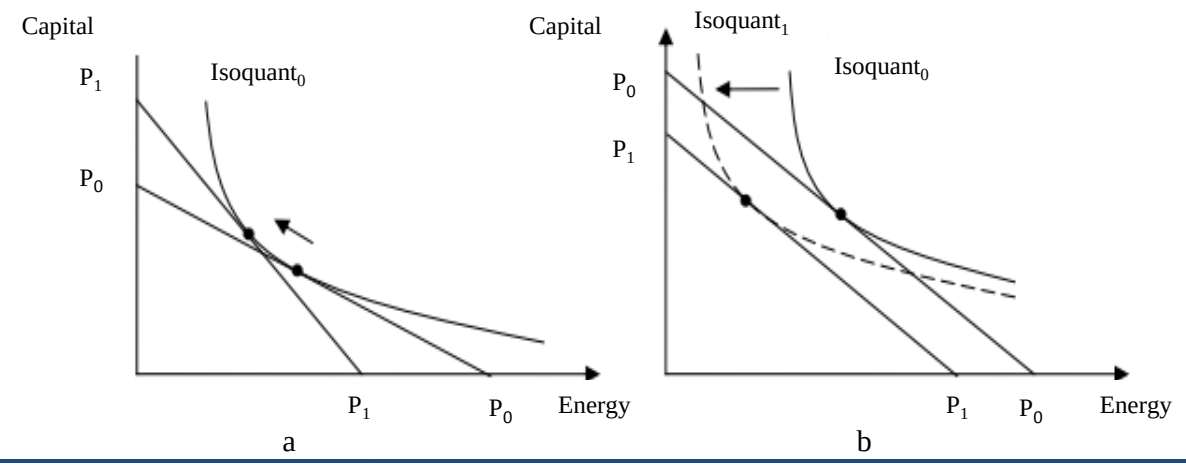
6.3. MEASURING THE IMPACT OF ENERGY PRICES ON ENERGY INTENSITY

The aim of this section is to estimate how individual industries' energy intensity has responded to energy price increases. Using a panel of 30 countries over the period between 1995 and 2009, the price elasticity of energy intensity are estimated, providing an assessment of whether energy efficiency improvements have been sufficient to offset the impact of increased energy prices. The exercise also provide some guidance as to the extent to which energy prices (which can be affected by policymakers e.g. via changes in taxation) can be used as a tool to induce the desired improvements in energy efficiency.

The responsiveness of energy intensity to changes of energy price depends essentially on the expected returns on investment in new energy-efficient equipment. Such a decision trades off higher initial capital costs and lower future energy operating costs. In theory, (See Figure 6.12a), an increase in the price of energy relative to capital induces a partial substitution of energy by capital in producing the same quantity of output (a shift from P_0 to P_1), thus resulting in a new equilibrium. In this case, energy and capital are substitutes. But capital may substitute labour rather than energy and have limited or no impact on energy intensity. Technological developments may also play a role. For instance, technological change (see Figure 6.12b) allows for the use of less capital and less energy at the same time to produce the same volume of output ($Isoquant_0$ shifts to $Isoquant_1$).

future gains from reduced energy consumption outweighs the initial costs of capital investment; in other words, the higher the cost of energy-efficient capital or the lower the energy savings, the less likely a firm is to invest in energy efficiency. For this reason, energy-saving investments in response to energy price increases are likely to be greater in energy-intensive sectors (as, for instance, pulp and paper, chemicals, glass, cement or basic metals). In fact, the massive use of energy magnifies even small price increases, resulting in much bigger gains from reduced energy consumption than in industries consuming little energy. But other factors can also constrain energy-efficient investments. For instance, access to external funds (e.g. bank credit), which may be required to finance investments, may play an important role. Moreover, information asymmetries in terms of the energy-efficient properties of

Figure 6.12: Energy efficiency-improving substitution (a) versus energy-saving technological change (b)



Source: Gillingham, Newell and Palmer (2009).

However, in real life a decision on whether to invest in new energy-saving equipment depends on many factors (a good overview is provided by Gillingham, Newell and Palmer, 2009). For instance, the role of expectations is crucial. If the energy price is expected to stay at a new (higher) level for a protracted period, the willingness to invest in new capital will clearly be greater than if the energy price shock is deemed temporary. Conversely, expectations of persistently lower energy prices may not lead to capital disinvestment. This means that expected lower energy prices may not symmetrically translate into energy efficiency losses. Also relevant are expectations with respect to other factors, such as changes in operating costs relating to energy use (e.g. pollution charges) or the lifetime of the equipment. Clearly, the time horizon for decisions plays a role as well.

Investment in energy-efficient technologies are undertaken only if the discounted present value of

investments, may result in suboptimal levels of energy-efficiency, determining the so called 'energy efficiency gap'.

To quantify the response of industrial energy intensity to energy price shocks, panel-data estimations with country fixed effects were undertaken. The estimation technique was chosen to capture the substitution effects between energy and energy-saving capital investment (seeing e.g. Dahl, 1993). The estimations are based on annual data for 30 countries between 1995 and 2009, sourced from IEA (energy prices) and WIOD (all other variables).[97] As electricity and natural gas are the two most important energy types for most industries,

[97] The panel covers 21 EU Member States (i.e. the EU-28 without Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta and Romania) and 9 non-EU countries: the United States, Turkey, Russia, Mexico, South Korea, Japan, Canada, China and Australia.

separate regressions were run for gas and electricity for each of the fourteen manufacturing industries.[98] The baseline estimating equation is the following:

$$\ln\left(\frac{\text{Energy Use(e)}_{it}}{VA_{it}}\right) = \alpha_1 \ln(RP^{e}_{it-1}) + \alpha_2 \ln(K_{it-1}) + \gamma_c + \text{time\_trend} + \varepsilon_{iet}$$

Where *i* is industry (according to NACE Rev. 1 classification at the 2-digit level), *e* is energy product (electricity or gas); *t* is year; *VA* is industrial value added in national currency at constant 1995 prices; *RP* is the relative energy price (nominal price in national currency/MJoule taken from IEA, deflated with the industry output deflator from WIOD); *K* is the capital stock per employee (at constant 1995 prices); γ is the country fixed effect; and ε is the error term.

Table 6.8 reports the results of the estimations for electricity intensity in the baseline specification, with capital stock per employee and the time trend serving as control variables. The regressions were run for the restricted sample of EU member states and for the full sample. To capture the long-run elasticities, regression were run using a moving average of energy prices over the past five years. The obtained price elasticities of electricity intensity are generally in line with expectations. In the EU-21, the price elasticity coefficient is negative and significant for eight industries, ranging between about -0.3 in Textile and Textile Products and -1.5 in Leather, leather products & footwear (see column 2). Thus, depending on the industry, a 1% increase in the price of electricity (relative to the output price) brings about a 0.3% to 1.5% reduction in the electricity intensity of production.

The regressions were also run using one year lagged prices to capture short-run changes. These can be induced by innovations that do not require large investments or deep restructuring of the production process. Examples could be the optimization of the existing processes, the use of more performing materials as well as behavioural changes. In this case (column 1), the absolute value of the price elasticity of electricity intensity tends to get somewhat smaller, albeit with some exceptions such as Transport Equipment, that is significant only in the short run. This result confirms that energy-efficiency improvements in response to energy price shocks mostly tend to take place with a time delay. [99]

When considering the full sample, the results are overall comparable but elasticities tend to be smaller in absolute terms, suggesting that EU member states performed better in terms of energy efficiency improvements. In particular, this is the case for Leather, Pulp and paper, and Basic metals industries (column 4). In the short-run, elasticities lose significance for some industries, including Textiles, Coke and refined petroleum and Transport

Table 6.8 : Own-price elasticities of electricity by industry

Manufacturing industries, according to NACE Rev. 1	EU-21		Total Sample	
	short-run	long-run	short-run	long-run
	(1)	(2)	(3)	(4)
Food, beverages & tobacco	-0.443***	-0.529***	-0.445***	-0.622***
Textiles & textile products	-0.289***	-0.292**	-0.011	0.211
Leather, leather products & footwear	-0.901***	-1.580***	-0.498***	-0.737**
Wood, products of wood & cork	-0.415***	-0.354	-0.452***	0.057
Pulp, paper, paper products, printing & publishing	-0.284***	-0.614***	-0.215***	-0.442***
Coke, refined retroleum & nuclear fuel	-0.344**	-0.183	-0.072	-0.177
Chemicals & chemical products	0.144	0.208	0.051	0.076
Rubber & plastics	-0.077	-0.177	0.233*	0.402
Other non-metallic mineral	-0.252***	-0.257	-0.216***	-0.345***
Basic metals & fabricated metal	-0.393***	-0.628***	-0.322***	-0.395***
Machinery, n.e.c	-0.446***	-0.427**	-0.240*	-0.360**
Electrical & optical equipment	-0.771***	-0.705**	-0.702***	-0.620**
Transport Equipment	-0.167**	0.017	0.029	0.468**
Manufacturing, n.e.c; Recycling	-0.425***	-0.605***	-0.128	-0.201

Source: own calculations.

[98] The details of the baseline econometric model and of alternative specifications are available in the Background study to this report.

[99] In many cases, the reason for the statistically insignificant own-price coefficients is the large Newey-West standard errors, which were computed to take into account autocorrelation when using the five-year moving averages. Using conventional standard errors instead would result in a total of seven industries exhibiting a negative and significant long-run relationship between gas prices and gas intensity.

industries.

The results for similar regression using natural gas intensity are more mixed, but generally in line with the analysis above. One reason for the different results may be that the WIOD data on gas consumption do not allow for differentiation between gas used for energy purposes and that used as a feedstock. See the background study to this report for a full analysis of the results.

All in all, these results confirm the responsiveness of industrial energy intensity to energy price shocks, with elasticities generally being higher in absolute value in the long run than in the short run. These elasticities are generally in line with, or somewhat higher than, those obtained in earlier econometric studies (Dahl, 1993; Bohi and Zimmerman, 1984). Another interesting finding is that capital investments tend to reduce the electricity intensity even when they are undertaken for reasons other than electricity price shocks.

Alternative specifications of the regression were tried. First, an additional control variable for the prices of alternative energy types (i.e. gas in the regression for electricity intensity, and *vice versa*) was included. Second, an 'outsourcing component' was included to capture the possibility of relocating the energy-intensive parts of the value chain to locations where the energy prices are lower. These specifications yield a number of interesting insights.[100] In particular, while electricity tends to substitute natural gas if the latter becomes more expensive, the reverse is not confirmed empirically. On the contrary, the cross-price elasticities of gas intensity with respect to electricity prices were found to be negative. Also, while virtually no evidence was found of outsourcing to cheaper locations in response to electricity price changes – the achieved improvements in electricity intensity are primarily due to technological rather than structural factors – in the case of natural gas, such 'outsourcing' effects appear to be present in at least some industries, particularly in the short run. Also in this case, the obtained results are highly industry-specific.

The results show that although the obtained own-price elasticities of energy intensity are generally negative and not negligible, even in the long run (at least when taking five years as a measure of the 'long run') their absolute value is in several cases smaller than one. One notable exception, for the EU-21 is Leather, leather products & footwear. This hints at the fact that energy efficiency improvements in response to price changes have generally not been strong enough to offset the adverse impact of rising energy prices, at least at the high level of aggregation underlying the present study, so that energy-related expenditures increased. Indeed, this is largely what has happened over the past two decades: notwithstanding the energy efficiency gains, the energy-related expenditures – and energy cost shares – have risen (see Section 6.2).

Of course, the findings need a cautious interpretation. Because of data availability, our estimations mainly cover the 'pre-crisis' period. In the 'post-crisis' period (i.e. starting from 2009), the more difficult access to finance, which is typically required to finance energy-saving investments, may result in price elasticities of energy intensity being lower than those obtained in the present study. Moreover, a thorough assessment of the impact of energy prices on competitiveness would require the estimation of elasticities at the country level for all EU's competitors and a careful comparison. Due to data limitation, this is unfortunately not possible.

6.4. ENERGY INTENSITY, ENERGY COST SHARES, AND INDUSTRIAL COMPETITIVENESS

As demonstrated in Section 6.3, higher energy prices have not been fully offset by energy efficiency improvements, resulting in higher energy costs. This chapter aims to understand how these developments have affected the competitiveness of manufacturing industries. Did export competitiveness suffer as a result of insufficient improvements in energy efficiency and/or higher energy costs?

