Council of the European Union

Brussels, 12 September 2014
(OR. en)

13141/14
ADD 2

IND 241
COMPET 504
RECH 363
ESPACE 67
TRANS 418
ENER 391
REGIO 97
ECOFIN 816
MI 648
EDUC 280
TELECOM 160

COVER NOTE

From:	Secretary-General of the European Commission, signed by Mr Jordi AYET PUIGARNAU, Director
date of receipt:	11 September 2014
To:	Mr Uwe CORSEPIUS, Secretary-General of the Council of the European Union
No. Cion doc.:	SWD(2014) 277 final (Part 3/4)
Subject:	COMMISSION STAFF WORKING DOCUMENT European Competitiveness Report 2014 Helping Firms Grow

Delegations will find attached document SWD(2014) 277 final (Part 3/4).

Encl.: SWD(2014) 277 final (Part 3/4)

EUROPEAN
COMMISSION

Brussels, 11.9.2014
SWD(2014) 277 final

PART 3/4

COMMISSION STAFF WORKING DOCUMENT

European Competitiveness Report 2014
Helping Firms Grow

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,[1] the Services Directive[2], the Action Programme for Reducing Administrative Burdens in the European Union[3]. 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[4] 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[5] (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.[6] 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 Section 4.1, these issues are discussed in greater

1 COM (2008) 394 final.
2 Official Journal of the European Union (2006), L 376/36.
3 SWD (2012) 423 final.
4 COM (2012)750 final.
5 Link:http://ec.europa.eu/enterprise/policies/industrial-competitiveness/monitoring-member-states/improving-public-administration/index_en.htm.
6 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*.

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[7], 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 dimensions of PA. Based on cross-country rankings

[7] 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.

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

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[9]	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[10]	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 of PA quality. Table 4.1 provides a detailed overview of the links and the associated indicators that are used in the empirical analysis.[8] 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

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

[9] 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.

[10] 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.

PA and its relation to the business environment, namely Government effectiveness, E-government, and Corruption and fraud. Government effectiveness 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 level and are highly correlated to other institutional factors and the level of economic development. Moreover, the short time series mean that it is

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

Source: Eurostat, WIFO calculations.

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. [11]

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 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.

[11] 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:

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

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.

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*.[12] 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.

[12] 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.

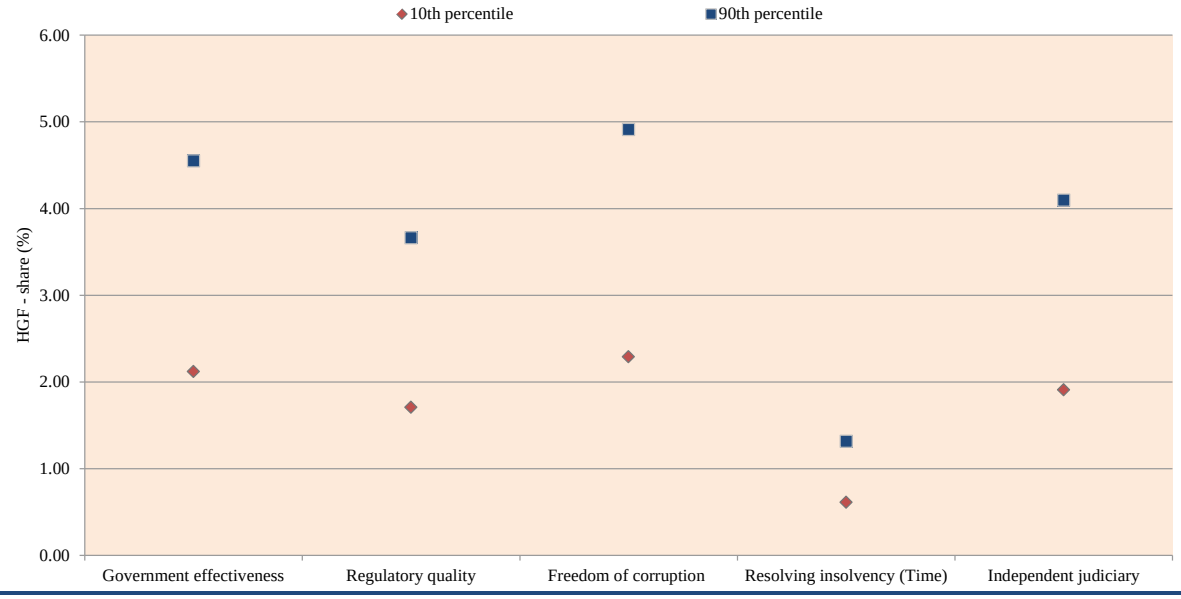
The predictions show that PA quality has a substantial impact on the share of high growth firms. The general indicators of PA quality (*government effectiveness*, *regulatory quality*, *freedom from corruption* and *independent judiciary*), have a greater impact than the specific link with *time to resolve 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[13]

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)[14] 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.

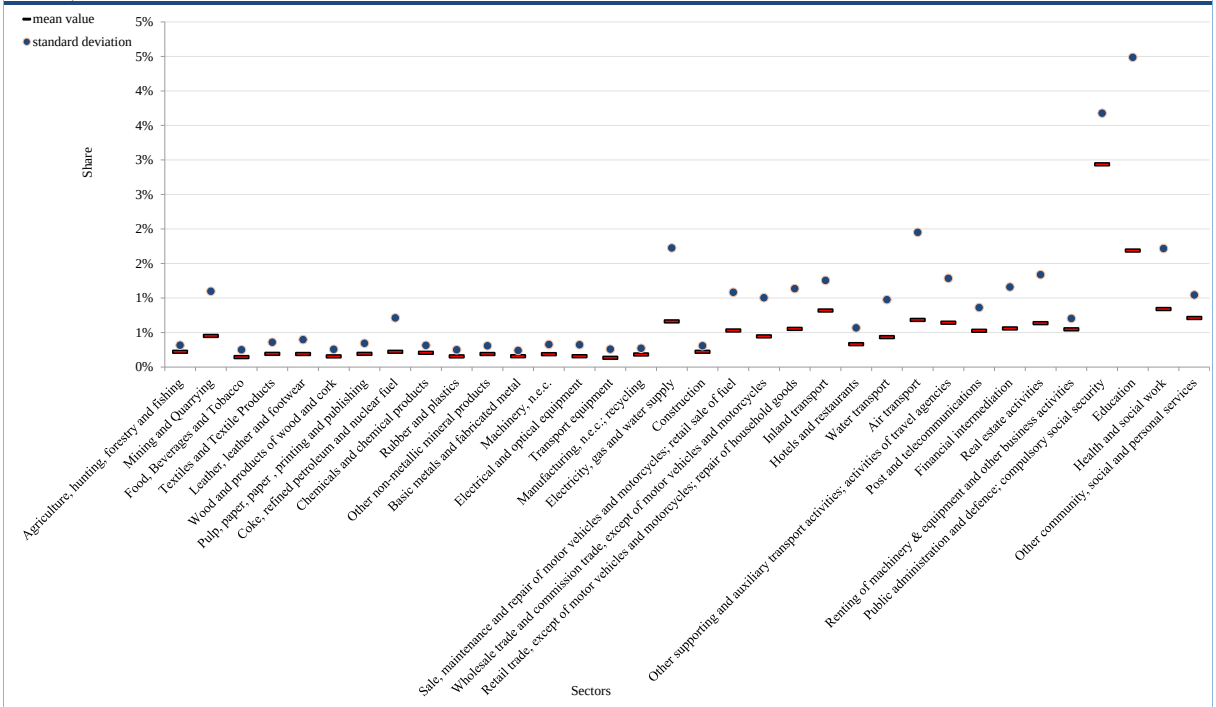
Figure 4.3 shows the share of PA services in total intermediate input by sector for the 40 WIOD countries.[15] The figure shows that for most sectors and most countries, the relevance of PA as a direct input is significantly lower for the manufacturing industries compared to the service industries. The 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.

[13] For the detailed analysis refer to the study: Misch et al. (2014).

[14] Sector 'L' (Public administration), together with sectors 'M' and 'N' (Health and Education, respectively), makes up the bulk of government consumption.

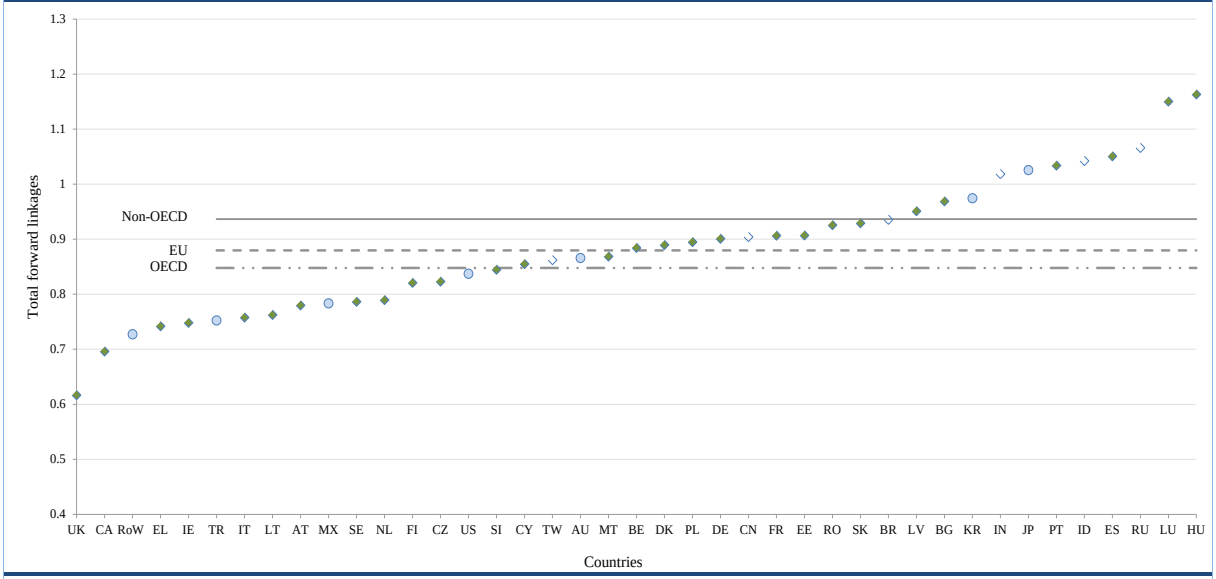
[15] A country-level analysis could not add to the discussion here.

