The nexus of innovation, exports and economic performance of firms – revisiting self-selection and learning-by-exporting

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Abstract

This paper investigates the relationship between innovation, exports and economic performance on the firm level using data from the Third Community Innovation Survey (CIS3). The major issue here is to control for endogeneity between these dimensions. Exporting might positively affect innovation via learning effects, resource effects or incentive effects. On the other hand, innovation improves the productivity and therefore increases a company's competitiveness such that it selects itself into the export market. Although the nature of the data does not allow drawing satisfactory conclusions on the casual link between innovation and exporting, the results from the empirical analyses indicate that exporting affects innovation activities only for small companies. Large companies are not more likely to innovate when they are exporting. I therefore conclude that the positive impact of exports result from additional financial resources available for exporting SMEs, while learning effects are comparably small. On the other hand, the results deliver strong evidence that innovation improves the export performance of companies whereas this pattern varies with the stage of economic development of the firm's home country. Finally, I find strong evidence that both innovation and exports have positive effects on a firm's economic performance, in particular when measured in terms of productivity growth.

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1. Introduction

In the literature there is broad consensus that exporting firms are more productive than non-exporting firms. Two hypotheses based on opposite causalities are mainly cited to explain these differences. First, only the more productive firms are able to start and maintain export activities as exporting is costly causing a pattern of a-priori self-selection of the more productive firms into export markets. Second, exporting firms might learn from their export activities through contacts to foreign customers and clients etc. and are therefore able to improve their productivity while exporting. While the first hypothesis is strongly confirmed by empirical evidence, the second one is not. However, in most of the related empirical papers in particular the second hypothesis is discussed in a quite undifferentiated way. For instance, these studies do not distinguish between learning effects and other export effects that might affect productivity such as economies of scale etc.. More recent papers try to include innovation activities in their analyses in order to capture the idea that learning-by-exporting requires at least some innovation activities or at least absorptive capacities to make use of the additional knowledge sources tapped through export activities. These papers implicitly try to disentangle the learning effects from other side effects of export activities.

In this paper I first discuss different aspects of the relationship between innovation, exports and economic performance (in particular measured in terms of productivity) and how these dimensions affect each other (see ch. 2). I also discuss the role of technological differences of industry sectors and the stage of development of the country the respective firm is located in. I argue that learning effects strongly depend on the technological regime of the firm (mainly sector-specific), i.e. learning potentials are different across sectors depending on technology specifics. Furthermore, firms might benefit more from their export activities if they export to more advanced countries, or – from the opposite perspective – are based in technologically laggard countries. While those papers that include innovation activities in their analyses of the relationship between exports and productivity are restricted on one country (or a very homogeneous group of countries) only, in this paper I am able to analyse this pattern using a set of 22 European countries.

In chapter 3 I discuss data sources and methodological issues. In particular I discuss the framework of analyses taking into account technological regimes of sectors and the stage of development of the home country of firms. I also discuss how I try to handle the endogeneity problem. As already mentioned, exports might affect economic performance and innovation and vice versa. Chapter 4 presents the empirical results of the analysis and the final chapter concludes.

2. Theoretical considerations on the relationship between innovation, exports and economic performance

This section discusses the relationship between innovation, exports and economic performance. In particular the following two questions shall be discussed. First, why are these dimensions related to each other? And second, how do they affect each other?

The self-selection hypothesis

When a company starts exporting, it does not usually have any export experience. Hence a company has to establish contacts to potential customers, set up logistic distribution channels, and modify its products to meet foreign tastes or country-specific regulations (López 2005). In principle, these activities are costly (concerning financial issues, human resources, etc.) and a company faces sunk-costs when overcoming the entry barriers of international markets. Moreover, selling products abroad is also more costly than serving the domestic market after entrance. These costs mainly include transportation, but also distribution, marketing, and customer support that usually require additional skilled staff (Horvath and Janger 2008). Hence, a company has to have a comparative advantage (in particular compared to firms located in the target country) to be competitive. Greenaway and Kneller (2007) argue that heterogeneity in firm productivity explains why not all firms export. It is the combination of sunk-costs and firm productivity that determines which firms are able to start (or continue) exporting. As a result only the most productive firms select themselves into foreign markets. Furthermore, the exposure to international competition forces low-productivity firms to exit the export market and to serve the domestic market only and eventually exit the market altogether (Melitz 2003).

Empirical evidence strongly supports the relationship between high productivity and exporting for many countries. A large number of studies has analysed whether firms that export or start exporting are more productive than firms that do not (see for instance Clerides, Lach and Tybout 1998, Bernard and Jensen 1999, Aw, Chung and Roberts 2000, Bigsten et al. 2000, Isgut 2001, Castellani 2002, Delgado, Farinas and Ruano 2002, Baldwin and Gu 2003, Arnold and Hussinger 2004, Girma, Greenaway and Kneller 2004, van Biesebroeck 2005, Aw, Roberts and Winston 2005, Cassiman and Golovko 2007, Harris and Li 2007, Wagner 2007a, Wagner 2007b, Aw, Roberts and Xu 2008, Horvath and Janger 2008, Serti and Tomasi 2008). These studies cover a wide range of countries and industries, and in general the evidence supports the self-selection view across countries.

The (indirect) impact of innovation on exports

The research summarised above has not explored the link between innovation and self-selection. Nevertheless, there is robust evidence that R&D positively affects productivity (e.g. Griliches and Mairesse 1984, Crepon, Duguet and Mairesse 1998, Wakelin 2001), and self-selection patterns strongly depend on productivity. A considerable number of studies have also provided evidence that both export propensity and export intensity (i.e. the share of export in total sales) are strongly affected by a company's innovation efforts (see for instance Hirsch and Bijaoui 1985, Brouwer and Kleinknecht 1993, Ito and Pucik 1993, Zhao and Li 1997, Lefebvre et al. 1998, Ebling and Janz 1999, Barrios, Görg and Strobl 2001, Basile 2001, Sterlacchini 2001, Bleaney and Wakelin 2002, Smith, Madsen and Dilling-Hansen 2002, Roper and Love 2002, Lachenmaier and Wössmann 2006, Hessels 2007, Cassiman and Golovko 2007, Cassiman and Martinez-Ros 2007, Damijan and Kostevc 2008, Becker and Egger 2009, Nguyen et al. 2009). The positive effects of innovation on a firm’s export performance might occur via increased productivity (for instance resulting from process innovations), or competitive advantages through innovative products leading to a price premium or (temporary) monopolies of the firm’s products.

The learning-by-exporting hypothesis

On the other hand, some authors also argue that firms need to have a sufficient degree of internationalisation, i.e. be active in many markets, in order to be able to successfully capture the fruits of innovation. From this one could draw the converse argument that exporting may also improve the innovation performance of companies (see e.g. Kafouros et al. 2008). The literature has indeed identified a number of potential channels through which exports may have an impact on the innovation activities of firms. These are:

- The "learning effects"
    - Adapting products and services to new markets
    - New ideas and inputs for innovation
    - New production processes / process innovation
- The "financial and resource effect"
    - Additional finance earned through exporting to be invested in innovation
    - Using a wider range of resources available globally
- The "incentive effects"
    - Returns to innovation: Higher potential returns on future innovation outcomes due to larger markets
    - Competition: Firms are forced to be more efficient stimulating innovation activities

In the process of exporting globally engaged firms interact with foreign competitors and customers from whom they learn. Firms could gain information from additional sources ('global knowledge sourcing') about processes or product features. This helps to improve the quality of the product or increase the efficiency of production processes (BIS 2010; Filippetti, Frenz, and Ietto-Gillies 2009; Greenaway and Kneller 2007; Zahra, Ucbasaran, and Newey 2009).

One can distinguish between 'learning effects' needed to engage in a foreign market at all, and 'learning effects' that result from the interaction with foreign firms and customers. In the first case, customers in foreign markets might have different preferences and demand improvements, amendments or changes to products or services (Chaplin 2009). These adaptations often require additional innovation efforts. In the latter case, companies learn from their customers via feedback loops.

However, learning strongly depends on a company's absorptive capacity, especially in fast changing industries. These companies have to react quickly to new developments and need the capacity in terms of resources and skills to take advantage of these opportunities (BIS 2010). However, sector specific technological regimes strongly determine potential learning effects. This implies that these learning opportunities are likely to vary across sectors. Within sectors instead, learning is more likely to occur either in young or in exporting firms (Delgado, Farinas, und Ruano 2002, Isgut and Fernandes 2007, Kraay 1999, Castellani 2002).

Nonetheless, whether a company benefits from exporting in terms of learning-by-exporting is strongly related to the relative stage of development of the country the firm is exporting to. The higher developed a target country, the more a company might learn, if it has adequate absorptive capacity (BIS 2010). Girma et al. (2008) argue that firms that lie below the international technology frontier have the highest potential to benefit from technology transfers, while on the other hand, domestic technologies are more important than foreign technologies in the US, since US firms are often world technology leaders (Baldwin and Gu 2004). Although some authors mainly concentrate their argument on less developed countries (Van Biesebroeck 2005; Blalock and Gertler 2004), it seems worthwhile to investigate the learning effects controlling for the stage of development also on the European level.

Exports and economic performance

In the analysis of the effects of exporting on productivity at the firm level two dimensions have to be considered. First, exporting can improve a firm's productivity performance (e.g. indirectly via learning effects and innovation as described above), second, exporting can results in growth of employment and/or turnover (Bernard and Jensen 1999, European Commission 2010). This last factor is referred to as the 'volume' effect. Exports lead to an expansion of business activities as the company serves a larger market. As the turnover increases the firm needs more employees to serve its market. The main argument for productivity growth through the volume effect are higher economies of scale leading to lower unit costs (Greenaway and Kneller 2007) or decreasing costs due to the 'full use of existing capacity' (BIS 2010).

