The Influence of Technological and Non-Technological Innovation on Employment Growth in European Service Firms

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Abstract

This paper investigates the effect of technological and non-technological innovation on employment growth in European service firms. Our analysis is based i) on cross-sectional CIS data from 20 European countries for the period 2006-2008 and ii) on panel data for different service sector groups and industries for the period 1998-2008. Using the employment model proposed by Harrison et al. (2008), we find that product innovation significantly stimulates employment in services. Main differences in the contribution of product innovation to employment growth across countries or industries are a result of differences in the average innovation engagement and innovation success across countries or industries but not of differences in the transformation of a given level of innovation success to employment growth. There is furthermore only weak evidence of employment effects of process innovation and mixed results for organizational innovation in European service firms. For most of the countries we can also reject the hypothesis of complementarity effects between process and organizational innovation.

Keywords: Employment growth, innovation, organizational changes, service sector, Europe

JEL-Codes: O33, J23, L80, C21, C23

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1 Motivation

"With an ageing population and strong competitive pressures from globalisation, Europe' s future economic growth and jobs will increasingly have to come from innovation in products, services and business models."
(EU 2012, Innovation Union)

Innovation is the classical source of knowledge creation considered in economic analysis. And it is seen as key driver for competitiveness of firms and, consequently, for economic growth. This is why innovation has been placed at the heart of the Europe 2020 strategy for smart, sustainable and inclusive growth and job creation. Within the Europe 2020 strategy, the Innovation Union is one of the seven flagship initiatives in order to reach smart, sustainable and inclusive growth. With several action points, the Innovation Union aims to improve conditions and access to finance for research and innovation in Europe and to ensure that innovative ideas can be turned into products and services that create growth and jobs. All in all, policies to foster innovation activities are, therefore, high on the list of priorities within the Europe 2020 strategy in general and the EU Innovation Union in particular.

Policy hopes that innovations could provide an important contribution to strengthen the competitiveness of firms and, consequently, to the preservation or creation of *new* jobs. Given the large share of services in economic activity in EU countries, innovation in services could be a major source of solving problems of high unemployment that we currently observe in many of these countries. High unemployment rates reinforce problems of tight public budgets and social security systems.

However, the question of how innovation affects the employment situation is an old one and has long been the focus of theoretical and empirical industrial organization research. The controversial debates on this issue mainly result from the fact that, from a theoretical point of view, different channels exist through which innovations can destroy existing jobs (displacement effects), but that there are also several mechanisms through which innovations may create new jobs (compensation effects). In addition, different types of innovation such as product, process or organizational innovation influence employment via different channels. Tab. 1 provides a brief overview of how different kinds of innovation might affect employment.[1] Employment effects of process innovation are closely related to productivity changes. New production processes most often leads to labor productivity improvements since they allow firms to produce the same amount of output with less labor input and, ceteris paribus, lower unit costs. The size of this effect depends on the current production technology and direction of the technological change. At the same time, firms can pass on lower unit costs to their product prices. In a dynamic perspective, lower prices can lead to a higher demand for the product, thus increasing output. The magnitude of this price effect depends on the price reduction, the price elasticity of demand, the degree of competition as well as on the behavior and relative strength of different agents such as managers and unions within the firm (Garcia et al., 2004). Similar arguments as for process innovations can be put forward for organizational innovation. Product innovation foster employment growth mainly via demand. Demand for the new product can either be the result of an overall market expansion, or it may come at the expense of the firm's competitors. And therefore, the size of this effect depends on the existence of substitutes and the reactions of competitors (see Garcia et al., 2004). In addition, indirect demand effects on the innovative firm's existing products have to be taken into account as the new products might (partially or totally) replace the old ones. However, in the case of complementary demand relationships, the new product will cause demand for existing products

[1] This paper studies firm-level employment effects. The firm level represents the main instance where these mechanisms are more or less explicitly supposed to work (Harrison et al., 2008). Additional employment effects of innovations exist at a sector or macro level.

to rise as well, and employment will increase further. Finally, the same amount of output of the new product may be produced at higher or lower productivity levels compared to the old product. That is, the new product may imply a change in production methods and input mix, which could either reduce or increase labor input. This effect is called productivity effect of product innovation (Harrison et al., 2008).

Tab. 1: Effects of product and process innovation on employment at the firm level

	Employment-reducing effects (Displacement effects)	**Employment-creating effects (Compensation effects)**
Product innovation	*Productivity effect of product innovation*: New products require less (or more) labor input (-) *Indirect demand effect*: Decrease in demand of existing substitutes (-)	*Direct demand effect*: New products increase overall demand (+) *Indirect demand effect*: Increase in demand of existing complementary products (+)
Process innovation	*Productivity effect of process innovation*: Less labor input for a given output (-)	*Price effect*: Cost reduction passed on to price expands demand (+)
Organizational innovation	*Productivity effect of orga innovation:* Less labor input for a given output (-)	*Price effect:* Cost reduction passed on to price expands demand (+)

Source: Dachs und Peters (2013).

In a nutshell, the total effect of each type of innovation is not explicitly inferable and depends on a number of firm-, sector- as well as country-specific factors. As a consequence it has to be determined empirically. The majority of empirical studies have shown that product innovations have stimulated employment both in manufacturing and in services, although the evidence for the service sector is still scarce.[2] Peters (2008) furthermore found that the effect does not depend on the product novelty degree. Evidence on the effect of process innovation is mixed, ranging from negative, zero to positive impact. Comparing the importance of both types of innovations, results in manufacturing are mixed as well (see e.g. Greenan and Guellec 2000, Lachenmeier and Rottmann 2011). Empirical studies have also shown that new technologies favor the demand for high-skilled personnel at the expense of demand for low-skilled workers (e.g. Kaiser 2000, 2001, Falk and Seim 2000, 2001). One flaw of these studies is that comparability is limited as most of them study only one country and they use different data sets and estimation methods.

While the importance of innovation in services is largely acknowledged, the bulk of existing empirical evidence on employment effects of innovation has focused on manufacturing. Furthermore, in many countries innovation policy has been designed having in mind technology-based innovation in manufacturing and has largely neglected innovation in services which is to a large extent non-technological. Taken together, it becomes evident that there is a lack of understanding on how employment effects of innovation in services differ from innovation in manufacturing. We furthermore lack evidence whether non-technological innovation matters for overall employment in services, whether there are any complementarity effects between process and organizational innovations and whether the role of innovation varies across different service industries with different technological regimes. This paper is aimed at analyzing the effects of innovation on employment growth in services and filling all four gaps.

For our empirical analysis we make use of a theoretical multi-product model proposed by Harrison et al. (2008). It is tailor-made for analyzing employment effects of innovation using the information provided in the Community Innovation Surveys (CIS) in Europe. In order to answer the above research questions, we

[2] For the effect on product and process innovation, see e.g. König et al. (1995), Entorf and Pohlmeier (1990), Blechinger et al. (1998), Smolny (1998, 2002), Van Reenen (1997), Greenan and Guellec (2000), Garcia et al (2002), Harrison et al (2008), Peters (2008), Hall et al. (2008), Lachenmaier and Rottmann (2011). An exception is Zimmermann (1991).

estimate the model at three different level (1) at the pooled level using data for 18 European countries using the most recent CIS2008 cross section; (2) at the country level using 20 European countries (extended by UK and Ireland); (3) at the level of sector groups (KIS, LKIS) and at industry level distinguishing eight industries. For step 3, we make use of three cross sections of CIS data spanning the period 1998-2008.

The outline of this paper is as follows: Section 2 briefly sketches the theoretical and econometric model used in the empirical part of the paper. The data set is explained in section 3. The empirical implementation and estimation strategy is explored in section 4, and we provide descriptive statistics on the main variables in the subsequent section. Section 6 presents the econometric evidence on the employment effects of technological and non-technological innovations in European service firms. Finally, section 7 summarizes the key findings and draws some policy conclusions on the relation between innovation and employment growth.

2 Theoretical and Econometric Model

Recently, Harrison et al. (2008) have developed a simple multi-product model that allows investigating the employment effects of different types of innovation in service firms. It was aimed at establishing a theoretical relationship between employment growth and innovation output at the firm level. The main virtue of the model is that we can disentangle some of the theoretical employment effects mentioned above. Moreover, it is particularly suited for examining firm-level employment impacts of innovation using the specific information provided by CIS data. In the original model, the effect of product innovation (sales growth rate due to new products which can be calculated from CIS data) and process innovation (yes/no) have been studied. It has already been used to evaluate employment effects of innovation in a cross-country comparison for the UK, Spain, France and Germany (Harrison et al 2008), Chile (Benavente and Lauterbach 2007), and Italy (Hall et al. 2008), as well as to study employment effects of different types of innovations (Peters 2008) and for comparing employment effects of domestic and foreign-owned firms (Dachs and Peters 2013). We will make a small extension to the model and additionally incorporate organizational innovation as a third type of innovation output.

In the following we will briefly outline the basic idea of the model. For more details, see Harrison et al. (2008). The model is based on a simple multi-product framework. That is, we assume that a firm can produce different products.[3] We furthermore observe a firm *j* at two points in time *t (= 1, 2)*. In *t=1* the firm produces one or more products which are aggregated to one product which is called the “old product” or “existing product”. Between *t=1* and *t=2*, the firm can decide to launch one or more new or significantly improved products. The new product can (partially or totally) replace the old one if they are substitutes or enhance the demand of the old product in case of complementarity. To produce the different outputs, we assume the following production function for product i in time t:

(1) $$Y_{it} = \theta_{it} F\left(C_{it}, L_{it}, M_{it}\right) e^{\eta + \omega_{it}} \quad i = 1,2; t = 1,2$$

We have a conventional production function F which is linear homogeneous in the conventional inputs labour L, capital C and material M. Moreover, specific efficiencies for the production process of both goods θ_{it} and its evolution over time are driven by the knowledge capital of the firm (which is assumed to be a non-rival input).

3 In the following the term product always comprises both goods and/or services unless stated otherwise.

Based on these assumptions, (Harrison et al 2008) derive the conditional labour demand functions for each product for each point in time and, as a result, the overall employment growth rate:

(2) $l = \alpha + y_1 + \beta y_2 + u$.

Following the theoretical considerations above, employment growth *l* in the model stems from three different sources, that is

- from the efficiency increase in the production of the old product, which negatively affects labour demand and which can be different for non-process innovators (α).
- from the rate of change in the real production of the old product (y_1). This change in the output production of old products is provoked by the new product to a certain degree, the induced change being negative for substitutes and positive for complements. But it also captures demand shifts due to general business cycle effects, changes in consumer preferences or new products that have been introduced by rivals.
- from starting production of the new product (positive sign). The employment effect of the latter depends on the efficiency ratio between both production technologies ($\beta = \theta_{22}/\theta_{11}$) and the real output growth due to new products (y_2).

Efficiency gains in the production of the old product may for instance result from process innovation, organizational innovation, better human capital endowment, training, within-firm learning effects, spillover effects, mergers and acquisitions, and so on. Harrison et al. (2008) suggested separating the effect of process innovation from the other sources of efficiency improvements. We extend this idea and estimate separately the effect of organizational innovation. This leads to the following equation:

(3) $l = \alpha_0 + \alpha_1 pc + \alpha_2 org + y_1 + \beta y_2 + u$.

α_0 captures efficiency improvements for firms without process and organizational innovation. α_1 and α_2 measures additional efficiency improvements in the production of the old product for firms having process and organizational innovation, respectively.

Substituting unobserved real output growth rates by observed nominal output growth rates, Harrison et al. (2008) derive the following estimation equation which describes the relationship between employment growth, efficiency gains through process innovation and the sales growth due to new products[4]:

(4) $l - (g_1 - \tilde{\pi}_1) = \alpha_0 + \alpha_1 pc + \alpha_2 org + \beta g_2 + v$.

g_1 and g_2 denote the nominal output growth (sales growth) due to old and new products, respectively, with $g_1 = y_1 + \pi_1$ and $g_2 = y_2 + \pi_2 y_2$. The variable g_2 can be calculated using CIS data (see section 4). g_1 can be calculated by the total sales growth rate minus the sales growth rate due to new products. π_1 measures the (unobserved) price growth rate of old products at the firm level. Since data sets usually do not include information on firm-level price changes, π_1 is proxied by $\tilde{\pi}_1$ which is the price growth rate of old products at the industry level. π_2 denotes the price difference between the new and the old product in

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[4] Since the coefficient of the real output growth y_1 is equal to one, it can be substracted from *l*. y_1 is not observed in the data but proxied by $g_1 - \tilde{\pi}_1$. For more details see Harrison et al. (2008) and Peters (2008).

relation to the price of the old product at the firm level. The new error term v equals $v = -E(\pi_1 - \tilde{\pi}_1) - \beta \pi_2 y_2 + u$.

One problem that arises in this model is the fact that the sales growth rate from new products g_2 is correlated with the error term *v*. An appropriate econometric method to deal with such an endogeneity problem is to use instrumental variable techniques. The instruments should be correlated with the sales growth due to new products (i.e. innovation success), but not correlated with the error term. In particular it has to be uncorrelated with the relative price difference of new to old products. We explain in section 4 in more detail how we empirically address this problem by using an instrumental variable estimation approach.

3 Data

For our empirical analysis we use data from the Community Innovation Survey (CIS). The CIS is a harmonized survey on innovation activities among all European member states. It is based on a harmonized questionnaire which follows the recommendations of the Oslo manual. The Oslo manual (OECD and Eurostat 2005, first published in 1993) provides a unique definition of innovation and recommendations on innovation indicators as well as on the survey methodology. Comparable surveys are likewise conducted in most of the other OECD countries, except for the US. The surveys are carried out by national statistical offices or research institutes under the coordination of Eurostat. Most but not all of the EU member countries provide access to their national micro data via Eurostat's Safecenter in Luxembourg. The first CIS (CIS1) started in 1993 for manufacturing firms, and it was extended to services four years later in the CIS2. Up to 2005 the survey had taken place every 4 yours (CIS3 in 2001, CIS4 in 2005), and it has been shifted to a biennial rhythm from 2005 onwards (called CIS2006 and CIS2008 conducted in 2007 and 2009, respectively).[5] Data at the micro level are accessible at Eurostat's Safecenter from CIS3 onwards. The country coverage depends on the survey wave.

Our empirical analysis is conducted in 3 steps: (1) pooled across all European countries, (2) at the country level, and (3) at the sector level. As already mentioned, the country coverage available at Eurostat varies across waves. Therefore, we restrict the analysis to the latest survey CIS2008 which refers to the period 2006-2008 in step 1 and 2 in order to be able to compare countries for the same time period. This has the additional virtue that we can investigate the employment impact of organizational innovation in more detail. Detailed information on organizational innovation has been only added to the CIS in 2005, related to the third edition of the Oslo manual. The CIS3 also retrieved information on organizational innovation but in a slightly different and less detailed way. Restricting the analysis to CIS2008 has the additional advantage that we can add Ireland and the UK at the country level analysis in step 2 since two of the authors have access to CIS micro data in their home country. Data for the UK is not available at Eurostat's Safecenter. In order to have a sufficient number of observations per industry, we pooled data from 3 waves for step 3. We employ data from CIS3, CIS4 and CIS2008 referring to the periods 1998-2000, 2002-2004 and 2006-2008, respectively. We did not take CIS2006 into account because we miss information on some of the relevant variables, in particular instrumental variables, in many countries.

For CIS, the target population covers all legally independent enterprises with 10 or more employees having their headquarters in the respective country. In step 1, the pooled sample (sample A) covers 40,320 service firms from 19 countries: Bulgaria, Cyprus, Czech Republic, Germany, Estonia, Spain, France, Hungary, Italy,

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[5] The latest surveys CIS 2010, conducted in 2011, is not yet accessible at Eurostat.

Lithuania, Luxembourg, Latvia, Malta, Netherlands, Norway, Portugal, Romania, Slovenia and Slovakia. The distribution across countries is depicted in Tab. 4 in the Table Appendix.6 Spain has the largest share in the sample (22.5%), followed by France (14.4) and Bulgaria, Italy and the Netherlands, each representing about 9.2% of the sample. Despite its large country size, German firms just represent 4.6% of the sample due to the voluntary character of the survey in Germany. In order to account for differences in the sample rate (ratio of the number of observations in the sample to the target population) across countries, weighting factors have been used throughout the empirical analysis for descriptive statistics and estimations. In step 2, we drop Norway but we additionally include the UK and Ireland.

The CIS target population covers most but not all market services. One problem that arises in the empirical analysis is the fact that the European sector classification scheme (NACE) has changed in 2008. While CIS3, CIS4 and CIS2006 had been based on the system NACE Rev 1.1, NACE Rev 2.0 has been in use since CIS2008. We use a concordance table to create a unified industry coding based on NACE Rev. 1.1.7 Business sectors that are covered by CIS are wholesale (51; WHOLE), transport (60-63; TRANS), post and telecommunication (64; TELE), financial intermediation (65-67, FIN), technical services (73, 74.2, 74.3; TECH), consultancies (74.1, 74.4; CON), other business related services (74.5-74.8; OBRS) and media (92, 22.1, MEDIA). The distribution of firms by industry is provided in Tab. 5 in the Appendix. The majority of firms belong to wholesale (about 33% in Sample A and B) and trade (20% and 25% in Sample A and B, respectively). Telecommunication and technical services account for about 9-10% each. In addition to the industry definition, we use a broader sector classification proposed by Eurostat in order to define knowledge intensive services (KIS) and less knowledge-intensive services (LKIS). The group of knowledge-intensive service firms can be analyzed on a more fine-grained way by distinguishing between High-tech KIS (HTKIS), market KIS (MKIS), knowledge-intensive financial services (FKIS) and knowledge-intensive other services (OKIS). The corresponding definitions of subsectors are summarized in Tab. 2. The distribution of sector groups across countries for Sample A is provided in Tab. 6 in the Appendix. The results show that the distribution between KIS and LKIS varies quite substantially across countries. Germany and Luxemburg are the only countries where the share of firms belonging to KIS (64% and 54%, respectively) is larger than for LKIS. Both countries are followed by Slovenia (45%) and France (44%). In other Western European countries such as Spain (28%) and Italy (24%), KIS firms account for a much smaller proportion of the sample. This again calls for using weighting factors in the empirical analysis.

Tab. 2: Definition of Service Sectors

Sector group	NACE rev. 1.1	Industry	Subsector
KIS	64	post and telecommunication	HTKIS
	72	computer and related activities	
	73	R&D	
	61	water transport	MKIS
	62	air transport	
	70	real estate	
	71	renting	
	74	business related activities	
	65-67	financial intermediation	FKIS
	92	media	OKIS
LKIS	51	wholesale	
	60	land transport	
	63	supporting transport activities	

6 Data for Norway is shown in the distribution tables and in the pooled descriptive statistics. However, Norway had to be dropped from the regressions as employment growth could not be accurately calculated, see Tab. 8.

7 More information is available from the authors upon request.

The main focus of our analysis is on service firms. In order to deepen our understanding about differences in the innovation-employment nexus between service and manufacturing firms, we rerun the main regressions in step 1 and 2 for a sample of manufacturing firms.

4 Empirical Implementation and Estimation Strategy

According to the theoretical model, we use EMP as dependent variable, where EMP is defined as $l-(g_1-\tilde{\pi}_1)$. l denotes the employment growth rate, g_1 the sales growth rate with old products and $\tilde{\pi}_1$ the price growth rate of old products at the industry level. All growth rates refer to the period *t* to *t-2*. More details on the calculation are given in Tab 2.[8]

One of the main explanatory variable in the theoretical model is the sales growth rate due to new products g_2. CIS defines product innovation as 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 main virtue of the CIS is that it collects information about the share of sales with new products in year t related to new products introduced in the three-year period t-2 to t (*s*). Multiplying this indicator with the ratio of sales in t to sales in t-2, we get the sales growth rate due to new products (SGR NEW PRODUCTS). A product innovation must be new to the enterprise, but it does not need to be new to the market. In order to investigate whether the type of product innovation matters for employment in services, we further calculate the sales growth rate due to new products that are new to the firm only (firm novelties; SGR FIRM NOV) and that are new to the market (market novelties; SGR MARKET NOV).