As demonstrated in Section 6.2.1, energy cost shares in manufacturing industries have been rising over the past two decades. Although they are typically low on the aggregate, energy cost shares may account for up to 40-80% of production costs for some particularly energy-intensive sectors as aluminium and chemicals (see e.g. European Commission, 2014b). For these industries, changes in energy intensity or energy costs can be expected to have a considerable impact on their export competitiveness. But even for less energy-intensive industries, any increase of energy cost shares may still affect export competitiveness on the margin. For instance, in highly competitive sectors, if profits are not high enough to offset even an incremental increase in energy costs, export competitiveness may suffer as a result.

In line with the so-called 'Porter hypothesis', environmental and energy regulations can induce energy efficiency and encourage innovations that help improve commercial competitiveness in the medium and long run (Porter and van der Linde, 1995). However, in order to lower their energy

[100] For details see the background study to this report.

intensity, companies often need to undertake investments into new technologies, which can have medium-run payback periods, thus making firms less competitive in the short run. Loss of competitiveness is particularly likely when domestic emission mitigation policies are unilateral: according to the 'pollution haven hypothesis', domestic manufacturers may lose market share to foreign competitors and/or relocate production activity to unregulated economies (Joseph and Pizer, 2011). In principle, government support policies can be used to mitigate the deterioration in industrial competitiveness. However, such measures risk subverting the incentives for companies to restructure, resulting in expenditures that show little long-term promise for stimulating the economy or protecting the environment (Frondel et al., 2010). A similar effect could be expected at the industry level, where it can be further reinforced by within-industry reallocations, with most energy-intensive firms potentially driven out of the market.

The findings of previous studies analysing the nexus between energy intensity and competitiveness have been mixed. Some early studies, which focused mostly on the impact of government regulations in the US, found a negative impact of regulations aimed at fostering eco-innovations on industrial competitiveness (see, for instance Christiansen and Haveman, 1981; Gollop and Roberts, 1983; Greenstone, 2002). Part of these studies was later disputed by Jaffe et al. (1995), and similarly inconsistent results were found for individual industries. For instance, while the competitiveness of the US pulp and paper industry suffered from environmental regulations (Gray and Shadbegian, 2003), the opposite was found for the oil refining industry (Berman and Bui, 2001). Riker (2012) found that energy price increases had a clear detrimental effect on the export competitiveness of US manufacturing industries, with the magnitude depending on the energy cost share and the price elasticity of industry's products in export markets. Using a very different approach, Eichhammer and Walz (2011) analysed the competitiveness gap between developed countries on the one hand, and developing and emerging economies on the other hand. Their conclusion was that at least part of the gap was explained by the much lower energy efficiency in the latter group of countries, which is itself a manifestation of their lower absorptive capacity for energy-efficient technologies.

Focusing on the EU, Rennings and Rexhäuser (2011) analysed the competitiveness effects of implementing energy-saving technologies on European industry, using data from the Community Innovation Survey (CIS). Their results suggest that energy-saving process innovation had only minor effects on the growth rate of firms' turnover. The European Competitiveness Report 2012 (European Commission, 2012c) found that, by and large, European manufacturing industries have been able to improve their competitiveness by offering new, more energy-efficient products such as consumer durables and capital goods. The report concluded that 'overall, there seems to be evidence that product innovators introducing energy-saving products on the market enjoy higher sales generated by product innovation compared to conventional product innovators. This, of course, may also reflect an important competitive advantage'.

The contribution of the present study is to attempt to quantify the link between energy intensity/energy cost shares and competitiveness for a wide range of countries and industries based on the time series available from a single dataset (WIOD), which ensures internal consistency and comparability of data.

6.4.1. Empirical Results and Interpretation

To measure the impact of changes in energy intensity and energy cost shares on industrial competitiveness, a panel-data model for the period 1995-2007 was set up, using total (intra- and extra-EU) exports as main dependent variable.[101] The model is estimated as a panel with country-industry fixed effects, in order to account for the unobserved country/industry heterogeneity, thus explaining the export dynamics of each industry in each country over time. The following equation is estimated for our main specification:

$$\dot{Comp}_{ijt} = \alpha_0 + \alpha_1 \dot{lnEnergyint}_{ijt} + \alpha_2 \dot{lnLPVAppp95}_{ijt} + \alpha_3 \dot{HSKL}_{ijt} + \alpha_4 \dot{MSKL}_{ijt} + \alpha_5 \dot{lnK}_{ijt} + \alpha_6 \dot{lnWagePe}_{ijt} + \alpha_7 \dot{lnGDPppp}_{jt} + \gamma_{ij} + \varepsilon_{ijt}$$

where $Comp_{ijt}$ is a measure of export competitiveness of industry *i* in country *j* in year *t*. The main independent variable of interest is *lnEnergyint*, measuring the log of energy intensity. We replace or integrate this variable with energy cost shares in alternative specifications. The model also includes a range of control variables customarily used to explain the export performance of a country or industry, such as labour productivity (*lnLPVAppp95*), the shares of high- and medium-skilled labour (*HSKL* and *MSKL*), capital intensity (*lnK*), wages (*lnWagePe*), and the size of the economy (*lnGDPppp*). The model is estimated in first differences, as indicated by the ˙ signs above the variables in the equation. The years 2008 and 2009 were excluded from the sample since the global

[101] This corresponds to the baseline specification. Alternative specifications using revealed comparative advantages (RCAs) as dependent variables were tried as well.

economic and financial crisis may have impacted very differently across sectors, thus making results difficult to interpret.[102] The model was run on a sample of 21 EU countries[103] and thirteen NACE 2-digit manufacturing sectors, available from the WIOD database.[104]

Table 6.9 shows the results of our estimations for the total sample of industries (columns 1-3). Energy intensity is negatively related to exports (column 1). Similar results are obtained when energy intensity is replaced by the total energy cost share (column 2). In column 3, we split the energy cost share into its main components. In this specification, only the cost share of electricity, gas, steam and hot water (CPA 40) has the expected significant negative relationship with exports, but energy intensity becomes insignificant.[105] These results suggest that a rise in the cost share component CPA 40 by 1 percentage point (pp) is statistically associated with a 1.6% decline of exports. The fact that only the cost component CPA 40 is significant is not surprising given that, as shown in Figure 6.9, it accounted for more than 60 percent in the EU 27 total energy costs in 2011.

Overall, these findings suggest that, despite energy cost shares being relatively small compared to other cost components, their growth had a significant negative impact on export competitiveness. A comparison of the results across specifications of the model suggests that, in terms of international competitiveness, energy cost shares matter more than energy efficiency. In fact, the coefficient of energy intensity loses significance when cost shares are added in the regression. This can be explained by the fact that energy cost shares are determined by both energy prices and energy intensity. Manufacturing firms across the globe may have access to the same energy saving technologies, so that investments in energy efficiency did not sufficiently alter the relative position of different countries. On the other hand, the substantial differences in energy prices documented in Section 6.1 seem to have impacted the competitiveness of European manufacturing industries.[106] This should be read in light of the results presented in Section 6.3, where it was shown that the price elasticity of EU manufacturing industries were in several cases larger than the full sample of OECD countries. This means that despite the significant achievements of European industry, the improvements in energy intensity were not large enough to compensate for the competitiveness gap generated by the energy price increase.

The results for most of the other control variables have an intuitive interpretation. The coefficient of labour productivity is positive and significant across all the model specifications, suggesting a positive productivity-competitiveness nexus. Wages are found to be positively though not significantly associated with exports. Intuitively, this makes sense: labour productivity gains need to be larger than wage increases in order to result in lower unit labour costs and improved competitiveness. Human capital matters for export competitiveness, too: an increase in the high-skilled labour share is associated with higher exports.

Relatively more counterintuitive is the coefficient of capital intensity, which is found to be negatively associated with exports. This can be explained by the simultaneous presence of two other variables connected to capital intensity: Labour productivity, which is measured as output per employed person; and the share of high-skilled labour, which is a proxy for human capital and relates to capital intensity via a capital-skill complementarity. This could point towards a certain degree of (multi-) collinearity amongst those variables. For this reason, two robustness checks were tried. First, the regressions were run excluding labour productivity. In this case the coefficient on energy intensity becomes larger in absolute terms and more significant, while the results for cost shares stay the same. The coefficient of capital intensity becomes lower in absolute terms, but remains significantly negative.[107] Second, the regressions were run excluding capital intensity. In this case, the coefficients of labour productivity become smaller.

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[102] Reassuringly, the main results are similar for the full sample.

[103] The panel covers 21 EU Member States, i.e. EU-28 without Bulgaria, Croatia, Cyprus, Latvia, Lithuania, Malta and Romania.

[104] Coke, refined petroleum, and nuclear fuel industry (NACE 23) was excluded from the model, since it uses energy inputs as crude oil primarily as a feedstock rather than as an energy source. As already demonstrated in Chapter 1, its inclusion may result in distorted estimation results.

[105] When separately including the other cost shares, these are insignificant whereas energy intensity remains significantly negative.

[106] The correlation between the measure of energy intensity and that of CPA 40 cost share is relatively low (0.19), that is reassuring in terms of the effects of potential collinearity.

[107] A possible explanation for this could be that industries which climb up the value chain tend to produce less capital-intensive goods or offshore capital-intensive production processes elsewhere. An indication for the latter aspect is that when replacing export with revealed comparative advantages as competitiveness indicator, capital intensity is negatively related when measured in value added terms, but insignificant when measured in gross trade. In these cases the coefficients concerning energy intensity become significantly negative.

The effects of energy intensity loose significance but the cost share coefficients remain again unaffected. It should be also noted that the coefficients of capital intensity in absolute terms are lower than or close to those for labour productivity. This can be interpreted as a positive effect of total factor productivity.

The results were tested against other robustness checks. When labour productivity and cost shares are recalculated based on value added, energy intensity becomes insignificant, whereas the cost share of CPA 40 remains significantly negative.[108] This finding also holds when a different measure of competiveness, i.e. revealed comparative advantage, is used for the total sample of industries. Interestingly, when revealed comparative advantages are measured in value added terms, the coefficient for energy intensity becomes more negative and more often significant, which might imply that industries which upgrade along value chains become less energy intensive. When including the crisis period, i.e. using data for the period 1995-2009, the main results concerning energy intensity and the cost share of Electricity gas, steam and hot water (CPA-40) still hold, with the coefficients of energy intensity being negative but insignificant, whereas the other cost share components, in some cases, become positive and significant. This might be the result of the much differentiated impact of the crisis across industries, and possibly to some substitution across energy sources (in particular, coal).

The regressions were run also for a sub-sample of energy-intensive sectors: *Chemicals and Chemical Products* (NACE Rev. 1 24), *Other Non-Metallic Minerals* (NACE Rev. 1 26) and *Basic Metals and Fabricated Metals* (NACE Rev. 1 27to28). The results point again towards a negative effect of a higher share of the cost component CPA 40 and the magnitude of the effect is similar. The coefficients for energy intensity are negative but insignificant in all specifications (columns 4-6 in Table 6.9). This counterintuitive result might be caused by the limited variation in this small subset of the sample. Furthermore, for these industries competitiveness is unrelated to the share of high and medium-skilled labour.

All in all, the analysis provide evidence that export competitiveness of manufacturing industries – as measured by export growth - is significantly related to energy intensity and to energy cost shares, particularly so for the cost share of Electricity, gas, steam and hot water (CPA-40). This last result is robust to all the specifications tried for this study. This suggests that industries that faced increases of this cost share have experienced a loss in competitiveness. However, at the level of aggregation allowed by the WIOD dataset, the observed impact is relatively small in magnitude.

The analysis is based on a relatively simple model specification and the results should be interpreted with some caution, since they are based on the developments prior to the 'shale gas revolution' in the US. It is possible that the increased energy price gap between the US and other countries may be impacting export competitiveness more strongly than what suggested by the estimates of this study. Unfortunately, these effects cannot be captured with the data used in this study. Moreover, due to data limitations, all findings are based on the NACE 2-digit level of aggregation. At a more disaggregated level, energy intensity and energy cost shares may potentially have a much greater impact on export competitiveness, especially for energy-intensive industries.

