Discussion paper

The relationship between R&D investments and exports in goods and services in Dutch enterprises

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Content

Summary

We investigate the relationship between R&D and export of goods and services, and the role of productivity therein, using firm-level data from the Netherlands for the period 2013-2018. We apply a three-stage least squares (3SLS) Generalized Method of Moments (GMM) estimation to empirically address the concerns of endogeneity and heteroscedasticity. Our results are in line with most previous studies and suggest that there is complementarity between R&D and export activities. We find that the effect of R&D on exports is stronger than the reverse effect of exports on R&D. This finding is driven by export of goods. For export of services, by contrast, the channel from exports to R&D is much stronger than from R&D to exports. Our results show that more productive firms engage more strongly in exports and they invest more in R&D. Heterogeneity analyses suggest that the complementarity between R&D and export activities varies across different types of firm and by export destination and type of product. As such, complementarity between two activities is stronger for larger firms. The effect of R&D on non-EU exports appears to be stronger than vice versa. Returns to R&D are higher from exports to low income economies, whereas investment in R&D has a much stronger effect on exports to high- and middle-income economies. The evidence further suggests that any additional R&D investments associated with a tax credit, indirectly also benefit the export activities of these firms. Our findings show that spill-over effects between R&D and exports should be considered in designing policies targeted at R&D or international trade.

Keywords

Businesses, international trade, R&D, productivity

1. Introduction

Decisions of firms to invest in new products and innovative activities are often driven by the necessity to compete in domestic and international markets. Worldwide, firms gradually increase their presence in the global market by means of international trade (WTO, 2020). In the Netherlands, for example, more than one third of all firms in 2018 were involved in international trade (CBS, 2020). Therefore, it is important to know whether investment in new products and activities can increase competitiveness of firms, especially internationally. This question is also relevant from the policy perspective: can policies that stimulate R&D have positive spill-over effects on international trade? In the Netherlands, for example, firms that want to carry out R&D activities can apply for government support (R&D tax credit).[1] On the other hand, international activities, in particular export, can improve the knowledge base of firms and boost their innovative capacities by learning from interactions in international markets, commonly referred to as the learning-by-exporting mechanism. If this mechanism exists, then government support to encourage firms to export is justified as an attempt to internalize positive externalities (Silva et al., 2012). Moreover, both export and R&D are likely to positively affect a firm's future productivity (Aw et al., 2011). Hence, knowing whether and to what extent export and investment in R&D are interrelated can help firms in optimising their investment strategies, as well as provide important insights for policy-making.

The vast majority of existing studies find that there is a positive link, between on the one hand, innovation, measured either by innovation input such as R&D investments or innovation outputs (e.g. patents), and on the other hand, internationalization, captured by the firm's presence in international market such as export activity (see among others Roper et al., 2006; Siedschlag & Zhang, 2015; Peters et al., 2018). Girma et al. (2008) compare Irish firms and British firms. For Irish firms they identify a positive relationship between R&D and export, however for British firms they find no statistically significant effects. The latter is in line with findings of Damijan et al. (2010) who conclude that there is no statistically significant relationship between the two activities for Slovenian firms. Roper & Love (2002) find that there is even a negative trade-off between expenditure on innovation activities and exports for German plants, which can be explained by the potential rival use of limited organizational resources (i.e. human and financial). The same study, however, shows that this conclusion is not supported for British plants: being a product innovator in the UK is positively related to the probability to export.

These differences in findings appear to be specific to the country from which the data are used (for instance, while most studies report a positive relationship between export and innovation activities for Irish firms, the results for German firms are mixed), as well as to the method applied to analyse this relationship. The

[1] For more information see https://english.rvo.nl/subsidies-programmes/wbso

main challenges in estimating these effects lie in (i) controlling for various factors that can (simultaneously) influence export and innovation activities, (ii) analysing dynamic relationships and (iii) also in addressing the issue of potential simultaneity between these two activities. Among a few studies that apply more advanced econometric techniques to address these issues are Aw et al. (2011), Esteve-Pérez and Rodríguez (2013) and Neves et al. (2016). Using data from the Taiwanese electrical industry, Aw et al. (2011) conclude that there is a small positive effect of R&D investment on the return to exporting, while the effect of export on the probability of R&D investment is not statistically significant. Esteve-Pérez & Rodríguez (2013) show that there is a two-way dynamic relationship between R&D and exporting activities of Spanish manufacturing SMEs. Finally, Neves et al. (2016) conclude that there is complementarity between R&D and export activities of non-financial companies based in Portugal.