In addition to new products, efficiency increases in the production of old products are a second source of employment growth in the model. We split these efficiency improvements into those that stem from process innovations, from organizational innovations and those that capture other reasons such as spillovers, learning effects, mergers, acquisitions, etc. In the CIS, a process innovation is 'the implementation of a new or significantly improved production process, distribution method, or support activity for goods or services. It should have a noticeable impact on the level of productivity, the quality of the product/service or the cost of production/distribution. Newly introduced procedures that enabled the introduction of product innovations, also count as process innovations.' The latter sentence points towards an important empirical problem in accurately disentangling the effect of product and process innovation since many firms do both kinds of innovation activities at the same time. This leads to a situation in which we do not know whether for process innovators (i) all process innovations relate to improving the efficiency of old products, (ii) all process innovations are related to the introduction of new products or (iii) a combination of (i) or (ii) exists. In order to identify the efficiency improvements in the production of old products we thus define a dummy variable that takes the value 1 if the firm has introduced only process innovations but no product innovations (PROCESS ONLY) as we know for sure that these must be related to the old products. For firms that do both, the effect of process innovations with respect to an increase in

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[8] Instead of using $l-(g_1-\tilde{\pi}_1)$ as dependent variable, we would have got the same results if we had specify l as dependent variable and $(g_1-\tilde{\pi}_1)$ as additional explanatory variable where the coefficient is restricted to be 1. Therefore, we can still interpret the results in terms of employment growth.

efficiency in the production of old products cannot be identified and is in fact captured by the sales growth due to new products.[9]

A main contribution of the paper to the literature is that is studies also the link between organizational innovation and employment. The Oslo manual defines an organizational innovation as a new organizational method in a firm's enterprise business practice, workplace organization or external relations that has not been previously used in the enterprise. Changes in business practices include for instance changes in knowledge management, supply chain management, business re-engineering, lean production or quality management. Innovation in workplace organization refer to new methods of how firms organize work responsibilities and decision making, for instance team work, decentralization, integration or de-integration of departments, job rotation and so on. New methods of organizing external relations with other firms or public institutions such as first use of alliances, partnerships, outsourcing or sub-contacting are likewise counted as organizational innovation. Unfortunately, the way the question was posed slightly differs across waves (for more details, see Tab 2). However, we compared the share of firms with organizational innovation in different waves and believe that they are by and large comparable across waves. Since organizational innovations capture quite heterogeneous changes with potentially different impacts on employment, we additionally perform a more fine-grained analysis of the effect of organizational innovations by defining three dummy variables for changes in business practices (BUSINESS PROC), workplace organizations (WORKPLACE ORG) and external relationships (EXTERNAL REL).

In addition to the innovation variables, the regressions control for a bunch of other variables that might affect employment growth. We include a set of industry dummies in each regression. We furthermore control for ownership effects since recent studies have shown that employment grows less in foreign-owned companies (Dachs and Peters 2013) and that employment is more volatile in foreign-owned companies (Scheve and Slaughter 2004; Buch and Lipponer 2010). We therefore include two dummy variables for firms belonging to a domestic and foreign group, respectively (reference group: unaffiliated firms). Moreover, many researchers have controversially discussed the role of firm size for employment growth. While Gibrat (1934) postulates that firms grow proportionally and independently of firm size, Jovanovic (1982) took the view that surviving young and small firms growth fast than older and larger ones for instance because of managerial efficiency and learning by doing. In order to control for size effects, we include two dummy variables indicating firms with 50-249 and 250 and more employees at the beginning of the reference period in t-2. Reference category builds firms with 10-49 employees. In step 1, we estimate the relationship between innovation and employment in European service firms in a pooled sample. In order to account for country-specific heterogeneity we either specify a set of country dummies or we include three country-level variables as controls that are likely to have an impact on employment growth. First we control for general demand effects by including real GDP (GDP).[10] Note that firm-specific demand effects should be already captured by g_1 and g_2. Second, we include a measure for the rate of unemployment (UNEMP) and third we measure the impact of employment protection on firm-level employment growth by using the OECD indicator on the strength of employment protection in a country (EMPPROT).

As already explored in section 3, we are confronted with the fact that one of our key variables, the sales growth rate due to new products (g_2), should be endogenous due to a measurement error if we believe in

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[9] We also experimented with an additional dummy variable that is 1 if firms do both product and process innovation. However, in most specifications it turns out to be insignificant. It is likely that this effect was in fact captured by the sales growth due to new products variable which as a quantitative variable had a much stronger explanatory power.

[10] As an alternative, we also used GDP growth.

the theoretical model. An appropriate econometric method to deal with such an endogeneity problem is to use an instrumental variable approach. The instruments should be correlated with the sales growth due to new products (i.e. innovation success), but not correlated with the error term. That means in particular that it has to be uncorrelated with the relative price difference of new to old products. As we have three CIS survey waves, one might think of lagged values of g_2 that could serve as instruments. However, firm identifiers are not available at Eurostat's Safecenter. As a consequence, we can only pool the data by using repeated cross-sections but we cannot create a true panel data set and exploit the distinctive features of a panel. We therefore follow suggestions about potential instruments made in prior studies (see Harrison et al. 2008, Peters 2008, Hall et al. 2009, Dachs and Peters 2013). We use three variables as instruments that have been found to be important in explaining innovation success but that are presumably uncorrelated with the relative price difference of new to old products. First, a dummy variable that indicates whether the firm carries out R&D continuously (R&D). Second, the variable RANGE measures whether the product innovation was aimed at increasing the product range (measured on a 4 point scale). The third instrument is a dummy variable that equals 1 if clients have been a highly or medium important information source of innovation. As will be explained in more detail in the next section, it turned out that R&D and CLIENT are not exogenous instruments in Ireland. As a consequence, three other instruments had been used: cooperation with universities (SCIENCE), with suppliers (SUPPLY) and a variable that measures the importance of replacing outdated products or processes as aim of innovations (UPDATE).

Tab. 3: Definition of Variables

Variables	Description
Dependent Variable	
EMP	According to the theoretical model, EMP is defined as $l-(g_1-\tilde{\pi}_1)$
l	Employment growth rate in head counts between *t* and *t-2.* Information for both years comes from the same CIS survey.
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).
$\tilde{\pi}_1$	Price growth rate for existing products between *t* and *t-2*. For the 2008 survey, we use Eurostat price deflators on producer prices for industries NACE rev. 2 51,52, 61, 71, 78 and 80 (at the country level). If the price deflators are not available we use the harmonized consumer price index instead and if not available the producer price index for manufacturing at the country level. For the CIS3 and CIS4 surveys, we only use the harmonized consumer price index instead and if not available the producer price index for manufacturing at the country level.
Explanatory Variables	
SGR NEW PRODUCTS (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.*
SGR FIRM NOV (g_{2f})	Sales growth rate between *t* and *t-2* due to product innovations that are only new to the firm (firm novelties). Can be calculated in a similar way as g_2 .
SGR MARKET NOV (g_{2m})	Sales growth rate between *t* and *t-2* due to product innovations that are new to the market (market novelties). Can be calculated in a similar way as g_2 .
PROCESS ONLY	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.
ORGA INNO	Dummy variable = 1 if a firm has undertaken at least one organizational innovation in the period *t-2* to *t* and zero otherwise. In CIS2008 the dummy equals 1 if the firm has

	changed its business processes (including knowledge management), workplace organization and external relations. The CIS4 survey asked for changes in knowledge management, work organization such as alterations in management structure or consolidation of different departments or activities and external relations. In CIS3, we only have two items that make up organization innovation: the introduction of new or significantly changed organizational structures and the introduction of progressive management technologies/concepts in the enterprise.
BUSINESS PROC	Dummy variable = 1 if a firm has introduced new business practices in the period *t-2* to *t* and zero otherwise. According to the survey this includes i.e. supply chain management, business re-engineering, knowledge management, lean production or quality management. Variable only used in step 2.
WORKPLACE ORG	Dummy variable = 1 if a firm has introduced new methods of organizing work responsibilities and decision making in the period *t-2* to *t* and zero otherwise. This kind of changes in workplace organization can take place through team work, decentralization, integration or de-integration of departments, job rotation and so on. Variable only used in step 2.
EXTERNAL REL	Dummy variable = 1 if a firm has introduced new methods organizing external relations with other firms or public institutions in the period *t-2* to *t* and zero otherwise. The first use of e.g. of alliances, partnerships, outsourcing or sub-contracting are counted as such organizational innovation. Variable only used in step 2.
COUNTRY	A set of dummy variables for each country in the sample. For a list of countries see Tab. 4.
INDUSTRY	A set of dummy variables for each industry. For a list of industries see Tab. 5
OWNERSHIP	Two dummy variables indicating that in year t a firm belongs to a company group which has a domestic and foreign headquarter, respectively. The reference group consists are unaffiliated firms.
SIZE	A set of dummy variables for each size class in year t-2. We distinguish between firms with 10-49 (reference), 50-249 and 250 and more employees.
GDP	Real GDP in year t.
EMPPROT	OECD indicator on the strength of employment protection. It is on a scale from 0 (least restrictive) to 6 (most restrictive). We have use EPR_v1 which is an unweighted average of version 1 sub-indicators for regular contracts (EPR_v1) and temporary contracts (EPT_v1)
UNEMP	Average unemployment rate in t. Source: Eurostat.
Instrumental Variables	
RANGE	Variable that indicates whether the product innovation was aimed at increasing the product range. Variable measured on a 4 point scale: 3=high importance, 2=medium, 1= low and 0=not relevant.
R&D	Dummy variable = 1 if the firm carries out R&D continuously (RDCONT). Information not available in Ireland. Instead we used the dummy variable RDENG that equals 1 if R&D investment is positive and zero otherwise
CLIENT	Dummy variable that equals 1 if clients have been a high-to-medium important information source for innovation (CLIENT)
SUPPLY	Dummy variable that equals 1 if a firm co-operated with suppliers of equipment, materials, components or software and zero otherwise (only used in Ireland).
UPDATE	Variable that defines the importance a firm places on replacing outdated products or processes. Variable measured on a 4 point scale: 3=high importance, 2=medium, 1=

	low and 0=not relevant (only used in Ireland).
SCIENCE	Dummy variable that equals 1 if a firm co-operated with universities and other higher education institutions and zero otherwise (only used in Ireland).

5 Descriptive Statistics

Before we present results from the econometric analysis, we first describe some main characteristics of the variables in use. Tab. 7 presents the share of innovative firms by country and Tab. 8 depicts mean, median and standard deviation of the main quantitative variables. This relates to employment growth rates (l), overall sales growth rates (g) and split into sales growth due to old (g_1) and new products (g_2 / SGR NEW PRODUCTS), market novelties (g_{2m} / SGR MARKET NOV) and firm novelties (g_{2f} / SGR FIRM NOV), labor productivity growth rate and price growth rates. Since most of the regressions make use of the cross section CIS2008 (sample A), we only present figures for this sample which refers to the period 2006-2008.[11] All figures are weighted.

27% of all European service firms have introduced at least one product or process innovation and can be thus characterized as having technological innovations. Roughly one third of them (9.5%) have introduced only process innovations whereas 17.5% of service firms have introduced product innovations. Among them 6% have introduced solely product innovations and 11.5% have introduced product and process innovations simultaneously (not reported in table). Among product innovators, we observe a relatively high share of service firms with market novelties (10.6%) though it is still slightly smaller than that with firm novelties (12.7%).

Though not reported in the table, we can also compare the figures with manufacturing firms. In services, technological innovations are less frequent than in manufacturing (38.6%). This is mainly due to a higher engagement in developing product innovations. Nearly comparable 11.5% and 7.4% of manufacturing firms have introduced only process and product innovations, respectively. But about 20% of manufacturing firms have introduced both types of technological innovations during that time period instead of only 11.5% in services.

In services, non-technological innovations, here measured as organizational innovation, are more prevalent than technological innovations (28.8% compared to 27%). This is in contrast to manufacturing where non-technological innovations are equally frequent (29.2%) but less important than technological innovations (38.6%). These numbers emphasize the important role organizational innovations play for service firms and they call for a more detailed investigation whether this matters for employment growth. Changes in workplace organization are the most frequent type of organizational innovation in services (22.9%), followed by changes in business practices (18.4%). About one tenth of service firms across Europe (11.3%) introduced new methods in order to organize external relations with other firms or public institutions in the period 2006-2008.

At the country level we observe a large heterogeneity in the occurrence of product, process and organizational innovation among European service firms. For instance, the share of firms with technological innovations varies between nearly 60% in Slovenia and 16% in Slovakia, Bulgaria and Romania. Even for the large West European countries we observe a rather large spread ranging from 48% in Germany, 30% in

[11] Descriptive statistics of sample B are available upon request.

Italy, 28% in France and the Netherlands to 22% in Spain. This spread is particularly large for product innovations but less so for process innovations only as can be seen from the coefficient of variation (0.54 compared to 0.39). This heterogeneity is even higher for organizational innovation. Apart from Slovenia where 100% of service firms reported an organizational innovation, the share of firms with organizational innovation ranges from 12% in Latvia to 52% in Germany. Again this share is remarkable higher than in other West European countries (France: 33%, Italy: 32%, Spain: 29% and the Netherlands: 21%). This corresponds to a coefficient of variation of 0.64 compared to 0.44 for technological innovation. This heterogeneity across countries is particularly large related to changes in managing external relationships but is also quite high for changes in workplace organizations but less so for innovations in business practices.

Tab. 8 shows that overall employment growth was on average about 9.2% during the period 2006-2008. These growth rates are generally larger than the official figures released by Statistical Offices. This is due to the fact that (i) we can only observe surviving firms in the survey, (ii) we restrict our analysis to firms with at least 10 employees and neglect some service industries that are not covered by the CIS, and (iii) we average the employment growth across firms instead of taking the ratio of the sum of changes in employment for all firms to the sum of employed personnel. Due to this method, average employment growth rates are influenced more heavily by outliers although we already excluded all firms below the 5^{th} and above the 95^{th} percentile in each country. Therefore, we also provide numbers on the median employment growth that was much lower at about 2.1%. Overall, the figures are consistent with the fact that services have gained in importance in recent years and that the period 2006-2008 was characterized by an expansionary or boom period in many European countries.

During the same period, nominal sales grew on average by 21.2% (median: 13%). About two thirds of this increase in sales can be attributed to demand for existing products whereas on average 7% stems from the introduction of product innovations. In the same period prices increased on average by roughly 7.9%, so that growth rate in real sales was about 13.3%. This implies an increase in average labor productivity of about 12% in nominal terms and 4.2% in real terms.

6 Empirical Results

As already explored we proceed with our empirical analysis in three steps. First, in section 6.1 we investigate the link between innovation and employment among European service firms using a pooled approach. This approach neglects firm-specific heterogeneity and assumes that the relationship (parameter) between innovation and employment is the same for all European firms. We relax this assumption in a second step in section 6.2 and allow for heterogeneity in the link between innovation and employment across countries by estimating separate regressions for each country. In section 6.3 we account for another potential type of heterogeneity, i.e. the one that we might observe across industries and sector groups. As already mentioned in section 4, we cannot create a real panel data set due to the lack of firm identifiers at Eurostat's Safecenter. Note, however, that each cross section allows us to define employment growth rates, i.e. an equation in first differences. Thus, we already accounted for time-invariant firm-specific (observable and unobservable) effects in the employment levels.

6.1 Employment Effects of Innovation among European Service Firms (Pooled Approach)

Using the pooled sample A, Tab. 9 depicts the results for employment effects of innovation among European service firms. As argued in section 3, 4 and 5, weighted IV estimation methods should be used for the current data (model 4). In order to check how sensitive our results are to the estimation method applied, we also perform weighted OLS (model 3) and unweighted OLS (model 1) and IV (model 2). In models (1) to (5) we included country dummies whereas in model (5) we use the country-specific variables on demand (GDP), unemployment rates (UNEMP) and employment protection (EMPPROT).

The results clearly show that successful product innovation has a significantly positive impact on employment growth in service firms. This effect remains highly significant across different model specifications. The difference-in-Hansen C test rejects the null hypothesis that the variable is exogenous, both in the weighted and unweighted regression. The endogeneity problem seems to lead to a downward bias of the estimated effect as the IV results (around 0.96) are about 0.1 larger than the OLS estimates (0.85). While OLS and unweighted IV indicate that this effect is significantly smaller than one, a t-test using the preferred weighted IV regression does reject the null hypothesis that the coefficient is one. Remember a value of 1 implies that old and new products are produced with same efficiency and that there are no additional productivity effects of new products. Thus an increase in sales growth due to new products of 1% leads to an increase in *gross* employment by 1%. At the same time, product innovations are likely to displace existing products to a considerable extent which is captured by g_1 and which might lead to downsizing. We present estimation results for the net employment effect of product innovation when we talk about the decomposition of employment growth below. Furthermore, we do not find significant differences in the way product innovation affects employment growth between service and manufacturing firms (0.99).

Process innovation is associated with significant productivity gains and thus displacement of labor in the unweighted OLS regression. But this effect becomes much smaller and is not significant any longer when we use weighted OLS or IV methods. This corresponds to prior findings for the service sector that mainly report no effect of process innovation in the service sector (see Harrison et al. 2008, Peters 2008, Hall et al. 2009, Dachs und Peters 2013). On the contrary, process innovation is significantly negatively related to employment growth in the manufacturing sector. The employment growth rate is about 2.48 percentage points smaller for process innovators than for non-innovators. As already pointed out in the papers cited above, this different result with respect to process innovation might be partly driven by the fact that process innovation in services is usually more difficult to identify than in manufacturing. In many cases services are customized to specific demands and lack a clearly structured production process.

A similar pattern as for process innovation emerges for organizational innovation. The effect turns out to be positive and significant in the unweighted OLS regression but vanishes when using weighted OLS or IV methods. That is, we do not find evidence for a significant impact of organizational innovation on employment growth in service firms. This weak result is confirmed in the manufacturing sector where we likewise do not find any significant employment effects of organizational innovation.

Comparing the four estimation methods, we find only small differences between the unweighted and weighted estimation results but larger ones between OLS and IV. In order to evaluate the IV estimation results, which means in particular to prove whether the instruments are non-weak and valid, we have performed many tests and checks. First we have checked whether the instruments are significantly correlated with the endogenous variable in the first stage. This is true for all three instruments. Furthermore, the F-statistic from the first stage regression is clearly larger than 10 which is often put as a rule of thumb for IV regressions. We furthermore report Kleibergen-Paap tests on underidentification and weak instruments.[12] Weak instruments can lead to a large relative bias of IV compared to the bias of OLS in case of endogenous rhs variables. Both null hypotheses, that the equation is underidentified and that the instruments are weak, can be rejected. In addition to non-weakness, we check for validity of instruments using the Hansen J-Test on overidentifying restrictions for overall instrument validity and the difference-in-Hansen C-Test on the instrument validity of single instruments.[13] Overall instrument validity cannot be rejected and each of the single instruments passes the test on exogeneity. The same diagnosis can be made for the manufacturing sector. Thus, weighted IV regressions seem to provide consistent and reliable results.