6.4.2. Energy Intensive Industries

A closer look at specific manufacturing sub-sectors generally reveals a great level of heterogeneity. This aspect ought to be considered when interpreting the results of the regressions showed in the previous section, especially the ones on the reduced sample of energy intensive industries. Unfortunately, data available from the WIOD project do not allow a more granular analysis. To cope with this limitation, additional information can be extracted from a series of specific sectoral studies undertaken by the European Commission.[109] In particular, the sectors Basic Metals, Chemicals and Other Non-Metals and Mineral Products can be considered. Because of differences in definitions and statistical methodologies, the figures provided are not meant to be exhaustive and direct comparisons with indicators calculated using WIOD should be avoided. The aim of this analysis is to provide insights into the variability of operating conditions in industrial plants across the EU. That should help in the interpretation of the results in Table 6.9.

Examining the share of energy costs on total production costs for the selected industries, reveals that the Basic Metals sector shows an average energy share of 19%, whereas the Chemicals sector

[108] This specification is closely linked to the analysis in European Commission (2014a), where Real Unit Energy Costs were used for sectoral and international comparisons.

[109] CEPS (2013a, 2013b, 2014a, 2014b). The results of the analysis have been delivered to Directorate General Enterprise and Industry of the European Commission. The figures provided are based on a survey. Details on the sampling technique and on the representativeness of the sample are provided in the original studies.

is characterized by a much higher share of 60%. The Other Metals and Mineral Products sector is somewhere in between, with an average energy share of about 30%.

Table 6.9 - Energy intensity, energy cost shares, and industrial competitiveness: empirical findings

	Total industries[1]			Energy intensive industries[2]		
Dependent variable: exports	**1**	**2**	**3**	**4**	**5**	**6**
Energy intensity	-0.024*		-0.018	-0.067		-0.055
	(-1.80)		(-1.33)	(-1.63)		(-1.30)
Energy cost share		-0.008*			-0.002	
		(-1.75)			(-0.36)	
Cost share coal			0.018			0.020
			(0.74)			(0.72)
Cost share of oil and natural gas			0.003			0.010
			(0.27)			(0.87)
Cost share of coke, ref. petroleum			0.001			0.012
			(0.12)			(1.09)
Cost share of electricity, gas, steam & hot water			-0.016***			-0.017**
			(-2.63)			(-1.99)
Labour productivity (GO based)	0.329***	0.335***	0.329***	0.418***	0.444***	0.395***
	(10.56)	(10.81)	(10.54)	(4.55)	(4.89)	(4.24)
Share of high-skilled labour	0.726***	0.725***	0.717***	0.962	0.960	0.894
	(2.89)	(2.89)	(2.86)	(1.64)	(1.63)	(1.52)
Share of medium-skilled labour	-0.376*	-0.398*	-0.365*	-0.757	-0.729	-0.674
	(-1.81)	(-1.91)	(-1.75)	(-1.58)	(-1.51)	(-1.40)
Capital intensity	-0.283***	-0.282***	-0.279***	-0.443***	-0.439***	-0.405***
	(-6.90)	(-6.87)	(-6.80)	(-3.78)	(-3.73)	(-3.42)
Wage per employee	0.066	0.064	0.061	0.010	-0.003	-0.013
	(1.45)	(1.42)	(1.35)	(0.10)	(-0.03)	(-0.12)
GDP	-0.011	0.025	-0.011	0.261	0.318	0.196
	(-0.06)	(0.14)	(-0.06)	(0.66)	(0.81)	(0.49)
Constant	0.070***	0.070***	0.071***	0.066***	0.066***	0.068***
	(10.46)	(10.41)	(10.44)	(4.55)	(4.52)	(4.66)
Observations	3,094	3,094	3,094	720	720	720
R-squared	0.06	0.06	0.06	0.06	0.059	0.08
Number of i	259	259	259	60	60	60

Note:
[1] *Excluding NACE 23 – Coke, refined petroleum and nuclear fuel.*
[2] *The sub-sample of energy-intensive sectors includes NACE 24 – Chemicals and chemical products, NACE 26 – Other non-metallic minerals, and NACE 27 to 28 – Basic metals and fabricated metals.*
Source: own calculations.

Table 6.10: Energy related characteristics of selected industries (2012)

Industry	Share of energy costs	Energy Intensity – Natural Gas	Energy Intensity – Electricity
Basic Metals			
Aluminium	30%	-	-
Steel	4.8-13%	0.21	0.24
Chemicals			
Ammonia	80-88%	10.8	-
Chlorine	43-45%	-	3.07
Other Non-Metals and Mineral Products			
Bricks and Roof Tiles	30-35%	0.07	0.56
Wall and Floor Tiles	25-30%	1.81	0.23

Note: Energy Intensity measured in MWh/tonne, Share of Energy Cost calculated over total production costs
Source: Data extracted from CEPS (2013a, 2013b, 2014a, 2014b).

More importantly, within-sector heterogeneity is also substantial. Aluminium and Steel are grouped together in the Basic Metals sector, despite bearing very different energy costs (30% for Aluminium and between 4.8 and 13% for Steel). A similar observation can be made for Chemicals: in the Ammonia industry, energy costs amount to 80-88% of total expenditure, whereas Chlorine's energy share is half as much, at 43-45%. The most homogeneous sector is Other Non-Metals and Mineral Products, with an average share of energy costs around 30% (See Table 6.10). This shows how important it is not to focus only on the aggregates.

Table 6.10 shows also energy intensities for the different industries but, different than in the rest of this study, the indicator is calculated dividing energy use by the physical output in tonnes (rather than gross output). As for the total sample, the relation between energy intensity and energy cost share is weak. The Ammonia industry is the most energy intensive, with an average of 10.8 MWh of natural gas consumed for each tonne of product, as well as the one with the highest share of energy costs. Similarly, the Steel industry is characterized by low energy intensity and low energy cost share. But the Wall and Floor Tiles industry, in which energy intensity is the second highest in the sample (1.81 MWh of natural gas per tonne of product), displays relatively low energy cost share, at approximately 30%.

These figures suggest that specific industrial sub-sector may suffer much more than others the increase of energy prices and the price gap between the EU and the rest of the world. In light of this, the results of the reduced sample regressions are particularly interesting. The fact that the electricity and gas cost share, even at a high level of aggregation, has a proven (statistically significant) negative effect on export competitiveness suggests that potentially some subsectors may be experiencing much stronger export losses.

6.5. CONCLUSIONS

The findings of this study suggest that energy is an important factor influencing industrial competitiveness. The chapter starts by highlighting the wide variation in energy price trends across countries and regions, with electricity and gas prices in the EU raising strongly relative to some of the main competitors.

It then shows that in advanced economies such as the EU, the United States and Japan, energy accounts for a relatively small fraction of production costs (measured in gross output terms). In manufacturing, if we exclude coke, petroleum and nuclear fuel, the share of energy costs is around 3%. But the aggregate figures mask wide divergence across individual manufacturing industries: in some of them, such as aluminium, selected chemical products, glass or cement production, the share of energy costs goes up to 30-40% of total production costs and even higher.

The analysis provides evidence of a general decline of energy intensity levels in the major economies over the past two decades. The primary driver of this trend has been technological improvement, but a structural shift away from energy-intensive sectors has also contributed in Central and Eastern Europe. This decline has been accompanied by a broad convergence of energy intensity levels, with the most energy-intensive economies (such as those in the EU-12) recording the greatest improvements.

Nevertheless, despite these favourable energy intensity trends, the energy cost shares have been generally on the rise, a reflection of the increasing energy prices. This issue is analysed in more details through econometric estimations in order to shed further light on the factors driving it. Essentially, the phenomenon reflects the difficulties faced by industries to respond to energy price increases with energy-saving measures and the energy-efficient

technologies. While there has been a sizable reduction in energy intensity in response to higher energy prices in a number of industries, the elasticity of this reduction has been in most cases less than one. This implies that the improvements in energy efficiency have been not sufficient to fully offset the energy price increase. But there is some evidence that European industries have performed better than their main competitors in reducing their energy intensity.

Despite that, the analysis shows that the increase of energy costs, in particular for Electricity, gas, steam and hot water (CPA-40) had a significant negative impact on export competitiveness in the period 1995-2009, confirming the importance of further improving the energy efficiency of European industries to compete on international markets. Moreover, the large within-sector heterogeneity suggests that the impact may be stronger for some specific energy intensive industries and highlights the fundamental importance of further research using more disaggregate data.

All in all, while energy efficiency improvements have helped European manufacturing industries to compete in international market, there is some evidence that the uneven development of energy prices had detrimental effects on export competitiveness. Energy-intensive industries may be suffering more from this phenomenon and should be studied with more attention.

These conclusions largely confirm the findings of the European Competitiveness Report 2012. They are also in line with the results in European Commission (2014a, 2014b) despite the different variables in focus (energy intensity/energy cost shares vs. energy prices) and the different the methodologies applied (econometric estimations vs. a forward-looking modelling approach). Moreover, it is important to bear in mind that, because of data availability, the conclusions in this study are based on the time period until 2009, i.e. before the start of the ‘shale gas revolution’. The asymmetric energy price shock that resulted can potentially have had stronger effects for industrial competitiveness that this study is not able to assess.

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7.1. SECTORAL COMPETITIVENESS INDICATORS

7.1.1. Explanatory notes

Geographical coverage: all indicators refer to EU-28

Production index[110]: The production index is actually an index of final production in volume terms.

Labour productivity: this indicator is calculated by combining the indexes of production and number of persons employed or number of hours worked[111]. Therefore, this indicator measures final production per person of final production per hour worked.

Unit Labour Cost: it is calculated from the production index and the index of wages and salaries and measures labour cost per unit of production. "Wages and salaries" is defined (Eurostat) as "the total remuneration, in cash or in kind, payable to all persons counted on the payroll (including homeworkers), in return for work done during the accounting period, regardless of whether it is paid on the basis of working time, output or piecework and whether it is paid regularly wages and salaries do not include social contributions payable by the employer".

Relative Trade Balance: it is calculated, for sector "i", as $(X_i-M_i)/(X_i+M_i)$, where X_i and M_i are EU-28 exports and imports of products of sector "i" to and from the rest of the World.

Revealed Comparative Advantage (RCA):

The RCA indicator for product "i" is defined as follows:

$$RCA_i = \frac{\frac{X_{EU,i}}{\sum_i X_{EU,i}}}{\frac{X_{W,i}}{\sum_i X_{W,i}}}$$

where: X=value of exports; the reference group ('W') is the EU-28 plus 105 other countries (see list below); the source used is the UN COMTRADE database. In the calculation of RCA, X_{EU} stands for exports to the rest of the world (excluding intra-EU trade) and X_W measures exports to the rest of the world by the countries in the reference group. The latter consists of the EU-28 plus the following countries: Albania, Algeria, Azerbaijan, Argentina, Australia, Bahamas, Armenia, Bermuda, Bolivia (Plurinational State of), Bosnia Herzegovina, Brazil, Belize, Brunei Darussalam, Belarus, Cambodia, Canada, Cabo Verde, Sri Lanka, Chile, China, Colombia, Costa Rica, Dominica, Dominican Republic, Ecuador, El Salvador, Ethiopia, Fiji, French Polynesia, Georgia, State of Palestine, Ghana, Greenland, Guatemala, Guyana, Honduras, Hong Kong SAR, Iceland, Indonesia, Israel, Ivory Coast, Jamaica, Japan, Kazakhstan, Jordan, Republic of Korea, Kyrgyzstan, Lebanon, Macao SAR, Madagascar, Malaysia, Maldives, Mali, Mauritania, Mauritius, Mexico, Other Asia, Republic of Moldova, Montenegro, Montserrat, Mozambique, Oman, Namibia, Aruba, New Caledonia, New Zealand, Nicaragua, Niger, Nigeria, Norway, Pakistan, Panama, Papua New Guinea, Paraguay, Peru, Russian Federation, Rwanda, Saint Vincent and the Grenadines, Sao Tome and Principe, Saudi Arabia, Senegal, Serbia, India, Singapore, Vietnam, South Africa, Zimbabwe, Sudan, Switzerland, Thailand, Togo, Tonga, Tunisia, Turkey, Turks and Caicos Islands, Uganda, Ukraine, TFYR of Macedonia, Egypt, United Republic of Tanzania, US, Uruguay, Samoa, Yemen, Zambia.

[110] The data are working-day adjusted for production.
[111] The data are working-day adjusted for hours worked.