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. [16] 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).

[16] See Figure 2.15 in background study (Misch et al., 2014).

Input-output linkages of PA and the quality of governance[17]

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[18] 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.

[17] For the detailed analysis refer to Misch et al. (2014)

[18] 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).

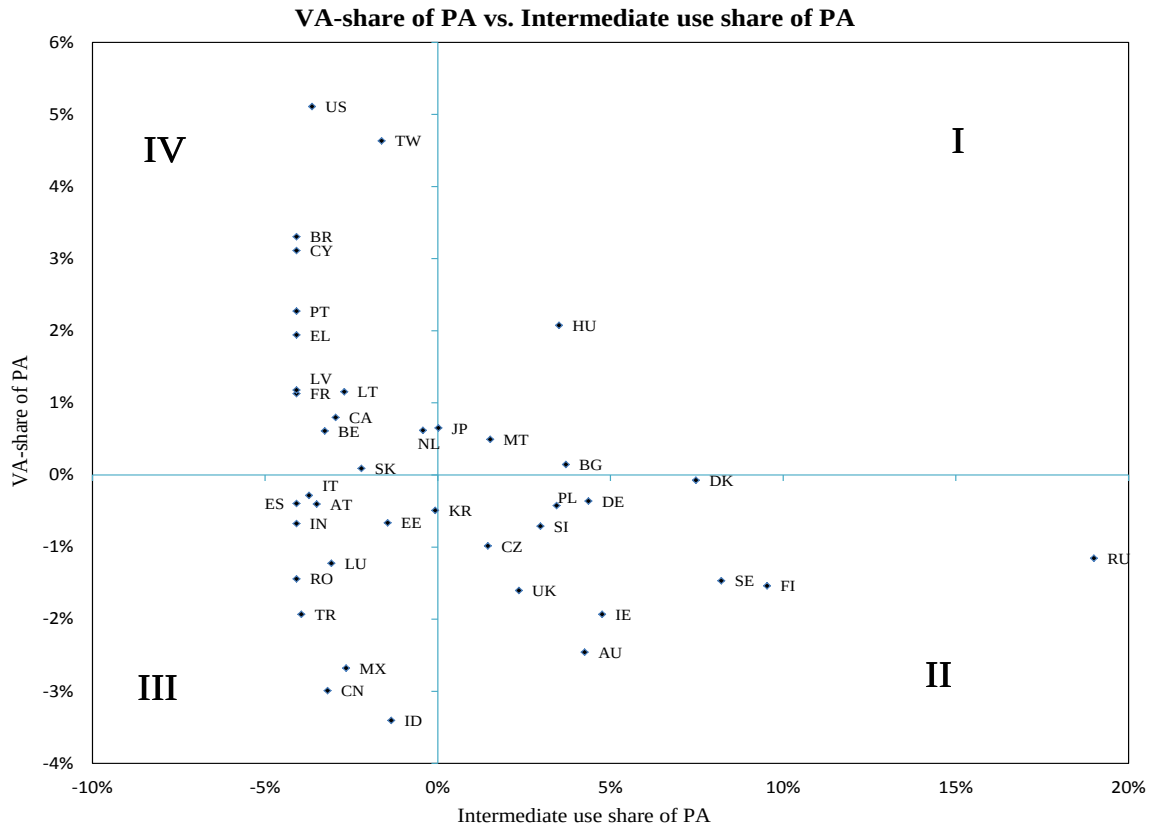
Figure 4.5 shows the positioning of 40 countries along these two dimensions. The first diagram is based on a narrow definition of government — only sector PA is included. The diagram underneath takes an aggregate of sectors: PA, Education, Health & Social Work, i.e. a broader definition of the government 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).

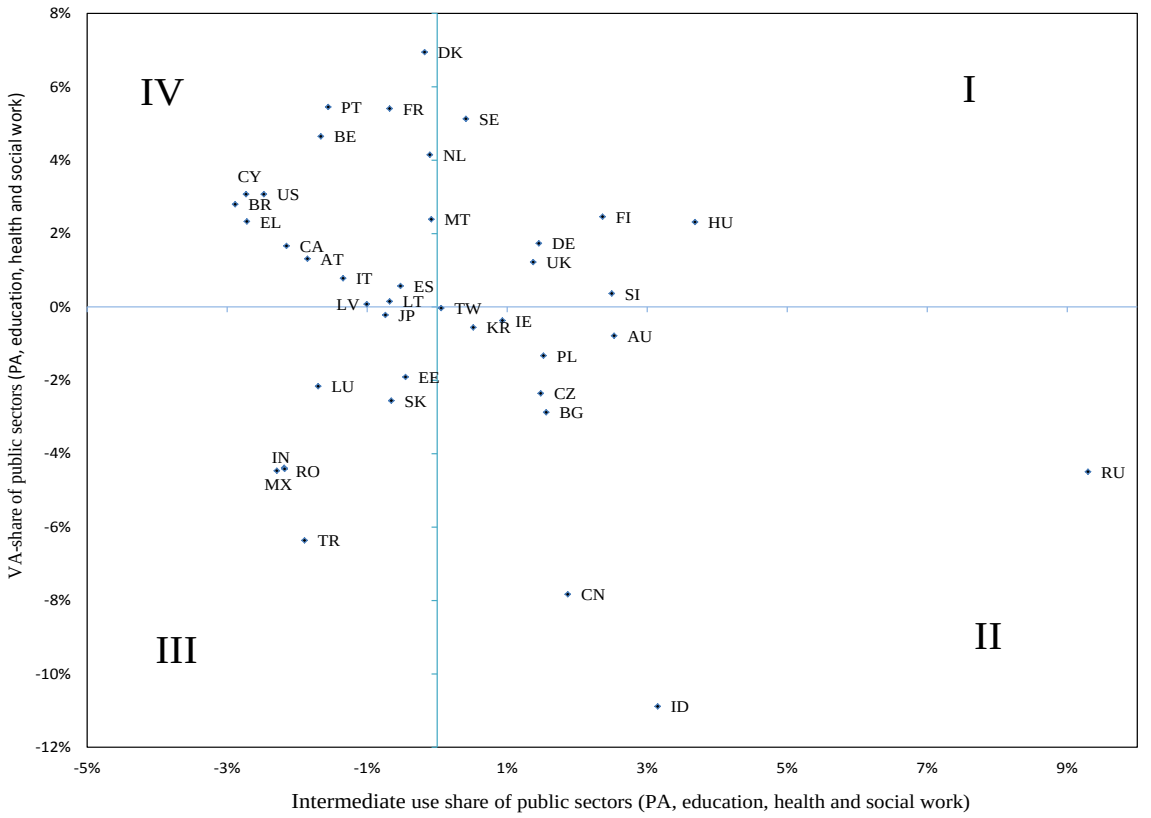
The main findings indicate that input-output analysis does not support the hypothesis that intermediate linkages of the PA sector can play a particularly important role in the overall economy; rather, PA services appear in the final demand category 'government consumption' (this implies that most public 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.[19] 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

[19] 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.[20]

$$perception_{jict} = \beta_1\, empl_{ict} + \beta_2\, sector_{ict} + \beta_3\, own_{ict} + \beta_4\, foreign_{ict} + \beta_5\, exports_{ict} + \beta_6\, age_{ict} + \beta_7\, productivity_{ict} + \eta_{jc} + \epsilon_{jict} \quad (4.9)$$

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).

$$\widetilde{perception}_{jict} = \frac{perception_{jict}}{\overline{tc}_{ict}} \quad (4.11)$$

$$\widetilde{rc}_{jct} = \frac{1}{N}\sum_{i=1}^{N} \widetilde{perception}_{jict} \quad (4.12)$$

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

[20] 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.