One flaw is that the model estimates do not allow us to disentangle the compensation effect of process innovation and the demand effect of product innovation on existing products which are both captured by g_1. This would require additional demand data. In order to evaluate the contribution of innovation to employment growth, Harrison et al. (2008) propose to use a decomposition of employment growth. For the extended model the following decomposition of the average employment growth holds:

$$l = \underbrace{\hat{\alpha}_0}_{1} + \underbrace{\hat{\alpha}_1 pc}_{2} + \underbrace{\hat{\alpha}_2 org}_{3} + \underbrace{\left[1 - I\left(g_2 > 0\right)\right]\left(g_1 - \tilde{\pi}_1\right)}_{4} + \underbrace{I\left(g_2 > 0\right)\left(g_1 - \tilde{\pi}_1 + \hat{\beta} g_2\right)}_{5} + \hat{v} \qquad \text{(XXX)}$$

I(·) denotes the indicator function. It is 1 if the condition in brackets is fulfilled and 0 otherwise. Thus, $I\left(g_2 > 0\right)$ indicates product innovators and $1 - I\left(g_2 > 0\right)$ equals 1 for non-product innovators. Equation (XXX) shows that five terms contribute to the average employment growth:

1. Changes in employment due to *general industry-, country-, size- and ownership-specific productivity trends* in the production of *old* products are captured by the first term. It is the average effect across innovators and non-innovators. We call this effect general productivity trend because these changes in efficiency and in turn in employment are not attributable to product, process or organizational innovation. They rather reflect the effects of training, improvements in the human capital endowment, corporate restructuring, acquisitions of firms, productivity effects from spillovers etc.
2. The second term presents the productivity or displacement effect of *process innovation* related to the production of *old* products.
3. The third term measures the contribution of organizational innovation to employment growth via productivity improvements in the production of *old* products.
4. The fourth term registers the employment change associated with *output growth of old products* for firms that do *not* introduce new products. This component thus accounts for shifts in employment that are due to changes in the demand for the existing products. The demand for existing products might shift because of changes in consumers' preferences, price reductions, business cycle impacts but also

[12] Kleibergen and Paap (2006) suggested a test on whether the equation is identified, i.e., that the excluded instruments are relevant meaning correlated with the endogenous regressors. H0 states that the equation is underidentified. The reported heteroskedasticity-robust Kleibergen-Paap rk LM statistic follows a $X^2(3)$-distribution in our case. The heteroskedasticity-robust Kleibergen-Paap rk Wald F statistic tests the null hypothesis that the instruments are weak, more precisely that the maximal relative bias of IV is larger than 5%. The critical value is 13.91 (critical value is for the Cragg-Donald F statistic and i.i.d. errors; see Baum et al., 2007; Cragg and Donald, 1993; Stock and Yogo, 2005).

[13] We use the Hansen statistic instead of the Sargan statistic since we estimate heteroskedasticity-robust or clustered standard errors. In contrast to the Hansen statistic, the Sargan statistic is not consistent if heteroskedasticity is present.

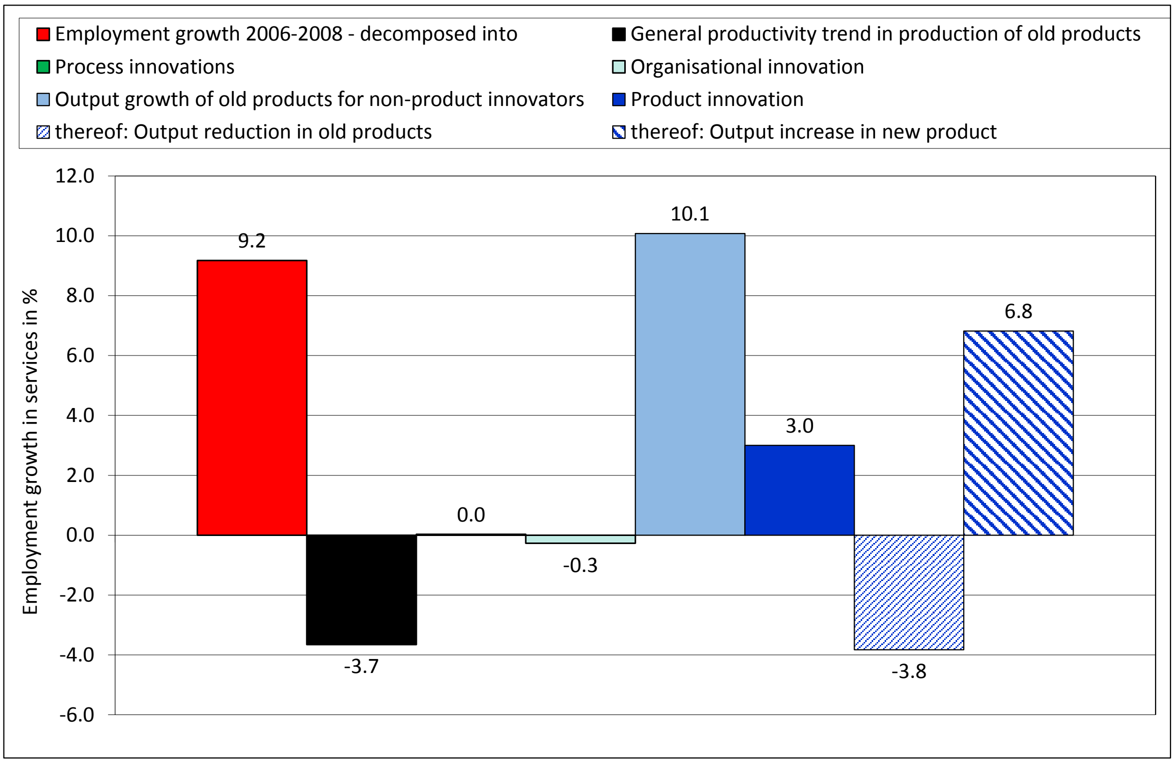
because of rivals' product innovations. This term therefore also comprises the (positive or negative) externalities that arise from product innovation of other firms. The occurrence of negative externalities is known as 'business stealing' effect. Substitution between sales from old and from new products within the same firm, however, is included in the subsequent fifth term.

5. The fifth term summarizes the *net* contribution of *product innovation* to employment growth for product innovators. This effect results from increases in the demand for the new product ($I\left(g_2>0\right)\hat{\beta}g_2$) and possible shifts in demand for the old one $\left(I\left(g_2>0\right)\left(g_1-\tilde{\pi}_1\right)\right)$. Note that shifts in the demand for existing products within firms that have introduced product innovations might be positive or negative. In Figure 1 and 2 the net effect and its two components are shown.

The final term is the residual which is zero by definition. The decomposition thus allows us to separate the effects of product, process and organizational innovation from effects arising from general demand and productivity trends. A dissection of the average employment growth can be obtained by inserting the estimated coefficients and the average shares of innovators and price and sales growth rates from the sample into the equation. Figures 1 and 2 show the decomposition results for services and manufacturing, respectively.

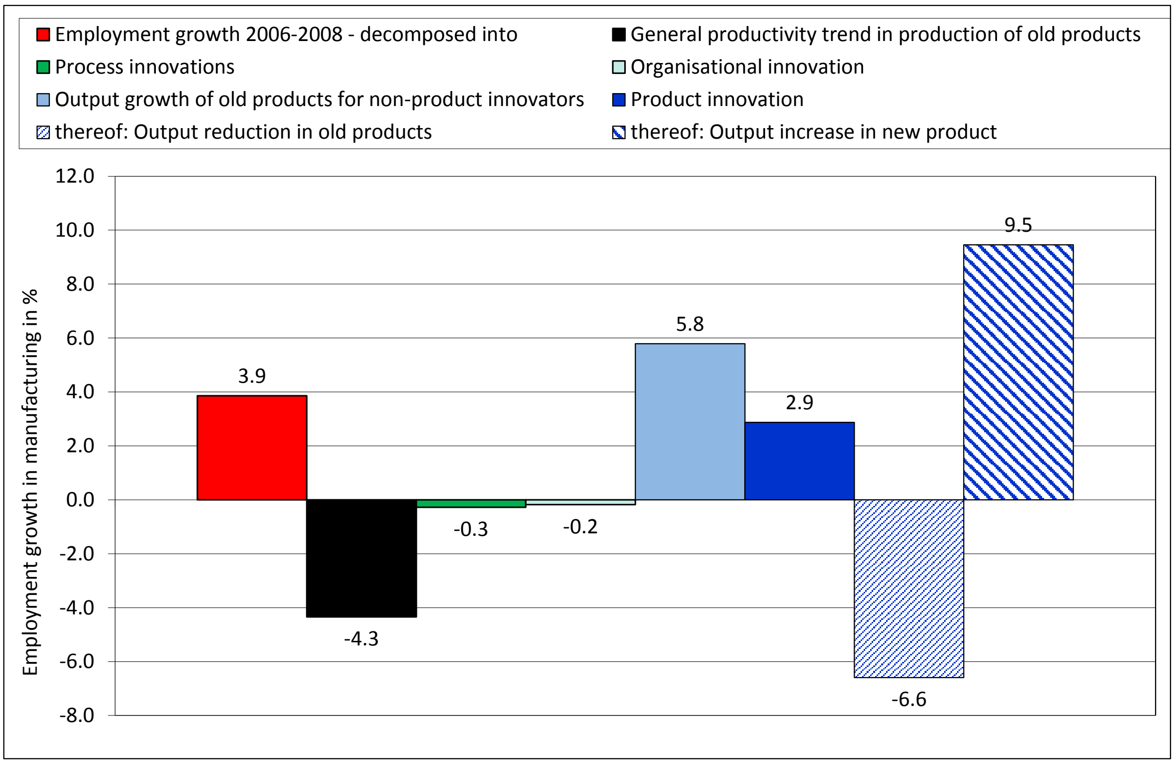
Some interesting similarities and dissimilarities emerge. In services, the overall employment growth was about 9.2% and much larger than in manufacturing (3.9%). In both sectors, the general productivity trend, however, turned out to be of similar magnitude in the period 2006-2008. General improvements in productivity would have led to a decrease in employment of about 3.7% in services and 4.3% in manufacturing in Europe. The contribution of both process and organizational innovation to employment growth is negative but of secondary importance when observed quantitatively. In services, we record a decrease in employment of about 0.3% due to organizational innovation. In manufacturing this amounts to -0.2%. The effect of process innovation is in the same range (-0.3%) in manufacturing and de facto zero in services. The decomposition further reveals a similar net contribution of product innovation in both sectors. Product innovation has stimulated employment by 3.0% in services and 2.9% in manufacturing. The main contributor to a positive employment growth has been the growth in output (demand) of old products in both sectors. It turns out that the output growth of old products contributes more to employment growth than product innovation. However, a large difference is observed in quantitative terms. In services, we record for non-product innovators a contribution of output growth of old products to employment of about 10.1% which is nearly twice as high as in manufacturing (5.8%). In a similar vein, we observe that for product innovators the output reduction in old products is only 3.8% in services compared to 6.6% in manufacturing. However, product innovators in manufacturing were able to offset this larger negative effect of existing products by a larger gross output growth of the new products (9.5% compared to 6.8%).

Fig. 1: Decomposition of Employment Growth in Services, Pooled Sample, 2006-2008



Source: CIS 4, Eurostat, own calculation.

Fig. 2: Decomposition of Employment Growth in Manufacturing, Pooled Sample, 2006-2008



Source: CIS 4, Eurostat, own calculation.

6.2 Employment Effects of Innovation at the Country Level

In the previous estimates, we have assumed that the relationship between innovation and employment is the same for all European firms. In this section, we relax this assumption and allow for heterogeneity in the link between innovation and employment across countries by estimating separate regressions for each country. For the basic model specification, estimation and decomposition results for services are shown in Tab. 10 and Tab. 11. For comparison, we also register corresponding results for manufacturing in Tab. 12 and Tab. 13.

Before we start discussing the results, we briefly comment on the quality of the estimates since there is a trade-off between estimating the same model for all countries and adjusting the model to country specificities. We mainly follow the first approach and should therefore prove that our estimates are reliable. We find that for all countries at least one instrument is highly significant in the first stage regression. In 5 countries (BG, DE, ES, FR, NL) all three instruments are highly correlated in the first stage and turned out to be a valid instruments. In 10 countries (CY, CZ, IT, LU, PT, RO, SI, SK, UK, IE) we find two significant and valid instruments.[14] In Estonia, Hungary, Lithuania, Latvia and Malta, however, we find only one instrument (RANGE) that is highly correlated with the endogenous variable. Since this variable is exogenous and thus a valid instrument in the other 15 countries, we are confident that it likewise qualifies as an instrument in these 5 countries. Though the Hansen tests are reported for these 5 countries, they should be interpreted with care since strictly speaking we are not in a situation of overidentifying restrictions.

The most intriguing result is that product innovation has a significantly positive impact on employment growth in service firms in *all* 20 countries. On this matter, the employment results for product innovation are as strong in services as for manufacturing. In 16 out of 20 countries we furthermore confirm a coefficient of 1. That is, a 1-percent increase in the sales due to new products also increases *gross* employment by one percent. This implies that in these countries old and new products are produced with same efficiency and that there is no evidence of additional productivity effects of new products. In Estonia, Spain, France and Slovenia, however, we find this coefficient to be significantly positive but smaller than 1 which means that new services are produced with a higher efficiency than old services and this in isolation leads to downsizing. For manufacturing, we find such productivity effects of product innovations to take place likewise in France, but also in the Czech Republic and Slovakia. But for the majority of countries we also confirm a coefficient of 1 in manufacturing.

A second striking result is that we also find a common pattern in services with respect to employment effects of process innovation across most European countries. That is, in 17 out of 20 countries we find no effect of process innovations on employment growth. This can be interpreted as such that potential negative labor displacement effects of process innovation and positive compensation effects (increase in demand if lower costs are passed on to customers) outweigh each other. In the three other countries the effect turns out to be either positive (UK and Luxemburg) or negative (Lithuania). To what extent is this pattern in services different from the one that we observe in manufacturing? A comparison reveals that both patterns are very similar in the period under consideration. That is, we also find not much evidence that process innovation affects employment in manufacturing. Only in Spain, Czech Republic and Cyprus

[14] The estimates for UK leave out RANGE since the Hansen C and J tests have rejected the exogeneity of RANGE and as a consequence they also rejected the overall instrument validity. Overall instrument validity was also rejected for Ireland when using RANGE, R&D and CLIENT. As a consequence, R&D and CLIENT were replaced by SCIENCE, SUPPLY and UPDATE, see section 4.

process innovation have led to a decrease in employment in manufacturing. In a nutshell, we can ascertain that there is only weak evidence of employment effects of process innovation among European countries.

A similar conclusion can be drawn for organizational innovation. Just in 18 out of 20 countries we do not find any significant impact of organizational innovation on employment. Only in France and Luxemburg, it turned out that this type of innovation significantly destroyed labor demand at the firm level. If we compare simply the magnitude of the coefficients of process and organizational innovation neglecting the fact that they insignificant in most countries, we find that in 15 out of 20 countries organizational innovation had a stronger negative or less positive impact on employment than process innovation in services. Comparing these results with manufacturing, we detect slightly more evidence that organizational innovation affects employment in manufacturing. In Estonia, Ireland, Portugal and Slovenia organizational innovation destroyed labor, whereas firms in the Czech Republic benefitted from changes in the organizational structure in terms of employment.

In general, one reason why we observe only little effects of process and organizational innovation might be due to high multicollinearity. Indeed, both variables are positively correlated but of reasonable size (0.178). And in fact the results remain largely the same when we either include process or organizational innovation in the regression (not reported).

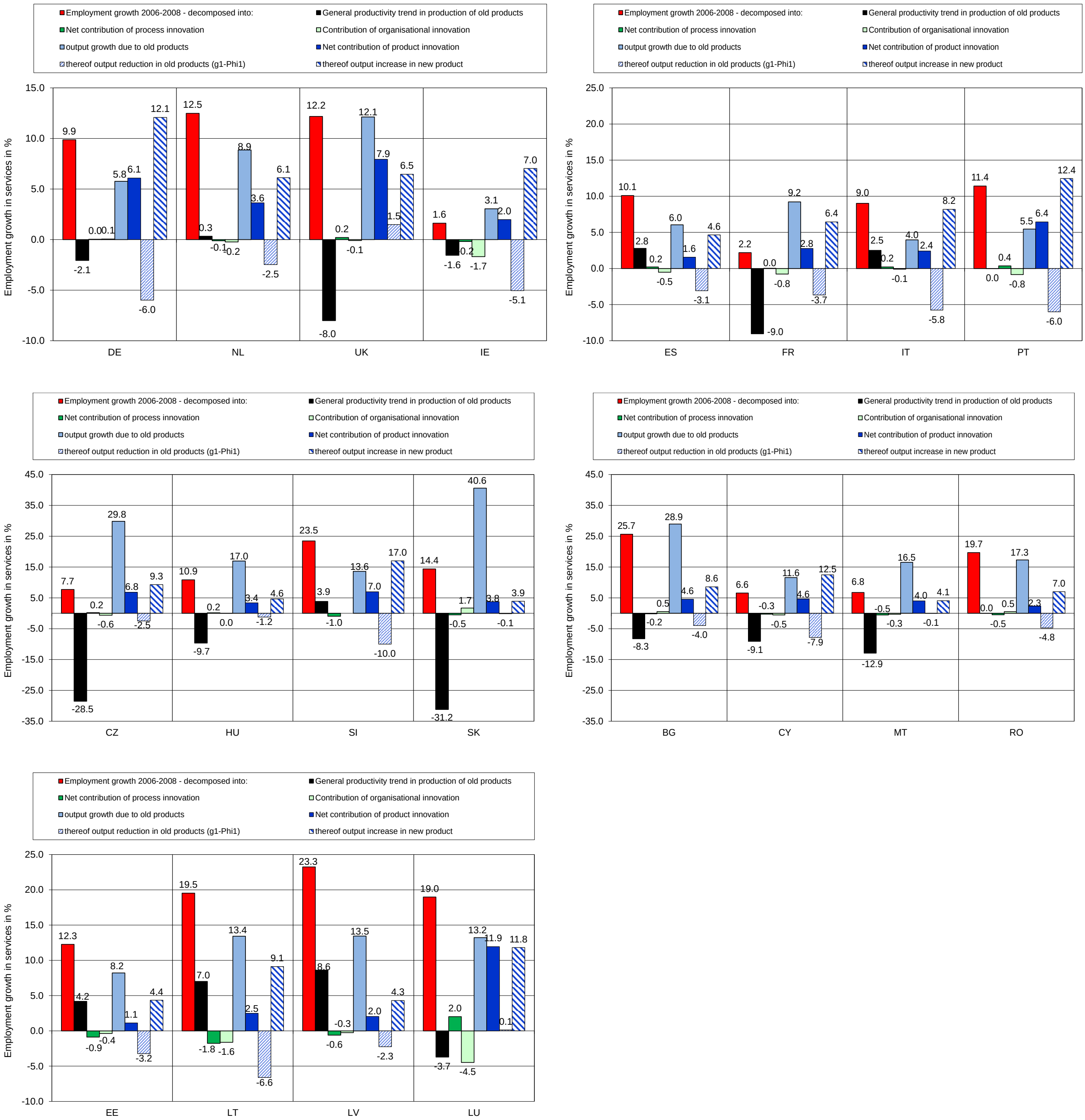
The decomposition results are given in Tab. 11 and Figure 3. They show that the net contribution of production innovation, i.e. the effect of sales growth due to new products net of the substitution for old products, is positive and sizeable for product innovators in all 20 countries. Despite its positive impact, product innovations have contributed less to employment growth than old products. The only exceptions are Germany and Portugal where the employment contribution of product innovation exceeds the one of old products. We will shed some light on this result in the next section.

Another interesting and exceptional finding is that there is no cannibalization between sales for old and new products for product innovators in the UK. Both old and new products contributed positively to employment growth for product innovators. In all other countries we find that the positive contribution of an output increase in new products is partly offset by an output reduction in old products for product innovators.

The decomposition further reveals that for France and Ireland the net contribution of product innovation is larger than the total employment growth rates. Such a finding indicates that both of these countries would have experienced in sum a negative employment growth due to the general productivity trend, process innovation, organizational innovation and output growth due to old products (for non-product innovators). Product innovations are able to compensate for this job loss, and employment growth in services can be solely attributed to the introduction of new products in these two countries.