Statistical nomenclatures: the indicators in Tables 7.1 to 7.6 are presented at the level of divisions of the statistical classification of economic activities in the European Community (NACE Rev. 2[112]), while those in Tables 7.7 to 7.10 are presented in terms of divisions of the statistical classification of products by activity (CPA). Table 7.11 uses extended balance of payments services classification. In terms of data sources: Tables 7.1 to 7.6 are based on Eurostat's short-term indicators data. Tables 7.7 to 7.10 are based on United Nations' COMTRADE. Table 7.11 is based on IMF balance of payments. Royalties and license fees were not included as it is not related to a special service activity.

[112] Compared to the statistical annexes of the previous publications, the new activity classification is used: NACE REV 2. The correspondence tables from NACE Rev. 2 – NACE Rev. 1.1 and from NACE Rev. 1.1 to NACE Rev. 2, are available on Eurostat: http://epp.eurostat.ec.europa.eu/portal/page/portal/nace_rev2/introduction

Table 7.1: EU-28 - Industry production index, annual growth rate (%)

Code (NACE Rev. 2)	Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 2008-2013
B	MINING AND QUARRYING	0.7	-3.0	-1.9	-5.3	-3.1	-0.1	-3.6	-10.9	0.4	-7.3	-5.3	-2.3	-5.2
C	MANUFACTURING	-0.7	0.2	2.5	1.8	4.8	4.2	-1.9	-15.3	7.4	4.5	-2.3	-0.4	-1.5
C10	Manufacture of food products	1.9	0.5	2.2	2.4	1.3	2.0	-0.4	-1.1	2.2	1.2	-0.5	-0.2	0.3
C11	Manufacture of beverages	1.7	1.2	-2.3	1.0	3.9	1.3	-2.1	-3.2	-0.8	6.1	-3.0	-0.5	-0.3
C12	Manufacture of tobacco products	-2.3	-5.9	-11.6	-5.4	-4.8	1.5	-11.9	-0.9	-5.8	-4.9	-3.9	-6.3	-4.4
C13	Manufacture of textiles	-4.5	-3.4	-4.9	-5.9	-0.8	-1.1	-10.4	-17.9	7.9	-2.0	-5.6	0.2	-3.9
C14	Manufacture of wearing apparel	-11.5	-7.3	-5.7	-10.4	-0.5	-0.5	-7.6	-13.9	-1.0	-3.5	-5.8	-3.8	-5.7
C15	Manufacture of leather and related products	-8.3	-6.9	-10.2	-9.1	-2.9	-5.7	-8.1	-14.2	2.1	5.4	-4.6	0.4	-2.4
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.6	2.2	3.2	0.2	4.2	1.0	-9.1	-15.1	3.1	3.5	-4.8	-1.0	-3.1
C17	Manufacture of paper and paper products	3.4	1.4	2.8	-0.1	3.9	2.6	-3.2	-8.8	6.2	-0.6	-1.6	-0.5	-1.2
C18	Printing and reproduction of recorded media	-0.6	-1.3	1.4	2.3	0.2	0.7	-2.2	-7.8	-0.2	-1.9	-6.1	-3.4	-3.9
C19	Manufacture of coke and refined petroleum products	0.9	1.3	4.6	0.7	-0.7	0.2	1.0	-8.0	-2.0	-1.3	-1.8	-1.7	-3.0
C20	Manufacture of chemicals and chemical products	1.8	-0.2	3.5	2.3	3.7	3.1	-3.2	-12.2	10.6	1.9	-2.3	-0.1	-0.7
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	8.5	4.7	-0.2	4.8	5.9	0.4	0.7	2.9	4.9	1.8	-0.3	3.4	2.5
C22	Manufacture of rubber and plastic products	-0.1	1.8	1.8	0.9	3.9	4.5	-4.6	-14.0	7.5	4.2	-3.2	0.4	-1.3
C23	Manufacture of other non-metallic mineral products	-1.6	0.3	1.6	0.6	4.3	1.9	-6.8	-19.4	1.9	3.1	-8.5	-3.0	-5.6
C24	Manufacture of basic metals	-0.4	-0.5	5.3	-0.8	6.4	1.5	-3.4	-27.3	18.8	4.4	-5.1	-1.0	-3.3
C25	Manufacture of fabricated metal products, except machinery and equipment	-0.5	0.9	2.6	1.6	4.8	6.2	-3.0	-22.7	7.1	7.4	-3.3	-0.9	-3.2
C26	Manufacture of computer, electronic and optical products	-10.4	0.5	6.3	2.6	8.8	7.5	0.8	-17.4	7.2	0.8	-2.5	-2.4	-3.2
C27	Manufacture of electrical equipment	-4.3	-1.5	2.3	1.0	8.5	4.3	-0.7	-21.0	11.4	4.5	-2.9	-2.2	-2.7
C28	Manufacture of machinery and equipment n.e.c.	-1.8	-0.8	4.1	4.0	8.4	8.4	1.5	-26.9	10.6	11.8	0.4	-2.8	-2.5
C29	Manufacture of motor vehicles, trailers and semi-trailers	0.7	1.6	4.4	1.4	3.3	6.1	-5.9	-25.1	21.6	12.1	-3.1	2.5	0.3
C30	Manufacture of other transport equipment	-4.0	0.3	0.5	2.1	8.6	4.7	3.4	-5.6	-1.0	4.6	3.1	4.1	1.0
C31	Manufacture of furniture	-5.1	-2.6	0.3	1.0	3.8	3.4	-5.0	-16.7	-0.9	2.0	-5.7	-3.7	-5.2
C32	Other manufacturing	2.9	-2.4	1.0	0.7	5.1	1.4	-1.6	-6.9	8.5	3.1	0.5	2.9	1.5
C33	Repair and installation of machinery and equipment	-4.5	-1.6	4.6	1.2	7.8	4.5	3.9	-10.3	2.9	5.0	-1.6	1.1	-0.7
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	0.9	3.0	2.2	2.0	0.8	-0.6	-0.1	-4.4	4.1	-4.3	0.1	-0.8	-1.1
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F	CONSTRUCTION	0.3	1.7	0.7	2.8	3.4	2.7	-3.0	-7.7	-4.5	-0.4	-5.3	-2.1	-4.0

Note: N/A: Data not available
Source: Eurostat

Table 7.2: EU-28 - Number of persons employed, annual growth rate (%)

Code (NACE Rev. 2)	Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 2008-2013
B	MINING AND QUARRYING	-4.6	-4.4	-4.6	-3.1	-3.7	-3.5	-1.4	-4.2	-4.1	-3.0	-0.8	-2.5	-2.9
C	MANUFACTURING	-1.9	-1.9	-1.9	-1.4	-0.7	0.5	-0.4	-7.3	-3.6	0.7	-0.5	-1.1	-2.4
C10	Manufacture of food products	-0.8	-0.3	-1.3	-0.2	-0.1	0.2	-0.2	-1.9	-0.6	0.7	-0.7	-0.4	-0.6
C11	Manufacture of beverages	-1.1	-1.8	-1.1	-1.7	-1.2	-0.1	-1.2	-6.1	-2.4	-1.7	-1.8	-0.9	-2.6
C12	Manufacture of tobacco products	-0.7	-5.1	-4.7	-2.3	-0.4	-11.2	-10.1	-7.1	-5.4	-3.3	-2.0	-2.8	-4.1
C13	Manufacture of textiles	-4.9	-7.0	-6.3	-4.6	-5.6	-5.2	-6.3	-13.0	-5.4	-3.2	-2.6	-4.3	-5.8
C14	Manufacture of wearing apparel	-3.5	-3.6	-6.0	-7.4	-5.9	-5.8	-6.0	-13.9	-7.8	-2.0	-2.4	-3.8	-6.1
C15	Manufacture of leather and related products	-0.8	-3.9	-6.5	-5.9	-3.0	-3.1	-5.0	-12.2	-3.5	3.8	-0.4	-2.9	-3.2
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-1.5	-1.5	-1.1	-0.9	-1.1	0.2	-2.5	-12.4	-2.6	-1.5	-2.0	-2.1	-4.2
C17	Manufacture of paper and paper products	-0.7	-2.9	-1.6	-2.8	-2.5	-2.9	-2.5	-5.5	-1.9	0.0	-0.9	-0.5	-1.8
C18	Printing and reproduction of recorded media	-2.0	-3.8	-1.8	-3.1	-1.3	0.1	-2.0	-6.8	-4.7	-4.8	-4.8	-2.8	-4.8
C19	Manufacture of coke and refined petroleum products	-3.2	-3.3	-1.9	-2.8	-3.3	0.6	-1.1	-3.7	-2.0	-4.7	-1.6	-2.1	-2.8
C20	Manufacture of chemicals and chemical products	-1.7	-2.6	-3.4	-2.1	-1.2	-0.7	-2.3	-4.5	-2.4	0.0	-0.5	-1.0	-1.7
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	2.2	-0.5	-2.5	-1.4	1.6	0.1	-2.4	-3.6	-0.9	-0.2	1.7	-0.8	-0.8
C22	Manufacture of rubber and plastic products	-0.9	0.2	-0.1	-0.9	-0.8	1.6	0.7	-7.1	-2.4	1.4	0.5	-0.6	-1.7
C23	Manufacture of other non-metallic mineral products	-2.2	-2.8	-2.3	-1.2	-0.6	1.3	-2.2	-10.7	-6.3	-1.2	-3.3	-3.7	-5.1
C24	Manufacture of basic metals	-3.9	-2.9	-4.1	-1.2	-1.0	-0.6	-0.6	-8.3	-5.2	1.4	-1.9	-2.4	-3.3
C25	Manufacture of fabricated metal products, except machinery and equipment	-1.1	-1.0	0.2	-0.1	1.6	3.0	2.6	-8.5	-5.1	2.1	-0.2	-1.5	-2.7
C26	Manufacture of computer, electronic and optical products	-5.5	-4.2	-2.8	-1.2	-0.7	1.3	-2.0	-8.9	-3.9	0.9	-1.2	-1.9	-3.1
C27	Manufacture of electrical equipment	-3.9	-3.9	-1.3	-0.6	0.9	2.4	1.2	-7.9	-1.9	3.7	-0.5	-0.7	-1.5
C28	Manufacture of machinery and equipment n.e.c.	-1.6	-2.2	-2.3	-0.9	0.7	2.8	1.8	-6.0	-4.9	2.9	2.0	-0.9	-1.4
C29	Manufacture of motor vehicles, trailers and semi-trailers	-1.0	-0.4	0.1	-0.7	-1.0	-0.2	0.8	-8.9	-2.9	2.8	0.7	0.7	-1.6
C30	Manufacture of other transport equipment	-1.6	-2.6	-1.8	0.3	0.8	2.7	1.6	-1.3	-4.8	0.3	0.6	-0.5	-1.2
C31	Manufacture of furniture	-3.3	0.1	-2.4	-2.5	-1.2	0.7	-2.2	-9.9	-8.6	0.2	-3.1	-2.9	-4.9
C32	Other manufacturing	-1.5	0.0	-1.0	-1.9	-0.4	0.6	-0.3	-3.1	-1.8	0.1	1.5	1.1	-0.5
C33	Repair and installation of machinery and equipment	-2.4	-2.0	-0.7	-0.6	0.5	0.6	3.1	-2.1	-2.2	-2.6	2.3	1.0	-0.7
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	-5.1	-4.8	-3.5	-2.3	-1.2	-1.5	-0.7	1.6	-0.3	-0.5	-2.0	-2.1	-0.7
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	-0.3	0.4	-0.9	-1.6	1.9	0.6	-0.9	-0.4	-0.1	0.0	1.3	0.2	0.2
F	CONSTRUCTION	-0.9	0.1	1.0	2.6	3.6	4.4	0.0	-6.7	-5.4	-2.6	-3.4	-3.6	-4.4

Note: N/A: Data not available
Source: Eurostat

Table 7.3: EU-28 - Number of hours worked, annual growth rate (%)