These effects are often difficult to isolate in empirical studies, however recent work documents conclusive evidence that exporting firms are more likely to be innovative or at least to invest more in innovation. Aw et al. (2007) find evidence for learning-by-exporting in the Taiwanese electronics industry. They conclude that firms benefit from technology that is transferred from foreign customers.

When looking on the effects of exporting on productivity at the firm level two dimensions have to be considered. First, exporting can improve a firm's productivity performance (e.g. indirectly via learning effects and innovation as described above), second, exporting can results in growth of employment and/or turnover (Bernard and Jensen 1999, European Commission 2010). This last factor is referred to as the 'volume' effect. Exports lead to an expansion of business activities as the company serves a larger market. As the turnover increases the firm needs more employees to serve its market. The main argument for productivity growth through the volume effect are higher economies of scale leading to lower unit costs (Greenaway and Kneller 2007) or decreasing costs due to the 'full use of existing capacity' (BIS 2010).

Innovation and economic performance

Innovation can lead to employment, turnover or sales growth. An early study by Hall (1987) established that R&D investments have a larger effect on employment growth than other types of physical investment in US manufacturing industries. Yasuda (2005) shows a positive effect for Japanese manufacturing companies, firms in wholesale and retail trade. Yang and Huang (2005)

confirm these results for industrial firms in Taiwan. Del Monte and Papagni (2003) establish that innovation has a positive effect on sales growth in Italian industrial firms.

Some studies find contradicting results, when economic performance is measured in terms of employment growth. An early study by Brouwer and Kleinknecht (1993) finds for a sample of Dutch manufacturing firms that the growth of R&D intensity correlates negatively with employment growth. Klette and Furre (1998) instead find no clear-cut relationship for Norway. This can be explained by at least two factors. First, as innovation has a positive impact on productivity the physical input of labour decreases per unit of output. If the labour-saving effect through process innovation outweighs the employment effect of market expansion, employment is likely to stay constant or even decrease (see Hölzl and Reinstaller 2007, 2010). Second, the positive effect of innovation on employment may be neutralised if firms are not able to appropriate the returns to their innovation activities either because of imitation or because competitors launch rival product innovations at the same time. In both case market shares may not change (cf. Kafouros et al. 2008). However, innovation is then still important as a company otherwise would lose market shares.

Recent research shows that R&D and innovation are important mostly for firms in countries close to the technological frontier. In other words, those firms that are at the leading edge have to innovate to increase their productivity and remain competitive. In non-frontier economies, companies settle their comparative advantage on lower wage levels and imitation (Acemoglu et al. 2006). While innovation is therefore a distinctive determinant for high-growth firms in frontier countries, no statistically significant effect can be found for non-frontier countries (Hölzl and Friesenbichler 2010).

Summarising the relationship between innovation, exports and economic performance

The basic findings from the literature review can be summarised as follows[1]:

- Innovative companies are more likely to be exporters.
- Exporting companies are more likely to be innovative.
- Exporting companies are more competitive than their non-internationalised counterparts.
- Exporting companies show a better economic performance than their non-internationalised counterparts.
- Exporting companies show higher growth rates than their non-internationalised counterparts.
- Innovative companies show a better economic performance than their non-innovative counterparts
- Innovative companies show higher growth rates than their non-innovative counterparts
- The joint effect of being both innovative and internationalised on the economic performance is positive.
- The joint effect of being both innovative and internationalised on the growth of companies is positive.

[1] For a more detailed discussion see Reinstaller et al. (2010).

- The effects of innovation and exports on the economic performance of companies are likely to differ systematically across EU countries subject to their level of economic development.

Overall the evidence suggests that innovation activities more broadly conceived and international activity are mutually reinforcing (Chaplin 2009; Filippetti, Frenz, and Ietto-Gillies 2009). This self-reinforcing process makes it difficult to analyse the relationship between innovation and exports. It also explains why some studies find contradicting results. For instance, some contributions find complementarities of innovation and exporting for a firms' future productivity (Aw, Roberts, and Winston 2007, 2005), other papers instead establish that no such complementarities exist (Aw, Roberts, and Xu 2008). Despite these issues I will explore this relationship in the empirical analysis in order to establish which factor explains economic performance better. I will discuss these issues and present the empirical results in the next section.

3. Data sources and methodology

Data

The principal results of the empirical analysis were obtained using firm level data from the Third European Community Innovation Survey (CIS 3) for 22 countries for the years 1998-2000. These data were accessed at the Eurostat Safe Centre in Luxemburg.[2] A shortcoming of this reliance on CIS data is that this survey has not been designed to provide information on the internationalisation and therefore exports of firms in terms of their expansion on foreign markets. Only the CIS 3 survey for the years 1998-2000 contains information on the export intensity of firms. All subsequent waves of the survey contain only information on whether an innovative firm actually exports or not. Other data sources that could provide information on both the innovation activities and aspects related to trade activities on the firm level are not available. The few data sets that exist cannot be used because they are proprietary. Furthermore, they do not cover a reasonably large number of EU member states (e.g. Mayer and Ottaviano 2007, Cassiman and Golovko 2007, Damijan and Kostevc 2008). For this reason the analyses in this study uses the CIS 3 data.

To appraise the trade barriers that may have an impact on export activities of innovative firms CIS data alone are not sufficient. For this reason I construct indicators using sector specific trade data for all EU member states. More specifically I use trade shares of each sector with the World's countries. These are used to weight several indicators capturing important obstacles for trade and internationalisation at the national level. The trade shares have been calculated using the Prodcom data base, whereas indicators on obstacles and hampering factors are available from the World Bank, the OECD or the World Economic Forum. These weighted sector specific indicators on obstacles and hampering factors are then combined with the sectoral innovation classification used in this paper (see Box 4). This permits to draw inferences on the effect of obstacles export activities on innovative firms. The main data sources are therefore:

- Third Community Innovation Survey (CIS 3) for 22 countries – firm level data

[2] See Box 3 for the list of countries used.

- UN-Comtrade; Balance of Payments (BoP) by Eurostat for services (sectoral export shares)
- World Bank "Doing Business", World Economic Forum (WEF) and OECD indicators on institutional characteristics of countries
- Market Access Data Base (MADB) EC

Box 1: List of main variables and description

turnin	Share of turnover from new or significantly improved products
indpdt	Product innovations developed in-house
inpcs	Process innovations developed in-house
rdcont	Enterprise engages continuously in R&D
lab_prod98_dist	Labour productivity in 1998, defined as share of the most productive company in the EU sector
app_pen	Appropriability according to the taxonomy of industries in Box 4
exp_prop98 / 00	Export propensity 1998 / 2000
exp_int98 / 00	Export intensity 1998 / 2000
internat_market	Enterprises most significant market is "International with a distance of more than 50 km)
exp_x_turnin	Interaction term between export intensity and share of turnover from new or sign. improved products

Specification issues and methodology

Using CIS3 data, I estimate 2-step Heckman models explaining (i) innovation intensity (defined as input variable, with innovation propensity in the first stage), and (ii) export intensity (with export propensity in the first stage). Besides controlling for firm size and other firm characteristics (such as dummies for enterprise group, newly founded firms, etc.), sector characteristics, the distance to the technological frontier (by estimating the equations for the four country groups separately), and innovation and internationalisation barriers respectively, I integrate innovation variables in the export equations and vice versa. In order to check for causality, I use export intensity in 1998 to explain innovation input in 2000, while I use innovation output indicators (turnover share of innovative products, a dummy for process innovation, and a dummy whether a company performs R&D continuously) to explain exports.

In order to analyse the effects of both innovation and exports on economic performance, I again use the CIS 3 data to explain the performance variables turnover growth, employment growth and productivity respectively by a set of control variables, export intensity in two years earlier, the turnover share of innovative products and a process innovation dummy (using OLS). I also include a variable (export intensity x share of innovative products) to analyse the joint effects of both dimensions on the performance.

Box 2 gives an overview on central aspects of the empirical analysis that will be performed here.

Box 2: Innovation and exporting: The problem of evaluating causality

Analysing the relationship between innovation, exporting and economic performance is impeded by a broad range of methodological issues:

- **How to measure innovation?** It is very difficult to find useful indicators reflecting innovation in a reasonable manner. R&D investments are used in most cases, but they do not directly translate into exports or productivity and allow therefore only an indirect assessment of the impact of innovation on export performance. Innovation output (the outcome of successful innovation activities) is a better measure, but the data are often not very reliable.
- **How to account for alternative ways of internationalisation?** A company can replace its exporting activities by establishing new production sites in the target country, etc. When doing so, the export share decreases although the company's internationalisation efforts are still successful.
- **How to control for, e.g. pure price and exchange rate effects, company-specific strategies, or product-related characteristics etc.?** Whether a company expands its economic activities, strongly depends on conscious decision. Some companies simply do not want to grow, although they could. Furthermore, some productivity changes result from unobservable changes in market structure affecting e.g. prices, or some products are outdated because a competitor has developed a more advanced product. These effects are hard to catch by quantitative data.
- **How to deal with causality and interdependence of exporting, innovation and productivity?** Maybe the most challenging issue how to identify the direction of causality as well as the direction of effects.
    - A firm, for instance, might be able to export as a consequence of innovation and due to this benefit it again increases its innovation efforts. Chaplin (2009) states that regarding to this spiral of innovation and exports, effects are difficult to be measured. Although innovation activities increase, innovation intensity might decrease due to fast sales growth driven by exporting (BIS 2010; Chaplin 2009).
    - Using time lags might be an option to model causality. However, on one hand export and innovation activities are highly persistent over time (Esteve-Péreza and Rodríguez 2009). On the other hand, large heterogeneity might be assumed, how long it takes from successful innovation to productivity growth, etc. Both issues complicate using time lags for analysis.
    - Large heterogeneity across countries, sectors (and technological regimes) and firms, as well as across potential effects within each of the relationships exist.