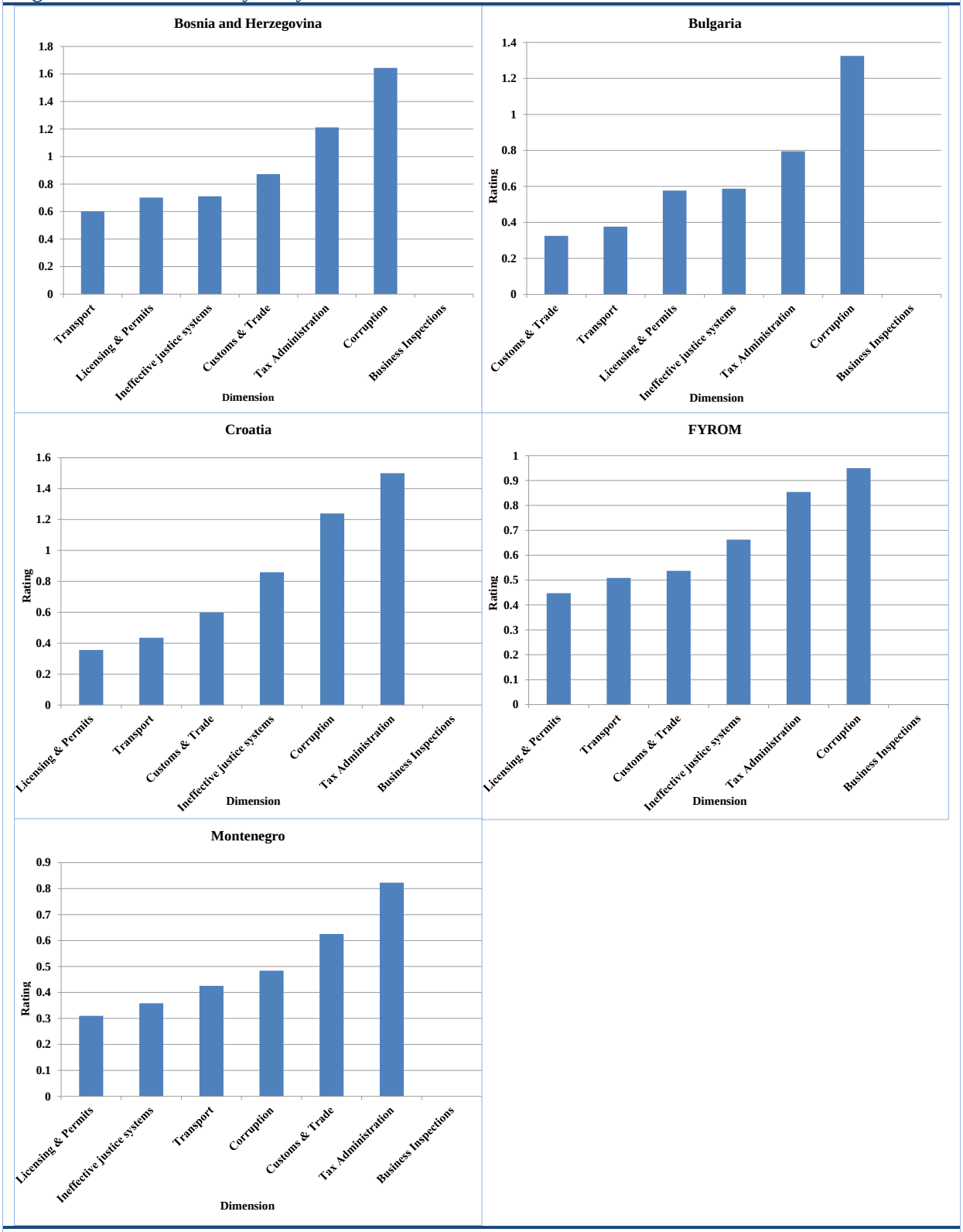
On the basis of the estimation results for all dimensions of PA covered, it is possible to carry out country-specific analyses identifying the factor most impeding firms' growth. Figure 4.6 summarises the results for countries for which 2013 data are available.

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.[21] 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.

[21] 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

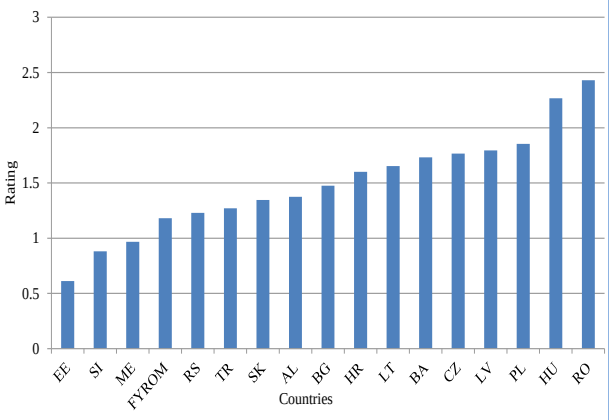
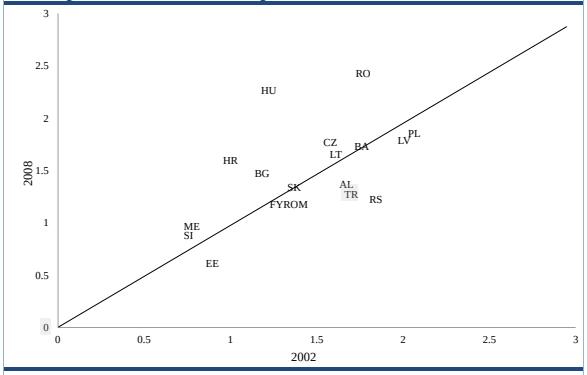


Figure 4.8: Scatterplot of between-country comparisons with respect to Tax Administration



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.[22] 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[23] 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. [24]

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

[22] Estimation results of the robustness checks can be found in the Annex of the study Misch et al. (2014).

[23] Refer to Table 3.42, Misch et al., 2014.

[24] 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.[25] 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,

[25] 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.

REFERENCES

Alesina, A., Ardagna, S., Nicoletti, G. and Schiantarelli, F., (2005), 'Regulation and Investment', Journal of the European Economic Association, 13 (4), pp. 791-825.

Altomonte, C. and Aquilante, T., (2012), 'The EU-EFIGE/Bruegel-unicredit dataset', Bruegel Working Paper, No 13.

Andersen, T. B., (2009), 'E-Government as an anti-corruption strategy', Information Economics and Policy, 21(3), pp. 201–210.

Badri, M.A. and Alshare, K. (2008), 'A path analytic model and measurement of the business value of e-government: An international perspective', International Journal of Information Management, 28, pp. 524–535.

Bartelsman, E. J., Haltiwanger, J. and Scarpetta, S., (2004), 'Microeconomic Evidence of Creative Destruction in Industrial and Developing Countries', SSRN Scholarly Paper, Social Science Research Network, Rochester, NY.

Bartelsman, E., Haltiwanger, J. and Scarpetta, S., (2013), 'Cross-Country Differences in Productivity: The Role of Allocation and Selection', American Economic Review, 103(1), pp. 305–334.

Bassanini, A. and Ernst, E., (2002), 'Labour Market Institutions, Product Market Regulation and Innovation: Cross-Country Evidence', Economics Department Working Papers, No 316, OECD Paris.

Bertrand, M. and Mullainathan, S., (2001), 'Do People Mean What They Say? Implications for Subjective Survey Data', American Economic Review, Papers and Proceedings, 91(2), pp. 67-72.

Bravo-Biosca, A., (2010), 'Growth Dynamics Exploring business growth and contraction in Europe and the US', NESTA.

Bravo-Biosca, A., Criscuolo, C. and Menon, C., (2013), 'What Drives the Dynamics of Business Growth?', OECD Science, Technology and Industry Policy Papers, 1, OECD Publishing, Paris.

Carlin, W., Schaffer, M. E. and Seabright, P., (2010), A Framework for Cross-Country Comparisons of Public Infrastructure Constraints on firm Growth, CEPR Discussion Paper Series, No. 7662.

Carlin, W., Schaffer, M. E. and Seabright, P., (2013), 'Soviet power plus electrification: What is the long-run legacy of communism?', Explorations in Economic History, 50(1), pp. 116-147.

Cegarra-Navarro, J.G., Dewhurst, F.W. and Briones-Penalver, A.J., (2007), 'Factors affecting the use of e-government in the telecommunications industry of Spain', Technovation, 27, pp. 595-604.

Ciccone, A. and Papaioannou, E., (2007), 'Red tape and delayed entry', Journal of the European Economic Association, 5(2-3), pp. 444–458.

Ciccone, A. and Papaioannou, E., (2010), 'Estimating cross-industry cross-country models using benchmark industry characteristics', Economics Working Papers, 1235, Department of Economics and Business, Universitat Pompeu Fabra.

Coad, A. and Hölzl, W., (2009), 'On the Autocorrelation of Growth Rates', Journal of Industry, Competition and Trade, 9(2), pp. 139–166.

Coad, A., (2007), 'A Closer Look at Serial Growth Rate Correlation', Review of Industrial Organization, 31(1), pp. 69–82.

Coad, A., Daunfeldt, S.-O., Hölzl, W., Johansson, D. and Nightingale, P., (2014), 'High-growth firms: introduction to the special section', Ind Corp Change, 23(1), pp. 91–112.

Cuaresma, J. C., Oberhofer, H. and Vincelette, G. A., (2014), 'Institutional barriers and job creation in Central and Eastern Europe', IZA Journal of European Labor Studies, 3(1), pp. 3.

Djankov, S., (2009), 'The Regulation of Entry', World Bank Research Observer, 24(2), pp. 183-203.

European Commission (2006), Official Journal of the European Union, L376/36.

European Commission (2008), 'Think Small First' A 'Small Business Act' for Europe',COM(2008) 394 final.

European Commission (2012a), 'Annual Growth Survey 2013', COM(2012) 750 final.

European Commission (2012b), 'Action Programme for Reducing Administrative Burdens in the EU Final Report', SWD 423 final.

European Commission (2013a), 'The EU Justice Scoreboard. A tool to promote effective justice and growth', COM(2013)160 final.

European Commission (2013b), 'Justice in the EU', Flash Eurobarometer 385, November 2013.