Code (NACE Rev. 2)	Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 2008-2013
B	MINING AND QUARRYING	-4.6	-5.3	-3.7	-2.8	-5.0	-3.5	-1.2	-5.9	-3.1	-1.9	0.2	-0.9	-2.3
C	MANUFACTURING	-2.4	-2.4	-1.5	-1.8	-0.2	0.3	-0.7	-10.3	-1.2	1.5	-1.0	-0.8	-2.5
C10	Manufacture of food products	-1.7	-1.6	-0.1	-0.6	0.0	-0.2	0.0	-2.6	0.3	0.4	-0.8	-0.4	-0.6
C11	Manufacture of beverages	-3.4	0.1	0.8	-3.2	-3.9	-1.1	-1.7	-4.7	-4.7	-0.6	-1.9	-1.4	-2.7
C12	Manufacture of tobacco products	-2.7	-9.9	-1.7	-3.7	-8.7	-2.9	-10.9	-7.0	-3.2	-2.2	0.9	-3.7	-3.1
C13	Manufacture of textiles	-6.1	-7.7	-8.3	-6.2	-6.2	-3.8	-7.1	-17.0	-3.9	-0.5	-2.7	-1.2	-5.3
C14	Manufacture of wearing apparel	-2.5	-2.9	-4.2	-6.0	-4.4	-5.8	-6.4	-16.9	-8.9	0.1	-4.2	-2.8	-6.7
C15	Manufacture of leather and related products	-0.6	-1.8	-4.4	-5.9	-1.6	-4.1	-6.3	-14.1	-1.2	4.6	0.8	0.9	-2.0
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-1.0	-1.3	-1.3	-2.5	-0.3	0.4	-3.0	-14.8	-0.7	0.0	-2.4	-3.4	-4.4
C17	Manufacture of paper and paper products	-0.4	-2.9	-1.9	-2.2	-1.1	-1.1	-4.5	-8.2	-0.6	0.7	-1.7	-1.9	-2.4
C18	Printing and reproduction of recorded media	-3.3	-3.7	-3.9	-2.8	0.0	0.2	-1.9	-6.7	-4.6	-3.4	-6.2	-2.2	-4.6
C19	Manufacture of coke and refined petroleum products	-4.1	-2.3	-1.1	0.3	-4.4	0.3	1.4	-8.8	-2.1	-1.3	0.7	-3.8	-3.1
C20	Manufacture of chemicals and chemical products	-2.4	-2.7	-2.1	-3.2	-1.3	-1.7	-2.2	-5.8	-1.9	1.0	0.6	-1.8	-1.6
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	2.5	0.2	-0.7	-2.0	0.5	0.5	-0.2	-2.4	-1.3	-0.3	1.4	1.5	-0.2
C22	Manufacture of rubber and plastic products	-1.8	-1.5	-0.4	-1.6	1.6	1.0	-0.3	-10.0	0.4	2.4	0.1	0.2	-1.5
C23	Manufacture of other non-metallic mineral products	-3.3	-2.7	-1.4	-1.2	-0.6	0.4	-3.0	-13.0	-3.2	-1.0	-4.6	-4.2	-5.3
C24	Manufacture of basic metals	-3.3	-4.7	-2.1	-2.3	-0.1	-0.5	-1.1	-13.5	1.3	2.7	-2.6	-3.3	-3.3
C25	Manufacture of fabricated metal products, except machinery and equipment	-1.3	-1.6	-0.1	-1.0	1.8	3.0	3.5	-13.2	-1.6	2.1	-0.3	-0.7	-2.9
C26	Manufacture of computer, electronic and optical products	-5.1	-4.3	-3.4	-1.8	-1.1	0.2	-1.2	-12.9	-3.3	0.5	-0.2	-2.8	-3.9
C27	Manufacture of electrical equipment	-3.2	-3.7	-1.5	-2.1	2.2	1.7	0.5	-13.7	3.2	3.5	-1.9	-2.0	-2.4
C28	Manufacture of machinery and equipment n.e.c.	-2.4	-2.1	-1.5	-1.6	1.6	2.9	1.7	-11.6	-0.8	4.9	1.2	-0.4	-1.5
C29	Manufacture of motor vehicles, trailers and semi-trailers	-2.2	-1.2	0.2	-0.2	-0.6	0.8	-1.5	-14.6	4.7	4.1	-0.9	1.6	-1.3
C30	Manufacture of other transport equipment	-1.9	-2.0	-2.2	0.7	0.5	1.0	1.1	-1.4	-6.1	0.5	0.2	-2.1	-1.8
C31	Manufacture of furniture	-3.8	-2.6	-1.7	-3.2	0.6	-0.1	-3.1	-12.6	-6.5	-0.6	-3.8	-2.5	-5.3
C32	Other manufacturing	-3.2	-2.5	0.2	-2.9	-0.9	0.8	0.0	-6.2	-0.1	2.1	0.9	0.1	-0.7
C33	Repair and installation of machinery and equipment	-2.5	-2.7	-1.9	0.1	1.2	0.8	2.2	-2.2	-3.9	0.7	0.4	0.3	-1.0
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	-5.3	-4.8	-2.3	-0.5	-1.5	-1.2	-0.2	-0.7	-0.4	0.4	-3.2	-1.2	-1.0
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	-0.8	-0.3	1.6	-1.6	0.0	0.8	0.7	-2.6	0.3	0.2	1.5	-1.3	-0.4
F	CONSTRUCTION	-2.2	0.7	0.4	5.6	3.4	3.6	-1.0	-9.9	-7.9	-1.3	-2.8	-2.6	-5.0

Note: N/A: Data not available
Source: Eurostat

Table 7.4: EU-28 - Labour productivity per person employed, annual growth rate (%)

Code (NACE Rev. 2)	Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 2008-2013
B	MINING AND QUARRYING	5.5	1.4	2.8	-2.3	0.6	3.5	-2.3	-7.0	4.7	-4.4	-4.5	0.2	-2.3
C	MANUFACTURING	1.2	2.1	4.5	3.3	5.6	3.7	-1.5	-8.6	11.4	3.7	-1.8	0.7	0.9
C10	Manufacture of food products	2.7	0.8	3.6	2.6	1.4	1.8	-0.2	0.8	2.8	0.5	0.2	0.3	0.9
C11	Manufacture of beverages	2.9	3.1	-1.2	2.7	5.2	1.4	-0.9	3.1	1.6	7.9	-1.2	0.4	2.3
C12	Manufacture of tobacco products	-1.7	-0.8	-7.2	-3.2	-4.4	14.4	-2.0	6.6	-0.4	-1.6	-2.0	-3.6	-0.3
C13	Manufacture of textiles	0.4	3.9	1.5	-1.4	5.1	4.4	-4.4	-5.6	14.1	1.2	-3.1	4.6	2.0
C14	Manufacture of wearing apparel	-8.3	-3.8	0.3	-3.2	5.7	5.6	-1.7	0.0	7.3	-1.5	-3.5	0.0	0.4
C15	Manufacture of leather and related products	-7.6	-3.1	-4.0	-3.4	0.1	-2.6	-3.2	-2.3	5.8	1.6	-4.2	3.4	0.8
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	2.1	3.8	4.4	1.1	5.4	0.8	-6.7	-3.1	5.8	5.1	-2.9	1.1	1.2
C17	Manufacture of paper and paper products	4.1	4.4	4.5	2.7	6.5	5.6	-0.8	-3.5	8.2	-0.6	-0.7	0.0	0.6
C18	Printing and reproduction of recorded media	1.4	2.6	3.3	5.5	1.6	0.6	-0.2	-1.0	4.7	3.0	-1.3	-0.6	0.9
C19	Manufacture of coke and refined petroleum products	4.2	4.7	6.6	3.6	2.7	-0.4	2.1	-4.4	0.0	3.6	-0.2	0.4	-0.2
C20	Manufacture of chemicals and chemical products	3.6	2.5	7.1	4.5	4.9	3.8	-0.9	-8.1	13.3	1.9	-1.8	0.9	1.0
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	6.2	5.2	2.4	6.3	4.3	0.3	3.1	6.7	5.8	2.0	-1.9	4.2	3.3
C22	Manufacture of rubber and plastic products	0.8	1.6	1.9	1.8	4.7	2.8	-5.3	-7.4	10.2	2.8	-3.7	1.0	0.4
C23	Manufacture of other non-metallic mineral products	0.7	3.2	3.9	1.9	4.9	0.6	-4.7	-9.7	8.8	4.4	-5.4	0.7	-0.5
C24	Manufacture of basic metals	3.6	2.5	9.8	0.4	7.4	2.1	-2.8	-20.7	25.3	2.9	-3.2	1.4	0.1
C25	Manufacture of fabricated metal products, except machinery and equipment	0.6	2.0	2.4	1.7	3.2	3.1	-5.5	-15.5	12.9	5.2	-3.1	0.6	-0.5
C26	Manufacture of computer, electronic and optical products	-5.2	4.9	9.4	3.9	9.6	6.1	2.8	-9.3	11.6	-0.1	-1.3	-0.5	-0.1
C27	Manufacture of electrical equipment	-0.5	2.5	3.6	1.6	7.6	1.9	-1.9	-14.3	13.6	0.8	-2.4	-1.5	-1.2
C28	Manufacture of machinery and equipment n.e.c.	-0.2	1.4	6.6	5.0	7.6	5.4	-0.3	-22.3	16.3	8.7	-1.6	-2.0	-1.1
C29	Manufacture of motor vehicles, trailers and semi-trailers	1.8	2.0	4.3	2.1	4.3	6.4	-6.6	-17.8	25.2	9.1	-3.8	1.8	1.9
C30	Manufacture of other transport equipment	-2.4	3.0	2.3	1.8	7.8	1.9	1.8	-4.4	4.0	4.3	2.5	4.6	2.1
C31	Manufacture of furniture	-1.8	-2.7	2.8	3.6	5.1	2.7	-2.9	-7.5	8.4	1.8	-2.7	-0.9	-0.3
C32	Other manufacturing	4.5	-2.4	2.0	2.6	5.5	0.8	-1.3	-4.0	10.5	3.0	-1.0	1.7	2.0
C33	Repair and installation of machinery and equipment	-2.2	0.4	5.3	1.8	7.3	3.8	0.7	-8.4	5.2	7.8	-3.8	0.1	0.0
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	6.3	8.2	5.9	4.4	2.0	1.0	0.6	-5.9	4.5	-3.8	2.1	1.4	-0.4
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F	CONSTRUCTION	1.2	1.6	-0.3	0.2	-0.2	-1.6	-3.0	-1.1	1.0	2.3	-2.0	1.6	0.3

Note: N/A: Data not available
Source: Eurostat

Table 7.5: EU-28 - Labour productivity per hour worked, annual growth rate (%)