The general framework of analysis

Distance to frontier

There are considerable differences in economic development and in the industrial specialisation across EU Member States, and this has a rather different impact on the export and innovation performance of firms across countries. It is today state of the art to view the process of growth and convergence across countries as being driven by different factors subject to the state of economic development of the country (Basu and Weil 1998, Aghion and Howitt 2006, Los and Timmer 2005). Differences in the national innovation system that have grown out of historical differences in up-front public investments in science, technology and the educational infrastructure affect the nature of innovation and growth processes across countries.

Countries with advanced scientific and technological capabilities and a highly productive economy are said to be close to the international technological frontier. In these countries growth is largely driven by innovation which is in turn fuelled by science based knowledge creation that leads to the creation of new industries or technologically advanced products. In countries farther off this technological frontier growth is instead driven by the diffusion of existing technologies as well as through the absorption of embodied and disembodied knowledge transfers. Firms in these countries innovate by imitating and refining products that have formerly been produced in the more advanced countries.

Acemoglu, Aghion, and Zilibotti (2006) have called for the development of appropriate institutions and policies subject to how far a country is from the international technological frontier: Far from this

frontier a country will maximise growth by favouring institutions that facilitate the imitation and implementation of technologies invented and developed abroad; however as it catches up with the technological frontier in order to sustain a high growth rate the country, it will have to shift from implementation-enhancing institutions to innovation-enhancing institutions as the relative importance of the generation of new knowledge increases.

Following this general line of reasoning Reinstaller and Unterlass (2010) have shown using CIS micro-data for 17 EU countries that the determinants of successful product innovation of European innovative firms vary across countries depending on how far they are from the technological frontier. Farther away from the technological frontier technology transfer is more important than own R&D; close to the frontier the cooperation with universities, own research, highly skilled personnel and intellectual property rights are very important. This suggests that also the barriers to internationalisation and growth will vary for innovative companies across country groups. Subject to the level of economic development of the countries in which they operate the crucial drivers of innovation will be different. For instance, a firm operating close to the technological frontier will be able to produce better value for money through its R&D activities and this will allow firms to be internationally competitive. However, a firm farther away from the technological frontier may be able to compensate differences in productivity or product quality with more favourable factor costs and export successfully thanks to this. If IPRs are now enforced only weakly in foreign markets this will constrain export activities of the former company more heavily than that of the latter, as its competitive advantage lies in specific factor endowments and not in technological capabilities that may be copied abroad. The examples show that innovation, internationalisation and the state of economic development are intrinsically related. For this reason this paper will take these dimensions into account when analysing the relationship between exporting and innovation in the EU member states.

Box 3: Country classification and data availability

Country group 1 (high direct technology intensity):

Belgium (BE), Denmark (DK), Germany (DE), Finland (FI), France (FR), Iceland (IS), Luxemburg (LU), Norway (NO), Sweden (SE), United Kingdom (UK)[§], Netherlands (NL)[§], Austria (AT)[§]

Country group 2 (high indirect technology intensity):

Czech Republic (CZ), Estonia (EE), Hungary (HU), Slovenia (SI), Slovak Republic (SK), Ireland (IE)[§]

Country group 3 (low direct and indirect technology intensity, with higher GDP per capita):

Spain (ES), Italy (IT), Portugal (PT), Greece (GR)

Country group 4 (low overall technology intensity):

Bulgaria (BG), Lithuania (LT), Latvia (LV), Poland (PL)[§], Romania (RO), Cyprus (CY)[§], Malta (MT)[§]

Note: [§] CIS 3 access not allowed by national statistical institute.

Reinstaller and Unterlass (2010) have constructed a classification of EU countries using the direct and indirect R&D intensity of each country resulting from an input-output analysis. The direct R&D intensity is the direct investment of the business sector into research and development as shown by the share of R&D in GDP of the business sector in the common STI statistics. The indirect R&D intensity instead captures the R&D embodied in capital goods used in the industries of a country. This is a measure for the level of technology transfer. The relative share of the two indicators and their absolute values therefore capture the level of technical development of a country in terms of its capability to generate

new technologies and its reliance on foreign technologies. This depends also on a country's industry structure.

Using a statistical cluster analysis on these data Reinstaller and Unterlass (2010) have identified four country groups. The first group of countries has high direct technology intensity and the relative share of indirect technology intensity decreases with respect to other country groups. The countries in the second group have high indirect technology intensity. Direct R&D intensity in these countries is low, but R&D embodied in imported equipment is high. The countries in the third group have relatively low levels of both direct and indirect technology intensity. The fourth group, finally, consists of countries with low overall technology intensity both in terms of direct and indirect R&D. Box 3 presents the classification of countries and indicates for which countries CIS 3 data could be accessed at the Eurostat Safe Centre in Luxemburg.

The firm as unit of analysis

The remit for this study was to analyse the relationship between innovation, exports and economic performance at the firm level. For this reason the unit of analysis of this paper is the firm. However, using micro level data makes it also difficult to make clear inferences on the behaviour and the impact of phenomena on the entire population because of the high heterogeneity I observe at this level. To circumvent this issue it is necessary to classify firms in such a way that information can be condensed in a meaningful way. In order to take better into account differences in innovation and internationalisation activities across firms the study will analyse firms according to a number of different criteria:

- innovators – non-innovators
- exporters – non-exporters
- sector groups
    - Based on the taxonomy by Peneder (2010) that captures the innovation intensity and the technological regimes of industries (see Box 4);
    - Services vs. Manufacturing vs. others
    - Manufacturing (NACE 15-37)
    - Services (NACE 51-74)
    - Others (NACE 10-14, and 40-41)

The industry classification based on innovation intensities will be used in the analysis. Box 4 contains a detailed description of the criteria underlying its construction. The benefit of using this classification is that it captures essential aspects of the innovation profile in an industry such that comparisons across industries and firms are more accurate.

Box 4: Industry classification based on appropriability, opportunity, cumulativeness and entrepreneurship (Peneder 2010) used in this paper

Peneder (2010) constructs an innovation classification based on Community Innovation Survey (CIS) micro data for 21 countries. He classifies firms on the basis of entrepreneurship types and technological regimes.

Entrepreneurship: The firm classification distinguishes between creative and adaptive entrepreneurship. Creative entrepreneurs are characterised by firm specific innovations and can be further separated into firms producing: (i) their own process innovations; (ii) their own, new-to-the-market product innovations; or (iii) both. All other firms are characterised as adaptive entrepreneurs. Among these Peneder distinguishes a fourth group of technology adopters, which create product innovations that are new to the firm, but not to the market, or produce process innovations mainly in cooperation with other enterprises or institutions. Finally, he identifies a fifth, residual group of adaptive entrepreneurs that pursue opportunities other than technological innovation.

'Technological regimes' are characterised in terms of opportunity, appropriability and cumulativeness conditions, whose combination defines the particular knowledge and learning environments within which the firm operates.

Opportunity conditions: The classification distinguishes four firm conditions according to the perceived technological opportunities demonstrated by the firm's innovation activity: (i) no opportunities - the firm neither performs intramural R&D nor purchases external innovations; (ii) acquisition - the firm innovates only by purchasing external R&D, machinery, or rights (patents, trademarks, etc.); (iii) intramural R&D - the firm undertakes its own R&D, but the ratio of innovation expenditure to total turnover is less than 5%; and (iv) high R&D - the firm performs intramural R&D and its share of innovation expenditures in total turnover is more than 5%.

Appropriability conditions: (i) strategic - for firms relying exclusively on secrecy, complexity of design, or lead-time advantages to protect their innovations; (ii) formal (other than patents) - firms that use the registration of design patterns, trademarks, or copyright; (iii) patenting (either as well as or without strategic or other formal methods of protection); (iv) full arsenal - firms make use of all of the above three means of protection; (v) none - firms employ none of these tools.

Degree of knowledge cumulativeness: CIS data do not provide direct measures of cumulativeness. Peneder (2010) combines two aspects of the CIS data. First he differentiates according to the relative importance of internal vs. external sources of information. Second, he applies contrasting identification rules depending on whether the firm seems to be a technology leader or a technology follower. Thus, firms within the 'creative response' classifications of entrepreneurship are characterised as operating within highly cumulative regimes if internal sources of knowledge are more or at least as important as external sources, and as operating in low cumulative regimes if the firm draws more on external than internal knowledge for its innovations. These identification rules are reversed for 'adaptive entrepreneurship' type firms.

Based on these criteria Peneder (2010) identifies five industry groups according to their innovation intensity and the underlying technological regime:

High innovation intensity: NACE 29, NACE 30, NACE 31, NACE 32, NACE 33, NACE 72, NACE 73

Medium-high innovation intensity: NACE 17, NACE 23, NACE 24, NACE 25, NACE 26, NACE 27, NACE 34, NACE 35, NACE 64

Medium innovation intensity: NACE 20, NACE 21, NACE 28, NACE 36, NACE 62, NACE 65, NACE 74

Medium-low innovation intensity: NACE 10, NACE 11, NACE 15*, NACE 16, NACE 22, NACE 40, NACE 41, NACE 66

Low innovation intensity: NACE 14, NACE 18, NACE 19, NACE 37, NACE 51, NACE 60, NACE 61, NACE 63, NACE 67.