While the contribution found for process and organizational innovation is rather small in terms of magnitude (exceptions: Ireland, Luxemburg and Lithuania), the numbers reveals a quite large heterogeneity in the general productivity trend across European service firms. Even for the large Western European countries this effect ranges from -9% in France, -2.1% in Germany to -0.3% in the Netherlands. The effect is even positive for Spain (+2.8%) and Italy (+2.5%). This indicated that these countries experienced a decline in labor productivity and hoard labor in this period.

Fig. 3: Decomposition of Employment Effects of Product, Process and Organizational Innovation in European Service Firms at the Country Level, 2006-2008



Source: CIS 4, Eurostat, own calculation.

As explained in section 4, organizational innovation captures a large variety of changes in the organizational structure of a firm. In order to improve our understanding about employment effects of different types of organizational innovation, we differentiate between changes in workplace organization, business processes and external relations in Tab. 14 and Tab. 15. Our main conclusions from this exercise is that there is slightly more evidence that organizational innovation impacts employment in services and that there is more variation in the estimated effects. More precisely, we find that workplace organization is negatively influences employment in 10 out of 18 countries, although this effect turns out to be significant only in France and Cyprus. For business process, we find mixed evidence. One the one hand, changes in business processes have fostered employment growth in Bulgaria, Italy and Slovakia, but on the other hand they have led to a decline in employment growth in Cyprus and Hungary. For the other large Western European countries (DE, FR, NL, ES) we find a negative though not significant employment effect.

In Tab. 16 and Tab. 17 we report to what extent employment effects differ according to the type of product innovation. That is, we differentiate between the sales growth rate due to firm and market novelties. Since we have now two endogenous right-hand-side variables, we need at least two instruments to identify the effects. This requirement is not fulfilled in Latvia, Malta, Slovenia and Lithuania. We therefore recommend not interpreting the results for these countries, and we leave them out of the discussion. We also exclude the Netherlands and Hungary. In both countries instrument validity cannot be rejected, but we get unreasonable negative effects for one of the coefficients. 7 out of the remaining 14 countries experience a positive impact of both firm and market novelties on employment. In Bulgaria, Germany, Spain, Italy and Romania the coefficient associated to market novelties is larger than the one of firm novelties. This implies that market novelties are introduced with a relatively lower productivity compared to firm novelties and that they therefore require relatively more labor. In contrast, in France and the Czech Republic, firm novelties are more important for employment creation than market novelties. In the UK, Portugal, Slovakia and Estonia, we only find market novelties to matter for employment growth. Service firms in Cyprus, Luxemburg and Ireland, however, only experience significant employment increases from firm novelties. In a nutshell, we can summarize that market novelties tend to be more important for employment creation than firm novelties, exceptions are FR, CZ, CY, LU and IE.

Finally, in Tab. 18 we test for complementarity effects between process and organizational innovation by including an interaction term. However, for the large majority of countries, the results do not support the view of complementarity or substitutability between both kinds of innovation. Only in Malta, Slovakia, and Ireland we find the interaction term to be significantly negative. On the contrary, we find evidence for complementarity in Luxemburg. The positive employment impact of process innovation is reinforced if firms also perform organizational innovation.

6.3 Employment Effects of Innovation at the Sector Level

In this section we investigate potential heterogeneity in the innovation-employment link across industries and sector groups (step 3). In order to increase the number of observations, we now use Sample B, that is the merge of three CIS cross sections. Tab. 19 and Tab. 20 depict estimation and decomposition results when we differentiate between different sector groups. First, we split the sample into knowledge-intensive (KIS) and less knowledge-intensive services (LKIS). In a second run, we investigate whether two important subsectors among KIS, namely high-tech knowledge-intensive services (HTKIS) and market-related knowledge-intensive services (MKIS), differ in their innovation-employment nexus. In Tab. 21 and Tab. 22, we use an even more detailed disaggregation of services by distinguishing eight different industries: wholesale, trade, telecommunication, banks and other types of financial intermediation, technical services, other business related services, consultancy and media.

The key finding from the two previous sections that product innovation stimulates employment is also confirmed at the sector and industry level. In all sector groups and in all industries, we find a positive and significant impact. Furthermore, t-tests show that the null hypothesis that the elasticity is 1 cannot be rejected, except for consultancies and media. In both industries the coefficients are significantly smaller than one, indicating once more that new services are produced with higher efficiency (less labor) than existing services. Taking into account that new products might also partially or totally replace existing products, the decomposition shows that product innovations have a positive net effect on employment growth in all sectors and industries. Also at the disaggregated level, we observe that product innovations contribute less to employment growth than existing products. The only exceptions are telecommunication and high-tech knowledge intensive services (HTKIS). For both of them we find that product innovations are the major source for employment growth.

By and large there are no sector or industry differences in the process innovation- employment link. That is, except for media, we find no significant effects of process innovation in any of the sector groups or industries. In media, process innovations have significantly reduced labor demand in the period 1998-2008.

On the contrary, our results emphasize that the role organizational innovation plays for employment growth differs according to the sector. In market knowledge-intensive services (MKIS, such as water transport, air transport, real estate activities, renting and other business activities) as well as in wholesale, financial services, other business related services and media, organizational innovations have been associated with a significant reduction in employment growth. Firms in high-technology knowledge-intensive services (like post and telecommunication, computer, research and development) or consultancies that have decided to implement new organizational structures have not demonstrated significantly different employment growth rates than firms without these organizational changes.

7 Conclusions

Services play a growing role in modern economics and a well performing services sector is increasingly seen a key dimension of an effective innovation system (see United Nations 2011). However, in many countries innovation policy has been designed having in mind technology-based innovation in manufacturing and has largely neglected innovation in services. We therefore need to further improve our understanding of innovation in services and its impact on economic performance and also sharpen policy awareness of the importance of innovation in the service sector. Our paper contributes to an improved understanding of how innovation affects employment growth in services. In the following, we will summarize the key findings and discuss potential lessons that can be drawn from a policy perspective.

First of all, our results demonstrate that product innovation is conducive to employment growth in European service firms. There is overwhelming evidence that this result holds for all countries, for all service sectors and all service industries. In most cases, a 1-percent increase in the sales due to new products also increases *gross* employment by one percent. This implies that there is no evidence that new products are produced with higher or lower efficiency than old products. Only in Estonia, Spain, France and Slovenia (at the country level) and in consultancies and media (at the industry level) results points towards the fact that new services are produced with higher productivity (less labor) than old services. Decomposing employment growth allows us to investigate the net effect of product innovation. It turns out that product innovations have a positive net effect in all countries, sectors and industries. Despite its positive impact, we have to ascertain that the contribution of product innovation to employment growth in services is smaller than that of (i) old products in services (except for DE, PT and HTKIS) and (ii) new products in manufacturing. Nevertheless, in order to solve problems of high unemployment in many European countries, policy is thus well advised to create an innovation-friendly environment also for service firms. Direct government interventions, for instance direct innovation subsidies, might be one solution in order to encounter market failure problems which arise because knowledge has the character of a public good and firms investing in innovation can often not fully reap the benefits of their investment.

Intriguingly, we have estimated a gross employment effect of product innovation that is very similar in nearly all countries and industries. The main differences that we find in the contribution of product innovation to employment growth across countries or industries are thus a result of differences in the average innovation engagement and innovation success across countries or industries, but not of differences in the transformation of a given level of innovation success to employment growth. This opens up similar employment potentials across countries or industries for policy if they are successful in stimulating innovation in services (assuming that there will be no structural breaks in this relationship). For a more detailed analysis of how policy might stimulate innovation in services, see United Nations (2011).

From a policy perspective, however, it is also important to take into account that our results show that the type of innovation matters for employment. When designing their innovation policies, governments should also take into account that process innovation plays only a little role for stimulating employment growth or releasing labor. This result is also quite robust across different countries and industries. For instance, in 17 out of 20 countries we find the common pattern that process innovation do not affect employment growth. This can be interpreted as such that potential negative labor displacement effects and positive compensation effects (increase in demand if lower costs are passed on to customers) outweigh each other. By and large there are no sector or industry differences in the process innovation- employment link in services (except for media). In contrast to that, we find more evidence that process innovation affect employment negatively in manufacturing.

Many studies stress the importance of organizational innovation or business model innovations for services. However, measuring the importance of this kind of innovation in terms of employment growth, policy should be careful as well. At best, we find mixed results of organizational innovation. However, our results clearly indicate that the role organizational innovation plays for employment growth differs according to the sector. In market knowledge-intensive services, financial services and media, organizational innovations had led to a significantly downsizing of labor whereas we cannot ascertain any employment effects of organizational innovations in firms belonging to high-technology knowledge-intensive services or low knowledge-intensive services.

Based on our analysis we would like to point out some additional research questions and directions for further research:

First, for some of the innovation types our results have demonstrated country-specific or industry-specific differences in the effect on employment. In particular for organizational innovation we have to admit that at first glance there are no obvious reasons that might explain the observed variations across different industries. One explanation might be that the type and quality of organizational innovations might largely differ across industries. However, the data at hand does not allow us to answer this question.

Second, our results have shown that *on average* product innovation is conducive to employment growth though there is some heterogeneity across industries and countries. In future research it might be worthwhile to investigate whether effects are heterogeneous across certain firm characteristics. For instance, we should examine whether the effects of product, process and organizational innovations are heterogeneous along the conditional distribution of employment growth. That is, do fast growing firms benefit more from different types of innovation that the least performing firms? This would also be interesting from a policy point of view in order to design innovation policies more effectively.

8 References

Baum, C.F., M.E. Schaffer and S. Stillman (2007), Enhanced Routines for Instrumental Variables/GMM Estimation and Testing, *STATA Journal* 7, 465-506.

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

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

Buch, C.M. and A. Lipponer (2010), Volatile multinationals? Evidence from the Labor Demand of German Firms, *Labour Economics* 17, 345-353.

Cragg, J.G. and S.G. Donald (1993), Testing Identifiability and Specification in Instrumental Variable Models, *Econometric Theory* 9, 222-240.

Dachs, B. and B. Peters (2013), *Innovation, Employment Growth and Foreign Ownership*, ZEW Discussion Paper 13-019, Mannheim.

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

Falk, M. and K. Seim (2000), Workers' Skill Level and Information Technology: A Censored Regression Model, *International Journal of Manpower* 22(1,2), 98–120.

Falk, M. and K. Seim (2001), The Impact of Information Technology on High- Skilled Labour in Services: Evidence from Firm-Level Panel Data, *Economics of Innovation and New Technology* 10(4), 289–323.

Garcia, A., J. Jaumandreu and C. Rodriguez (2004), *Innovation and Jobs: Evidence From Manufacturing Firms*, Open Access Publication from Universidad Carlos III de Madrid hdl:10016/5263.

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

Gibrat, R. (1934), *Les Inégalités Économiques; Applications: Aux Inégalités des Richesses, à la Concentration des Enterprises, aux Populations des Villes, aux Statistiques des Familles, etc., d'une Loi Nouvelle, la Loi des l'Effet Proportionnel*, Paris.

Hall, B.H., F. Lotti and J. Mairesse (2008), Employment, Innovation, and Productivity: Evidence from Italian Microdata, *Industrial Corporate Change* 17, 813-839.

Harrison, R., J. Jaumandreu, J. Mairesse and B. Peters (2008), *Does Innovation Stimulate Employment? A Firm-Level Analysis Using Comparable Micro-Data From Four European Countries*, NBER Working Paper 14216, Cambridge [Mass.].

Jovanovic, B. (1982), Selection and the Evolution of Industry, *Econometrica* 50(3), 649–670.

Kaiser, U. (2000), New Technologies and the Demand for Heterogeneous Labor: Firm-Level Evidence for German Business-Related Services, *Economics of Innovation and New Technology* 9(5), 465–484.

Kaiser, U. (2001), The Impact of Foreign Competition and New Technologies on the Demand for Heterogeneous Labor: Empirical Evidence from the German Business-Related Services Sector, *Review of Industrial Organization* 19(1), 109–120.

Kleibergen, F. and R. Paap (2006), Generalized Reduced Rank Tests Using the Singular Value Decomposition, *Journal of Econometrics* 133, 97-126.

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

Lachenmaier, S. and H. Rottmann (2011), Effects of Innovation on Employment: A Dynamic Panel Analysis, *International Journal of Industrial Organization* 29, 210-220.

OECD/Eurostat (2005), *Oslo Manual: Guidelines for Collecting and Interpreting Innovation Data*, Paris: OECD, 3rd edition.

Peters, B. (2008), *Innovation and Firm Performance - An Empirical Investigation for German Firms,* ZEW Economic Studies 38, Heidelberg, New York.

Scheve, K. and M.J. Slaughter (2004), Economic Insecurity and the Globalization of Production, *American Journal of Political Science* 48, 662-674.

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.

Stock, J.H. and M. Yogo (2005), Testing for Weak Instruments in Linear IV Regression, in: Stock, J.H. and D.W.K. Andrews (Eds.), *Identification and Inference for Econometric Models: Essays in Honor of Thomas J. Rothenberg*, Cambridge University Press, New York.

United Nations (2011), *Promoting Innovation in the Services Sector: A Review of Experiences and Policies*, New York and Geneva.

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

Zimmermann, K. F. (1991), The Employment Consequences of Technological Advance, Demand and Labour Costs in 16 German Industries, *Empirical Economics* 16(2), 253–266.

9 Table Appendix

9.1 Descriptive Statistics

Tab. 4: Distribution by Countries, 2006-2008

Sample	A 2006-2008 (step 1 & 2)			B 1998-2008 (step 3)	
	N	%	Cum	N	%
BG	3,717	9.22	9.22	6,966	8.72
CY	536	1.33	10.55	536	0.67
CZ	1,852	4.59	15.14	4,782	5.98
DE	1,402	3.48	18.62	2,466	3.09
EE	619	1.54	20.15	1,895	2.37
ES	9,089	22.54	42.7	11,717	14.66
FR	5,817	14.43	57.12	9,347	11.69
HU	1,166	2.89	60.01	2,209	2.76
IT	3,695	9.16	69.18	11,858	14.84
LT	363	0.9	70.08	1,344	1.68
LU	330	0.82	70.9	903	1.13
LV	344	0.85	71.75	1,611	2.02
MT	469	1.16	72.91	478	0.60
NL	3,704	9.19	82.1	5,791	7.25
NO	1,547	3.84	85.94	2,967	3.71
PT	2,052	5.09	91.03	2,838	3.55
RO	2,694	6.68	97.71	6,690	8.37
SI	260	0.64	98.35	1,378	1.72
SK	664	1.65	100	1,177	1.47
BE	-	-	-	470	0.59
DK	-	-	-	875	1.09
FI	-	-	-	422	0.53
GR	-	-	-	457	0.57
IS	-	-	-	182	0.23
SE	-	-	-	571	0.71
Pooled	40,320	100	100	79,930	100
UK	3,562	-	-	-	-
IE	515	-	-	-	

Notes: Sample A: Data for the UK and Ireland were accessed via the National Statistical Offices and thus could not be pooled with data for the other countries that have been accessed via Eurostat's Safecenter. Pooled data used in step 1, pooled data and data for the UK and Ireland used in step 2.

Source: CIS3, CIS4 and CIS2008, Eurostat; CIS2008: Office for National Statistics (ONS), UK; CIS2008: Central Statistical Office (CSO) of Ireland, own calculation.

Tab. 5: Distribution by Industry, 1998-2008

	2006-2008 (step 1 & 2)			1998-2008 (step 3)		
	N	%	Cum	N	%	Cum
WHOLE	13,454	33.37	33.37	25,674	32.12	32.12
TRANS	8,088	20.06	53.43	20,311	25.41	57.53
TELE	4,175	10.35	63.78	7,558	9.46	66.99
BANK	3,179	7.88	71.67	7,030	8.80	75.78
TECH	3,717	9.22	80.89	7,972	9.97	85.76
CON	2,412	5.98	86.87	3,327	4.16	89.92
OBRS	3,221	7.99	94.86	4,942	6.18	96.10
MEDIA	2,074	5.14	100	3,116	3.90	100
Pooled	40320	100	-	79,930	100	-

Notes: Data for the UK and Ireland are not included in Table 5.

Source: CIS3, CIS4 and CIS2008, Eurostat; CIS2008: Office for National Statistics (ONS), UK; CIS2008: Central Statistical Office (CSO) of Ireland, own calculation.

Tab. 6: Distribution of Sector Groups, Pooled and by Country, 2006-2008

Country	KIS	LKIS	HTKIS	MKIS
BG	18.6	81.4	7.7	8.2
CY	24.4	75.6	4.3	8.2
CZ	33.1	66.9	7.0	24.1
DE	64.6	35.4	21.3	34.8
EE	24.3	75.7	6.6	14.1
ES	27.7	72.3	6.5	18.7
FR	43.7	56.3	8.2	30.6
HU	28.5	71.5	10.0	10.7
IT	23.9	76.1	13.2	4.7
LT	35.7	64.3	6.2	26.3
LU	53.7	46.3	15.1	17.4
LV	24.3	75.7	5.7	12.4
MT	36.9	63.1	6.6	22.2
NL	43.3	56.7	8.2	30.5
NO	40.5	59.5	13.2	26.8
PT	27.9	72.1	5.1	17.4
RO	21.2	78.8	7.2	9.7
SI	45.1	54.9	20.4	15.1
SK	24.1	75.9	9.3	11.7
Pooled	32.4	67.6	8.8	19.1

Notes: Weighted figures. Weights extrapolate to the number of firms in each stratum. Weighting factors are provided by Eurostat.

Source: CIS 4, Eurostat, own calculation.

Tab. 7: Share of Innovative Firms, Pooled and by Country, 2006-2008

	INNO	PCONLY	PD	MN	FN	OI	OI-WKP	OI-BUP	OI-EXR
BG	16.5	4.5	12.0	5.6	7.9	14.2	10.5	8.9	6.0
CY	34.5	11.5	23.0	7.1	23.0	36.0	31.5	27.7	20.1
CZ	28.6	11.0	17.5	9.9	13.5	32.7	26.5	23.0	11.8
DE	47.6	11.6	36.0	14.3	32.5	51.9	32.3	37.1	21.6
EE	37.5	17.4	20.1	10.9	15.6	28.9	20.8	14.4	15.0
ES	21.8	12.6	9.2	4.3	7.6	25.3	20.7	18.7	7.4
FR	27.8	9.2	18.5	11.4	13.7	33.4	27.2	22.2	12.4
HU	19.8	5.6	14.2	8.4	10.4	17.5	12.5	11.7	8.4
IT	30.3	8.4	21.9	15.5	13.9	32.0	24.7	15.9	14.0
LT	22.9	10.6	12.3	7.5	10.4	18.7	14.9	11.7	8.6
LU	43.4	7.9	35.5	22.4	26.5	46.6	38.8	30.3	23.7
LV	13.2	6.1	7.2	4.9	5.6	12.2	8.4	9.3	05.6
MT	20.9	6.8	14.1	8.3	11.1	18.8	16.6	12.6	7.7
NL	27.7	6.7	21.0	14.5	14.7	20.8	13.7	15.3	8.6
NO	29.8	6.2	23.6	14.1	17.4	19.9	16.5	11.2	8.6
PT	52.7	14.9	37.8	19.7	28.2	45.3	38.5	34.4	22.0
RO	16.6	6.0	10.6	4.9	9.2	22.5	20.2	10.2	10.7
SI	59.8	13.3	46.5	36.1	36.1	100.0	91.5	.	57.2
SK	16.1	5.4	10.7	6.1	7.5	20.9	15.7	13.8	7.5
Pooled	27.0	9.5	17.5	10.6	12.7	28.8	22.9	18.4	11.3
SD	13.17	3.63	11.03	7.78	8.99	20.05	18.34	8.87	11.81
M	29.87	9.25	20.62	11.89	16.04	31.45	25.34	18.24	14.57
CV	0.44	0.39	0.54	0.65	0.56	0.64	0.72	0.49	0.81

Notes: Weighted figures. Weights extrapolate to the number of firms in each stratum. Weighting factors are provided by Eurostat. INNO denotes the share of firms with technological innovation (product or process innovation), PCONLY measures the share of firms with process innovation only. PD, MN and FN denote the share of firms with product innovation, market novelties and firm novelties. OI, OI-WKP, OI-BUP, OI-EXR describe the share of firms with organizational innovation in general and changes in workplace organisation, business processes and external relationships in particular. SD, M and CV describe the simple (unweighted) standard deviation, mean and coefficient of variation of the corresponding shares.