Code (NACE Rev. 2)	Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 2008-2013
B	MINING AND QUARRYING	5.6	2.4	1.9	-2.6	2.0	3.6	-2.4	-5.3	3.6	-5.5	-5.5	-1.4	-2.9
C	MANUFACTURING	1.8	2.6	4.1	3.6	5.0	3.9	-1.2	-5.6	8.7	3.0	-1.3	0.4	0.9
C10	Manufacture of food products	3.7	2.1	2.3	3.0	1.3	2.2	-0.4	1.5	1.9	0.8	0.3	0.2	0.9
C11	Manufacture of beverages	5.3	1.1	-3.0	4.3	8.1	2.4	-0.4	1.6	4.1	6.8	-1.1	0.9	2.4
C12	Manufacture of tobacco products	0.4	4.5	-10.0	-1.8	4.2	4.6	-1.1	6.6	-2.7	-2.7	-4.7	-2.7	-1.3
C13	Manufacture of textiles	1.7	4.6	3.7	0.3	5.8	2.8	-3.6	-1.1	12.3	-1.5	-3.0	1.4	1.5
C14	Manufacture of wearing apparel	-9.2	-4.5	-1.6	-4.7	4.1	5.6	-1.3	3.6	8.6	-3.6	-1.7	-1.1	1.1
C15	Manufacture of leather and related products	-7.7	-5.2	-6.1	-3.4	-1.3	-1.6	-1.9	-0.1	3.4	0.7	-5.4	-0.5	-0.4
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	1.7	3.5	4.6	2.8	4.5	0.6	-6.3	-0.4	3.9	3.5	-2.4	2.5	1.4
C17	Manufacture of paper and paper products	3.8	4.4	4.8	2.1	5.0	3.7	1.4	-0.7	6.8	-1.3	0.1	1.5	1.2
C18	Printing and reproduction of recorded media	2.8	2.5	5.5	5.3	0.2	0.5	-0.4	-1.2	4.6	1.6	0.1	-1.2	0.7
C19	Manufacture of coke and refined petroleum products	5.2	3.7	5.7	0.4	3.9	-0.1	-0.4	0.8	0.1	0.0	-2.5	2.2	0.1
C20	Manufacture of chemicals and chemical products	4.3	2.6	5.8	5.7	5.1	4.9	-1.0	-6.7	12.7	0.9	-2.9	1.7	0.9
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	5.9	4.5	0.5	6.9	5.4	-0.1	0.9	5.4	6.3	2.1	-1.7	1.9	2.8
C22	Manufacture of rubber and plastic products	1.7	3.3	2.2	2.6	2.2	3.5	-4.3	-4.4	7.1	1.7	-3.3	0.2	0.2
C23	Manufacture of other non-metallic mineral products	1.7	3.1	3.0	1.8	4.9	1.5	-3.9	-7.4	5.2	4.1	-4.1	1.2	-0.3
C24	Manufacture of basic metals	3.0	4.4	7.6	1.5	6.5	2.0	-2.4	-15.9	17.3	1.7	-2.6	2.4	0.0
C25	Manufacture of fabricated metal products, except machinery and equipment	0.8	2.5	2.8	2.6	2.9	3.1	-6.3	-10.9	8.8	5.2	-3.0	-0.2	-0.3
C26	Manufacture of computer, electronic and optical products	-5.5	5.0	10.0	4.5	10.0	7.2	2.1	-5.2	10.8	0.3	-2.3	0.5	0.7
C27	Manufacture of electrical equipment	-1.2	2.2	3.9	3.1	6.2	2.6	-1.2	-8.4	7.9	1.0	-1.0	-0.2	-0.3
C28	Manufacture of machinery and equipment n.e.c.	0.6	1.4	5.7	5.7	6.7	5.4	-0.2	-17.3	11.5	6.6	-0.8	-2.4	-1.0
C29	Manufacture of motor vehicles, trailers and semi-trailers	3.0	2.9	4.2	1.6	3.9	5.3	-4.5	-12.3	16.2	7.6	-2.2	0.9	1.6
C30	Manufacture of other transport equipment	-2.2	2.4	2.8	1.4	8.0	3.7	2.2	-4.3	5.4	4.1	2.9	6.3	2.8
C31	Manufacture of furniture	-1.4	0.0	2.0	4.4	3.2	3.5	-2.0	-4.7	6.0	2.6	-2.0	-1.3	0.1
C32	Other manufacturing	6.3	0.1	0.8	3.7	6.1	0.6	-1.6	-0.7	8.6	1.0	-0.4	2.8	2.2
C33	Repair and installation of machinery and equipment	-2.0	1.1	6.6	1.1	6.6	3.7	1.7	-8.3	7.1	4.3	-2.0	0.8	0.2
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	6.5	8.2	4.6	2.5	2.4	0.6	0.1	-3.7	4.5	-4.7	3.4	0.4	-0.1
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F	CONSTRUCTION	2.6	1.0	0.3	-2.7	0.0	-0.9	-2.0	2.4	3.7	0.9	-2.6	0.5	1.0

Note: N/A: Data not available
Source: Eurostat

Table 7.6: EU-28 - Unit labour cost, annual growth rate (%)

Code (NACE Rev. 2)	Sector	2002	2003	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	Average 2008-2013
B	MINING AND QUARRYING	-0.9	6.5	4.2	-1.0	6.6	4.8	10.9	11.9	0.9	10.4	8.5	4.8	7.2
C	MANUFACTURING	1.6	0.4	-1.2	-0.6	-2.2	-0.1	6.0	10.6	-6.4	-0.6	4.6	2.0	1.9
C10	Manufacture of food products	0.9	2.2	-0.8	-0.7	0.5	1.4	4.8	1.3	-0.1	0.5	2.0	2.0	1.1
C11	Manufacture of beverages	-1.2	3.0	3.5	-1.3	-3.9	1.0	4.6	2.2	-0.9	-3.4	3.5	2.5	0.7
C12	Manufacture of tobacco products	2.4	5.9	19.3	7.5	2.2	-1.8	8.3	-3.1	1.5	-2.2	7.0	5.0	1.6
C13	Manufacture of textiles	3.0	0.5	0.9	2.9	-2.3	0.5	9.8	6.2	-8.7	2.0	4.8	-1.4	0.4
C14	Manufacture of wearing apparel	10.9	4.1	2.3	5.5	-0.8	2.0	8.4	4.8	-3.8	4.3	4.1	3.3	2.5
C15	Manufacture of leather and related products	8.2	4.3	8.1	6.0	5.9	9.2	10.9	5.8	-0.1	0.4	8.9	1.4	3.2
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-1.3	-1.8	-0.6	0.7	-0.3	4.7	12.5	5.8	-4.1	-1.4	3.1	-1.2	0.4
C17	Manufacture of paper and paper products	-2.5	-1.5	-1.4	0.7	-3.5	-1.3	3.7	4.0	-5.2	1.9	2.1	1.4	0.8
C18	Printing and reproduction of recorded media	0.3	-1.4	-1.5	-2.2	-0.5	0.4	4.6	2.3	-4.7	-1.2	2.3	-0.4	-0.4
C19	Manufacture of coke and refined petroleum products	4.9	-4.4	-0.5	2.3	3.7	2.5	5.1	6.5	3.7	2.2	2.6	4.0	3.8
C20	Manufacture of chemicals and chemical products	-1.0	1.8	-3.6	-1.2	-3.7	-0.2	5.3	10.8	-9.2	3.9	4.6	1.9	2.2
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	-2.5	0.2	1.5	-2.8	-2.6	5.1	0.8	-2.4	-3.6	0.0	4.7	-1.5	-0.6
C22	Manufacture of rubber and plastic products	1.4	-0.1	0.6	0.1	-2.3	-0.6	8.1	8.4	-5.0	0.5	5.9	1.8	2.2
C23	Manufacture of other non-metallic mineral products	2.6	0.4	-0.7	0.4	-1.8	2.7	9.4	13.1	-2.9	-2.4	7.4	0.7	3.0
C24	Manufacture of basic metals	-0.8	0.5	-3.9	3.2	-3.0	2.8	7.0	24.0	-14.2	0.7	6.3	0.7	2.8
C25	Manufacture of fabricated metal products, except machinery and equipment	1.7	-0.2	0.1	0.0	-0.9	0.8	10.8	16.2	-6.7	-2.9	5.9	1.7	2.6
C26	Manufacture of computer, electronic and optical products	8.2	-4.5	-6.1	-2.5	-7.5	-4.1	2.4	11.7	-8.1	1.6	4.7	3.9	2.6
C27	Manufacture of electrical equipment	3.5	-0.6	-0.5	-0.5	-4.3	1.2	5.9	12.7	-8.4	2.2	5.0	3.7	2.8
C28	Manufacture of machinery and equipment n.e.c.	2.5	1.7	-1.9	-2.6	-3.7	-1.5	4.3	28.1	-8.8	-3.9	4.1	5.3	4.2
C29	Manufacture of motor vehicles, trailers and semi-trailers	1.0	0.9	-2.0	0.1	-0.1	-5.2	9.3	17.6	-15.4	-3.5	7.2	1.8	0.9
C30	Manufacture of other transport equipment	8.2	1.8	-1.2	0.9	-4.7	0.2	3.0	7.9	2.5	-1.8	3.8	0.9	2.6
C31	Manufacture of furniture	4.7	-0.6	-0.9	-0.6	-0.8	0.2	7.8	10.6	-3.7	-2.4	3.9	2.0	2.0
C32	Other manufacturing	-1.2	3.5	1.4	-1.1	-2.8	4.5	4.3	4.4	-5.7	0.4	2.2	0.3	0.3
C33	Repair and installation of machinery and equipment	5.9	1.4	-2.7	1.6	-4.3	-0.2	3.5	14.1	-6.1	-4.1	4.6	2.1	1.9
D	ELECTRICITY, GAS, STEAM AND AIR CONDITIONING SUPPLY	1.6	-1.7	-1.3	0.1	4.1	4.8	4.6	8.3	-1.7	6.7	1.5	2.8	3.4
E	WATER SUPPLY; SEWERAGE, WASTE MANAGEMENT AND REMEDIATION ACTIVITIES	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A
F	CONSTRUCTION	3.0	0.3	1.6	5.7	3.1	6.5	6.9	0.8	-1.7	1.7	4.6	1.2	1.3

Note: N/A: Data not available
Source: Eurostat

Table 7.7: EU-28 - Revealed comparative advantage index

Code (NACE Rev. 2)	Sector	2007	2008	2009	2010	2011	2012
C10	Manufacture of food products	0.72	0.66	0.63	0.66	0.65	0.66
C11	Manufacture of beverages	2.33	2.01	1.96	2.12	2.22	2.25
C12	Manufacture of tobacco products	0.77	0.88	0.92	0.98	1.02	1.11
C13	Manufacture of textiles	0.73	0.69	0.62	0.59	0.56	0.54
C14	Manufacture of wearing apparel	0.55	0.57	0.51	0.48	0.49	0.52
C15	Manufacture of leather and related products	0.93	0.88	0.80	0.77	0.82	0.81
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	0.88	0.94	0.95	0.94	0.93	0.95
C17	Manufacture of paper and paper products	0.96	0.98	0.99	1.00	1.00	1.00
C18	Printing and reproduction of recorded media	1.61	1.51	1.61	1.50	1.30	1.32
C19	Manufacture of coke and refined petroleum products	0.88	0.85	0.80	0.79	0.76	0.86
C20	Manufacture of chemicals and chemical products	1.07	1.02	1.16	1.10	1.02	1.03
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	1.83	1.80	1.69	1.87	1.95	1.96
C22	Manufacture of rubber and plastic products	0.85	0.85	0.81	0.83	0.82	0.79
C23	Manufacture of other non-metallic mineral products	1.20	1.14	1.10	1.08	1.05	1.02
C24	Manufacture of basic metals	0.71	0.70	0.74	0.77	0.71	0.74
C25	Manufacture of fabricated metal products, except machinery and equipment	1.06	1.07	1.07	1.08	1.03	1.01
C26	Manufacture of computer, electronic and optical products	0.63	0.63	0.58	0.55	0.59	0.55
C27	Manufacture of electrical equipment	1.06	1.09	1.08	1.02	1.03	0.98
C28	Manufacture of machinery and equipment n.e.c.	1.57	1.63	1.68	1.66	1.67	1.62
C29	Manufacture of motor vehicles, trailers and semi-trailers	0.99	1.03	1.00	1.15	1.24	1.28
C30	Manufacture of other transport equipment	1.48	1.50	1.88	1.92	1.79	1.92
C31	Manufacture of furniture	1.04	1.04	0.95	0.88	0.91	0.84
C32	Other manufacturing	1.06	0.98	0.89	0.92	0.87	0.85

Note: There was a transition from NACE Rev. 1 to NACE Rev. 2, therefore the data are only available from 2007
Source: Own calculations using Comtrade data

Table 7.8: EU-28 - Relative trade balance (X-M)/(X+M)

Code (NACE Rev. 2)	Sector	2007	2008	2009	2010	2011	2012
C10	Manufacture of food products	-0.15	-0.15	-0.13	-0.08	-0.11	-0.03
C11	Manufacture of beverages	0.58	0.59	0.57	0.60	0.62	0.67
C12	Manufacture of tobacco products	0.69	0.75	0.76	0.79	0.79	0.83
C13	Manufacture of textiles	-0.10	-0.10	-0.13	-0.16	-0.22	-0.14
C14	Manufacture of wearing apparel	-0.54	-0.53	-0.58	-0.58	-0.58	-0.50
C15	Manufacture of leather and related products	-0.27	-0.27	-0.30	-0.30	-0.28	-0.20
C16	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials	-0.11	-0.07	0.00	0.01	-0.02	0.13
C17	Manufacture of paper and paper products	0.21	0.23	0.25	0.24	0.22	0.31
C18	Printing and reproduction of recorded media	0.20	0.20	0.26	0.17	0.15	0.34
C19	Manufacture of coke and refined petroleum products	-0.10	-0.08	-0.10	-0.10	-0.16	-0.02
C20	Manufacture of chemicals and chemical products	0.15	0.16	0.25	0.20	0.13	0.19
C21	Manufacture of basic pharmaceutical products and pharmaceutical preparations	0.28	0.30	0.26	0.30	0.24	0.28
C22	Manufacture of rubber and plastic products	0.06	0.06	0.07	0.06	0.02	0.09
C23	Manufacture of other non-metallic mineral products	0.19	0.19	0.21	0.18	0.16	0.25
C24	Manufacture of basic metals	-0.23	-0.15	-0.01	-0.15	-0.10	-0.14
C25	Manufacture of fabricated metal products, except machinery and equipment	0.16	0.17	0.19	0.18	0.12	0.20
C26	Manufacture of computer, electronic and optical products	-0.28	-0.28	-0.29	-0.32	-0.30	-0.25
C27	Manufacture of electrical equipment	0.13	0.16	0.16	0.12	0.08	0.14
C28	Manufacture of machinery and equipment n.e.c.	0.37	0.40	0.44	0.42	0.40	0.46
C29	Manufacture of motor vehicles, trailers and semi-trailers	0.36	0.40	0.38	0.48	0.48	0.56
C30	Manufacture of other transport equipment	0.13	0.17	0.12	0.14	0.16	0.22
C31	Manufacture of furniture	-0.04	-0.01	-0.04	-0.08	-0.05	0.03
C32	Other manufacturing	-0.13	-0.13	-0.13	-0.10	-0.13	-0.03