Descriptive evidence on the productivity of exporting firms

Table 1 presents descriptive evidence based on CIS data on productivity differentials for exporting and non-exporting firms in order to verify the assumption that exporting companies are more productive than non-exporting firms. This assumption is fundamental for both the learning-by-exporting hypothesis and the self-selection hypothesis. The table presents the average productivity differential between the most productive firm in each industry group and the industry average across country groups (average distance to the productivity frontier). The percentages indicate how much of the top productivity level in an industry firms reach on average in each country-sector group. Table 1 therefore shows the average distance to the productivity frontier by industry groups. The industry groups follow the classification of industries based on innovation intensity, whereas the country groups summarise countries with similar levels of technological development.[3]

[3] For details on the industry classification see Box 4. Details on the country classification are given in Box 3.

Table 1: Productivity of exporters vs. non exporters across country and sector groups, CIS 2006 (2004-2006) [4].

		Country groups							
		1		2		3		4	
Sector groups		Non-exp.	Exp.	Non-exp.	Exp.	Non-exp.	Exp.	Non-exp.	Exp.
High		4.92%	6.82%	1.97%	2.64%	3.64%	5.47%	1.12%	1.10%
	p-value	0.000		0.001		0.000		0.635	
Medium high		4.84%	8.06%	2.32%	3.29%	3.06%	7.02%	0.93%	1.75%
	p-value	0.000		0.000		0.000		0.000	
Medium		1.33%	2.42%	0.76%	0.79%	1.10%	2.08%	0.24%	0.31%
	p-value	0.000		0.379		0.000		0.000	
Medium low		3.67%	5.10%	1.09%	1.78%	2.25%	3.35%	0.36%	0.74%
	p-value	0.000		0.000		0.000		0.000	
Low		3.23%	3.61%	1.01%	1.56%	1.74%	2.42%	0.35%	0.68%
	p-value	0.122		0.000		0.000		0.000	

Note: Labour productivity is defined as relative labour productivity compared with the best performing firm within the same NACE-2digit EU-sector. The percentages indicate how much of the top productivity level in an industry firms reach on average in each country-sector group. The p-values refer to a t-test for statistically significant differences in the means values. Values close to zero indicate that means are different in a statistically significant way: H0: mean(labour productivity of exporters) = mean(labour productivity of non-exporters), HA: mean(labour productivity of exporters) > mean(labour productivity of non-exporters.

Country group 1: Belgium, Denmark, Germany, Finland, France, Iceland, Luxemburg, Norway, Sweden; Country group 2: Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Ireland; Country group 3: Spain, Italy, Portugal, Greece; Country group 4: Bulgaria, Lithuania, Latvia, Romania, Cyprus, Malta).

Table 1 shows that across industry and country groups exporting firms are more productive.[5] It is also apparent that across all industries firms in country group 1 (i.e. countries with high direct technological intensity) and country group 3 (i.e. Southern European countries with low direct and indirect technology intensity) are more productive on average as compared to the firms located in country groups 2 and 4 that collect the New Member States. This indicates that there are considerable differences in the sources of competitive advantage across country groups. Another aspect worth mentioning is that in the technologically most advanced member states (country group 1) firms are on average most productive in the industries with medium-high, medium and medium low innovation intensity. These are the industries where these countries have traditionally a strong competitive position.

[4] See Box 3 for a description of the country groups, and Box 4 for a description of the industry groups.

[5] The only exception are highly innovation intense firms in country group 4, medium innovation intense firms in country group 2 and firms in low innovation intensive sectors in country group 1.

4. The empirical analysis

The impact of innovation on exports

Our empirical results strongly support the conclusions I have drawn in our literature review: innovation has significantly positive effects on the export performance of companies. Those companies that introduced innovative products or processes have also higher probability to be exporters (c.f. inpdt and inpcs in Table 2). This is a very robust finding as I observe it for almost all country-sector subsamples (Table 3).

Furthermore, the self-selection pattern is confirmed. The more productive firms are also more often exporters, which is also in line with the result presented in Table 1. When investigating the results concerning the distance to the technological frontier, I find that competitiveness in terms of labour productivity is highly relevant for medium to low innovation intensive sectors. On the contrary, labour productivity differences do not well explain export intensity. Although I find positive effects of productivity on export intensity when investigating the pooled sample of all firms, this result is not confirmed for specific subsamples. Results are quite mixed there, reaching from strongly and significantly negative effects to strongly positive effects. However, the significance of these results changes with the used specification. Overall they indicate that productivity is important to be able to participate in export markets (at least in some sectors). However, nothing can be said about how much a company sells in foreign markets in comparison to its home market.

Table 2: Regression results on the impact of innovation on exports, pooled sample

Exports in 2000	All		SMEs	
	Intensity	Propensity	Intensity	Propensity
turnin	0.370***		0.402***	
rdcont	0.319***		0.329***	
lab_prod	0.808***	0.516***	0.832***	0.520***
app_pen	0.142***		0.149***	
inpdt		0.104***		0.108***
inpcs		0.026***		0.034***
Industry Group Dummies	YES	YES	YES	YES
Country Dummies	NO	NO	NO	NO
Other Control Variables	YES	YES	YES	YES
Observations	66989	66989	57866	57866
Heckman Correction	YES	-	YES	-
ρ	0.588	-	0.571	-
p(ρ)	0.000	-	0.000	-

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations. Note: empty cells => not estimated. Full results are presented in the appendix.

On the other hand, sectors with high or medium high innovation intensity show the self-selection pattern only for the group of southern EU-member states (and in the medium high innovation intensity

sectors in the less advanced new member states)[6]. Overall, these findings indicate that the self-selection thesis is more relevant for those sectors that might be assumed to face substantial price competition. Innovation intensive sectors compete through quality making price differences and productivity less stringent for commercial success. For these reasons appropriability and the possibility to protect critical knowledge from competitors is highly important in these sectors in frontier countries. However, the importance of IPR protection decreases with decreasing innovation intensity (sector groups) and increasing distance to frontier (country groups). Companies that are engaged into product quality based competition are more inclined to export if the risk of knowledge leakage is low. For companies in the catching-up countries the impact on export propensity is reversed: The probability that these firms export is lower whenever they face high appropriability in foreign markets.

Furthermore, I find strong evidence that continuous R&D is very important for highly innovation intensive sectors in the technologically more developed countries of country group 1. Again, this is related to the fact that firms in these sectors compete on product quality rather than on price. They have to steadily push their own technology and knowledge level forward to remain competitive.

Furthermore, the share of innovative products in turnover (turnin) is mainly important for export intensity of firms in country group 2 and 3. These are the more developed new member states and the southern EU countries. In both other country group subsamples, this share is more or less irrelevant.

[6] In the rest of the country sector subsamples, I do not find robust results, although the sign of the results tends to be positive. When using CIS4 and CIS2006 data, these differences between country groups are not confirmed. In CIS2006, almost all country-sector groups show self-selection patterns, while in CIS4 self-selection occurs in the more advanced country groups. Nevertheless, these results have to be interpreted with caution as in CIS4 and CIS2006 the indicator about labour productivity differences has been constructed on the NACE 2-digit level (in contrast to 3-digit level for CIS3). The indicator is therefore more accurate for CIS3 data.

Table 3: Regression results on the impact of innovation on exports, subsamples by country and industry groups.

Country groups -->		**1**				**2**				**3**				**4**			
Variable	Sector group	All		SMEs		All		SMEs		All		SMEs		All		SMEs	
		Int	Prop	Int	Prop	Int	Prop	Int	Prop	Int	Prop	Int	Prop	Int	Prop	Int	Prop
turnin	High	0		0		(++)		+++		(++)		(++)		0		0	
rdcont	High	+++		+++		0		0		++		++		0		0	
lab_prod98_dis	High	(++)	0	(+++)	0	---	(+)	(---)	(++)	0	+++	0	+++	0	(++)	0	0
app_pen	High	++		++		0		(--)		++		++		0		0	
inpdt	High		+		+		+		+		++		++		+		+
lnpcs	High		0		0		0		0		+		+		0		0
turnin	Med-high	0		0		0		+++		(+)		(++)		0		0	
rdcont	Med-high	++		++		(+)		0		++		++		(--)		0	
lab_prod98_dis	Med-high	(++)	(+)	(+++)	0	(---)	0	(---)	0	(-)	+	0	+	(+++)	+++	0	+++
app_pen	Med-high	+		(+)		(+)		(++)		+		+		(-)		--	
inpdt	Med-high		+		+		+		+		+		+		0		(+)
lnpcs	Med-high		(+)		(+)		0		0		+		+		0		0
turnin	Med	(+++)		(+++)		(+++)		+++		(+)		(++)		0		0	
rdcont	Med	++		(++)		0		0		(++)		0		0		0	
lab_prod98_dis	Med	+++	++	+++	++	(+++)	+++	(+++)	+++	0	+++	(++)	+++	(---)	(+++)	(---)	(+++)
app_pen	Med	+		++				0		++		++		(--)		--	
inpdt	Med		+		+		+		+		+		+		(+)		(+)
lnpcs	Med		0		0		0		0		(+)		(+)		0		0
turnin	Med-low	---		0		0		0		0		0		0		0	
rdcont	Med-low	0		0		+++		+++		(--)		0		(---)		(---)	
lab_prod98_dis	Med-low	(+++)	+++	0	+++	(+++)	(+++)	0	(+++)	0	++	0	++	0	+++	0	(+++)
app_pen	Med-low	0		0		(--)		---		0		(++)		--		---	
inpdt	Med-low		(+)		(+)		0		0		+		+		(+)		(+)
lnpcs	Med-low		0		0		0		0		+		+		(+)		(+)
turnin	Low	(--)		(---)		0		0		(++)		(++)		(+)		(++)	
rdcont	Low	0		0		++		++		0		0		---		---	
lab_prod98_dis	Low	(+++)	++	(+++)	++	0	+++	0	+++	(+++)	(+++)	(+++)	+++	(+++)	(+++)	(+++)	(+++)
app_pen	Low	++		++		(-)		(--)		(+)		(+)		(-)		(-)	
inpdt	Low		(+)		+		(+)		(+)		(+)		+		(+)		(+)
lnpcs	Low		0		0		(+)		+		+		+		(-)		(-)

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations.