Source: CIS 4, Eurostat, own calculation.

Tab. 8: Growth Rates of Employment, Sales, Productivity and Prices, Pooled and by Country, 2006-2008

	Employment (l)	Labour Prod.	Sales (g)	Sales – old products (g_1)	Sales – new products (g_2)	Sales – Market nov (g_{2m})	Sales – Firm nov (g_{2f})	Prices ($\tilde{\pi}_1$)
BG	25.651	22.589	49.844	41.215	8.629	1.972	5.466	16.259
	18.182	17.671	40.829	35.313	0.000	0.000	0.000	16.880
	35.412	37.253	50.822	56.881	31.922	11.149	25.356	5.126
CY	6.570	20.011	26.817	14.671	12.146	2.327	9.212	10.924
	4.762	13.813	21.655	15.385	0.000	0.000	0.000	11.785
	15.391	25.303	27.575	36.761	28.542	9.751	22.25	6.078
CZ	7.719	33.332	41.285	32.469	8.816	2.579	5.239	5.113
	0.000	26.988	46.109	36.243	0.000	0.000	0.000	1.056
	22.015	31.51	34.441	42.415	27.437	10.678	19.645	5.214
DE	9.874	5.352	15.013	3.511	11.502	1.866	9.177	3.745
	4.484	3.159	8.421	3.571	0.000	0.000	0.000	4.297
	22.10	19.278	29.610	33.272	25.335	7.937	21.461	2.232
EE	12.275	13.006	25.768	18.796	6.972	1.760	4.447	13.814
	5.128	8.439	15.785	11.688	0.000	0.000	0.000	14.724
	25.531	31.012	41.873	43.757	25.397	8.495	20.695	4.553
ES	10.094	6.181	15.608	10.548	5.060	1.356	3.346	7.581
	4.783	3.082	9.128	7.282	0.000	0.000	0.000	8.401
	24.553	25.204	34.016	37.958	22.935	8.983	17.816	2.182
FR	2.194	18.447	19.011	11.851	7.160	2.439	3.99	6.305
	-1.583	15.517	11.868	9.074	0.000	0.000	0.000	6.907
	22.682	27.287	31.535	35.527	23.836	10.526	16.758	1.231
HU	10.855	14.311	24.195	19.743	4.452	1.433	2.494	4.034
	4.545	10.141	18.468	15.526	0.000	0.000	0.000	0.892
	26.515	29.141	34.655	36.921	17.412	7.818	11.152	5.478
IT	9.017	5.109	12.889	4.913	7.976	3.208	4.245	6.721
	5.000	1.633	7.642	3.948	0.000	0.000	0.000	7.580
	21.273	23.164	26.72	30.981	22.242	10.581	16.03	1.514
LT	19.529	17.119	39.527	30.199	9.328	2.515	5.874	23.401
	12.500	14.951	29.548	23.633	0.000	0.000	0.000	24.414
	25.474	27.964	44.389	51.435	31.275	12.881	24.481	11.937
LU	18.987	12.570	31.675	22.579	9.096	3.151	4.688	9.230
	10.811	8.175	18.435	12.642	0.000	0.000	0.000	12.394
	28.873	31.367	42.921	43.777	22.972	10.805	13.132	4.059
LV	23.250	13.387	36.386	33.101	3.285	1.205	1.592	21.906
	14.179	11.308	25.147	23.420	0.000	0.000	0.000	24.861
	36.145	35.798	52.564	54.742	17.898	8.506	10.544	7.636
MT	6.755	8.460	14.042	9.996	4.046	1.857	1.832	-6.481
	0.000	0.000	4.363	2.531	0.000	0.000	0.000	-10.870
	19.893	24.655	26.801	29.55	16.381	9.480	9.313	7.169
NL	12.490	8.627	21.043	15.405	5.638	2.135	2.886	9.013
	8.333	5.525	14.971	11.613	0.000	0.000	0.000	11.939
	21.583	23.026	30.448	32.969	19.517	8.587	13.351	3.732
NO	0.000	23.795	23.795	15.793	8.002	2.670	4.388	6.246
	0.000	16.347	16.347	10.529	0.000	0.000	0.000	6.904
	0.000	31.796	31.796	35.242	22.926	10.607	14.855	2.016
PT	11.412	8.148	18.642	5.847	12.795	3.999	7.537	6.394
	1.852	3.878	11.426	2.898	0.000	0.000	0.000	6.904
	26.244	25.958	33.743	37.549	29.085	12.761	20.535	1.294
RO	19.697	21.066	41.971	33.944	8.027	1.531	5.674	21.402
	11.765	14.686	30.397	24.937	0.000	0.000	0.000	26.161
	33.104	36.584	50.888	54.792	29.542	9.225	23.966	7.978
SI	23.484	11.115	33.836	11.840	21.996	8.264	10.326	8.243
	14.493	7.730	26.198	12.128	0.000	0.000	0.000	7.239
	30.787	28.187	35.792	44.296	36.281	15.838	21.104	3.334
SK	14.393	28.690	44.406	40.176	4.229	1.628	2.020	-0.302
	9.804	27.434	38.313	35.940	0.000	0.000	0.000	-2.259
	25.282	34.697	42.500	46.545	18.201	9.210	12.044	3.525
Total	9.176	12.679	21.183	14.137	7.045	2.299	4.103	7.885
	2.083	8.395	12.992	9.753	0.000	0.000	0.000	7.097
	24.433	28.213	35.146	39.048	23.793	10.045	17.436	5.402

Notes: Weighted figures. Weights extrapolate to the number of firms in each stratum. Weighting factors are provided by Eurostat. For each country, the figures reported are the mean (1), median (2) and the standard deviation (3) of the corresponding variable.
Source: CIS 4, Eurostat, own calculation.

9.2 Employment Effects, Pooled Sample

Tab. 9: Employment Effects of Product, Process and Organizational Innovation in Services and Manufacturing, Pooled Sample, 2006-2008

Sample	Pooled-Services					Pooled-Manufacturing
Model / estimation method	**(1) OLS unweighted**	**(2) IV unweighted**	**(3) OLS weighted**	**(4) IV weighted**	**(5) IV weighted**	**(6) IV weighted**
Constant	-29.176 ***	-29.305 ***	-27.600 ***	-27.574 ***	-16.178 *	-20.889 ***
	(1.543)	(1.573)	(1.720)	(1.738)	(8.428)	(2.423)
SGR NEW PRODUCTS	0.854 ***	0.952 ***	0.858 ***	0.968 ***	1.008 ***	0.989 ***
	(0.009)	(0.016)	(0.015)	(0.022)	(0.027)	(0.028)
PROCESS ONLY	-2.395 ***	-0.848	-1.038	0.308	1.914 **	-2.475 ***
	(0.616)	(0.588)	(1.011)	(0.954)	(0.945)	(0.671)
ORGA INNO	1.009 **	-0.526	0.580	-0.939	-1.290	-0.621
	(0.471)	(0.471)	(0.706)	(0.634)	(0.809)	(0.681)
GDP	---	---	---	---	0.646 ***	
					(0.199)	
UNEMP	---	---	---	---	2.928 ***	
					(0.863)	
EMPPROT	---	---	---	---	-9.529 **	
					(4.082)	
R2_adj	0.409	0.404	0.357	0.353	0.320	0.469
Hypotheses tests (p-value)						
Wald-Test: industry dummies	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.025 ***	0.000 ***
Wald-Test: size dummies	0.016 **	0.029 **	0.053 *	0.052 *	0.050 **	0.964
Wald-Test: ownership dummies	0.074 **	0.059 *	0.260	0.179	0.089 *	0.362
Wald-Test: country dummies	0.000 ***	0.000 ***	0.000 ***	0.000 ***	---	0.000 ***
Wald-Test: β=1	0.000 ***	0.002 ***	0.000 ***	0.147	0.769	0.695
Tests on Exogeneity						
SGR NEW PRODUCTS	---	0.000 ***	---	0.000 ***	0.000 ***	0.001 ***
Tests on instr. validity (p-value)						
Sargan/Hansen J-Test	---	0.310	---	0.635	0.008	0.921
Difference-in-Sargan test						
RANGE	---	0.127	---	0.348	0.017	0.850
R&D	---	0.765	---	0.944	0.135	0.695
CLIENT	---	0.165	---	0.369	0.002	0.987
Summary of first stage results:						
RANGE	---	8.904 ***	---	8.633 ***	8.160 ***	8.322 ***
		(0.442)		(0.451)	(0.401)	(0.345)
R&D	---	10.119 ***	---	9.713 ***	10.381 ***	4.948 ***
		(1.459)		(1.555)	(1.611)	(1.538)
CLIENT	---	9.022 ***	---	8.655 ***	7.391 ***	5.014 ***
		(0.951)		(1.170)	(1.132)	(0.811)
F-statistic	---	45.38 ***	---	68.20 ***	92.43 ***	87.28 ***
Tests on underidentif. (p-value)						
Kleibergen-Paap LM test	---	0.000 ***	---	0.000 ***	0.000 ***	0.000 ***
Test on weak instruments						
Kleibergen-Paap F statistic	---	194.30	---	252.79	348.24	405.64
Weak-instr. robust inf. (p-value)						
Anderson-Rubin Wald test	---	0.000 ***	---	0.000 ***	0.000 ***	0.000 ***
Stock-Wright LM test	---	0.000 ***	---	0.000 ***	0.000 ***	0.000 ***
Number of observations	40425	40425	40320	40320	31937	49087

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level. Clustered standard errors are reported (clustered by country). *Summary of first stage results*: Reported are only coefficients and standard errors of the instruments, results for the other exogenous variables in the first stage are available upon request.

Source: CIS 4, Eurostat, own calculation.

9.3 Country-Level Employment Effects

Tab. 10: Employment Effects of Product, Process and Organizational Innovation in Services at the Country Level, 2006-2008

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT
Constant	-5.820 ***	-7.263 **	-35.034 ***	-5.444 **	12.931 ***	7.560 ***	-9.075 ***	-10.099 ***	6.878 ***	10.654
	(1.050)	(2.417)	(2.272)	(2.236)	(4.076)	(0.944)	(0.818)	(2.104)	(1.264)	(7.148)
SGR NEW PRODUCTS	0.994 ***	1.028 ***	1.054 ***	1.050 ***	0.624 ***	0.918 ***	0.899 ***	1.042 ***	1.026 ***	0.978 ***
	(0.042)	(0.078)	(0.090)	(0.066)	(0.159)	(0.039)	(0.039)	(0.136)	(0.073)	(0.131)
PROCESS ONLY	-3.771	-0.246	1.870	0.346	-5.092	1.652	0.256	2.917	2.564	-16.689 **
	(3.566)	(3.249)	(4.075)	(1.949)	(5.509)	(1.525)	(1.441)	(5.017)	(2.100)	(7.943)
ORGA INNO	3.820	-1.507	-1.906	0.098	-1.251	-2.026	-2.314 **	-0.011	-0.265	-8.698
	(1.050)	(3.508)	(3.464)	(1.438)	(4.180)	(1.342)	(1.078)	(2.104)	(1.772)	(8.272)
R2_adj	0.263	0.514	0.395	0.515	0.249	0.356	0.345	0.213	0.340	0.422
Hypotheses tests (p-value)										
Wald-Test: industry dummies	0.000 ***	0.000 ***	0.002 ***	0.224	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Wald-Test: size dummies	0.137	0.454	0.010 ***	0.208	0.133	0.041 **	0.163	0.398	0.053 *	0.822
Wald-Test: ownership dummies	0.243	0.129	0.126	0.256	0.304	0.236	0.083 *	0.100 *	0.131	0.601
Wald-Test: β=1	0.880	0.719	0.546	0.447	0.018 **	0.036 **	0.011 **	0.755	0.726	0.865
Tests on Exogeneity										
SGR NEW PRODUCTS	0.000 ***	0.054 *	0.036 **	0.023 **	0.260	0.761	0.034 **	0.264	0.003 ***	0.608
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.274	0.703	0.250	0.561	0.267	0.713	0.168	0.458	0.245	0.431
Difference-in-Sargan test										
RANGE	0.569	0.579	0.136	0.662	0.122	0.744	0.856	0.782	0.254	0.976
R&D	0.146	0.575	0.207	0.284	0.199	0.432	0.165	0.216	0.161	0.237
CLIENT	0.408	0.539	0.384	0.934	0.647	0.670	0.142	0.843	0.638	0.775
Summary of first stage results:										
RANGE	17.126 ***	10-148 ***	11.108 ***	4.220 ***	7.641 ***	8.368 ***	8.307 ***	5.769 ***	8.587 ***	14.929 ***
	(1.748)	(1.361)	(1.570)	(0.628)	(1.446)	(0.804)	(0.675)	(1.229)	(0.976)	(4.000)
R&D	22.751 **	6.924	7.297	10.179 ***	10.145	15.346 ***	13.553 ***	10.137	3.081	1.586
	(10.743)	(9.366)	(5.724)	(2.451)	(6.227)	(2.615)	(2.202)	(6.244)	(3.580)	(9.400)
CLIENT	20.967 ***	17.364 ***	12.227 **	7.657 ***	3.915	10.571 ***	4.228 **	7.585	9.357 ***	14.696
	(4.696)	(3.971)	(5.462)	(1.737)	(3.715)	(2.747)	(1.995)	(5.032)	(2.615)	(10.913)
F-statistic	33.68 ***	21.78 ***	21.06 ***	23.38 ***	8.13 ***	53.88 ***	60.57 ***	10.67 ***	41.75 ***	9.10 ***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Test on weak inst.s (p-value)										
Kleibergen-Paap F statistic	126.25	39.75	45.16	82.51	17.21	151.22	187.05	29.32	81.57	12.91
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.020 **	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Stock-Wright LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.008 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.001 ***
Number of observations	3717	536	1852	1402	619	9089	5817	1166	3695	363

Tab. 10: Employment Effects of Product, Process and Organizational Innovation in Services at the Country Level, 2006-2008 (Continued)

	LU	LV	MT	NL	PT	RO	SI	SK	UK	IE*
Constant (Suits method)	0.511	14.455 ***	-16.162 ***	3.871 ***	1.195	6.912 ***	-1.348	-28.010 ***	-7.209 ***	-5.785
	(5.222)	(3.881)	(1.855)	(1.363)	(1.621)	(1.410)	(5.333)	(3.217)	(1.472)	(11.776)
SGR NEW PRODUCTS	1.299 ***	1.310 ***	1.008 ***	1.085 ***	0.973 ***	0.885 ***	0.773 ***	0.925 ***	1.107 ***	1.123 ***
	(0.251)	(0.274)	(0.230)	(0.079)	(0.077)	(0.069)	(0.115)	(0.149)	(0.093)	(0.168)
PROCESS ONLY	25.596 ***	-9.976	-7.759	-1.738	2.431	-7.811	-7.315	-9.193	4.383 *	-1.205
	(7.012)	(15.757)	(5.889)	(2.351)	(2.517)	(6.219)	(7.713)	(10.190)	(2.422)	(3.472)
ORGA INNO	-9.611 *	-2.100	-1.833	-1.104	-1.871	2.419	5.837	8.134	-0.292	-4.813
	(5.775)	(10.602)	(4.533)	(1.880)	(2.299)	(2.948)	(5.627)	(5.217)	(1.845)	(3.365)
R2_adj	0.174	0.209	0.280	0.262	0.421	0.259	0.485	0.195	0.350	0.207
Hypotheses tests (p-value)										
Wald-Test: industry dummies	0.147	0.001 ***	0.000 ***	0.000 ***	0.036 **	0.096 *	0.008 ***	0.390	0.077 *	0.489
Wald-Test: size dummies	0.716	0.096 *	0.278	0.288	0.417	0.000 ***	0.370	0.069 *	0.125	0.381
Wald-Test: ownership dummies	0.765	0.096 *	0.278	0.288	0.417	0.000 ***	0.370	0.069 *	0.253	0.657
Wald-Test: β=1	0.234	0.259	0.972	0.283	0.722	0.442	0.048 **	0.613	0.252	0.463
Tests on Exogeneity										
SGR NEW PRODUCTS	0.039 **	0.029 **	0.679	0.001 ***	0.075 *	0.058 *	0.321	0.777	0.186	0.116
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.351	0.684	0.145	0.458	0.602	0.202	0.343	0.502	0.400	0.217
Difference-in-Sargan test										
RANGE	0.186	0.672	0.895	0.623	0.468	0.292	0.241	0.284	-	0.144
R&D	0.945	0.810	0.060 *	0.338	0.625	0.289	0.702	0.931	0.400	---
CLIENT	0.153	0.383	0.595	0.292	0.357	0.157	0.146	0.242	0.400	---
Summary of first stage results:										
RANGE	5.083 ***	7.978 ***	6.353 **	5.495 ***	7.859 ***	18.690 ***	14.249 ***	12.606 ***	---	3.982 ***
	(1.557)	(2.697)	(2.623)	(0.880)	(0.964)	(1.991)	(2.737)	(2.864)		(1.135)
R&D	8.950	34.245	13.508	7.293 ***	3.688	8.096	13.099 *	22.948 **	9.442 ***	---
	(6.378)	(29.812)	(11.324)	(2.556)	(4.207)	(6.222)	(7.144)	(9.808)	(2.740)	
CLIENT	9.148 *	1.549	7.232	7.055 ***	5.865 **	18.503 ***	-2.789	-0.644	11.142 ***	---
	(5.026)	(7.181)	(5.653)	(2.193)	(2.523)	(5.697)	(7.918)	(6.862	(2.430)	
F-statistic	6.53 ***	3.87 ***	4.49 ***	23.42 ***	21.89 ***	38.38 ***	14.58 ***	6.69 ***	25.74 ***	8.400 ***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Test on weak instruments (p-value)										
Kleibergen-Paap F statistic	15.83	8.91	11.07	52.90	56.10	119.22	39.28	20.12	77.94	14.78
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Stock-Wright LM test	0.000 ***	0.000 ***	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.001 ***	0.000 ***	0.000 ***
Number of observations	330	344	469	3704	2052	2694	260	664	3562	515

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level. R&D and CLIENT turned out to be endogenous in Ireland. Instead UPDATE [3.321** (1.315) ; 0.301], SCIENCE [1.543 (4.654); 0.627] and SUPPLY [4.086 (4.264); 0.326] were used as instruments (in parenthesis coefficient (standard error) and difference-in-Sargan statistic.