Note: There was a transition from NACE Rev. 1 to NACE Rev. 2, therefore the data are only available from 2007
Source: Own calculations using Comtrade data

Table 7.9: Revealed comparative advantage index in manufacturing industries in 2012 - EU countries, US and Japan, Brazil, China, India and Russia

	Food	Bevarages	Tobacco	Textiles	Clothing	Leather & footwear	Wood & wood products	Paper	Printing	Refined petroleum	Chemicals	Pharma-ceuticals	Rubber & plastics	Non-metallic mineral products	Basic metals	Metal products	Computers electronic & optical	Electrical equipment	Machinery	Motor vehicles	Other transport	Furniture	Other manu-facturing
	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29	C30	C31	C32
Austria	0.88	2.24	0.00	0.68	0.54	0.68	4.26	2.32	1.40	0.27	0.53	1.66	1.23	1.29	1.30	2.22	0.43	1.30	1.47	1.25	0.78	0.95	0.66
Belgium	1.30	1.15	1.12	0.76	0.68	0.98	0.82	1.01	7.69	1.30	2.30	3.23	0.95	0.96	1.01	0.64	0.21	0.40	0.72	1.09	0.19	0.43	1.18
Bulgaria	1.32	0.88	6.79	1.12	2.73	0.98	1.69	0.83	0.15	2.06	0.56	0.96	0.97	2.32	2.52	0.79	0.24	1.19	0.86	0.32	0.28	1.34	0.38
Croatia	1.39	2.00	3.47	0.50	1.65	2.10	5.84	1.12	1.33	2.00	0.78	1.34	0.64	3.14	0.65	2.17	0.19	1.54	0.76	0.21	2.38	2.69	0.17
Cyprus	2.24	2.04	23.15	0.18	0.52	1.01	0.13	0.26	0.00	0.00	1.14	6.88	0.45	0.90	1.12	0.63	0.49	0.78	0.47	0.31	1.23	0.97	0.58
Czech Republic	0.51	0.59	1.73	0.86	0.33	0.51	1.38	0.96	1.82	0.20	0.56	0.30	1.65	1.58	0.66	2.12	1.06	1.70	1.16	1.99	0.41	1.39	0.76
Denmark	3.04	1.45	1.25	0.72	1.62	0.71	0.99	0.74	1.13	0.95	0.65	1.69	1.12	0.94	0.30	1.58	0.54	1.01	1.64	0.32	0.25	2.53	0.72
Estonia	1.08	2.33	0.20	1.44	1.04	0.98	7.54	0.79	0.70	2.16	0.69	0.10	1.36	1.18	0.51	1.81	0.88	1.42	0.87	0.52	0.21	2.46	0.49
Finland	0.36	0.47	0.02	0.26	0.22	0.22	5.35	10.23	0.68	1.82	0.86	0.58	0.88	0.76	1.57	1.05	0.41	1.34	1.47	0.26	0.55	0.20	0.54
France	1.16	4.72	0.62	0.52	0.70	1.26	0.62	1.01	1.83	0.51	1.33	1.86	1.04	0.93	0.70	0.87	0.45	0.84	0.88	1.04	4.59	0.45	0.76
Germany	0.75	0.65	1.93	0.52	0.49	0.36	0.76	1.22	2.47	0.23	1.05	1.40	1.25	0.96	0.72	1.29	0.56	1.16	1.61	1.90	1.58	0.78	0.55
Greece	2.03	1.28	4.64	0.83	1.21	0.44	0.47	0.59	0.88	5.94	0.64	1.15	0.86	1.42	1.46	0.68	0.18	0.65	0.26	0.09	0.38	0.17	0.28
Hungary	0.95	0.44	0.50	0.38	0.25	0.52	0.75	0.99	0.03	0.45	0.65	1.23	1.55	1.20	0.34	0.85	1.39	1.86	0.91	1.89	0.15	1.07	0.30
Ireland	1.46	1.75	0.49	0.09	0.15	0.09	0.46	0.13	0.00	0.26	2.82	9.46	0.34	0.27	0.08	0.26	0.67	0.22	0.32	0.03	0.39	0.09	1.55
Italy	0.88	2.29	0.03	1.30	1.61	3.09	0.54	1.07	1.28	0.80	0.72	1.20	1.28	1.86	1.14	1.62	0.21	0.98	1.84	0.70	0.75	2.20	0.96
Latvia	1.56	7.89	1.47	0.95	1.09	0.35	18.47	0.90	2.07	0.97	0.57	0.89	0.92	1.98	1.47	1.48	0.53	0.76	0.45	0.57	0.29	2.23	0.42
Lithuania	1.63	1.79	6.47	0.95	1.10	0.38	3.36	1.20	0.27	4.00	1.32	0.41	1.11	0.99	0.19	1.05	0.23	0.60	0.66	0.63	0.23	5.70	0.44
Luxembourg	1.10	1.02	6.54	2.33	0.36	0.25	2.27	2.11	0.01	0.02	0.57	0.14	4.38	2.50	3.55	1.33	0.28	0.63	0.82	0.64	0.66	0.11	0.24
Malta	0.63	0.28	2.68	0.81	0.14	0.15	0.02	0.03	1.55	5.42	0.17	1.99	0.91	0.18	0.04	0.19	1.56	0.87	0.20	0.06	1.79	0.06	1.52
Netherlands	1.91	1.30	4.86	0.44	0.59	0.64	0.30	0.87	0.34	2.29	1.73	1.10	0.77	0.47	0.57	0.76	0.99	0.54	0.93	0.37	0.34	0.40	0.83
Poland	1.55	0.44	5.25	0.60	0.70	0.45	2.33	1.86	0.69	0.60	0.81	0.35	1.82	1.56	0.95	1.80	0.59	1.32	0.65	1.45	1.18	4.59	0.30
Portugal	1.12	3.61	4.03	1.82	2.11	3.01	4.23	3.29	0.73	0.77	0.78	0.45	1.83	3.02	0.71	2.08	0.29	1.09	0.49	1.25	0.20	2.62	0.31
Romania	0.48	0.27	5.81	1.10	2.21	2.26	4.86	0.37	2.07	0.83	0.59	0.57	1.69	0.54	0.93	1.15	0.42	1.55	0.84	1.91	0.87	3.62	0.22
Slovakia	0.57	0.50	0.01	0.37	0.51	1.09	1.17	1.08	0.57	0.73	0.38	0.13	1.42	1.10	1.04	1.47	1.28	0.88	0.74	2.67	0.17	1.32	0.26
Slovenia	0.50	0.61	0.00	0.86	0.33	0.58	3.12	1.85	0.27	0.58	0.94	2.75	1.71	1.53	0.98	2.05	0.22	2.20	1.00	1.35	0.23	2.39	0.42
Spain	1.67	2.50	0.55	0.78	1.36	1.17	0.77	1.42	0.64	0.86	1.13	1.40	1.13	2.12	1.07	1.24	0.15	0.93	0.72	1.93	1.10	0.70	0.37
Sweden	0.52	0.88	0.68	0.30	0.40	0.23	3.64	5.78	0.20	1.31	0.73	1.42	0.86	0.62	1.08	1.12	0.69	1.03	1.30	1.21	0.33	1.50	0.44
United Kingdom	0.66	3.87	0.58	0.50	0.68	0.51	0.17	0.67	2.30	1.22	1.20	2.59	0.86	0.67	0.79	0.71	0.59	0.71	1.16	1.32	1.76	0.37	1.05
EU-28	0.66	2.25	1.11	0.54	0.52	0.81	0.95	1.00	1.32	0.86	1.03	1.96	0.79	1.02	0.74	1.01	0.55	0.98	1.62	1.28	1.92	0.84	0.85
US	0.89	0.77	0.22	0.50	0.16	0.20	0.60	1.18	0.56	1.30	1.38	0.99	0.97	0.69	0.79	0.92	0.94	0.87	1.39	1.08	0.51	0.48	1.46
Japan	0.07	0.07	0.06	0.44	0.02	0.02	0.02	0.27	0.21	0.26	0.96	0.16	1.07	1.00	1.07	0.79	1.08	1.09	2.00	2.25	1.26	0.14	0.36
Brazil	5.04	0.12	0.57	0.35	0.04	1.64	1.79	3.06	0.42	0.46	1.01	0.38	0.68	0.98	1.68	0.85	0.08	0.46	0.86	0.96	1.75	0.49	0.16
China	0.35	0.10	0.16	2.47	2.66	2.51	0.93	0.48	0.19	0.18	0.49	0.22	1.11	1.67	0.48	1.34	1.87	1.48	0.74	0.27	0.74	2.30	1.46
India	1.73	0.11	0.46	2.82	1.81	1.11	0.13	0.24	0.67	3.00	1.04	1.13	0.63	0.74	0.77	1.02	0.17	0.36	0.42	0.37	0.81	0.31	4.60
Russia	0.62	0.29	1.48	0.07	0.04	0.13	3.03	0.93	0.15	7.11	1.41	0.08	0.29	0.54	2.71	0.33	0.10	0.22	0.17	0.14	0.71	0.13	0.31

Source: Own calculations using COMTRADE data

Table 7.10: Relative trade balance (X-M)/(X+M) in manufacturing industries in 2012 - EU countries, US and Japan, Brazil, China, India and Russia