European Commission (2013c), 'European Public Sector Innovation Scoreboard', Belgium, European Commission.

European Commission (2013d), 'Member States' Competitiveness Performance and Implementation of EU Industrial Policy', SWD (2013) 346.

European Commission (2014a), 'Business' Attitudes Towards Corruption in the EU', Flash Eurobarometer 374, February 2014.

European Commission (2014b), 'Corruption', Special Eurobarometer 397, February 2014.

European Commission (2014c), 'The 2014 EU Justice Scoreboard', COM(2014)155 final.

European Commission (2014d), 'The Puzzle of missing Greek exports', Economic Papers 518, June 2014.

Eurostat (2008), 'Eurostat Manual of Supply, Use and Input-Output Tables', Office for Official Publications of the European Communities, Luxembourg.

Eurostat − OECD (2007), 'Manual on Business Demography Statistics', Office for Official Publications of the European Communities, Luxembourg .

Haltiwanger, J., Scarpetta, S. and Schweiger, H., (2008), 'Assessing Job Flows Across Countries: The Role of Industry, Firm Size and Regulations', NBER Working Paper, National Bureau of Economic Research, Inc, No. 13920.

Henrekson, M. and Johansson, D., (2010), 'Gazelles as job creators: a survey and interpretation of the evidence', Small Business Economics, 35(2), pp. 227–244.

Hirst, P. and Norton, M., (1998), 'Electronic government: information technologies and the citizen', United Kingdom Parliament, Parliamentary Office of Science and Technology.

Hölzl, W., (2014), 'Persistence, survival, and growth: a closer look at 20 years of fast-growing firms in Austria', Industrial and Corporate Change, 23(1), pp. 199–231.

Hsieh, C.-T. and Klenow, P. J., (2009), 'Misallocation and Manufacturing TFP in China and India', The Quarterly Journal of Economics, 124(4), pp. 1403–1448.

Klapper, L., Laeven, L. and Rajan, R., (2006), 'Entry regulation as a barrier to entrepreneurship', Journal of Financial Economics, 82(3), pp. 591–629.

Laeven, L. and Woodruff, C., (2007), 'The Quality of the Legal System, Firm Ownership, and Firm Size', Review of Economics and Statistics, 89(4), pp. 601–614.

Méon, P.-G. and Weill, L., (2005), 'Does better governance foster efficiency? An aggregate frontier analysis', Economics of Governance, 6(1), pp. 75–90.

Misch, F., Fiesenbichler, K., Fritz, O., Holz, W., Streicher, G. and Yeter, M., (2014), 'The efficiency of EU public administration in helping firms grow'.

OECD, (2011), The Call for Innovative and Open Government. An Overview of Country Initiatives, OECD Publishing [DOI :10.1787/9789264107052-en].

Pitlik, H., Brandtner, C., Gagnage, S., Heinemann, F., Hölzl, W., Mertens, K., Misch, F., Steurs, G. and Yeter, M., (2012), 'Excellence in PA for competitiveness in EU Member States'. [http://ec.europa.eu/enterprise/policies/industrial-competitiveness/monitoring-member-states/improving-public-administration/index_en.htm]

Rajan, R. G. and Zingales, L., (1998), 'Financial Dependence and Growth', The American Economic Review, 88(3), pp. 559–586.

Restuccia, D. and Rogerson, R., (2008), 'Policy distortions and aggregate productivity with heterogeneous establishments', Review of Economic Dynamics, 11(4), pp. 707–720.

Rothstein, B. and Teorell, J. (2008), 'What is the Quality of Government? A Theory of Impartial Government Institutions', Governance: An International Journal of Policy, Administration, and Institutions, 21(2), pp. 165-190.

Shim, D. C. and Eom, T. H., (2009), 'Anticorruption effects of information communication and technology (ICT) and social capital', International Review of Administrative Sciences, 75(1), pp. 99–116.

Srivastava, S. C. and Teo, T. S. H., (2007), 'E-Government Payoffs: Evidence from Cross-Country Data', Journal of Global Information Management, 15(4), pp. 20–40.

Thompson, D.V., Rust, R.T., Rhoda, J., (2005), 'The business value of e-government for small firms', International Journal of Service Industry Management, 16(4), pp.385–407.

Timmer, M. P. (2012), 'The World Input-Output Database (WIOD): Contents, Sources and Methods',WIOD Working Paper Number 10.

Veenhoven, R., (2002), 'Why social policy needs subjective indicators', Social Indicators Research, 58(1), pp. 33-45.

World Bank (2014), 'Enterprise Surveys' [available at: http://www.enterprisesurveys.org].

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)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) 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) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) 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) Turnover	(2) Net entry	(3) Avg. firm size	(4) GVA growth	(5) 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) Turnover	(7) Net entry	(8) Avg. firm size	(9) GVA growth	(10) 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)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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)**	**(2)**	**(3)**	**(4)**	**(5)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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)**	**(7)**	**(8)**	**(9)**	**(10)**
	Turnover	**Net entry**	**Avg. firm size**	**GVA growth**	**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 vary 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 to reduce 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).

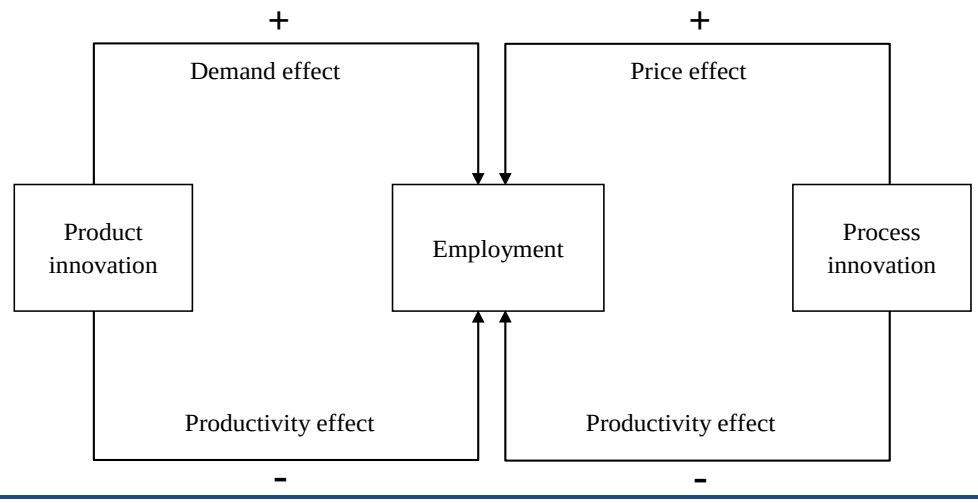
A new product introduced to the market provides higher utility for consumers, and creates new demand for the firm (see Figure 5.1). For the firm producing the new product, this *demand effect of product innovation* can result either in an overall market expansion, which has a positive effect on labour 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[26], 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,

[26] 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 leads to productivity improvements has a negative effect on employment. The size of this negative effect depends on the current production technology and, thus, 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 innovations 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[27], 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[28]). The survey covers firms in manufacturing and selected services sectors[29]. 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

---

[27] 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.

[28] The estimations for France and Spain are not included in this report.

[29] 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[30]:

- *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.

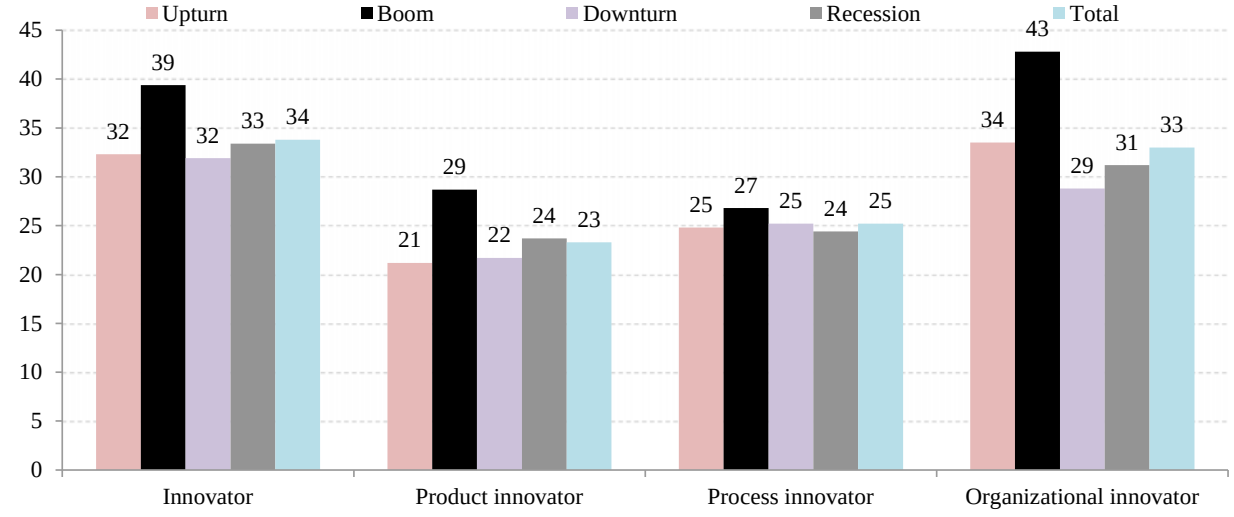
5.3. TRENDS IN EMPLOYMENT AND PRODUCTIVITY GROWTH FOR INNOVATIVE AND NON-INNOVATIVE FIRMS OVER THE BUSINESS CYCLE

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.