Source: CIS 4, Eurostat, CIS 4, Eurostat; Office for National Statistics (ONS), UK; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 11: Employment Growth Decomposition in Services at the Country Level, 2006-2008 (I)

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT	LU	LV	MT	NL	PT	RO	SI	SK	UK	IE
Employment growth	25.65	6.57	7.72	9.87	12.28	10.09	2.19	10.86	9.02	19.53	18.99	23.25	6.76	12.49	11.41	19.70	23.48	14.39	12.18	1.62
Decomposed into contribution of																				
General productivity trend in production of old products	-8.25	-9.09	-28.51	-2.06	4.19	2.79	-9.04	-9.65	2.51	7.01	-3.72	8.61	-12.93	0.33	0.00	-0.02	3.86	-31.20	-8.01	-1.55
Process innovations	-0.17	-0.28	0.21	0.04	-0.89	0.21	0.02	0.16	0.22	-1.77	2.02	-0.60	-0.53	-0.12	0.36	-0.47	-0.97	-0.50	0.21	-0.19
Organizational innovation	0.54	-0.54	-0.62	0.05	-0.36	-0.51	-0.77	0.00	-0.09	-1.63	-4.48	-0.26	-0.34	-0.23	-0.85	0.54	-	1.70	-0.09	-1.68
Output growth of old products for non-product innovators	28.95	11.61	29.85	5.76	8.21	6.05	9.22	16.96	3.96	13.42	13.22	13.45	16.54	8.87	5.45	17.30	13.61	40.61	12.13	3.05
Thereof for																				
Non-innovators	*27.15*	*9.56*	*25.92*	*4.39*	*6.17*	*4.91*	*7.99*	*15.89*	*3.48*	*10.24*	*12.90*	*12.40*	*14.31*	*7.82*	*3.77*	*15.57*	*9.19*	*37.66*	11.32	*2.18*
Process innovators only	*1.80*	*2.06*	*3.93*	*1.37*	*2.05*	*1.13*	*1.23*	*1.06*	*0.48*	*3.18*	*0.32*	*1.06*	*2.23*	*1.05*	*1.69*	*1.74*	*4.42*	*2.95*	0.81	*0.87*
Product innovation	4.59	4.62	6.80	6.09	1.12	1.57	2.77	3.39	2.42	2.50	11.95	2.04	4.02	3.64	6.45	2.34	6.99	3.78	7.94	1.98
Thereof																				
Output reduction in old products	*-3.99*	*-7.87*	*-2.49*	*-5.99*	*-3.23*	*-3.08*	*-3.67*	*-1.25*	*-5.77*	*-6.63*	*0.13*	*-2.26*	*-0.06*	*-2.48*	*-6.00*	*-4.76*	*-10.01*	*-0.13*	1.48	*-5.05*
Output increase in new product	*8.57*	*12.49*	*9.29*	*12.08*	*4.35*	*4.64*	*6.44*	*4.64*	*8.18*	*9.12*	*11.82*	*4.30*	*4.08*	*6.12*	*12.45*	*7.01*	*17.01*	*3.91*	6.46	*7.03*

Source: CIS 4, Eurostat, CIS 4, Eurostat; Office for National Statistics (ONS), UK; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 12: Employment Effects of Product, Process and Organizational Innovation in Manufacturing at the Country Level, 2006-2008

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT
Constant	4.558 ***	-5.811 **	-31.700 ***	3.667 **	-2.686	2.390 ***	-6.047 ***	-2.332	5.051 ***	-38.09 ***
	(1.235)	(2.574)	(4.136)	(1.430)	(2.870)	(0.756)	(0.986)	(2.236)	(1.399)	(6.359)
SGR NEW PRODUCTS	1.011 ***	0.975 ***	0.886 ***	0.9517 ***	1.075 ***	0.963 ***	0.937 ***	1.004 ***	1.053 ***	0.926 ***
	(0.032)	(0.076)	(0.064)	(0.048)	(0.093)	(0.023)	(0.033)	(0.075)	(0.052)	(0.103)
PROCESS ONLY	-0.799	-8.383 **	-8.600 **	-2.505	-1.207	-1.701 *	-1.699	1.797	-1.251	2.758
	(1.619)	(3.929)	(4.100)	(1.690)	(2.907)	(0.947)	(1.189)	(2.810)	(1.488)	(7.251)
ORGA INNO	0.868	-3.200	4.884 *	1.277	-5.658 *	-0.733	0.210	2.293	-1.478	4.874
	(1.328)	(3.495)	(2.838)	(1.116)	(2.838)	(0.829)	(0.844)	(2.420)	(1.388)	(5.402)
R2_adj	0.439	0.713	0.515	0.556	0.417	0.523	0.465	0.270	0.440	0.623
Hypotheses tests (p-value)										
Wald-Test: industry dummies	0.000 ***	0.045 **	0.000 ***	0.000 ***	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Wald-Test: size dummies	0.003 ***	0.045 **	0.000 ***	0.994	0.351	0.489	0.033 **	0.074 *	0.225	0.045 **
Wald-Test: ownership dummies	0.918	0.461	0.694	0.259	0.057 *	0.003 ***	0.492	0.181	0.671	0.398
Wald-Test: country dummies	---	---	---	---	---	---	---	---	---	---
Wald-Test: β=1	0.718	0.745	0.072 *	0.316	0.419	0.119	0.055 *	0.958	0.306	0.471
Tests on Exogeneity										
SGR NEW PRODUCTS	0.000 ***	0.274	0.618	0.062 *	0.029 **	0.099 *	0.371	0.135	0.000 ***	0.100
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.721	0.674	0.513	0.441	0.400	0.831	0.674	0.295	0.706	0.371
Difference-in-Sargan test										
RANGE	0.532	0.375	0.623	0.857	0.176	0.988	0.818	0.123	0.950	0.165
R&D	0.646	0.756	0.321	0.215	0.443	0.623	0.549	0.488	0.448	0.475
CLIENT	0.493	0.395	0.705	0.529	0.297	0.709	0.452	0.208	0.634	0.261
Summary of first stage results:										
RANGE	13.581 ***	13.808 ***	14.689 ***	3.301 ***	8.613 ***	8.661 ***	6.779 ***	6.904 ***	7.856 ***	16.119 ***
	(0. 877)	(2.143)	(1.670)	(0.582)	(1.435)	(0.531)	(0.487)	(0.997)	(0.581)	(3.387)
R&D	-2.402	8.026	13.683 **	9.614 ***	3.659	8.923 ***	7.129 ***	5.007	3.720	2.797
	(5.448)	(10.662)	(6.543)	(1.551)	(3.790)	(1.676)	(1.497)	(4.063)	(2.407)	(8.819)
CLIENT	10.001 ***	3.241	-10.369 **	7.954 ***	2.679	6.948 ***	4.355 ***	7.170 ***	4.539 ***	0.845
	(2.347)	(6.610)	(4.963)	(1.646)	(3.450)	(1.400)	(1.437)	(2.726)	(1.511)	(8.861)
F-statistic	42.62 ***	10.10 ***	32.24 ***	51.02 ***	14.58 ***	113.29 ***	80.92 ***	19.30 ***	49.14 ***	6.86 ***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Test on weak instruments										
Kleibergen-Paap F statistic	215.38	27.38	62.66	130.48	45.46	312.07	230.40	38.74	119.77	16.94
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Stock-Wright LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Number of observations	4865	404	2338	2157	844	12357	6197	2079	5849	403

Tab. 12: Employment Effects of Product, Process and Organizational Innovation in Manufacturing at the Country Level, 2006-2008 (continued)

	LU	LV	MT	NL	PT	RO	SI	SK	IE
Constant	5.789	1.672	6.562 *	1.188	2.737	-0.565	-2.864	-26.180 ***	6.404 **
	(4.393)	(12.769)	(3.414)	(1.951)	(2.405)	(2.671)	(4.736)	(5.578)	(2.514)
SGR NEW PRODUCTS	0.778 ***	1.011 ***	1.048 ***	1.032 ***	1.048 ***	0.991 ***	0.967 ***	0.619 ***	1.060 ***
	(0.186)	(0.218)	(0.198)	(0.075)	(0.064)	(0.051)	(0.094)	(0.157)	(0.120)
PROCESS ONLY	1.738	4.034	-3.382	-2.388	-2.712	-4.901	-3.230	-15.007	-2.783
	(4.561)	(6.915)	(5.522)	(2.331)	(2.273)	(4.321)	(4.803)	(12.959)	(2.513)
ORGA INNO	-1.062	2.830	0.184	-1.722	-3.756 **	-3.264	-6.564 *	6.316	-4.228 *
	(3.569)	(6.867)	(4.326)	(1.826)	(1.822)	(2.634)	(3.403)	(5.197)	(2.252)
R2_adj	0.342	0.510	0.420	0.370	0.438	0.416	0.645	0.266	0.459
Hypotheses tests (p-value)									
Wald-Test: industry dummies	0.181	0.124	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.017 **	0.369	0.143
Wald-Test: size dummies	0.196	0.022 **	0.604	0.651	0.032 **	0.360	0.265	0.860	0.068 *
Wald-Test: ownership dummies	0.085 *	0.009 ***	0.586	0.122	0.709	0.830	0.088 *	0.039 **	0.192
Wald-Test: β=1	0.233	0.959	0.808	0.667	0.450	0.858	0.725	0.016 **	0.618
Tests on Exogeneity									
SGR NEW PRODUCTS	0.949	0.226	n.a.	0.006 ***	0.002 ***	0.012 **	0.503	0.441	0.111
Tests on instr. validity (p-value)									
Sargan/Hansen J-Test	0.420	0.974	n.a.	0.116	0.109	0.361	0.129	0.551	0.955
Difference-in-Sargan test									
RANGE	0.705	0.938	n.a.	0.050	0.302	0.491	0.047 **	0.351	0.851
R&D	0.249	0.934	n.a.	0.127	0.038 **	0.188	0.591	0.380	---
CLIENT	0.405	0.854	n.a.	0.336	0.852	0.782	0.070 *	0.768	---
Summary of first stage results:									
RANGE	4.686 ***	14.978 **	8.506 ***	4.097 ***	6.178 ***	16.835 ***	13.577 ***	8.792 ***	0.985
	(1.238)	(6.213)	(2.364)	(0.886)	(0.733)	(1.768)	(2.167)	(2.398)	(1.139)
R&D	11.635 **	30.190 *	6.851	2.666	1.664	4.407	-4.183	3.147	---
	(5.586)	(16.504)	(8.131)	(2.157)	(2.056)	(9.671)	(5.229)	(7.430)	
CLIENT	5.061	8.242	-5.556	8.697 ***	7.907 ***	8.674 **	1.893	11.976 *	---
	(4.796)	(22.128)	(6.331)	(2.569)	(2.123)	(4.140)	(5.550)	(6.829)	
F-statistic	6.54	4.77	1602.14	26.60	35.17	32.65	10.68	8.49	---
Tests on underidentif. (p-value)									
Kleibergen-Paap LM test	0.000 ***	0.022 **	0.002 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Test on weak inst.s (p-value)									
Kleibergen-Paap F statistic	15.91	6.21	6.01	75.25	106.76	71.95	37.79	24.04	24.21
Weak-instr. robust inf. (p-value)									
Anderson-Rubin Wald test	0.003 ***	0.000 ***	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.003 ***	0.000 ***
Stock-Wright LM test	0.005 ***	0.012 **	0.009 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.008 ***	0.000 ***
Number of observations	147	248	208	2396	3165	3049	332	628	539

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level. Results for the UK are currently not available. The Sargan/Hansen statistic could not be calculated in Malta because the estimated matrix of moment conditions was not of full rank. R&D and CLIENT turned out to be endogenous in Ireland. Instead UPDATE [4.421*** (1.547); 0.836], SCIENCE [4.902 (4.109); 0.589] and SUPPLY [5.222* (2.928); 0.846] were used as instruments (in parenthesis coefficient (standard error) and difference-in-Sargan statistic.

Source: CIS 4, Eurostat, CIS 4, Eurostat; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 13: Employment Growth Decomposition in Manufacturing at the Country Level, 2006-2008 (I)

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT	LU	LV	MT	NL	PT	RO	SI	SK	IE
Employment growth	7.02	6.00	2.98	7.32	2.43	1.69	2.65	3.83	4.95	5.36	6.14	1.87	2.29	6.49	3.16	4.75	6.68	4.89	2.97
Decomposed into contribution of																			
General productivity trend in production of old products	-8.63	-9.28	-29.98	-4.96	-8.43	1.99	-5.93	-11.99	-1.74	-13.70	-0.95	-16.42	-0.27	-2.81	-3.28	1.60	-8.22	-22.36	5.32
Process innovations	-0.09	-1.51	-1.03	-0.31	-0.24	-0.25	-0.19	0.10	-0.14	0.37	0.17	0.20	-0.36	-0.24	-0.40	-0.39	-0.35	-1.02	-0.60
Organizational innovation	0.19	-1.31	1.54	0.64	-1.07	-0.20	0.08	0.32	-0.46	1.26	-0.42	0.39	0.04	-0.42	-1.15	-0.75	-	1.42	-1.60
Output growth of old products for non-product innovators	12.13	10.51	23.71	4.92	7.73	-0.23	6.06	12.39	4.18	14.41	5.31	13.24	0.73	6.87	4.62	3.11	4.55	22.09	-0.51
Thereof for																			
Non-innovators	*10.18*	*6.18*	*18.69*	*3.20*	*4.75*	*-0.65*	*4.91*	*11.37*	*3.24*	*12.62*	*4.12*	*12.20*	*0.14*	*5.39*	*2.99*	*2.25*	*2.60*	*19.29*	*-1.02*
Process innovators only	*1.94*	*4.34*	*5.02*	*1.72*	*2.98*	*0.41*	*1.15*	*1.02*	*0.94*	*1.79*	*1.18*	*1.04*	*0.60*	*1.48*	*1.62*	*0.86*	*1.95*	*2.80*	*0.51*
Product innovation	3.42	7.58	8.74	7.02	4.44	0.39	2.64	3.01	3.10	3.01	2.03	4.45	2.15	3.08	3.38	1.17	10.70	4.76	0.36
Thereof																			
Output reduction in old products	*-7.45*	*-11.19*	*-3.31*	*-8.65*	*-5.89*	*-7.51*	*-5.83*	*-2.11*	*-7.28*	*-10.73*	*-4.68*	*-6.10*	*-4.98*	*-4.71*	*-8.01*	*-8.51*	*-14.39*	*0.38*	*-8.52*
Output increase in new product	*10.88*	*18.76*	*12.05*	*15.68*	*10.33*	*7.89*	*8.47*	*5.12*	*10.38*	*13.73*	*6.71*	*10.55*	*7.13*	*7.79*	*11.39*	*9.69*	*25.09*	*4.38*	*8.88*

Source: CIS 4, Eurostat, CIS 4, Eurostat; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 14: Employment Effects of Different Types of Organizational Innovations in Services at the Country Level, 2006-2008

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT
Constant	-5.765 ***	-7.095 ***	-35.308 ***	-5.289 **	12.590 ***	7.420 ***	-9.154 ***	-10.163 ***	6.847 ***	10.770
	(1.047)	(2.397)	(2.257)	(2.219)	(4.094)	(0.942)	(0.815)	(2.091)	(1.244)	(7.227)
SGR NEW PRODUCTS	0.986 ***	1.063 ***	1.044 ***	1.056 ***	0.597 ***	0.925 ***	0.895 ***	0.995 ***	0.997 ***	0.963 ***
	(0.041)	(0.082)	(0.089)	(0.068)	(0.171)	(0.041)	(0.041)	(0.141)	(0.077)	(0.110)
PROCESS ONLY	-3.50	1.107	1.656	0.698	-5.66	1.58	-0.016	2.697	2.019	-17.708 **
	(3.563)	(3.232)	(3.958)	(1.950)	(5.429)	(1.543)	(1.45)	(4.927)	(2.837)	(7.737)
WORKPLACE ORG	-2.523	-1.837 ***	1.655	2.077	-0.239	0.559	-2.302 *	4.541	-2.990	-4.457
	(3.252)	(3.487)	(4.005)	(1.617)	(6.535)	(1.804)	(1.276)	(4.629)	(2.293)	(6.402)
BUSINESS PROC.	7.573 **	-6.748 **	-1.304	-2.386	-0.715	-1.745	-0.242	-8.508 *	4.422 *	-0.972
	(3.243)	(3.720)	(4.070)	(1.562)	(6.144)	(1.816)	(1.359)	(4.714)	(2.406)	(6.543)
EXTERNAL REL.	2.926	5.276	-2.636	0.592	1.731	-3.014	0.594	7.932 *	1.461	-6.251
	(3.570)	(3.571)	(4.296)	(1.622)	(5.904)	(2.651)	(1.590)	(4.699)	(2.721)	(7.936)
R2_adj	0.265	0.513	0.395	0.515	0.239	0.356	0.345	0.219	0.347	0.420
Hypotheses tests (p-value)										
Wald-Test: group dummies	0.240	0.128	0.129	0.240	0.312	0.233	0.079 *	0.086 *	0.126	0.575
Wald-Test: industry dummies	0.000 ***	0.000 ***	0.003 ***	0.254	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Wald-Test: orga dummies	0.050 **	0.179	0.900	0.375	0.986	0.405	0.230	0.136	0.263	0.673
Wald-Test: size dummies	0.108	0.429	0.010 **	0.189	0.120	0.055 *	0.135	0.401	0.035 **	0.894
Wald-Test: β=1	0.724	0.438	0.624	0.408	0.019 **	0.071 *	0.010 **	0.973	0.971	0.738
Tests on Exogeneity										
SGR NEW PRODUCTS	0.000 ***	0.032 **	0.036 **	0.020 **	0.257	0.918	0.044 **	0.448	0.007 ***	0.677
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.242	0.749	0.296	0.535	0.276	0.749	0.161	0.543	0.236	0.415
Difference-in-Sargan test										
RANGE	0.600	0.737	0.163	0.686	0.138	0.808	0.840	0.826	0.208	0.994
R&D	0.121	0.519	0.229	0.263	0.207	0.482	0.166	0.272	0.151	0.227
CLIENT	0.416	0.696	0.421	0.890	0.633	0.655	0.132	0.857	0.628	0.763
Summary of first stage results:										
RANGE	17.300 ***	9.660 ***	11.204 ***	4.242 ***	7.299 ***	8.323 ***	8.249 ***	5.739 ***	8.655	16.046
	(1.761)	(1.405)	(1.584)	(0.635)	(1.378)	(0.799)	(0.675)	(1.219)	(1.026)	(4.243)
R&D	22.405 **	5.979	8.402	9.893 ***	9.643	14.930 ***	13.359 ***	9.901	3.804	2.691
	(10.678)	(9.577)	(5.394)	(2.444)	(6.222)	(2.621)	(2.196)	(6.286)	(3.350)	(9.226)
CLIENT	20.956 ***	17.378 ***	11.964 **	7.480 ***	3.629	10.308 ***	4.136 **	7.563	8.878	16.892
	(4.675)	(4.088)	(5.539)	(1.740)	(3.663)	(2.742)	(2.000)	(5.034)	(2.659)	(10.883)
F-statistic	29.67 ***	19.70 ***	19.16 ***	21.11 ***	7.42 ***	48.75 ***	55.03 ***	9.82 ***	39.69 ***	8.40 ***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Test on weak instr.s (p-value)										
Kleibergen-Paap F statistic	127.84 ***	39.71 ***	44.02 ***	78.15 ***	16.92 ***	147.97 ***	171.38 ***	26.66	66.95	13.95
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.038 **	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Stock-Wright LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.015 **	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.001 ***
Number of observations	3717	536	1852	1402	619	9089	5817	1166	3695	363

Tab. 14: Employment Effects of Different Types of Organizational Innovations in Services at the Country Level, 2006-2008 (continued)