Note: Table based on average marginal effects (x) and significance levels: "+++" / "---" => sign. strongly positive / negative impact (|x| > 0.5); "++" / "—" => sign. positive / negative impact (0.2 < |x| ≤ 0.5); "+" / "-" => sign. positive / negative impact (0 < |x| ≤ 0.2) "+/-" => contradicting results (both sign. positive and negative impact depending on specification); "0" => no sign. impact; empty cells => not estimated

Country group 1: Belgium, Denmark, Germany, Finland, France, Iceland, Luxemburg, Norway, Sweden; Country group 2: Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Ireland; Country group 3: Spain, Italy, Portugal, Greece; Country group 4: Bulgaria, Lithuania, Latvia, Romania, Cyprus, Malta.

The impact of exports on innovation

In order to analyse the effects of exporting on innovation of companies, I have used innovation input variables as dependent variables to circumvent problems of endogeneity. The idea is that only innovation output affects export performance. Therefore, I assume that when I find correlation between innovation input and exporting, the direction of causality should be clearly going from exporting to innovation. However, since innovation input is correlated with innovation output, the conclusions about causality still have to be interpreted with caution.

In Table 4, the results for the pooled sample of all companies in the CIS3 data are presented. Exporting companies have higher probability to show innovation activities. Furthermore, when comparing exporting companies, those companies with higher export shares also have higher innovation intensity. However, this result is mainly driven by the majority of SMEs in the sample, since I did not find any significant results for the sample of large companies (not presented here). For the SME-subgroup I also find a weak hint that exporters are more likely to invest in innovation.

Table 4: Regression results on the impact of exports on innovation, pooled sample.

Innovation	All		SMEs	
	Intensity	Propensity	Intensity	Propensity
exp_int98	0.510***		0.527***	
internat_market		0.002*		0.003*
Industry Group Dummies	YES	YES	YES	YES
Country Dummies	YES	YES	YES	YES
Other Control Variables	YES	YES	YES	YES
Observations	80342	80342	69632	69632
Heckman Correction	YES		YES	
ρ	0.998		0.999	
p(ρ)	0.000		0.000	

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations. *Note:* empty cells => not estimated. Full results are presented in the appendix.

When investigating the impacts of exporting on innovation for country-sector groups subsamples using CIS3 data (Table 7), most results are not significant. This indicates that the results above are not robust. In a nutshell, I do not find significant patterns by country or sector groups, but in general small companies are more likely to innovate when they are also exporting. On the contrary, whether large companies innovate or not does not depend on their export behaviour.

When considering the main channels how innovation is affected by exports our results indicate that the resource effect in terms of finance dominates. Exporting SMEs are assumed to have more financial resources than their non-exporting counterparts. On the other hand, financial constraints might play a minor role for large companies. Furthermore, the results also suggest that the learning effect is likely to be small. Otherwise, the analysis should deliver a positive impact of exporting for companies in the sample of non-SMEs. However, this result is less at odds with the learning-by-exporting thesis when I take into account that our analysis focused on explaining innovation input. Learning effects are more likely to be observed when looking at the link between innovation output and export behaviour. Companies might gain efficiency improvements in their innovation process (i.e. higher innovation output relative to invested innovation inputs) when they export. Furthermore, learning effects can be expected to be of high relevance for companies that are internationally active (e.g. via FDI, offshoring etc.). The more intense the contact with foreign markets, the more important are foreign sources and benchmarks and the higher are learning potentials.

Table 5: Regression results on the impact of exports on innovation, subsamples by country and industry groups[7]

Country groups →		1		2		3		4	
Variable	Sector groups	All	SMEs	All	SMEs	All	SMEs	All	SMEs
exp_int98	High	++	0	0	0	0	0	0	0
internat_market	High	+	0	0	0	0	0	+	+
exp_int98	Med-high	0	0	0	(+++)	0	0	0	0
internat_market	Med-high	0	0	0	0	0	0	0	0
exp_int98	Med	(++)	0	0	0	0	0	0	(---)
internat_market	Med	0	0	0	0	-	-	0	0
exp_int98	Med-low	0	0	0	0	0	0	+++	(+++)
internat_market	Med-low	0	0	0	0	0	0	0	0
exp_int98	Low	(+++)	0	+++	+++	0	0	0	0
internat_market	Low	++	0	0	0	0	0	0	0

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations.

Note: Table based on average marginal effects (x) and significance levels: "+++" / "---" => sign. strongly positive / negative impact ($|x| > 0.5$); "++" / "—" => sign. positive / negative impact ($0.2 < |x| \leq 0.5$); "+" / " -" => sign. positive / negative impact ($0 < |x| \leq 0.2$) "+/ -" => contradicting results (both sign. positive and negative impact depending on specification); "0" => no sign. impact; empty cells => not estimated

Country group 1: Belgium, Denmark, Germany, Finland, France, Iceland, Luxemburg, Norway, Sweden; Country group 2: Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Ireland; Country group 3: Spain, Italy, Portugal, Greece; Country group 4: Bulgaria, Lithuania, Latvia, Romania, Cyprus, Malta.

The impact of exports and innovation on economic performance

The literature reviewed in the previous sections suggests that innovation should have a positive effect on productivity due to improved technological production processes or products with higher quality. Productivity growth should also increase competitiveness and therefore gains in market shares and turnover as well as employment growth. On the other hand, productivity effects of exporting are assumed to result from volume effects and scale economies, price effects, competition related incentives and pressures, learning effects as well as from additional resources to be invested in production facilities.

Table 6: Regression results on the impact of innovation and exports on employment growth, pooled sample

	All	SMEs
turnin	0.081***	0.076***
inpcs	0.060***	0.060***
rdcont	0.076***	0.072***
exp_int_98	0.073***	0.083***
exp_x_turnin	-0.060***	-0.082***
Industry Group Dummies	YES	YES
Country Dummies	YES	YES
Other Control Variables	YES	YES
Observations	77983	67582
R^2	0.170	0.204

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations. *Note:* Full results are presented in the appendix.

[7] I estimated a two-step Heckman model. For clarity reasons, I collapsed the table horizontally, i.e. export intensity has been used to explain innovation intensity only, while the dummy of export propensity (internat_market) has been used to explain innovation propensity.

Table 7: Regression results on the impact of innovation and exports on employment growth, subsamples by country and industry groups

Country groups →		1		2		3		4	
Variable	Sector group	All	SMEs	All	SMEs	All	SMEs	All	SMEs
turnin	High	+	+	0	(+)	+	+	0	0
inpcs	High	+	+	+	+	+	+	0	0
rdcont	High	+	+	(+)	(+)	+	+	+	(+)
exp_int_98	High	0	(-)	+	++	(+)	(+)	++	++
exp_x_turnin	High	0	0	0	(-)	(-)	0	0	0
turnin	Med-high	+	+	0	(+)	+	+	0	0
inpcs	Med-high	+	+	+	+	+	+	+	+
rdcont	Med-high	+	+	0	0	+	+	+	0
exp_int_98	Med-high	0	0	+	+	0	0	++	++
exp_x_turnin	Med-high	(++)	(+)	0	0	0	(-)	0	--
turnin	Med	+	+	++	++	(+)	(+)	0	0
inpcs	Med	+	+	(+)	(+)	+	+	+	+
rdcont	Med	+	+	+	+	+	+	+	+
exp_int_98	Med	(+)	+	+	+	(+)	(+)	++	++
exp_x_turnin	Med	+/-	+/-	(-)	(-)	(+)	(+)	0	0
turnin	Med-low	+	+	+	(+)	+	+	0	0
inpcs	Med-low	+	+	0	0	+	+	+	++
rdcont	Med-low	0	+/-	+	+	+	+	(+)	0
exp_int_98	Med-low	0	0	(+)	0	(+)	(+)	+	+
exp_x_turnin	Med-low	(+)	0	0	(++)	0	0	0	0
turnin	Low	+	+	(+)	(+)	0	0	(+)	+
inpcs	Low	+	+	+	+	+	+	+	+
rdcont	Low	+	+	+	+	+	+	0	0
exp_int_98	Low	(+)	(+)	+	+	(+)	(+)	++	++
exp_x_turnin	Low	(---)	(---)	(-)	0	(-)	0	0	(-)

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations.

Note: Table based on average marginal effects (x) and significance levels: "+++" / "---" => sign. strongly positive / negative impact ($|x| > 0.5$); "++" / "—" => sign. positive / negative impact ($0.2 < |x| \leq 0.5$); "+" / " -" => sign. positive / negative impact ($0 < |x| \leq 0.2$) "+/-" => contradicting results (both sign. positive and negative impact depending on specification); "0" => no sign. impact; empty cells => not estimated

Country group 1: Belgium, Denmark, Germany, Finland, France, Iceland, Luxemburg, Norway, Sweden; Country group 2: Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Ireland; Country group 3: Spain, Italy, Portugal, Greece; Country group 4: Bulgaria, Lithuania, Latvia, Romania, Cyprus, Malta.

In order to analyse the impact of innovation and exports on economic performance, I explain employment growth, turnover growth and labour productivity growth by a set of both innovation and export indicators as well as an interaction term to catch potential joint effects. Table 6 illustrates the regression results for employment growth for the pooled sample of all companies and the subsample of SMEs respectively. Both innovation as well as exports are positively correlated with employment growth for the pooled samples. The interaction term between labour productivity and share of turnover from new or significant improved products, however has a negative influence on the economic performance of enterprises and especially on the performance of small firms, whereas the total effect is positive.