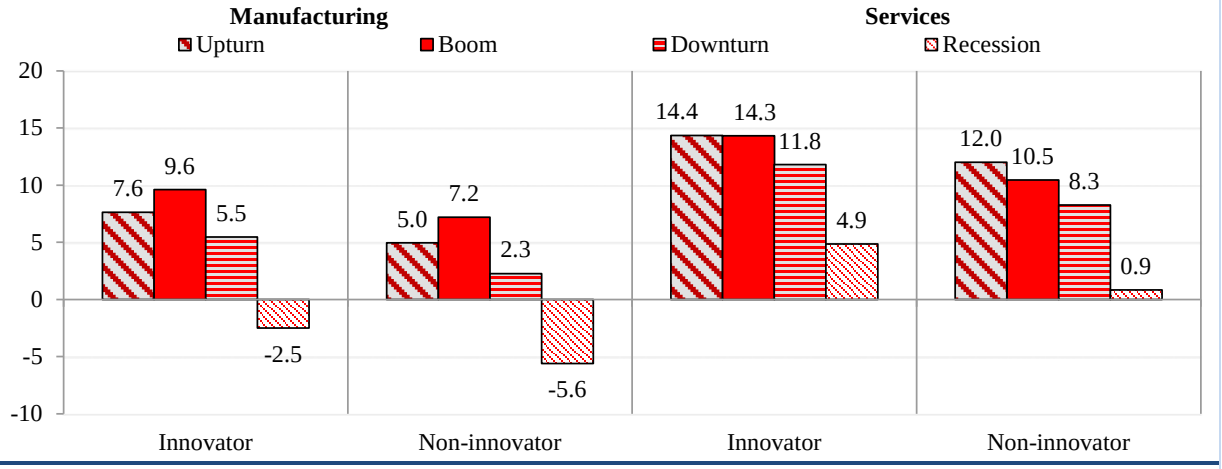
Figure 5.2: Innovator shares over the business cycle (in %), 1998-2010



Note: Innovator shares are weighted. Weights are provided by Eurostat.
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

[30] 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[31] in manufacturing and service sectors, in each phase of the business cycle for the period 1998-2010[32].

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[33]. 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.

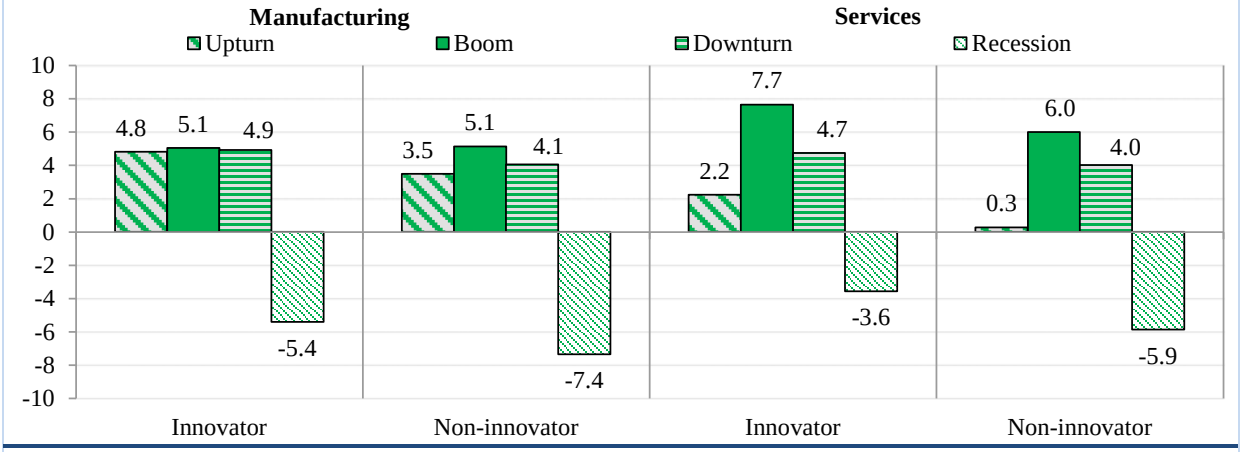
To investigate the role of product innovation in different stages of the business cycle in more detail, we examine graphically the sales growth due to new and old products. Both are key variables in the empirical model relating product innovation to employment growth (see section 5.4). Average nominal sales growth due to new and old products for all four phases of the business cycle is displayed in Figure 5.5.

[31] 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.

[32] 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.

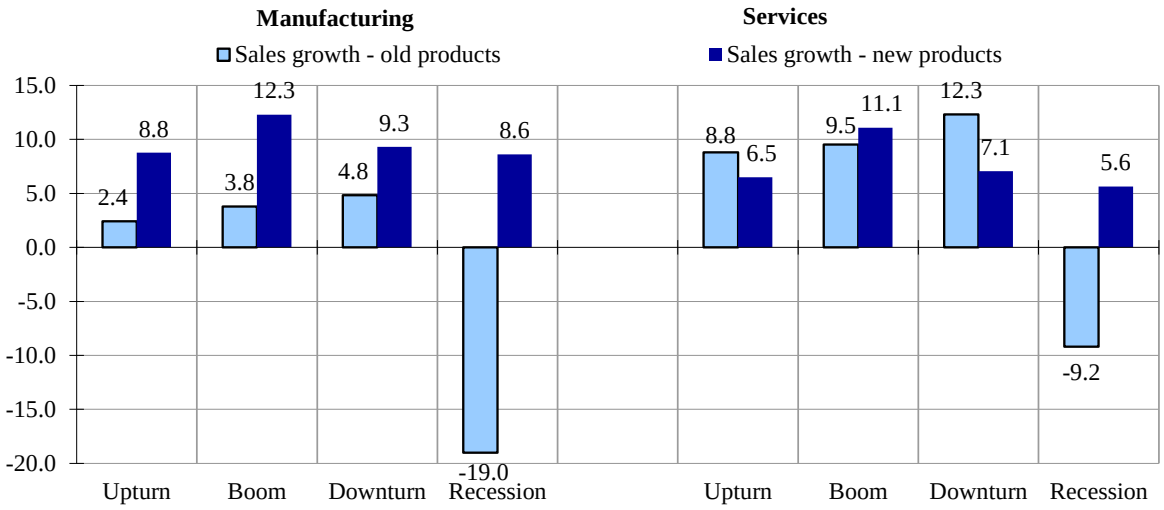
[33] Productivity growth is measured by growth in labour productivity (ratio of sales to employment) in real terms. CIS data do not include information on capital, which would be essential to calculate total factor productivity.

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.[34] 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.

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

[34] In the following, the term product covers both goods and/or services unless stated otherwise.

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[35], 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:

$$I = \underbrace{\hat{\alpha}_0}_{1} + \underbrace{\hat{\alpha}_1\, pc}_{2} + \underbrace{\hat{\alpha}_2\, orga}_{3} + \underbrace{\left[1 - I(g_2 > 0)\right](g_1 - \bar{\pi}_1)}_{4} + \underbrace{I(g_2 > 0)(g_1 - \bar{\pi}_1)}_{5a} + \underbrace{I(g_2 > 0)\hat{\beta}\, g_2}_{5b} + \hat{v} \qquad (5.2)$$

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) [36] 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.

[35] 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.

[36] 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.

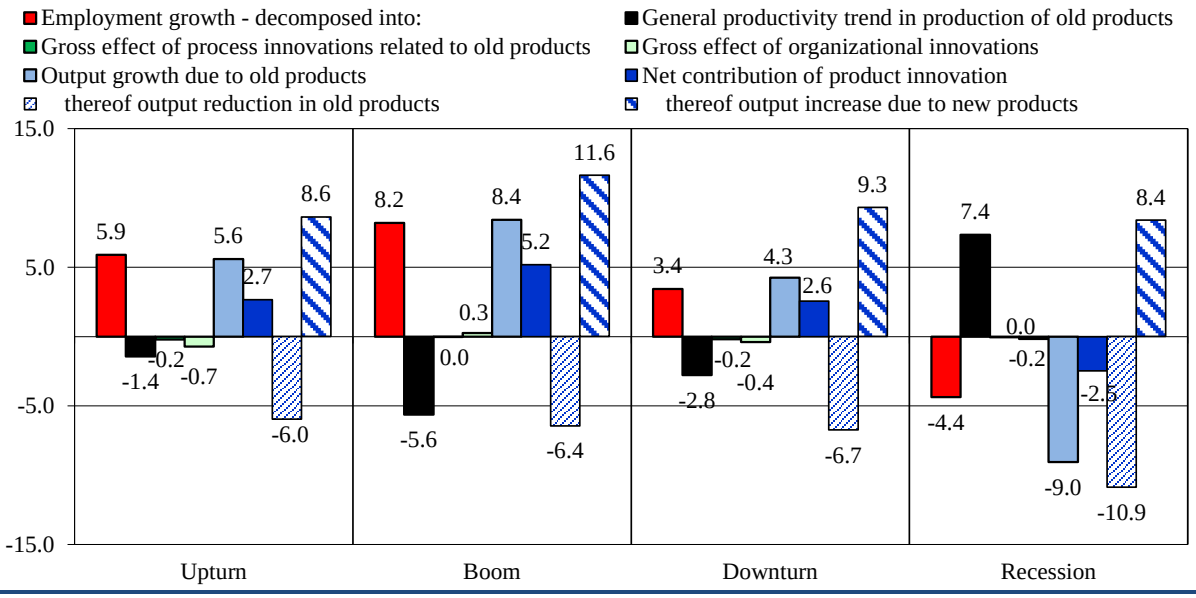
Figure 5.6 provides the decomposition of employment growth for firms in manufacturing sectors based on equation (5.2). It shows employment growth (red bar) broken-down into employment growth due to: general productivity trend in production of old products (black bar), process (dark green bar) and organisational 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.