	LU	LV	MT	NL	PT	RO	SI	SK	UK	IE
Constant	0.101	14.209 ***	-16.210 ***	3.893 ***	0.931	6.950 ***	-5.382	-27.970 ***	---	0.429
	(5.169)	(3.819)	(1.863)	(1.361)	(1.628)	(1.399)	(11.026)	(3.202)		(2.382)
SGR NEW PRODUCTS	1.297 ***	1.283 ***	0.988 ***	1.090 ***	0.952 ***	0.883 ***	---	0.895 ***	---	1.120 ***
	(0.255)	(0.263)	(0.270)	(0.080)	(0.076)	(0.069)		(0.155)		(0.164)
PROCESS ONLY	25.342 ***	-11.307	-8.140	-1.591	1.766	-8.269	--7.890 ***	-7.342	---	-1.334
	(6.938)	(15.548)	(5.787)	(2.339)	(2.441)	(6.058)	(7.986)	(9.978)		(3.436)
WORKPLACE ORG	-9.295	12.933	0.033	-0.056	0.300	5.477	---	-3.968	---	-0.179
	(7.914)	(13.070)	(5.629)	(2.191)	(2.363)	(3.911)		(5.495)		(4.493)
BUSINESS PROC.	-2.521	-7.232	-1.689	-2.733	0.082	1.220	---	15.013 **	---	-0.717
	(7.747)	(12.127)	(6.295)	(2.326)	(2.623)	(4.622)		(6.030)		(4.819)
EXTERNAL REL.	2.605	-5.861	1.087	1.322	-1.737	-6.596	---	0.952	---	-7.671 *
	(7.106)	(17.261)	(9.115)	(2.604)	(2.951)	(4.866)		(8.396)		(4.521)
R2_adj	0.170	0.209	0.277	0.261	0.422	0.260	0.094 *	0.198		0.208
Hypotheses tests (p-value)										
Wald-Test: group dummies	0.746	0.432	0.551	0.116	0.035 **	0.837	0.831	0.039 **	---	0.430
Wald-Test: industry dummies	0.148	0.001 ***	0.000 ***	0.000 ***	0.034 **	0.000 ***	0.155	0.392	---	0.372
Wald-Test: orga dummies	0.394	0.795	0.991	0.705	0.945	0.355	---	0.089 *	---	0.252
Wald-Test: size dummies	0.730	0.089 *	0.269	0.295	0.432	0.461	0.643	0.040 **	---	0.764
Wald-Test: β=1	0.245	0.281	0.964	0.260	0.530	0.087 *	0.680	0.500	---	0.463
Tests on Exogeneity										
SGR NEW PRODUCTS	0.040 **	0.026 **	0.745	0.001 ***	0.131	0.055 *	---	0.886	---	0.103
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.324	0.704	0.127	0.471	1.036	0.209	0.540	0.576	---	0.239
Difference-in-Sargan test										
RANGE	0.169	0.718	0.897	0.614	0.461	0.311	---	0.364	---	0.172
R&D	0.940	0.794	0.054 *	0.355	0.626	0.279	---	0.828	---	---
CLIENT	0.137	0.403	0.550	0.297	0.358	0.167	---	0.293	---	---
Summary of first stage results:										
RANGE	4.973 ***	8.587 ***	5.913 **	5.549 ***	7.716 ***	18.705 ***	5.395 ***	12.377 ***	---	4.202 ***
	(1.491)	(2.753)	(2.634)	(0.877)	(0.937)	(1.995)	(1.327)	(2.897)		(1.142)
R&D	8.958	30.174	12.611	7.240 ***	2.854	8.371	3.073	23.030 **	---	---
	(6.219)	(27.593)	(11.331)	(2.528)	(4.136)	(6.189)	(3.417)	(9.754)		
CLIENT	8.924 *	1.291	5.343	6.963 ***	5.208 **	18.332 ***	-0.682	-0.603	---	---
	(4.970)	(7.017)	(5.738)	(2.203)	(2.594)	(5.709)	(3.406)	(6.804)		
F-statistic	5.72 ***	3.46 ***	4.66 ***	20.92 ***	19.70 ***	35.56 ***	9.01 ***	6.11 ***	---	7.950 ***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.949	0.000 ***	---	0.000 ***
Test on weak instr.s (p-value)										
Kleibergen-Paap F statistic	16.17	9.23	8.94	53.41	54.73	119.74	0.03 **	19.54	---	14.42
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000 ***	0.000 ***	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	---	0.000 ***
Stock-Wright LM test	0.000 ***	0.000 ***	0.004 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.001 ***	---	0.000 ***
Number of observations	330	344	469	3704	2052	2694	260	664	---	515

Notes: Ireland uses as additional instrument UPDATE (3.491*** (1.3129) ; 0.330), SCIENCE (2.721 (4.467); 0.553) and SUPPLY (3.334 (4.166); 0.396) were used as instruments. See also notes to Table 10.

Source: CIS 4, Eurostat, CIS 4, Eurostat; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 15: Employment Decomposition in Services at the Country Level, 2006-2008 (II)

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT	LU	LV	MT	NL	PT	RO	SI	SK	UK	IE
Employment growth	25.65	6.57	7.72	9.87	12.28	10.09	2.19	10.86	9.02	19.53	18.99	23.25	6.76	12.49	11.41	19.70	23.48	14.39	12.18	1.62
Decomposed into contribution of																				
General productivity trend in production of old products	-8.24	-8.83	-28.85	-2.03	4.01	2.68	-9.15	-9.67	2.53	6.95	-4.41	8.43	-13.04	0.37	-0.25	0.04	4.52	-31.00	---	12.46
Process innovation	-0.16	0.13	0.18	0.08	-0.99	0.20	-0.00	0.15	0.17	-1.88	2.00	-0.68	-0.56	-0.11	0.26	-0.50	-1.05	-0.40	---	-0.21
Organizational innovation																				
Workplace organisation	-0.26	-0.58	0.44	0.67	-0.05	0.12	-0.63	0.57	-0.74	-0.66	-3.60	1.09	0.01	-0.01	0.12	1.11	---	-0.62	---	-0.31
Business processes.	0.68	-1.87	-0.30	-0.88	-0.10	-0.33	-0.05	-1.00	0.70	-0.11	-0.77	-0.70	-0.21	-0.42	0.03	0.13	---	2.08	---	-1.24
External relationships	0.17	1.06	-0.31	0.13	0.26	-0.22	0.07	0.67	0.21	-0.54	0.62	-0.33	0.08	0.11	-0.38	-0.70	---	0.07	---	-14.09
Output growth of old products for non-product innovators	28.95	11.61	29.85	5.76	8.21	6.05	9.22	16.96	3.96	13.42	13.22	13.45	16.54	8.87	5.45	17.30	13.61	40.61	---	3.05
Thereof for																				
Non-innovators	*27.15*	*9.56*	*25.92*	*4.39*	*6.17*	*4.91*	*7.99*	*15.89*	*3.48*	*10.24*	*12.90*	*12.40*	*14.31*	*7.82*	*3.77*	*15.57*	*9.19*	*37.66*	---	*2.18*
Process innovators only	*1.80*	*2.06*	*3.93*	*1.37*	*2.05*	*1.13*	*1.23*	*1.06*	*0.48*	*3.18*	*0.32*	*1.06*	*2.23*	*1.05*	*1.69*	*1.74*	*4.42*	*2.95*	---	*0.87*
Product innovation	4.51	5.05	6.71	6.15	0.94	1.60	2.73	3.18	2.19	2.36	11.93	1.96	3.94	3.67	6.18	2.32	6.41	3.66	---	1.97
Thereof																				
Output reduction in old products	*-3.99*	*-7.87*	*-2.49*	*-5.99*	*-3.23*	*-3.08*	*-3.67*	*-1.25*	*-5.77*	*-6.63*	*0.13*	*-2.26*	*-0.06*	*-2.48*	*-6.00*	*-4.76*	*-10.01*	*-0.13*	---	*-5.05*
Output increase in new product	*8.50*	*12.92*	*9.20*	*12.15*	*4.16*	*4.68*	*6.41*	*4.43*	*7.95*	*8.99*	*11.80*	*4.22*	*4.00*	*6.15*	*12.18*	*7.09*	---	*3.79*	---	*7.02*

Source: CIS 4, Eurostat, CIS 4, Eurostat; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 16: Employment Effects of Market and Firm Novelties in Services at the Country Level, 2006-2008

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT
Constant	-5.823 ***	-7.816 ***	-35.145 ***	-5.029 **	11.614 ***	7.380 ***	-9.089 ***	-10.908 ***	5.580 ***	10.183
	(1.057)	(2.668)	(2.280)	(2.211)	(4.340)	(0.947)	(0.831)	(2.310)	(1.410)	(7.164)
SGR MARKET NOV	1.802 ***	0.852	1.029 **	1.918 ***	1.837 **	1.131 ***	0.783 *	-0.674	1.975 ***	0.474
	(0.258)	(1.123)	(0.460)	(0.580)	(0.747)	(0.355)	(0.458)	(2.686)	(0.420)	(1.135)
SGR FIRM NOV	0.911 ***	1.162 ***	1.234 ***	0.901 ***	0.150	0.946 ***	1.198 ***	2.404	0.464 *	1.341 ***
	(0.110)	(0.362)	(0.281)	(0.156)	(0.442)	(0.200)	(0.326)	(1.787)	(0.279)	(0.466)
PROCESS ONLY	-3.862	0.223	1.248	0.130	-5.850	1.693	0.769	4.630	2.059	-16.097 *
	(3.558)	(3.408)	(4.086)	(1.986)	(5.585)	(1.542)	(1.518)	(5.614)	(2.830)	(8.517)
ORGA INNO	2.976	-1.937	-0.823 ***	0.234	-1.517	-1.992	-2.872 **	-4.391	1.335	-10.162
	(2.350)	(3.864)	(3.734)	(1.469)	(4.584)	(1.324)	(1.231)	(6.926)	(1.854)	(9.232)
R2_adj	0.277	0.491	0.382	0.514	0.144	0.366	0.325	-0.112	0.317	0.336
Hypotheses tests (p-value)										
Wald-Test: group dummies	0.363	0.195	0.106	0.056 *	0.227	0.227	0.055 *	0.139	0.663	0.489
Wald-Test: industry dummies	0.000 ***	0.000 ***	0.002 ***	0.203	0.027 **	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.001 ***
Wald-Test: size dummies	0.148	0.299	0.005 ***	0.301	0.067 *	0.040 **	0.165	0.571	0.068 *	0.873
Wald-Test: βm=1	0.002 ***	0.860	0.949	0.113	0.263	0.711	0.636	0.533	0.020 **	0.643
Wald-Test: βf=1	0.419	0.656	0.404	0.524	0.055 *	0.789	0.544	0.432	0.055 *	0.464
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.381	0.387	0.243	0.792	0.534	0.797	0.304	0.888	0.781	0.863
1st stage: market novelties:										
RANGE	3.568 ***	2.104 ***	2.998 ***	0.554 ***	1.298 ***	2.392 ***	2.698 ***	2.354 ***	2.536 ***	1.127
	(0.706)	(0.660)	(0.647)	(0.213)	(0.465)	(0.426)	(0.325)	(0.830)	(0.368)	(2.596)
R&D	26.170 ***	7.739	8.420 ***	4.463 ***	8.553 ***	7.629 ***	6.799 ***	5.133 *	5.505 ***	6.556
	(6.299)	(5.376)	(2.853)	(0.935)	(3.009)	(1.272)	(1.123)	(3.106)	(1.843)	(6.147)
CLIENT	5.689 ***	3.931 *	1.433	0.565	1.478	1.944 **	1.827 *	0.539	5.439 ***	9.671
	(1.809)	(2.009)	(1.913)	(0.703)	(1.213)	(0.998)	(0.958)	(2.767)	(1.088)	(8.179)
Partialled out F-statistic	12.03 ***	3.81 ***	11.35 ***	6.64 ***	4.79 ***	32.09 ***	33.91 ***	5.77 ***	28.07 ***	2.19 ***
1st stage: firm novelties:										
RANGE	11.369 ***	7.766 ***	7.178 ***	3.561 ***	5.423 ***	5.512 ***	4.692 ***	3.278 ***	5.720 ***	12.347 ***
	(1.569)	(1.129)	(1.240)	(0.560)	(1.271)	(0.736)	(0.537)	(0.957)	(0.958)	(3.440)
R&D	-13.406 **	-3.807	-4.528	4.535 **	-2.080	3.767 *	4.018 **	2.621	-4.116 *	-12.181
	(5.626)	(7.084)	(4.393)	(2.090)	(4.819)	(2.224)	(1.660)	(3.959)	(2.446)	(8.961)
CLIENT	11.461 ***	11.692 ***	10.164 **	6.826 ***	3.053	8.321 ***	2.504	4.239	2.855	3.609
	(4.292)	(3.187)	(4.762)	(1.510)	(3.025)	(2.595)	(1.573)	(2.949)	(2.398)	(8.069)
Partialled out F-statistic	15.17 ***	18.18 ***	10.20 ***	19.15 ***	4.35 ***	27.97 ***	30.03 ***	5.94 ***	17.01 ***	2.97 ***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.001 ***	0.539	0.890	0.001 ***	0.587	0.790	0.949	0.973	0.947	0.939
Test on weak instr.s (p-value)										
Kleibergen-Paap F statistic	6.98	0.44	0.08	4.53	0.36	0.16	0.03	0.02	0.04	0.03
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.020 **	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Stock-Wright LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.008 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.001 ***
Number of observations	3717	536	1852	1402	619	9089	5817	1166	3695	363

Tab. 16: Employment Effects of Market and Firm Novelties in Services at the Country Level, 2006-2008 (continued)

	LU	LV	MT	NL	PT	RO	SI	SK	UK	IE
Constant	-1.205	16.765***	-18.136***	2.190	1.550	7.298***	-5.382	-29.002***	-6.994***	0.931
	(5.467)	(5.383)	(2.885)	(3.296)	(1.714)	(1.469)	(11.026)	(3.456)	(1.498)	(2.388)
SGR MARKET NOV	0.989	-0.713	3.673*	3.269	2.084***	2.109***	-0.639	1.955**	2.410***	0.921
	(0.976)	(3.608)	(2.205)	(4.264)	(0.560)	(0.479)	(3.972)	(0.848)	(0.692)	(0.732)
SGR FIRM NOV	1.850***	2.695	-0.961	-0.606	0.500	0.682***	2.102	0.287	0.337	1.289**
	(0.680)	(1.910)	(1.91)	(3.833)	(0.352)	(0.154)	(3.076)	(0.825)	(0.365)	(0.604)
PROCESS ONLY	25.740***	-10.570	-7.941	-3.489	1.541	-7.286	-7.890	-10.353	4.288*	-1.062
	(7.093)	(16.291)	(6.163)	(4.879)	(2.670)	(6.187)	(7.986)	(10.17)	(2.473)	(3.475)
ORGA INNO	-8.026	-2.950	-6.352	3.557	-1.493	1.888	-	9.246	-1.265	-4.881
	(5.877)	(10.932)	(7.266)	(11.048)	(2.455)	(2.976)		(5.726)	(2.149)	(3.415)
R2_adj	0.206	0.029	-0.293	-0.215	0.351	0.254	0.094	0.137	0.125	0.187
Hypotheses tests (p-value)										
Wald-Test: group dummies	0.686	0.412	0.576	0.332	0.203	0.839	0.831	0.070*	0.325	0.461
Wald-Test: industry dummies	0.273	0.002	0.015**	0.000***	0.239	0.000***	0.155	0.414	0.034**	0.404
Wald-Test: size dummies	0.379	0.084	0.298	0.295	0.119	0.195	0.643	0.158	0.253	0.666
Wald-Test: βm=1	0.991	0.635	0.225	0.595	0.053	0.021**	0.680	0.260	0.042**	0.914
Wald-Test: βf=1	0.211	0.375	0.306	0.675	0.156	0.040**	0.720	0.387	0.069*	0.632
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.120	0.771	0.924	0.436	0.732	0.487	0.540	0.718	0.297	0.127
1st stage: market novelties:										
RANGE	2.267**	2.326**	2.629	2.189***	2.840***	3.856***	5.395***	5.882***	0.049	-1.931***
	(1.098)	(0.952)	(1.742)	(0.422)	(0.475)	(0.715)	(1.327)	(2.107)	(0.651)	(0.655)
R&D	6.011**	14.078	10.886	3.199**	3.571	11.803***	3.073	13.187*	5.377***	---
	(2.928)	(11.454)	(8.796)	(1.273)	(2.205)	(3.381)	(3.417)	(7.154)	(1.034)	
CLIENT	-0.241	-1.091	1.150	3.191***	0.625	-0.289	-0.682	-4.892	2.190	---
	(3.018)	(2.332)	(3.541)	(0.956)	(1.207)	(2.068)	(3.406)	(4.639)	(1.674)	
F-statistic	4.49***	2.35***	1.98**	15.36***	13.08***	10.44***	9.01***	2.58**	11.69***	3.680***
1st stage: firm novelties:										
RANGE	2.367***	4.017**	3.075**	2.675***	4.041***1	13.124***	5.933***	5.882***	2.062**	2.051**
	(0.629)	(1.696)	(1.326)	(0.698)	(0.602)	(1.783)	(1.408)	(2.107)	(0.992)	(0.919)
R&D	-0.881	17.200	0.647	2.617	-3.147	-11.498**	6.747	13.187*	2.814	---
	(3.595)	(13.755)	(4.942)	(1.778)	(2.870)	(5.040)	(4.664)	(7.154)	(2.577)	
CLIENT	8.533***	4.456	5.509	3.489**	5.775***	18.194***	1.755	-4.892	5.189*	---
	(2.606)	(5.339)	(3.409)	(1.687)	(1.814)	(5.253)	(4.555)	(4.639)	(2.759)	
F-statistic	4.91***	3.04***	2.28***	13.95***	14.36***	21.36***	6.79***	2.58***	15.72***	5.10***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.687	0.955	0.352	0.994	0.800	0.527	0.949	0.950	0.111	0.958
Test on weak instr.s (p-value)										
Kleibergen-Paap F statistic	0.25	0.03	0.65	0.00	0.15	0.50	0.03	0.03	1.61	0.09
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***	0.000***
Stock-Wright LM test	0.001***	0.001***	0.001***	0.000***	0.000***	0.000***	0.000***	0.001***	0.001***	0.000***
Number of observations	330	344	469	3704	2052	2694	260	664	3562	515

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level. Ireland uses as additional instruments UPDATE, SCIENCE and SUPPLY. First stage results for market and firm novelties novelties, respectively: UPDATE (1.344* (0.782); 1.977* (1.021)), SCIENCE (5.910* (3.451); -4.367 (3.484)) and SUPPLY (-1.211 (2.040); 5.297 (3.857)). See also notes to Table 10.

Source: CIS 4, Eurostat, CIS 4, Eurostat; Office for National Statistics (ONS), UK; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 17: Employment Decomposition in Services at the Country Level, 2006-2008 (III)

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT	LU	LV	MT	NL	PT	RO	SI	SK	UK	IE
Employment growth	25.65	6.57	7.72	9.87	12.28	10.09	2.19	10.86	9.02	19.53	18.99	23.25	6.76	12.49	11.41	19.70	23.48	14.39	12.18	1.62
Decomposed into contribution of																				
General productivity trend in production of old products	-8.09	-9.19	-28.63	-1.88	4.85	2.72	-9.15	-9.37	1.91	7.27	-4.45	9.62	-13.05	0.36	0.30	0.07	4.52	-31.23	-7.54	-1.67
Process innovation	-0.17	0.03	0.14	0.02	-1.02	0.21	0.07	0.26	0.17	-1.71	2.03	-0.64	-0.54	-0.23	0.23	-0.44	-1.05	-0.56	0.21	-0.17
Organizational innovation	0.42	-0.70	-0.27	0.12	-0.44	-0.50	-0.96	-0.77	0.43	-1.90	-3.74	-0.36	-1.19	0.74	-0.68	0.42	-	1.94	-0.39	-1.70
Output growth of old products for non-product innovators	28.95	11.61	29.85	5.76	8.21	6.05	9.22	16.96	3.96	13.42	13.22	13.45	16.54	8.87	5.45	17.30	13.61	40.61	12.14	3.05
Thereof for																				
Non-innovators	27.15	9.56	25.92	4.39	6.17	4.91	7.99	15.89	3.48	10.24	12.90	12.39	14.31	7.82	3.77	15.56	9.19	37.66	11.32	2.18
Process innovators only	1.80	2.06	3.93	1.37	2.05	1.13	1.23	1.06	0.48	3.18	0.32	1.06	2.23	1.05	1.69	1.74	4.42	2.95	0.81	0.87
Product innovation	4.54	4.82	6.63	5.85	0.67	1.62	3.02	3.78	2.54	2.45	11.92	1.18	5.00	2.75	6.11	2.34	6.41	3.63	7.78	2.11
Thereof																				
Output reduction in old products	-3.99	-7.87	-2.49	-5.99	-3.23	-3.08	-3.67	-1.25	-5.76	-6.62	0.13	-2.26	-0.06	-2.48	-6.00	-4.76	-10.01	-0.13	1.48	-5.05
Output increase in market novelt.	3.55	1.98	2.65	3.58	3.23	1.53	1.91	-0.97	6.34	1.19	3.12	-0.86	6.82	6.98	8.34	3.23	-5.28	3.18	5.04	2.30
Output increase in firm novelties	4.98	10.70	6.47	8.27	0.67	3.17	4.78	6.00	1.97	7.88	8.67	4.29	-1.76	-1.75	3.77	3.87	21.70	0.58	1.26	4.86

Source: CIS 4, Eurostat, CIS 4, Eurostat; Office for National Statistics (ONS), UK; Central Statistical Office (CSO) of Ireland own calculation.