In Table 7, I present results for country-sector group subsamples. On the one hand, export intensity is mainly important for employment growth of enterprises in the new member states (country groups 2 and 4) indicating that exporting gets more important with increasing distance to the technological frontier. On the other hand, the importance of innovation is highest for country group 1 but decreasing with increasing distance to the technological frontier. The interaction term between export intensity and share of turnover from new or significantly improved products has mixed impact in the subsamples. Nevertheless, the total effect of both innovation and exporting is positive in all cases.

Looking at the effects on turnover growth, both innovation and exports show a positive impact on turnover growth of all enterprises and SMEs in the pooled sample (Table 10).The interaction term of innovation and exports is not significant.

Table 8: Regression results on the impact of innovation and exports on turnover growth, pooled sample

	All	SMEs
turnin	0.0832***	0.0808***
inpcs	0.0715***	0.0731***
rdcont	0.0915***	0.0938***
exp_int_98	0.0969***	0.108***
exp_x_turnin	0.004	-0.014
Industry Group Dummies	YES	YES
Country Dummies	YES	YES
Other Control Variables	YES	YES
Observations	77983	67582
R^2	0.114	0.124

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations. Note: Full results are presented in the appendix.

When investigating subsamples differentiated by country and sector groups (Table 9), exports turn out to be highly relevant for turnover growth in country groups 4 and 1 (for all sectors, as shown in Table 9). Interestingly, in highly innovation-intensive sectors in country group 1, exports have a negative effect on turnover growth, but this negative effect is strongly dominated by a positive joint effect of innovation and exports. In high-tech sectors close to the technological frontier, it is therefore very important to commercialise the innovation outcome on a large or rather internationalised market. For other sector and country group-combinations I do not find a robustly positive joint effect. In some cases it tends to be negative.

Table 9: Regression results on the impact of innovation and exports on turnover growth, subsamples by country and industry groups

Country groups →		1		2		3		4	
Variable	Sector group	All	SMEs	All	SMEs	All	SMEs	All	SMEs
turnin	High	+	(+)	++	++	+	+	0	0
inpcs	High	+	+	(+)	0	+	+	0	0
rdcont	High	+	+	0	0	+	+	(+)	(+)
exp_int_98	High	(-)	(-)	+	+	+	+	++	++
exp_x_turnin	High	++	++	0	(--)	(-)	(-)	0	0
turnin	Med-high	+	+	++	(++)	+	+	0	0
inpcs	Med-high	(+)	0	+	(+)	+	+	++	+
rdcont	Med-high	+	+	(+)	(+)	+	+	(+)	0
exp_int_98	Med-high	+	+	(+)	(+)	(+)	+	++	++
exp_x_turnin	Med-high	(+)	(++)	(+)	(--)	0	0	0	0
turnin	Med	+	+	++	++	(+)	(+)	(+)	0
inpcs	Med	+	+	+	+	+	+	+	+
rdcont	Med	+	(+)	0	0	+	+	+	++
exp_int_98	Med	+	+	(+)	(+)	0	0	++	++
exp_x_turnin	Med	0	0	0	0	(+)	(+)	0	0
turnin	Med-low	(+)	(+)	+++	+++	+	+	++	++
inpcs	Med-low	+	+	+	+	+	+	++	++
rdcont	Med-low	+	+	(+)	(+)	(+)	(+)	0	0
exp_int_98	Med-low	+	+	++	++	(+)	(+)	++	++
exp_x_turnin	Med-low	0	(+)	---	(---)	---	---	---	---
turnin	Low	(-)	(-)	++	++	(-)	(-)	0	0
inpcs	Low	+	+	0	0	+	+	++	++
rdcont	Low	+	(+)	+	(+)	++	++	0	0
exp_int_98	Low	(+)	(+)	+	+	(+)	(+)	++	++
exp_x_turnin	Low	(-)	(-)	(--)	(--)	(+)	(+)	0	0

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations.

Note: Table based on average marginal effects (x) and significance levels: "+++" / "---" => sign. strongly positive / negative impact ($|x| > 0.5$); "++" / "—" => sign. positive / negative impact ($0.2 < |x| \leq 0.5$); "+" / " -" => sign. positive / negative impact ($0 < |x| \leq 0.2$) "+/-" => contradicting results (both sign. positive and negative impact depending on specification); "0" => no sign. impact; empty cells => not estimated

Country group 1: Belgium, Denmark, Germany, Finland, France, Iceland, Luxemburg, Norway, Sweden; Country group 2: Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Ireland; Country group 3: Spain, Italy, Portugal, Greece; Country group 4: Bulgaria, Lithuania, Latvia, Romania, Cyprus, Malta.

Innovation in terms of turnover share of innovative products is of high importance for employment growth in country group 2. In the subsample of less advanced new member states I find no evidence for a positive impact. On the contrary, in these countries (and there mainly in industries with medium to low innovation intensity) process innovation affects turnover growth positively. Furthermore, comparing sector groups, continuous R&D is very important for turnover growth in sectors with high innovation intensity, less important for low-innovation intensive sectors[8].

Finally, the results for labour productivity growth indicate that overall both exports and innovation increase labour productivity growth. Results for the pooled sample and the SME-subsample (Table 12) also indicate that the joint effects of both innovation and exporting on labour productivity growth are positive. However, the positive joint effect is not robust, as I find mixed results in country-sector subsamples (Table 11). Overall, innovation has also positive effects on labour productivity growth,

[8] However, I found two outliers in our estimation results: one in the low innovation intensive industries in the southern EU member states and one for SMEs in the mediocre innovation intensive sectors in the less advanced new member states. Overall, the results become less robust and less significant the further away a country group from the technology frontier.

whereas the parameters measuring the impact of turnover share of innovative products are significantly positive in some of the specified equations only.

Table 10: Regression results on the impact of innovation and exports on labour productivity growth, pooled sample

	All	SMEs
turnin	0.004	0.006
inpcs	0.018***	0.019***
rdcont	0.019***	0.025***
exp_int_98	0.039***	0.038***
exp_x_turnin	0.065***	0.068***
Industry Group Dummies	YES	YES
Country Dummies	YES	YES
Other Control Variables	YES	YES
Observations	77983	67582
R^2	0.134	0.133

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations. Note: Full results are presented in the appendix.

When investigating subsamples defined by country-sector groups, the effect of export intensity on labour productivity growth is most important for sectors with low innovation intensity. In the more innovation intensive sectors, I only find positive contributions of exporting to productivity growth in the more advanced country groups. However, export does not always have a direct positive impact in these frontier countries. The same holds for the impact of the share of turnover on innovative products on productivity growth, but I find a dominant positive joint effect of both innovation and exports instead. The joint effect is strongest in the highly innovation intensive sectors in the group of frontier countries, whereas the share of innovative products in turnover is relevant for sectors in country group 2, and with exception of the low innovation intensive sectors in country group 3.

All in all, process innovation tends to be more relevant for productivity growth in sectors with low innovation intensity and in catching-up countries. On the contrary, continuous R&D is only relevant for productivity growth in the frontier countries of group 1 and the southern EU member states. Considering the positive joint effect (innovation and export) for highly innovation-intensive sectors in country group 1[9], the importance of innovation for productivity growth tends to decrease with increasing distance to the frontier (by country groups) and decreasing innovation intensity (on the sector level). In contrast, the importance of process innovation and other investments shows the opposite pattern, i.e. their importance increases with an increasing distance to the technological frontier.[10]

[9] With the exception of medium high innovation intensive sectors where I did not find any significant results neither for the turnover share of innovative products nor for the interaction term with exports, the overall effect of the variable turnin and the interaction term is positive.

[10] Result not presented in Table 12 or Table 13.

Table 11: Regression results on the impact of innovation and exports on labour productivity growth

Country groups →		1		2		3		4	
Variable	Sector groups	All	SMEs	All	SMEs	All	SMEs	All	SMEs
turnin	High	(-)	(-)	(+)	(++)	+	+	0	0
inpcs	High	-	(-)	0	0	(-)	(-)	0	0
rdcont	High	(+)	(+)	(-)	(-)	+	+	0	0
exp_int_98	High	(-)	(-)	(-)	(-)	+	+	0	0
exp_x_turnin	High	++	++	0	0	(-)	(-)	0	0
turnin	Med-high	0	0	(+)	(++)	0	0	0	0
inpcs	Med-high	(-)	(-)	0	(-)	(+)	(+)	(+)	(+)
rdcont	Med-high	(+)	(+)	+	(+)	(+)	+	0	0
exp_int_98	Med-high	+	+	(-)	(-)	(+)	(+)	(-)	(-)
exp_x_turnin	Med-high	0	0	(+)	(-)	0	0	0	0
turnin	Med	(+)	(+)	+	+	(+)	(+)	0	0
inpcs	Med	0	0	+	+	+	+	+	+
rdcont	Med	0	0	-	-	(+)	(+)	0	(+)
exp_int_98	Med	+	(+)	(-)	(-)	(-)	(-)	0	0
exp_x_turnin	Med	(-)	(-)	0	0	(+)	(+)	--	--
turnin	Med-low	0	(-)	(++)	(++)	+	(+)	++	++
inpcs	Med-low	0	0	(+)	+	0	(+)	(+)	(+)
rdcont	Med-low	(+)	(+)	(-)	(-)	(-)	0	(+)	(+)
exp_int_98	Med-low	+	(+)	++	++	(+)	(+)	++	++
exp_x_turnin	Med-low	0	(+)	---	---	---	---	---	---
turnin	Low	-	-	++	++	-	(-)	0	0
inpcs	Low	(+)	(+)	(-)	(-)	+	+	(+)	(+)
rdcont	Low	(+)	(+)	0	0	+	+	(+)	0
exp_int_98	Low	(+)	(+)	(+)	(+)	(+)	(+)	+	+
exp_x_turnin	Low	(++)	(++)	(--)	(--)	(+)	(+)	0	0

Source: CIS 3 data accessed at the Eurostat Safe Centre, own calculations.