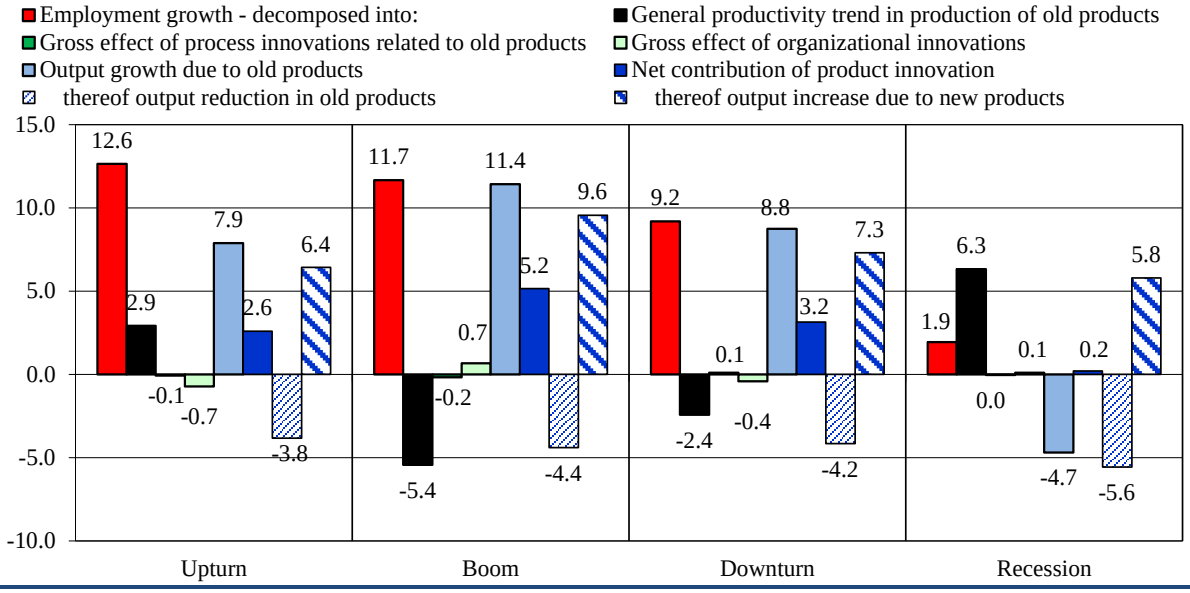
The results of the decomposition are similar to those obtained for manufacturing sector. However, employment growth and the contributions of different forms of innovation are higher than in manufacturing sector. Another important difference is that, in recessions, the net contribution of product

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.

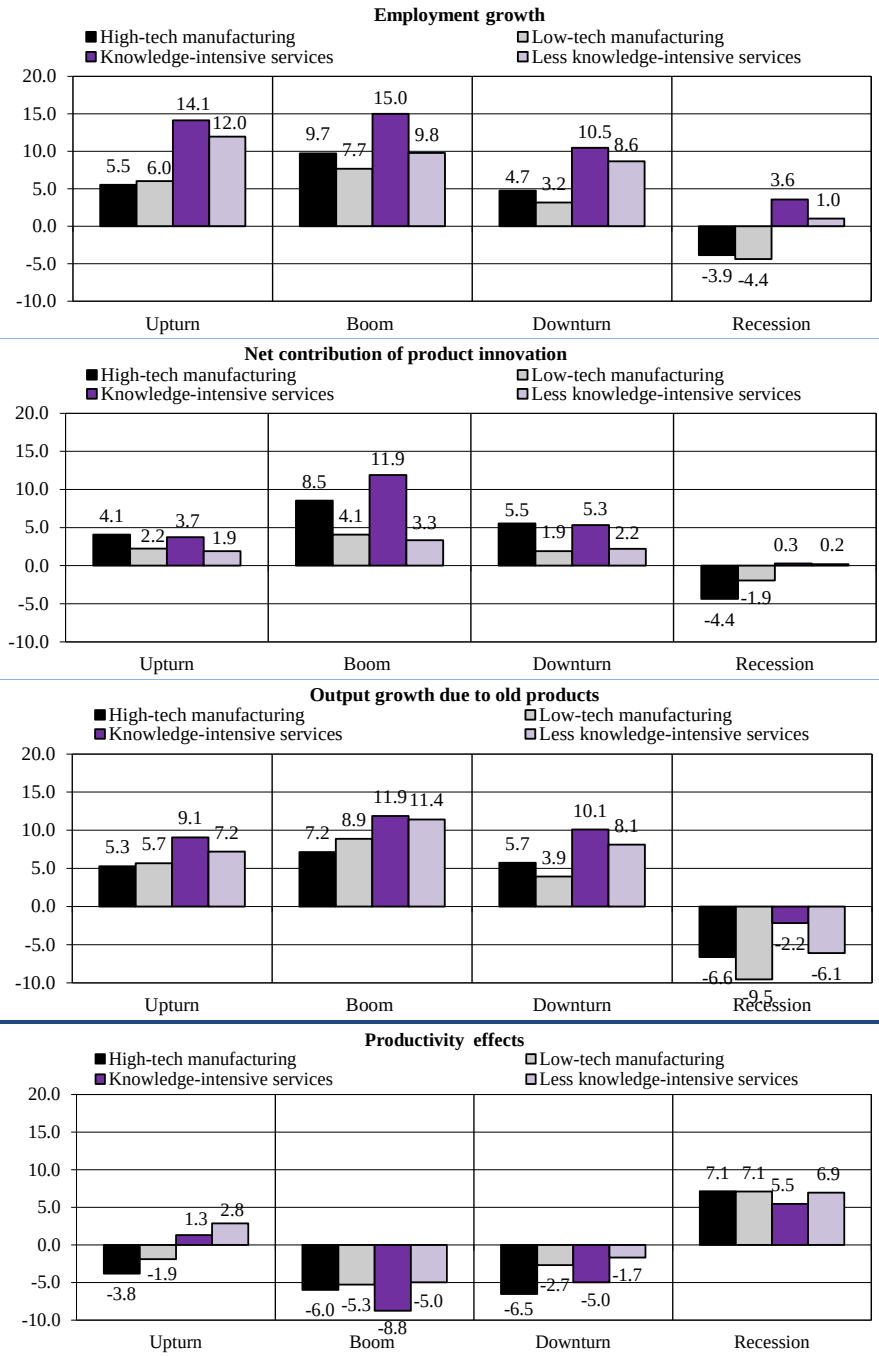
The results presented so far indicate the average effects for firms in manufacturing and service sectors. The following sections will examine whether these effects depend on technology intensity of the sector, size, ownership and geographical location of firms. In these sections, for expositional reasons 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[37] 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

[37] 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[38].

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.

[38] 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).

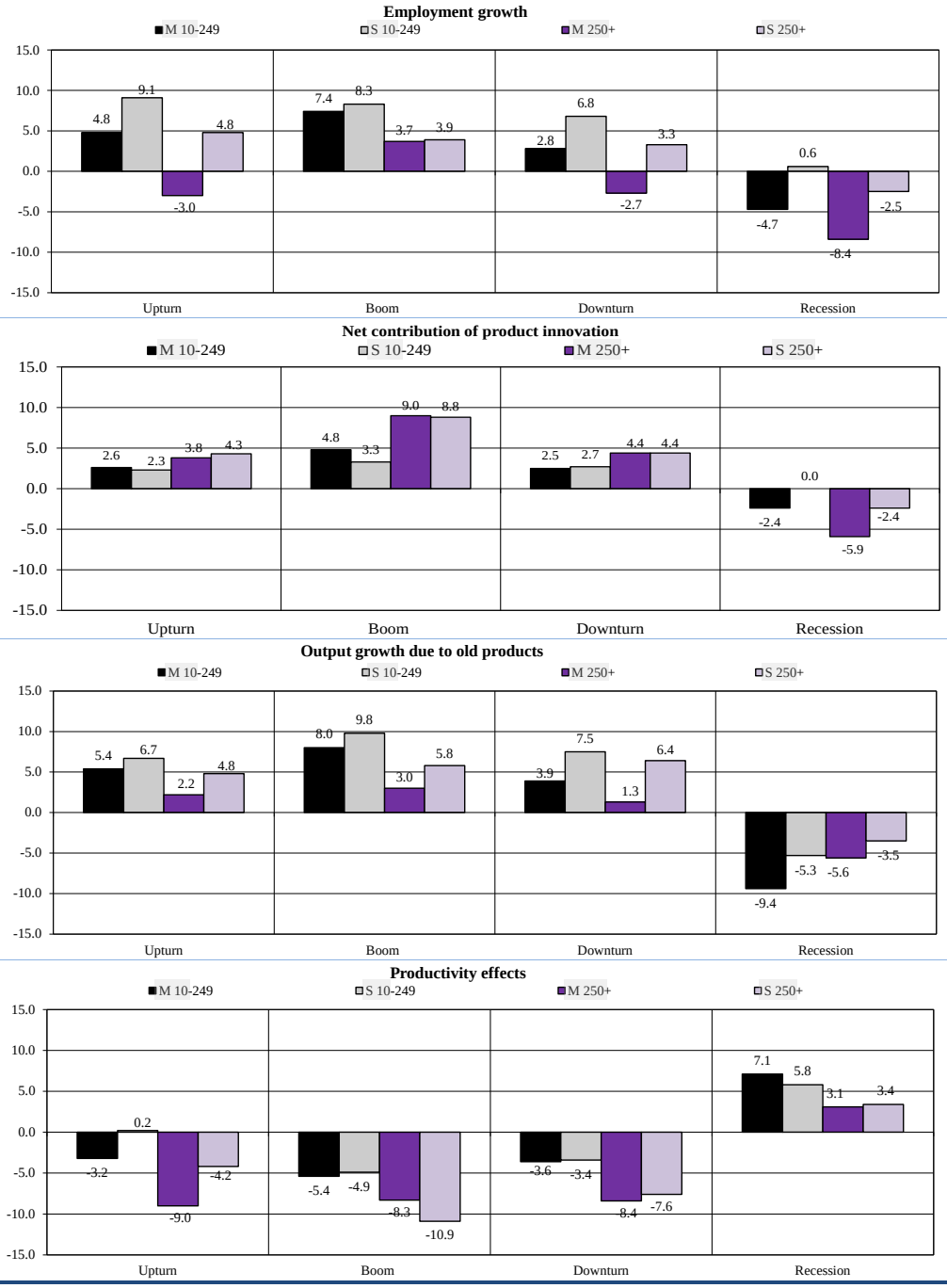
Figure 5.9 shows that SMEs grew faster (or had lower employment losses) than large firms in all stages of the business cycle, in both manufacturing and service sectors (first panel). Large manufacturing firms, on average, did not grow at all except in boom times.