Tab. 18: Complementarity Effects of Process and Organizational Innovations in Services at the Country Level, 2006-2008

	BG	CY	CZ	DE	EE	ES	FR	HU	IT	LT
Constant	-5.844 ***	-7.262 ***	-35.192 ***	-5.263 **	12.358 ***	7.626 ***	-8.991 ***	-10.079 ***	6.950 ***	10.935
	(1.050)	(2.431)	(2.276)	(2.249)	(4.140)	(0.943)	(0.820)	(2.104)	(1.253)	(7.159)
SGR NEW PRODUCTS	0.985 ***	1.027 ***	1.042 ***	1.057 ***	0.590 ***	0.919 ***	0.904 ***	1.046 ***	1.029 ***	1.016 ***
	(0.042)	(0.080)	(0.091)	(0.066)	(0.170)	(0.039)	(0.040)	(0.141)	(0.074)	(0.141)
PROCESS INNO ONLY	-0.577	-0.272	5.605	-3.543	-0.024	0.449	-2.195	1.965	1.008	-22.511 **
	(4.280)	(3.840)	(6.018)	(3.891)	(6.963)	(1.901)	(2.474)	(6.453)	(3.155)	(9.277)
ORGA INNO	4.932 **	-1.498	-0.796	-0.586	1.810	-2.475	-2.737 **	-0.300	-0.592	-13.109
	(2.382)	(4.099)	(3.836)	(1.508)	(4.966)	(1.532)	(1.158)	(3.787)	(1.968)	(9.423)
PROCESS*ORGA	-6.504	-1.742	-2.089	1.713	-10.302	0.376	-1.105	3.934	3.224	-14.299
	(5.766)	(4.156)	(4.159)	(1.884)	(7.233)	(1.991)	(1.467)	(7.234)	(3.954)	(8.788)
R2_adj	0.264	0.513	0.396	0.514	0.242	0.356	0.345	0.213	0.340	0.423
Hypotheses tests (p-value)										
Wald-Test: group dummies	0.234	0.138	0.122	0.267	0.306	0.240	0.085 *	0.099 *	0.129	0.519
Wald-Test: industry dummies	0.000 ***	0.000 ***	0.003 ***	0.213	0.001 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Wald-Test: size dummies	0.128	0.453	0.010 ***	0.199	0.083 *	0.043 **	0.174	0.419	0.055 *	0.856
Wald-Test: β=1	0.714	0.732	0.644	0.390	0.016 **	0.041 **	0.016 **	0.744	0.700	0.911
Tests on Exogeneity										
SGR NEW PRODUCTS	0.000 ***	0.058 *	0.045 **	0.019 **	0.250	0.763	0.029 **	0.279	0.003 ***	0.538
Tests on instr. validity (p-value)										
Sargan/Hansen J-Test	0.275	0.703	0.275	0.591	0.222	0.728	0.178	0.459	0.235	0.371
Difference-in-Sargan test										
RANGE	0.570	0.592	0.142	0.651	0.100	0.760	0.878	0.781	0.242	0.995
R&D	0.147	0.576	0.242	0.308	0.169	0.448	0.164	0.218	0.149	0.184
CLIENT	0.409	0.540	0.386	0.963	0.648	0.674	0.154	0.853	0.630	0.714
Summary of first stage results:										
RANGE	17.227 ***	9.640 ***	10.906 ***	4.205 ***	7.403 ***	8.366 ***	8.224 ***	5.533 ***	8.423 ***	14.289 ***
	(1.758)	(1.394)	(1.556)	(0.627)	(1.459)	(0.803)	(0.676)	(1.217)	(0.966)	(3.889)
R&D	22.973 **	8.792	7.719	10.200 ***	10.350 *	14.943 ***	13.450 ***	9.954	3.284	4.104
	(10.747)	(9.405)	(5.659)	(2.451)	(6.192)	(2.592)	(2.199)	(6.226)	(3.411)	(8.925)
CLIENT	21.079 ***	17.361 ***	11.866 **	7.560 ***	3.922	10.569 ***	4.319 **	7.915	9.554 ***	12.709
	(4.700)	(3.964)	(5.500)	(1.735)	(3.700)	(2.743)	(1.996)	(5.021)	(2.591)	(10.637)
F-statistic	31.45 ***	20.90 ***	19.93 ***	22.06 ***	7.73 ***	51.81 ***	57.23 ***	9.99 ***	40.88 ***	9.18 ***
Tests on underidentif. (p-value)										
Kleibergen-Paap LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Test on weak instr.s (p-value)										
Kleibergen-Paap F statistic	124.31	35.26	44.16	81.73	15.84	149.77	184.88	28.25	82.84	11.12
Weak-instr. robust inf. (p-value)										
Anderson-Rubin Wald test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.036 **	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Stock-Wright LM test	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.015 **	0.000 ***	0.000 ***	0.000 ***	0.000 ***	0.000 ***
Number of observations	3717	536	1852	1402	619	9089	5817	1166	3695	363

Tab. 18: Complementarity Effects of Process and Organizational Innovations in Services at the Country Level, 2006-2008 (continued)

	LU		LV		MT		NL		PT		RO		SI		SK		UK		IE	
Constant	0.799		14.493	***	-16.455	***	3.807	***	1.250		6.602	***	---		-28.267	***	-7.205	***	6.514	**
	(5.210)		(3.852)		(1.857)		(1.372))		(1.617)		(1.389)				(3.212)		(1.475)		(2.542)	
SGR NEW PRODUCTS	1.287	***	1.325	***	1.006	***	1.081	***	0.976	***	0.872	***	---		0.878	***	1.108	***	1.065	***
	(0.249)		(0.280)		(0.229)		(0.080)		(0.081)		(0.071)				(0.151)		(0.094)		(0.131)	
PROCESS INNO ONLY	15.372		-11.915		0.267		-0.563		1.702		1.881		---		12.193		4.096		-3.316	
	(13.815)		(23.483)		(7.429)		(2.424)		(2.639)		(5.429)				(14.501)		(2.673)		(2.836)	
ORGA INNO	-10.516	**	-3.006		0.618		-0.760		-2.131		4.557		---		12.831	**	-0.347		-4.617	
	(6.085)		(11.956)		(4.797)		(2.022)		(2.738)		(3.067)				(5.454)		(1.937)		(2.946)	
PROCESS*ORGA	19.345	***	-10.485		-20.636	***	-4.378		0.927		-15.137		---		-23.238	***	4.431		-6.473	**
	(6.596)		(14.468)		(6.450)		(4.323)		(2.916)		(10.765)				(6.596)		(4.151)		(3.058)	
R2_adj	0.176		0.205		0.285		0.263		0.420		0.262		---		0.208		0.349		0.458	
Hypotheses tests (p-value)																				
Wald-Test: group dummies	0.785		0.441		0.512		0.110		0.033	**	0.835		---		0.008	***	0.258		0.066	*
Wald-Test: industry dummies	0.135		0.001	***	0.000	***	0.000	***	0.036	**	0.000	***	---		0.409		0.076	*	0.197	
Wald-Test: size dummies	0.710		0.093	*	0.396		0.290		0.428		0.434		---		0.098	*	0.125		0.146	
Wald-Test: β=1	0.250		0.247		0.980		0.310		0.768		0.070	*	---		0.417		0.248		0.623	
Tests on Exogeneity																				
SGR NEW PRODUCTS	0.045	**	0.052		0.595		0.001	***	0.082	*	0.090	*	---		0.824		0.186		0.132	
Tests on instr. validity (p-value)																				
Sargan/Hansen J-Test	0.291		0.660		0.171		0.451		0.585		0.208		---		0.412		0.402		0.943	
Difference-in-Sargan test																				
RANGE	0.148		0.611		0.888		0.613		0.446		0.300		---		0.355		---		0.983	
R&D	0.966		0.849		0.071	**	0.336		0.625		0.290		---		0.579		0.402		---	
CLIENT	0.121		0.362		0.644		0.285		0.340		0.160		---		0.203		0.402		---	
Summary of first stage results:																				
RANGE	5.303	***	8.426	***	6.343	**	5.470	***	7.487	***	18.680	***	---		12.602	***	---		0.696	
	(1.593)		(2.885)		(2.630)		(0.881)		(0.970)		(2.000)				(2.890)				(1.131)	
R&D	8.880		34.518		12.778		7.270	***	3.548		8.085		---		22.967	**	9.486	***	---	
	(6.375)		(29.830)		(11.4015)		(2.553)		(4.189)		(6.222)				(9.954)		(2.741)			
CLIENT	8.641	*	1.120		7.563		6.924	***	6.104	**	18.495	***	---		-0.650		10.986	***	---	
	(5.053)		(7.269)		(5.682)		(2.194)		(2.528)		(5.688)				(6.866)		(2.444)			
F-statistic	6.30	***	3.59	***	4.29	***	22.42	***	20.78	**	35.92	***	---		6.34	***	24.08	***	9.960	***
Tests on underidentif. (p-value)																				
Kleibergen-Paap LM test	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	---		0.000	***	0.000	***	0.000	***
Test on weak instr.s (p-value)																				
Kleibergen-Paap F statistic	15.84		8.34		11.05		50.68		51.52		118.29		---		19.81		75.55		20.155	
Weak-instr. robust inf. (p-value)																				
Anderson-Rubin Wald test	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	---		0.000	***	0.000	***	0.000	***
Stock-Wright LM test	0.000	***	0.003	***	0.001	***	0.000	***	0.000	***	0.000	***	---		0.001	***	0.000	***	0.000	***
Number of observations	330		344		469		3704		2052		2694		---		664		3562		539	

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level. Ireland uses as additional instruments UPDATE, SCIENCE and SUPPLY. First stage results: UPDATE [4.229** (1.545); 0.646), SCIENCE [3.734 (4.135); 0.202] and SUPPLY [5.784** (2.897); 0.738]. See also notes to Table 10.

Source: CIS 4, Eurostat, CIS 4, Eurostat; Office for National Statistics (ONS), UK; Central Statistical Office (CSO) of Ireland own calculation.

9.4 Sector-Level Employment Effects

Tab. 19: Employment Effects of Product, Process and Organizational Innovation in European Service Firms, by Sectors, 1998-2008

	KIS		LKIS		HTKIS		MKIS	
Constant (Suits method)	-30.354	***	-19.645	***	-25.548	***	-37.836	***
	(4.383)		(2.665)		(2.360)		(4.562)	
SGR NEW PRODUCTS	1.011	***	0.990	***	0.977	***	1.011	***
	(0.026)		(0.021)		(0.023)		(0.035)	
PROCESS ONLY	2.459		-0.788		-0.965		4.023	
	(2.228)		(0.853)		(1.666)		(3.172)	
ORGA INNO	-3.141	***	-1.078		-2.108		-3.595	***
	(0.744)		(1.037)		(1.340)		(1.065)	
R2_adj	0.390		0.258		0.503		0.311	
Hypotheses tests (p-value)								
Wald-Test: industry dummies	0.001	***	0.000	***	0.000	***	0.000	***
Wald-Test: size dummies	0.011	**	0.001	***	0.617		0.070	*
Wald-Test: β=1	0.664		0.622		0.304		0.748	
Tests on Exogeneity								
SGR NEW PRODUCTS	0.000	***	0.003	***	0.045	**	0.000	***
Tests on instr. validity (p-value)								
Sargan/Hansen J-Test	0.895		0.363		0.160		0.435	
Difference-in-Sargan test								
RANGE	0.707		0.425		0.340		0.415	
R&D	0.842		0.629		0.137		0.295	
CLIENT	0.692		0.317		0.060	*	0.899	
Summary of first stage results:								
RANGE	8.138	***	9.378	***	10.876	***	5.874	***
	(1.052)		(0.389)		(0.960)		(1.510)	
R&D	15.169	***	5.346	***	20.476	***	11.337	***
	(2.108)		(1.634)		(3.666)		(1.386)	
CLIENT	9.072	***	7.627	***	4.005		15.437	***
	(3.458)		(1.485)		(6.093)		(3.340)	
F-statistic	89.75	***	158.19	***	182.60	***	199.76	***
Tests on underidentif. (p-value)								
Kleibergen-Paap LM test	0.000	***	0.000	***	0.000	***	0.000	***
Test on weak instruments (p-value)								
Kleibergen-Paap F statistic	385.33		288.08		444.94		235.57	
Weak-instr. robust inf. (p-value)								
Anderson-Rubin Wald test	0.000	***	0.000	***	0.000	***	0.000	***
Stock-Wright LM test	0.000	***	0.000	***	0.000	***	0.000	***
Number of observations	32425		45651		9911		15527	

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level.
Source: CIS 4, Eurostat, own calculation.

Tab. 20: Employment Growth Decomposition in European Service Firms, by Sectors, 1998-2008

	KIS	LKIS	HTKIS	MKIS
Employment growth	13.56	11.07	16.53	12.11
Contribution of				
General productivity trend in production of old products	-3.18	-1.61	-4.29	-2.21
Process innovations	0.22	-0.08	-0.06	0.39
Organizational innovation	-1.31	-0.35	-0.99	-1.33
Output growth of old products for non-product innovators	10.38	10.45	9.85	10.77
Thereof for				
Non-innovators	8.80	9.12	8.68	9.02
Process innovators only	1.58	1.33	1.17	1.75
Product innovation	7.46	2.65	12.02	4.484
Thereof				
Output reduction in old products	-6.61	-2.97	-11.75	-4.66
Output increase in new products	14.07	5.63	23.76	9.14

Source: CIS 4, Eurostat, own calculation.

Tab. 21: Employment Effects of Product, Process and Organizational Innovation in European Service Firms, by Industries, 1998-2008

	WHOLE		TRANS		TELE		FIN		TECH		OBRS		CON		MEDIA	
Constant	-21.239	***	-16.628	***	-26.239	***	-26.805	***	-34.752	***	-14.122	**	-14.236	**	-32.917	**
	(2.083)		(3.393)		(7.243)		(7.853)		(6.077)		(6.889)		(7.089)		(14.099)	
SGR NEW PRODUCTS	1.008	***	0.937	***	0.960	***	1.059	***	1.035	***	1.087	***	0.758	***	0.885	***
	(0.040)		(0.056)		(0.46)		(0.065)		(0.071)		(0.077)		(0.102)		(0.061)	
PROCESS ONLY	-1.026		-1.339		-1.540		0.313		7.541		2.473		1.398		-4.922	*
	(1.563)		(1.673)		(2.557)		(2.032)		(4.836)		(2.831)		(3.417)		(2.885)	
ORGA INNO	-2.726	***	1.862		-1.915		-2.706	**	-2.109		-6.792	***	-2.727		-4.806	**
	(0.868)		(1.230)		(2.147)		(1.336)		(2.224)		(2.363)		(2.354)		(2.065)	
R2_adj	0.277		0.254		0.508		0.312		0.385		0.237		0.264		0.348	
Hypotheses tests (p-value)																
Wald-Test: time dummies	0.010	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.014	**	0.188	
Wald-Test: size dummies	0.010	***	0.228		0.484		0.000	***	0.439		0.097	*	0.030	**	0.023	**
Wald-Test: β=1	0.845		0.255		0.378		0.363		0.624		0.263		0.018	**	0.057	*
Tests on Exogeneity																
SGR NEW PRODUCTS	0.001	***	0.133		0.000	***	0.000	***	0.001	***	0.009	***	0.262		0.107	
Tests on instr. Valid. (p-va)																
Sargan/Hansen J-Test	0.017	**	0.206		0.967		0.051	*	0.484		0.3815		0.282		0.029	
Diff.-in-Sargan test																
RANGE	0.012	**	0.078	*	0.874		0.823		0.438		0.861		0.178		0.466	
R&D	0.008	***	0.418		0.812		0.936		0.928		0.262		0.951		0.330	
COOP	0.496		0.263		0.897		0.844		0.234		0.469		0.144		0.011	**
Summary of first stage:																
RANGE	10.284	***	11.572	***	11.397	***	8.591	***	6.473	***	12.435	***	7.844		9.284	***
	(0.476)		(0.743)		(1.036)		(0.616)		(1.820)		(1.322)		(0.756)		(0.851)	
R&D	7.230	***	4.132		19.176	***	5.247		15.351	**	3.862		6.051		12.485	***
	(1.799)		(2.953)		(4.167)		(3.243)		(6.865)		(3.763)		(3.057)		(3.463)	
COOP	1.688		4.164	**	6.423	*	5.787	**	14.441	***	2.521		5.404		3.255	
	(1.333)		(2.059)		(3.702)		(2.451)		(4.259)		(3.993)		(2.322)		(2.975)	
F-statistic	42.50	***	23.58	***	25.74	***	26.36	***	18.05	***	9.77	***	16.71	***	13.38	***
Test on underident. (p-val)																
Kleibergen-Paap LM test	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***
Test on weak instr. (p-val)																
Kleibergen-Paap F statistic	257.83		112..17		127.34		76.67		71.15		43.92		64.01		107.53	
Weak-instr. Rob. inf. (p-v)																
Anderson-Rubin Wald test	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***
Stock-Wright LM test	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***	0.000	***
Number of observations	25351		20101		7501		6974		7858		4919		3210		3089	

Notes: ***, ** and * indicates significance at the 1%, 5% and 10% level.
Source: CIS 4, Eurostat, own calculation.

Tab. 22: Employment Growth Decomposition in European Service Firms, by Industries, 1998-2008

	WHOLE	TRANS	TELE	FIN	TECH	OBRS	CON	MEDIA
Employment growth	10.66	11.66	17.43	13.14	11.83	15.94	9.48	8.45
Contribution of								
General productivity trend in prod. of old products	-0.11	-3.89	-4.34	-3.93	-6.55	-0.38	2.42	0.95
Process innovations	-0.10	-0.13	-0.10	0.03	0.74	0.17	0.14	-0.44
Organizational innovation	-0.94	0.57	-0.92	-1.33	-0.99	-1.59	-0.84	-1.53
Output growth of old products for non-product innovators	8.61	13.17	10.32	10.04	10.89	15.40	6.19	6.32
Thereof for								
Non-innovators	7.41	11.37	9.15	8.27	9.22	14.16	5.25	5.09
Process innovators only	1.20	1.80	1.17	1.78	1.67	1.23	0.95	1.23
Product innovation	3.19	1.94	12.47	8.33	7.74	2.35	1.57	3.15
Thereof								
Output reduction in old products	-3.34	-2.50	-11.99	-3.94	-8.30	-2.07	-1.85	-5.43
Output increase in new products	6.53	4.44	24.47	12.27	16.04	4.41	3.42	8.58

Source: CIS 4, Eurostat, own calculation.