Note: Table based on average marginal effects (x) and significance levels: "+++" / "---" => sign. strongly positive / negative impact ($|x| > 0.5$); "++" / "—" => sign. positive / negative impact ($0.2 < |x| \leq 0.5$); "+" / "-" => sign. positive / negative impact ($0 < |x| \leq 0.2$) "+/-" => contradicting results (both sign. positive and negative impact depending on specification); "0" => no sign. impact; empty cells => not estimated

Country group 1: Belgium, Denmark, Germany, Finland, France, Iceland, Luxemburg, Norway, Sweden; Country group 2: Czech Republic, Estonia, Hungary, Slovenia, Slovak Republic, Ireland; Country group 3: Spain, Italy, Portugal, Greece; Country group 4: Bulgaria, Lithuania, Latvia, Romania, Cyprus, Malta.

5. Conclusions

This paper discusses the interplay between exports and innovation and both their effects on economic performance. The major issue here is to control for endogeneity between these dimensions. As described, exporting might positively affect innovation via learning effects, resource effects and / or incentive effects. On the other hand, innovation improves productivity and therefore increases a company's competitiveness such that it selects itself into the export market. Alternatively, product innovations might also create (temporary) monopolies in niche markets.

I tested these issues emerging from the literature using CIS data. In order to overcome problems referring to endogeneity, I empirically investigated the effects of exporting in the first year of the observed time frame on innovation input, while I explained in a second model exports in the final observed year by innovation output indicators. I found strong evidence that innovation improves the export performance of companies, whereas this pattern varies with the stage of economic development. While firms in highly innovative sectors in the more advanced member states need high degrees of appropriability, i.e. the possibility to protect their innovations, and have to continuously

improve their knowledge base to participate in export markets, it is productivity and price-based competitiveness for low innovation-intensive sectors. This reflects the alternative patterns of niche markets on one hand, and self-selection on the other, that allow firms to export.

While the nature of the data does not allow us to draw satisfactory conclusions on the causal link between exports and innovation, I could find positive effects of exporting on innovation activities only for small companies, while large companies are not more likely to innovate when they are exporting. I therefore concluded that the positive impact of exports results from additional financial resources available for exporting SMEs, while learning effects are comparably small. However, I only investigated exports but did not consider different kinds of internationalisation due to data constraints. The picture might change in this case.

Finally, in this paper I argue that both innovation and exports have positive effects on a firm's economic performance. I find strong evidence that innovation is an important driver for productivity growth, whereas the positive effect increases when a company (and the country the firm is located in) approaches the technology frontier. Furthermore, the results indicate that in the medium to low innovation intensive sectors productivity growth is mainly driven by process innovations, while in high-technology sectors in the more advanced member states productivity growth is strongly driven by product innovations. This is in line with the idea that in high-tech niche markets it is product quality which leads to higher prices. Competition in these markets is not based on prices but on product quality. In the low-technology sectors, competition is mainly based on prices and therefore process innovation plays a decisive role.

In addition, I also find evidence that the effects of innovation and exporting on employment and turnover growth follow patterns that are dependent of the technological stage of development. The impact of exports on employment growth increases with an increasing distance of the company's home country from the technological frontier. Companies in these countries have a comparative advantage in wage levels. Interestingly, exporting has positive effects on labour productivity mainly in highly innovation-intensive sectors in the more advanced countries on the one hand, and in less innovation-intensive sectors in countries that are further away from the technological frontier. Probably, this result reflects comparative advantages and volume effects (economies of scale) of exporting. The prior companies increase their export share by increased competitiveness based on high-quality products, the latter based on wage levels.

Finally, the joint effects of exporting and innovation on turnover growth and therefore also productivity growth are positive for high-tech sectors in technologically advanced countries. This indicates that companies that are active in these sectors have to internationalise their economic activities to reap the benefits from their innovation efforts. Domestic markets tend to be too small and niche. This result claims for supporting innovative companies in these sectors to start exporting.

Box 5: Innovation, exports and economic performance – main conclusions from the econometric analysis

- Innovation positively affects exporting:
  - Innovators (both products and processes) are more likely to be exporters
  - Appropriability and continuous R&D are most important for exporting in highly innovation intensive sectors in technologically leading countries
- The self-selection pattern between productivity and exporting is confirmed:
  - The more productive companies are more likely to be exporters
  - Process innovations and competitiveness based on productivity are highly relevant in medium to low innovation intensive sectors with price based competition
- Exports positively affects innovation, but results are less robust than for the innovation – exporting relationship:
  - Within the sample of exporting companies, those firms with higher export shares also have higher innovation intensities.
  - Exporters are slightly more likely to invest in innovation activities than non-exporters.
- Both innovation and exports are positively correlated with economic performance:
  - Innovation is more important in frontier countries than in catching-up countries.
  - Exports are more important in catching-up countries than in frontier countries
  - Process innovations and other non-innovation related investments are more important for low innovation intensive industries.
  - The global exploitation of technology is most important in highly innovation intensive niche markets in the frontier countries.

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APPENDIX

Table 12: Regression results on the impact of exports on innovation. Full table.

	(1) Pooled Sample	(2) Pooled Sample	(3) Pooled Sample	(4) Pooled Sample	(5) SME	(6) SME	(7) SME	(8) SME
	Heckman Innovation Intensity	Heckman - selection equation Innovation Propensity	OLS Innovation Intensity	OLS Innovation Propensity	Heckman Innovation Intensity	Heckman - selection equation Innovation Propensity	OLS Innovation Intensity	OLS Innovation Propensity
Export Intensity 1998	0.510***		0.478***		0.527***		0.430***	
	(5.737)		(11.83)		(3.819)		(9.261)	
	0.000		0.000		0.000		0.000	
Export Propensity		0.0318*		0.00148		0.0438**		0.00319
		(1.684)		(0.631)		(1.978)		(1.345)
		0.092		0.528		0.048		0.179
Foreign-owned Group	-0.0400	-0.0135	-0.168***	-0.00676*	0.0335	0.0155	-0.257***	-0.000820
	(-0.492)	(-0.582)	(-5.534)	(-1.753)	(0.238)	(0.520)	(-6.547)	(-0.199)
	0.622	0.561	0.000	0.080	0.812	0.603	0.000	0.842
Start-Up	0.298**	-0.00662	0.243***	0.0107***	0.156	-0.0366	0.246***	0.00590
	(1.971)	(-0.159)	(4.173)	(2.741)	(0.679)	(-0.770)	(3.822)	(1.596)
	0.049	0.874	0.000	0.006	0.497	0.441	0.000	0.110
Employees ≤ 20	-0.209*	-0.0129	-0.138***	0.00324				
	(-1.809)	(-0.387)	(-3.057)	(0.619)				
	0.071	0.699	0.002	0.536				
20 < Employees ≤ 50	0.455***	0.0905**	0.297***	0.0358***	0.309	0.0951*	0.0235	0.00759
	(3.415)	(2.501)	(5.628)	(7.003)	(1.129)	(1.786)	(0.313)	(1.643)
	0.001	0.012	0.000	0.000	0.259	0.074	0.754	0.100
50 < Employees ≤ 250	0.243**	0.0463*	0.158***	0.0180***	0.158	0.0485	0.00897	0.00243
	(2.443)	(1.700)	(4.143)	(5.327)	(0.902)	(1.385)	(0.185)	(0.772)
	0.015	0.089	0.000	0.000	0.367	0.166	0.853	0.440
ln(Employment 1998)	0.211**	0.132***	-0.134***	0.0234***	0.193	0.127***	-0.251***	0.0100***
	(2.332)	(9.751)	(-6.865)	(10.59)	(1.099)	(5.548)	(-7.870)	(5.075)
	0.020	0.000	0.000	0.000	0.272	0.000	0.000	0.000
Manufacturing	-1.427***	-0.498***	-0.225***	-0.0567***	-1.940***	-0.505***	-0.264***	-0.0496***
	(-4.441)	(-25.29)	(-7.302)	(-24.15)	(-3.584)	(-22.43)	(-7.641)	(-21.14)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Opportunity	2.472***	0.868***	0.0487*	0.137***	3.324***	0.893***	0.0708**	0.133***
	(4.270)	(45.33)	(1.664)	(35.95)	(3.367)	(41.07)	(2.213)	(31.70)
	0.000	0.000	0.096	0.000	0.001	0.000	0.027	0.000
Appropriability	0.949***	0.307***	0.183***	0.0502***	1.231***	0.327***	0.139***	0.0483***
	(4.611)	(17.09)	(7.623)	(15.75)	(3.421)	(15.82)	(5.107)	(14.24)
	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Cumulativeness	1.403***	0.474***	0.187***	0.0768***	1.804***	0.494***	0.170***	0.0719***
	(4.512)	(27.35)	(8.283)	(20.18)	(3.349)	(24.48)	(6.545)	(17.55)
	0.000	0.000	0.000	0.000	0.001	0.000	0.000	0.000
Country Group Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Sector Group Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Innovation Barriers	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES
Observations	80342		24935	80428	69632		18703	69701
Censored observations	74398				65586			
R-squared			0.110	0.156			0.101	0.138
σ(λ)	0.812				1.334			
λ	3.235***				4.236***			
ρ	0.998				1.000			

Source: CIS 3 micro data accessed at the Eurostat safe centre. own calculations.