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



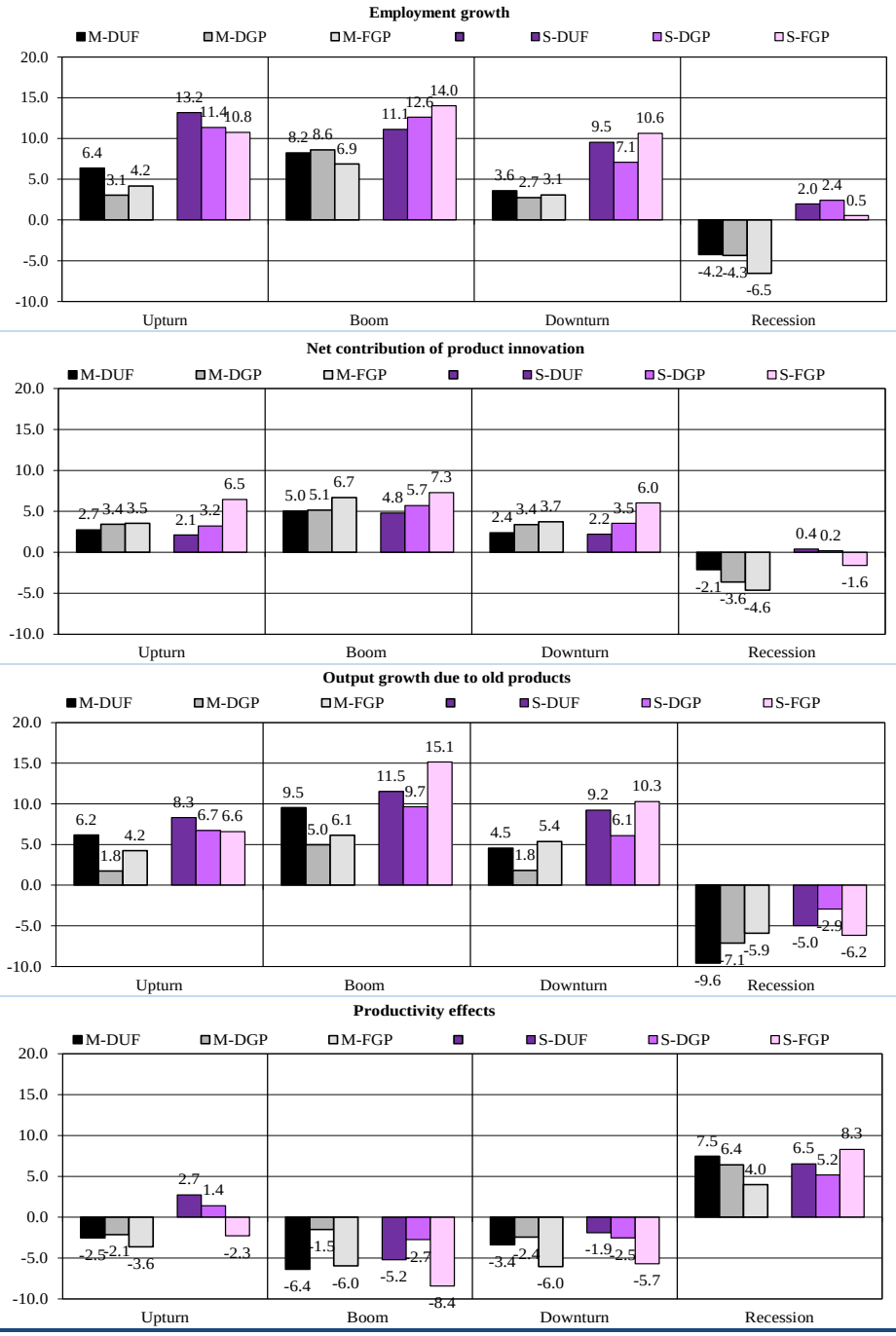
Source: CIS3, CIS4, CIS2006, CIS2008 and CIS2010, Eurostat; own calculations.

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.

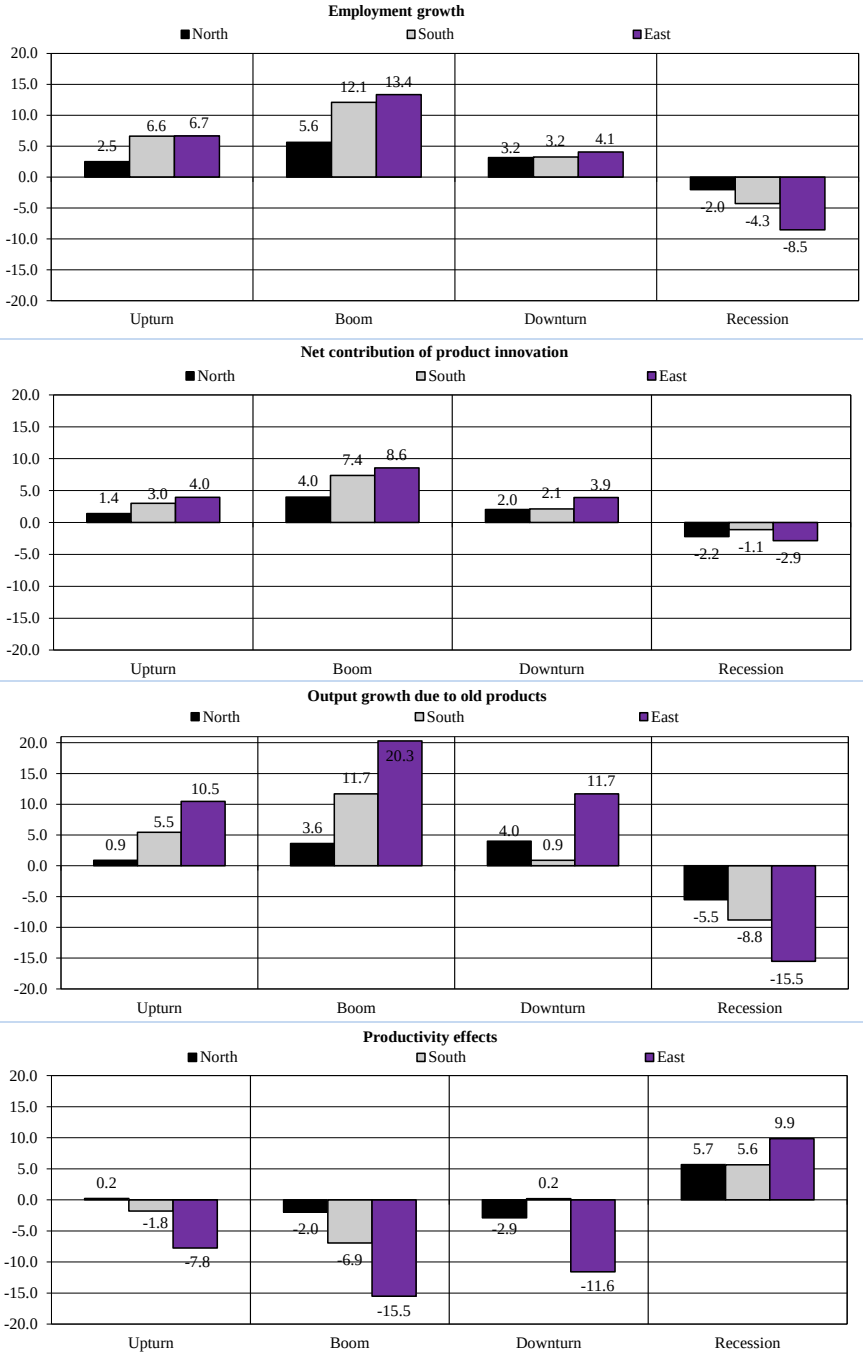
The first panel in Figure 5.11 shows the average two-year employment growth rates for manufacturing firms from these groups of countries between 1998 and 2010. In all groups, employment growth follows a pro-cyclical pattern but this pattern is much more pronounced in countries in Eastern and Southern 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[39].