	Food	Bevarages	Tobacco	Textiles	Clothing	Leather & footwear	Wood & wood products	Paper	Printing	Refined petroleum	Chemicals	Pharma-ceuticals	Rubber & plastics	Non-metallic mineral products	Basic metals	Metal products	Computers electronic & optical	Electrical equipment	Machinery	Motor vehicles	Other transport	Furniture	Other manu-facturing
	C10	C11	C12	C13	C14	C15	C16	C17	C18	C19	C20	C21	C22	C23	C24	C25	C26	C27	C28	C29	C30	C31	C32
Austria	-0.08	0.53	-1.00	-0.01	-0.42	-0.20	0.40	0.22	-0.29	-0.52	-0.23	0.08	-0.04	-0.04	0.09	0.13	-0.11	0.08	0.09	0.01	0.19	-0.28	-0.12
Belgium	0.14	0.01	0.05	0.24	-0.04	0.14	-0.01	-0.03	0.06	0.05	0.13	0.09	0.04	0.09	0.19	-0.04	-0.18	-0.08	0.05	-0.02	-0.13	-0.23	0.02
Bulgaria	-0.11	-0.17	0.55	-0.43	0.54	0.03	0.24	-0.34	-0.82	0.22	-0.39	-0.18	-0.21	0.24	0.40	-0.24	-0.48	-0.02	-0.09	-0.30	-0.43	0.32	-0.11
Croatia	-0.34	0.11	0.07	-0.57	-0.08	0.00	0.40	-0.47	-0.46	-0.03	-0.40	-0.22	-0.58	0.10	-0.39	-0.01	-0.54	0.04	-0.30	-0.59	0.22	0.02	-0.68
Cyprus	-0.66	-0.80	-0.38	-0.87	-0.89	-0.75	-0.96	-0.93	-1.00	-1.00	-0.56	0.00	-0.85	-0.82	-0.29	-0.76	-0.60	-0.64	-0.65	-0.83	0.12	-0.81	-0.74
Czech Rep.	-0.14	0.07	0.27	0.10	-0.15	-0.07	0.32	-0.04	0.04	-0.18	-0.18	-0.39	0.04	0.19	-0.17	0.21	0.02	0.17	0.17	0.34	0.33	0.25	0.21
Denmark	0.25	-0.06	0.24	-0.03	-0.08	-0.25	-0.37	-0.33	-0.24	-0.06	-0.11	0.19	-0.07	-0.14	-0.35	0.06	-0.15	-0.03	0.24	-0.36	-0.44	0.23	-0.09
Estonia	0.02	-0.20	-0.75	0.18	0.12	0.11	0.43	-0.18	-0.52	-0.15	-0.20	-0.71	-0.07	0.05	-0.14	0.21	0.00	0.04	-0.04	-0.15	-0.58	0.62	0.06
Finland	-0.46	-0.38	-0.95	-0.36	-0.63	-0.46	0.57	0.80	-0.54	0.31	-0.07	-0.23	-0.02	-0.13	0.44	0.03	-0.20	0.16	0.23	-0.45	-0.02	-0.64	-0.01
France	-0.06	0.64	-0.60	-0.14	-0.36	-0.08	-0.32	-0.19	0.26	-0.42	0.02	0.06	-0.13	-0.17	-0.06	-0.14	-0.20	-0.07	-0.03	-0.04	0.24	-0.53	-0.13
Germany	0.07	-0.04	0.56	0.04	-0.29	-0.28	0.05	0.14	0.42	-0.31	0.14	0.17	0.21	0.18	0.04	0.23	-0.01	0.20	0.41	0.41	0.22	-0.07	0.06
Greece	-0.25	-0.16	0.11	-0.13	-0.27	-0.64	-0.44	-0.64	-0.65	0.44	-0.46	-0.52	-0.19	0.05	0.15	-0.16	-0.64	-0.24	-0.44	-0.67	-0.80	-0.74	-0.55
Hungary	0.20	0.10	-0.23	-0.14	-0.09	-0.04	0.15	0.01	-0.92	0.08	-0.08	0.09	0.09	0.19	-0.30	-0.13	0.06	0.18	-0.06	0.44	0.14	0.45	0.10
Ireland	0.21	0.20	0.05	-0.35	-0.59	-0.59	0.13	-0.67	-1.00	-0.36	0.62	0.73	-0.22	-0.16	-0.32	-0.10	0.30	-0.15	-0.07	-0.76	-0.17	-0.56	0.53
Italy	-0.09	0.64	-0.98	0.23	0.17	0.32	-0.34	-0.01	0.06	0.31	-0.20	-0.08	0.27	0.46	0.03	0.45	-0.34	0.21	0.51	0.01	0.26	0.68	0.20
Latvia	-0.20	0.38	-0.39	-0.09	-0.10	-0.47	0.78	-0.38	-0.46	-0.51	-0.33	-0.20	-0.29	0.02	0.17	0.02	-0.13	-0.15	-0.45	-0.28	-0.40	0.23	-0.29
Lithuania	0.13	-0.13	0.52	-0.07	0.28	-0.15	0.26	-0.16	-0.64	0.66	0.03	-0.35	0.03	-0.02	-0.38	0.08	-0.21	0.01	-0.02	-0.13	-0.09	0.83	0.10
Luxembourg	-0.26	-0.57	-0.07	0.54	-0.53	-0.53	0.09	-0.08	-0.98	-0.99	-0.46	-0.71	0.31	0.00	0.34	-0.12	-0.36	-0.25	-0.01	-0.49	-0.80	-0.90	-0.43
Malta	-0.50	-0.77	-0.28	0.39	-0.66	-0.62	-0.95	-0.96	-0.48	-0.39	-0.69	0.33	-0.09	-0.80	-0.74	-0.56	0.13	0.13	-0.48	-0.68	-0.40	-0.91	0.33
Netherlands	0.22	0.13	0.62	0.08	-0.12	-0.05	-0.44	-0.05	-0.23	0.14	0.22	0.09	0.01	-0.15	-0.01	0.05	0.00	-0.01	0.15	-0.13	0.07	-0.26	0.07
Poland	0.20	-0.12	0.82	-0.27	-0.03	-0.26	0.45	0.02	-0.14	0.21	-0.21	-0.40	0.11	0.22	0.00	0.16	-0.17	0.16	-0.16	0.25	0.11	0.76	-0.17
Portugal	-0.31	0.48	0.46	0.10	0.21	0.25	0.50	0.30	-0.22	0.07	-0.34	-0.52	0.17	0.46	-0.10	0.30	-0.30	0.10	-0.16	0.06	-0.27	0.40	-0.37
Romania	-0.43	-0.47	0.58	-0.46	0.51	0.10	0.65	-0.60	-0.12	0.01	-0.37	-0.47	-0.12	-0.41	-0.09	-0.26	-0.29	-0.09	-0.23	0.29	0.55	0.65	-0.29
Slovakia	0.03	0.05	-0.98	-0.11	0.06	0.14	0.31	0.21	0.23	0.43	-0.15	-0.57	0.11	0.16	0.29	0.09	0.09	0.00	0.08	0.34	0.10	0.20	0.02
Slovenia	-0.36	-0.12	-1.00	0.10	-0.34	-0.34	0.16	0.07	-0.62	-0.54	-0.15	0.42	0.14	0.07	-0.07	0.14	-0.18	0.35	0.14	0.09	-0.08	0.36	-0.07
Spain	0.09	0.34	-0.72	-0.01	-0.18	-0.07	0.04	0.03	-0.40	-0.06	-0.09	-0.07	0.03	0.44	0.21	0.16	-0.54	0.07	0.03	0.19	0.39	-0.13	-0.32
Sweden	-0.33	-0.12	0.18	-0.22	-0.39	-0.45	0.53	0.70	-0.64	0.26	-0.13	0.30	-0.09	-0.21	0.20	0.09	-0.08	0.05	0.15	0.10	-0.19	0.11	-0.09
United Kingdo	-0.45	0.13	-0.39	-0.31	-0.55	-0.55	-0.81	-0.46	0.46	0.01	-0.05	0.10	-0.22	-0.25	-0.22	-0.24	-0.28	-0.22	0.02	-0.13	0.14	-0.66	-0.14
EU-28	-0.03	0.67	0.83	-0.14	-0.50	-0.20	0.13	0.31	0.34	-0.02	0.19	0.28	0.09	0.25	-0.14	0.20	-0.25	0.14	0.46	0.56	0.22	0.03	-0.03
US	-0.03	-0.45	-0.25	-0.35	-0.87	-0.82	-0.44	0.05	0.54	0.05	0.13	-0.23	-0.18	-0.26	-0.13	-0.17	-0.28	-0.25	-0.03	-0.33	-0.41	-0.69	-0.16
Japan	-0.88	-0.82	-0.97	-0.20	-0.97	-0.96	-0.98	-0.30	0.42	-0.56	0.18	-0.70	0.31	0.27	0.37	0.19	0.09	0.29	0.61	0.74	0.40	-0.69	-0.38
Brazil	0.76	-0.79	0.92	-0.55	-0.87	0.49	0.83	0.53	-0.19	-0.61	-0.45	-0.62	-0.33	-0.12	0.33	-0.17	-0.88	-0.44	-0.38	-0.24	0.12	0.19	-0.59
China	0.04	-0.44	0.69	0.71	0.95	0.82	0.29	-0.03	0.38	-0.22	-0.23	0.07	0.49	0.62	-0.02	0.65	0.23	0.41	0.11	-0.16	0.31	0.93	0.78
India	0.36	-0.20	0.82	0.64	0.94	0.62	-0.41	-0.52	-0.34	0.58	-0.27	0.51	0.16	0.01	-0.64	0.19	-0.64	-0.30	-0.42	0.23	-0.16	0.08	0.50
Russia	-0.47	-0.73	0.54	-0.86	-0.95	-0.85	0.53	-0.20	-0.88	0.95	0.13	-0.91	-0.69	-0.50	0.56	-0.69	-0.82	-0.76	-0.84	-0.88	-0.31	-0.82	-0.49

Source: Own calculations using COMTRADE data

Table 7.11: Revealed comparative advantage index in service industries in 2012 - EU countries, US and Japan, Brazil, China, India and Russia.

Country name	Telecommunications, computer and information	Construction	Finance	Insurance and pension	Other business services	Personal, cultural and recreational	Transport	Travel
Austria	0.69	0.46	0.34	1.00	1.09	0.72	1.11	1.14
Belgium	0.87	0.82	0.66	0.57	1.57	0.77	1.17	0.44
Bulgaria	1.01	1.24	0.13	0.99	0.59	0.77	0.88	1.76
Croatia	0.41	0.26	0.10	0.13	0.45	0.40	0.47	2.53
Cyprus	0.17	0.33	1.66	0.26	1.07	0.45	1.17	1.26
Czech Republic	1.04	1.25	0.04	0.67	1.17	1.08	1.00	1.05
Denmark	0.41	0.10	0.17	0.30	0.85	0.72	2.74	0.35
Estonia	0.83	1.95	0.27	0.08	0.81	0.54	1.72	0.76
Finland	2.34	3.24	0.46	0.30	0.93	0.21	0.58	0.53
France	0.66	0.83	0.59	0.81	1.18	2.52	1.01	0.93
Germany	0.89	1.44	0.95	1.06	1.15	0.37	1.00	0.48
Greece	0.24	0.68	0.07	0.78	0.25	0.60	2.19	1.31
Hungary	0.67	0.58	0.13	0.07	0.95	5.71	0.94	0.75
Ireland	4.30	0.00	1.56	5.47	1.04	0.31	0.25	0.13
Italy	0.75	0.27	0.49	1.46	1.22	0.17	0.63	1.39
Latvia	0.65	0.95	1.17	0.21	0.64	0.32	2.22	0.56
Lithuania	0.28	1.05	0.15	0.00	0.28	0.43	2.43	0.70
Luxembourg	0.67	0.16	9.85	2.24	0.78	4.76	0.23	0.22
Malta	0.32	0.00	1.07	0.37	0.44	43.87	0.42	0.87
Netherlands	1.09	1.00	0.24	0.33	1.57	0.70	1.26	0.46
Poland	0.77	1.47	0.22	0.49	1.19	1.04	1.33	1.01
Portugal	0.49	1.03	0.22	0.27	0.59	1.48	1.28	1.57
Romania	1.54	1.01	0.45	0.65	0.99	0.75	1.15	0.40
Slovak Republic	0.99	1.59	0.10	0.41	0.99	1.11	1.29	1.15
Slovenia	0.82	1.59	0.11	0.81	0.63	1.36	1.22	1.47
Spain	0.63	1.30	0.57	0.63	1.10	1.72	0.74	1.46
Sweden	1.51	0.43	0.44	0.67	1.41	0.90	0.82	0.60
United Kingdom	0.81	0.28	3.64	4.10	1.47	1.82	0.53	0.43
EU-28	1.17	0.73	1.18	1.24	1.11	1.38	1.01	0.81
US	0.48	0.18	2.16	1.26	0.79	0.46	0.58	0.87
Japan	0.17	3.04	0.63	0.15	0.87	0.14	1.35	0.38
Brazil	0.23	0.02	1.24	0.69	2.45	0.11	0.62	0.58
China	0.82	2.20	0.18	0.87	1.22	0.07	0.90	0.89
India	4.55	0.22	0.67	0.79	0.90	0.54	0.54	0.43
Russia	0.55	2.67	0.39	0.35	1.21	0.91	1.39	0.61

Source: Own calculations based on IMF and OECD data

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HELPING FIRMS GROW

EUROPEAN COMPETITIVENESS REPORT 2014

A Europe 2020 Initiative

As the EU economy gradually recovers from the longest and deepest recession in post-war history, the 2014 edition of the European Competitiveness Report focuses on firms' growth – in particular a number of growth-enhancing measures and framework conditions affecting EU firms. These include the availability of different forms of funding, which is especially important if small and medium-sized enterprises (SMEs) are to expand, as well as the importance of having an efficient and modern public administration as part of the institutional set-up. One chapter examines how innovation – another important driver of growth – varies over the business cycle and how the impact of innovation on firms' growth also varies. A final chapter related to firms' growth looks at the extent to which SMEs are active outside their home markets, the forms of their international presence, the impact and drivers of SME internationalisation, and what can be done to increase their presence abroad.

This year's edition also contains a chapter on energy costs and energy efficiency. Rising energy costs have dented the competitiveness of EU manufacturing industries, especially energy-intensive industries. To some extent, manufacturers have been able to mitigate the effect of rising energy prices through higher energy efficiency, but the scope for further efficiency gains narrows as firms become more energy efficient. This chapter also assesses the importance of energy costs in relation to other costs, across manufacturing generally, as well as in energy-intensive industries such as steel, aluminium, ceramics and chemicals.