Table 13: Regression results on the impact of innovation on exports. Full table.

	(1) Pooled Sample Heckman Export Intensity	(2) Pooled Sample Heckman - selection equation Export Propensity	(4) Pooled Sample OLS Export Intensity	(5) Pooled Sample OLS Export Propensity	(6) SME Heckman Export Intensity	(7) SME Heckman - selection equation Export Propensity	(9) SME OLS Export Intensity	(10) SME OLS Export Propensity
Share of turnover of innovative products	0.370***		0.162***		0.402***		0.166***	
	(7.145)		(3.497)		(6.503)		(3.126)	
	0.000		0.000		0.000		0.002	
Continuous R&D	0.319***		0.287***		0.329***		0.291***	
	(11.00)		(10.81)		(9.263)		(8.903)	
	0.000		0.000		0.000		0.000	
Labour Productivity	0.808***	1.308***	0.248**	0.368***	0.832***	1.303***	0.174	0.413***
Distance	(7.450)	(19.59)	(2.474)	(19.59)	(6.113)	(18.52)	(1.448)	(18.39)
	0.000	0.000	0.013	0.000	0.000	0.000	0.148	0.000
Appropriability	0.142***		0.114***		0.149***		0.123***	
	(6.098)		(5.011)		(5.533)		(4.688)	
	0.000		0.000		0.000		0.000	
Product Innovations		0.268***		0.0850***		0.271***		0.0895***
		(17.56)		(18.47)		(16.64)		(17.23)
		0.000		0.000		0.000		0.000
Process Innovations		0.0651***		0.0201***		0.0841***		0.0252***
		(4.115)		(4.298)		(4.927)		(4.666)
		0.000		0.000		0.000		0.000
Foreign-owned Group	0.431***	0.365***	0.276***	0.0974***	0.491***	0.357***	0.321***	0.107***
	(13.00)	(16.76)	(9.923)	(18.07)	(11.51)	(14.36)	(9.014)	(15.30)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
Start-Up	-0.0583	-0.303***	0.133**	-0.102***	0.00260	-0.283***	0.187***	-0.0958***
	(-1.046)	(-11.43)	(2.481)	(-12.63)	(0.0417)	(-10.27)	(3.296)	(-11.24)
	0.296	0.000	0.013	0.000	0.967	0.000	0.001	0.000
Employees ≤ 20	0.0785*	0.0306	0.0835**	-0.00363				
	(1.817)	(1.082)	(2.157)	(-0.488)				
	0.069	0.279	0.031	0.625				
20 < Employees ≤ 50	-0.580***	-0.348***	-0.303***	-0.143***	-0.375***	-0.255***	-0.210***	-0.0961***
	(-10.71)	(-12.26)	(-6.561)	(-16.96)	(-5.783)	(-7.803)	(-3.575)	(-9.209)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
50 < Employees ≤ 250	-0.361***	-0.129***	-0.266***	-0.0530***	-0.238***	-0.0784***	-0.205***	-0.0275***
	(-10.34)	(-6.499)	(-8.227)	(-8.697)	(-5.869)	(-3.593)	(-5.378)	(-3.945)
	0.000	0.000	0.000	0.000	0.000	0.000	0.000	0.000
ln(Employment 1998)	0.0918***	0.161***	0.0152	0.0437***	0.193***	0.211***	0.0640***	0.0652***
	(4.493)	(13.70)	(0.849)	(13.31)	(6.317)	(14.98)	(2.598)	(15.02)
	0.000	0.000	0.396	0.000	0.000	0.000	0.009	0.000
Manufacturing	2.368***	1.962***	1.022***	0.528***	1.141***	2.054***	-0.449	0.544***
	(10.58)	(27.63)	(3.011)	(31.55)	(3.528)	(23.64)	(-1.195)	(29.14)
	0.000	0.000	0.003	0.000	0.000	0.000	0.232	0.000
Services	0.546***	0.935***	-0.200	0.195***	-0.524*	1.122***	-1.549***	0.233***
	(2.689)	(12.83)	(-0.584)	(11.03)	(-1.780)	(12.62)	(-4.061)	(11.86)
	0.007	0.000	0.560	0.000	0.075	0.000	0.000	0.000
Investments	-5.89e-11	-3.39e-10***	9.94e-11	-6.50e-11***	4.98e-10	-5.55e-10	8.51e-10	-2.03e-10
	(-0.431)	(-3.801)	(1.103)	(-2.594)	(0.403)	(-0.819)	(0.952)	(-1.002)
	0.667	0.000	0.270	0.009	0.687	0.413	0.341	0.317
Country Dummies	NO	NO	NO	NO	NO	NO	NO	NO
Export Barriers	YES	YES	YES	YES	YES	YES	YES	YES
Sector Group Dummies	YES	YES	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES	YES	YES
Observations	66989		36436	66989	57866		29392	57866
Censored observations	30553				28474			
R-squared			0.163	0.256			0.144	0.227
σ(λ)	0.0998				0.128			
λ	1.109***				1.097***			
ρ	0.588				0.571			

Source: CIS 3 micro data accessed at the Eurostat safe centre. own calculations.

Table 14: Regression results on the impact of innovation and exports on economic performance. Full table.

	(1) Pooled Sample ln(Empl. Growth)	(2) SME ln(Empl. Growth)	(3) Pooled Sample ln(Labour Productivity Growth)	(4) SME ln(Labour Productivity Growth)	(5) Pooled Sample ln(Turnover Growth)	(6) SME ln(Turnover Growth)
Share of turnover of innovative products	0.0806***	0.0757***	0.00361	0.00607	0.0832***	0.0808***
	(28.67)	(27.53)	(0.882)	(1.460)	(18.79)	(17.93)
	0.000	0.000	0.378	0.144	0.000	0.000
Continuous R&D	0.0596***	0.0595***	0.0176***	0.0185***	0.0715***	0.0731***
	(51.82)	(52.47)	(10.49)	(10.76)	(39.33)	(39.24)
	0.000	0.000	0.000	0.000	0.000	0.000
Labour Productivity Distance	0.0761***	0.0715***	0.0191***	0.0246***	0.0915***	0.0938***
	(46.27)	(42.89)	(7.964)	(9.753)	(35.30)	(34.32)
	0.000	0.000	0.000	0.000	0.000	0.000
Export Intensity 1998	0.0730***	0.0834***	0.0388***	0.0381***	0.0969***	0.108***
	(31.86)	(36.69)	(11.61)	(11.02)	(26.76)	(28.92)
	0.000	0.000	0.000	0.000	0.000	0.000
Export Intensity 1998 x Share of turnover of innovative products	-0.0595***	-0.0817***	0.0648***	0.0675***	0.00372	-0.0144
	(-7.112)	(-9.685)	(5.318)	(5.288)	(0.282)	(-1.043)
	0.000	0.000	0.000	0.000	0.778	0.297
Foreign-owned Group	0.0432***	0.0548***	0.110***	0.114***	0.132***	0.151***
	(23.30)	(28.83)	(40.20)	(39.08)	(44.87)	(47.86)
	0.000	0.000	0.000	0.000	0.000	0.000
Start-Up	0.169***	0.162***	0.123***	0.127***	0.307***	0.302***
	(74.15)	(73.44)	(37.08)	(37.90)	(85.32)	(83.04)
	0.000	0.000	0.000	0.000	0.000	0.000
Investment Intensity	7.72e-06***	8.41e-06***	9.06e-05***	8.96e-05***	0.000103***	0.000102***
	(3.578)	(4.069)	(28.84)	(28.63)	(30.29)	(30.00)
	0.000	0.000	0.000	0.000	0.000	0.000
Employees ≤ 20	0.386***		-0.140***		0.238***	
	(115.8)		(-28.87)		(45.32)	
	0.000		0.000		0.000	
20 < Employees ≤ 50	-0.297***	-0.475***	0.129***	0.172***	-0.162***	-0.295***
	(-111.9)	(-161.7)	(33.41)	(38.70)	(-38.67)	(-61.10)
	0.000	0.000	0.000	0.000	0.000	0.000
50 < Employees ≤ 250	-0.215***	-0.315***	0.0993***	0.124***	-0.112***	-0.187***
	(-114.1)	(-158.8)	(36.26)	(41.17)	(-37.77)	(-57.34)
	0.000	0.000	0.000	0.000	0.000	0.000
ln(Employment 1998)	-0.241***	-0.332***	0.0983***	0.119***	-0.0122***	-0.0755***
	(-206.7)	(-246.6)	(57.81)	(58.65)	(-6.239)	(-32.95)
	0.000	0.000	0.000	0.000	0.000	0.000
ln(Turnover 1998)			-0.164***	-0.162***	-0.127***	-0.132***
			(-247.5)	(-239.8)	(-178.0)	(-180.5)
			0.000	0.000	0.000	0.000
Manufacturing	0.0139***	0.0185***	-0.0845***	-0.0897***	-0.0582***	-0.0609***
	(3.854)	(5.078)	(-16.12)	(-16.25)	(-10.25)	(-10.18)
	0.000	0.000	0.000	0.000	0.000	0.000
Services	0.0463***	0.0437***	0.0274***	0.0216***	0.0631***	0.0568***
	(12.58)	(11.77)	(5.118)	(3.837)	(10.87)	(9.322)
	0.000	0.000	0.000	0.000	0.000	0.000
Country Dummies	YES	YES	YES	YES	YES	YES
Sector Group Dummies	YES	YES	YES	YES	YES	YES
Constant	YES	YES	YES	YES	YES	YES
Observations	514137	491863	514137	491863	514137	491863
R-squared	0.170	0.204	0.134	0.133	0.114	0.124

Source: CIS 3 micro data accessed at the Eurostat safe centre. own calculations.