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[40]. 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

[39] In addition, the background study also examined non-linear effects of product innovation on employment growth, but found no evidence of such effects.

[40] 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.

REFERENCES

Aghion, P., Askenazy, P., Berman, N., Cette, G., Eymard, L., 2012. Credit Constraints and the Cyclicality of R&D Investment: Evidence from France. *Journal of the European Economic Association* 10, 1001-1024.

Aghion, P., Howitt, P., 1992. A Model of Growth Through Creative Destruction. *Econometrica* 60, 323-351.

Archibugi, D., Filippetti, A., Frenz, M., 2013. Economic crisis and innovation: Is destruction prevailing over accumulation? *Research Policy* 42, 303-314.

Arvanitis, S., Wörter, M., 2013. Firm characteristics and the cyclicality of R&D investments. *Industrial and Corporate Change*, forthcoming.

Barlevy, G., 2007. On the Cyclicality of Research and Development. *American Economic Review* 97, 1131-1164.

Benavente, J.M., Lauterbach, R., 2007. The Effect of Innovation on Employment, Evidence from Chilean Firms, UNU-MERIT Working Paper, Maastricht.

Blechinger, D., Kleinknecht, A., G., L., Pfeiffer, F., 1998. *The Impact of Innovation on Employment in Europe – An Analysis Using CIS Data*. ZEW Dokumentation 98-02, Mannheim.

Blechinger, D., Pfeiffer, F., 1999. Qualifikation, Beschäftigung und technischer Fortschritt. Empirische Evidenz mit den Daten des Mannheimer Innovationspanels. *Jahrbücher für Nationalökonomie und Statistik* 218, 128–146.

Cohen, W.M., 1995. Empirical Studies of Innovative Activity, in: Stoneman, P. (Ed.), *Handbook of Innovation and Technological Change*. Blackwell, Oxford, pp. 182-264.

Cohen, W.M., 2010. Fifty Years of Empirical Studies of Innovative Activity and Performance, in: Hall, B.A., Rosenberg, N. (eds.), *Handbook of Economics of Innovation*. Elsevier, Amsterdam, pp. 129-213.

Crespi, F., Tacsir, E., 2013. Effects of Innovation on Employment in Latin America. MERIT Working Papers No. 2013-001, Maastricht.

Dachs, B., Peters, B., 2014. Innovation, Employment Growth and Foreign Ownership of Firms. A European Perspective. *Research Policy* 43, 214–232.

Edquist, C., Hommen, L., McKelvey, M.D., 2001. *Innovation and Employment: Process Versus Product Innovation*. Edward Elgar, Cheltenham.

Entorf, H., Pohlmeier, W., 1990. Employment, Innovation and Export Activity: Evidence from Firm-Level Data, in: Florens, J.-P., Ivaldi, M., Laffont, J.-J., Laisney, F. (Eds.), *Microeconometrics: Surveys and Applications*, Oxford, pp. 394–415.

Eurostat, 2013. Methodological notes: CIS 2012 questionnaire. Unpublished manuscript, Luxembourg

Evangelista, R., Vezzani, A., 2011. The impact of technological and organisational innovations on employment in European firms, *Industrial and Corporate Change*, 21(4), 871–899.

Falk, M., 1999. Technological innovations and the expected demand for skilled labour at the firm level, ZEW Discussion Papers 99-59, ZEW - Zentrum für Europäische Wirtschaftsforschung / Center for European Economic Research.

Fort, T.C., Haltiwanger, J., Jarmin, R.S., Miranda, J., 2013. How Firms Respond to Business Cycles: The Role of Firm Age and Firm Size. *IMF Economic Review* 61, 520–559.

Garcia, A., Jaumandreu, J., Rodriguez, C., 2002. *Innovation and Jobs: Evidence from Manufacturing Firms*. mimeo.

Greenan, N., Guellec, D., 2000. Technological Innovation and Employment Reallocation. *Labour* 14, 547-590.

Hall, B.H., Lotti, F., Mairesse, J., 2008. Employment, innovation, and productivity: evidence from Italian microdata. *Industrial and Corporate Change* 17, 813-839.

Harrison, R., Jaumandreu, J., Mairesse, J., Peters, B., 2014. Does Innovation Stimulate Employment? A Firm-Level Analysis Using Comparable Micro-Data From Four European Countries. *International Journal of Industrial Organization* 35, 29-43.

Himmelberg, C. P., Petersen, B. C., 1994. R&D and Internal Finance: A Panel Study of Small Firms in High-Tech Industries. *Review of Economics and Statistics* 76(1), 38–51.

Judd, K. L., 1985. On the Performance of Patents. *Econometrica* 53(3), 567–585.

Kleinknecht, A., 1989. Firm size and Innovation. *Small Business Economics* 1, 215-222.

König, H., Licht, G., Buscher, H., 1995. Employment, Investment and Innovation at the Firm Level, in: OECD (Ed.), *The OECD Jobs Study – Investment, Productivity and Employment*, Paris, pp. 67–81.

Lachenmaier, S., Rottmann, H., 2011. Effects of innovation on employment: A dynamic panel analysis. *International Journal of Industrial Organization* 29, 210-220.

Lucchese, M., Pianta, M. 2012. Innovation and Employment in Economic Cycles. *Comparative Economic Studies*, 54(June), 341-359.

Mairesse, J., Wu, Y., Zhao, Y., Zhen, F., 2011. Employment growth and innovation in China: A firm-level comparison across regions, industries, ownership types and size classes, mimeo, CREST.

Mairesse, J., Wu, Y., 2014. An assessment of the firm-level impacts of innovation, exports, catch-up and wage on employment growth in Chinese manufacturing, mimeo, CREST.

Milgrom, P., Roberts, J., 1990. The Economics of Modern Manufacturing: Technology, Strategy, and Organization, *American Economic Review*, 80(3), 511-528

OECD, 2005. *Oslo Manual. Guidelines for Collecting and Interpreting Innovation Data*, 3rd ed. Organisation for Economic Co-operation and Development, Paris.

OECD, 2012. *OECD Science, Technology and Industry Outlook 2012*. Organisation for Economic Co-operation and Development, Paris.

Paunov, C., 2012. The global crisis and firms' investments in innovation. *Research Policy* 41, 24-35.

Peters, B., 2008. Innovation and firm performance an empirical investigation for German firms. Mannheim: ZEW Economic Studies No. 38.

Peters, B., Riley, R., Siedschlag, I., 2013. The Influence of Technological and Non-Technological Innovation on Employment Growth in European Service Firms. *Service gap Discussion Paper* No. 40, Mannheim.

Peters, B., Dachs, B., Duenser, M., Hud, M., Koehler, C., and C. Rammer 2014. Firm Growth, Innovation and the Business Cycle. Background study for the European Competitiveness Report 2014.

Pianta, M., 2005. Innovation and Employment, in: Fagerberg, J., Movery, D.C., Nelson, R.R. (Eds.), *The Oxford Handbook of Innovation*. Oxford University Press, Oxford, pp. 568-598.

Rammer, C., 2012. *Schwerpunktbericht zur Innovationserhebung 2010*. Centre for European Economic Research, Mannheim.

Rincon-Aznar, A., Robinson, C., Loveridge, P., 2009. Productivity, in: Peneder, M. (Ed.), *Sectoral Growth Drivers and Competitiveness in the European Union*. Background Studies to the Competitiveness Report 2008, European Commission, DG Enterprise and Industry, Brussels, pp. 113-132.

Rosenberg, N., 1990. Why Do Firms Do Basic Research (With Their Own Money)? *Research Policy* 9, 165-174.

Rottmann, H., Ruschinski, M., 1998. The Labour Demand and the Innovation Behaviour of Firms. *Jahrbücher für Nationalökonomie und Statistik* 217, 741–752.

Rubalcaba, L., Gallego, J., Hipp, C., Gallouj, F., Gallouj, C., Savona, M., et al. 2008. Towards a European Strategy in Support of Innovation in Services. A Review of Key Evidence and Policy Issues. Final Report. Brussels: INNOVA Innovation Watch.

Schumpeter, J. A.,1911. Theorie der wirtschaftlichen Entwicklung (8th ed., reprinted in 1997). Berlin: Dunckner & Humbolt.

Smolny, W., 1998. Innovations, Prices and Employment: A Theoretical Model and an Empirical Application for West German Manufacturing Firms. *The Journal of Industrial Economics* 46, 359-381.

Smolny, W., 2002. Employment Adjustment at the Firm Level. A Theoretical Model and an Empirical Investigation for West German Manufacturing Firms. *Labour* 16, 65-88.

Van Beveren, I., Vandenbussche, H., 2010. Product and process innovation and firms' decision to export, *Journal of Economic Policy Reform*, 13(1), 3-24.

Van Reenen, J., 1997. Employment and Technological Innovation: Evidence from U.K. Manufacturing Firms. *Journal of Labor Economics* 15, 255-284.

Veugelers, R., 2014, Public R&D budgets for smart fiscal consolidation, presented at the 2nd Simpatic Workshop, April 2nd 2014, Den Hague, http://simpatic.eu/wp-content/uploads/2014/04/Veugelers_-lunch-talk.pdf

Vivarelli, M., 2012. Innovation, Employment and Skills in Advanced and Developing Countries: A Survey of the Literature, IZA Discussion Papers 6291.

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*