The aim of this study is to gain insights into the relationship between internationalization and innovation activities using a rich firm-level panel data from the Netherlands for the period 2013-2018. Internationalization in this study is measured by the value and intensity of export activities of firms, whereas innovation is captured by innovation inputs, i.e. investments in R&D reported by the firms. Our data allow us to estimate the model for the whole range of firms: with R&D investments and/or export activities and without. Both manufacturing and service firms are represented in our data. While we focus on the intensity of both export and R&D in the main results section, we also perform analyses for the extensive margin, i.e. using R&D investment and export activities as binary measures[2].

Furthermore, the rich dataset allows us to control for different factors underlying the relationship between R&D investment and export and to account for the role of productivity, in particular. The vast majority of previous empirical studies show that exporting firms are more productive than non-exporters (see Aw et al. 2011 and references therein). Similarly, there is ample evidence that more innovative firms are more productive (e.g. Hall, 2011). In our analysis, we allow productivity to be an endogenous determinant of both R&D and export. Moreover, as a part of our heterogeneity analyses, we split the sample into high and low productive firms, in order to check whether the relation between export and R&D is different between these groups.

Besides the distinction between low and high productive firms, the data enable us to examine other causes of heterogeneity in the export and innovation relation. As such, we analyse export of goods within the manufacturing sector versus export of services within the (non-financial) services sector; export to intra-EU countries versus extra-EU export; and export of domestically produced goods versus re-exports. We also look at export to advanced economies versus export to emerging economies and low-income economies, since some studies suggest that exporting to developed countries may be more beneficial in terms of incoming knowledge spillovers, with stronger complementarity between export and R&D (Salomon,

[2] Interestingly, Girma et al. (2008) conclude that being an exporter is what appears to matter for improving R&D activity, rather than the extent to which a firm exports; we also test this finding in our study.

2006; Golovko & Valentini, 2011). Furthermore, we look at small and medium-sized firms (SMEs) versus large firms, as SMEs can be in a less favourable position in terms of R&D investment and exporting compared to their larger counterparts (Esteve-Pérez & Rodríguez, 2013).

Using three-stage least squares (3SLS) Generalized Method of Moments (GMM) estimation, we empirically address the concerns of endogeneity and heteroscedasticity in the relationship between R&D investment and export activities. We apply the GMM method in a simultaneous model in which we estimate the export and the R&D equations jointly, allowing for contemporaneous mutual effects between R&D and export, and correlation between the disturbances.

The remainder of the paper proceeds as follows. In the next section we discuss proposed mechanisms that can underlie the relationship between internationalization and innovative activities of firms. Section 3 discusses the model, estimation and data used in this study. Section 4 presents descriptive statistics. Section 5 discusses the results of our main analyses. Heterogeneity analyses are provided in Section 6. Finally, Section 7 concludes and provides suggestions for future research.

2. Mechanisms underlying interdependence between R&D and export

Different mechanisms have been proposed to explain how R&D activities and export are related. In this section, we discuss some of these mechanisms that have been provided in the literature.

The relationship between exports and R&D can be explained by endogenous growth theory. Grossman & Helpman (1991) show that trade reveals information to exporters and gives them access to the knowledge stocks of their trading partners. Vice versa, knowledge gained through performing R&D activities can help firms to build absorptive technological capabilities to acquire external knowledge in the export market (Esteve-Pérez & Rodríguez, 2013). More specifically, the "absorptive capacity" of firms that already have some know-how can be higher than that of non-innovative firms, suggesting that they can more easily make use of new knowledge (see e.g. Griffith et al., 2006). As such, accumulation of knowledge through internal R&D can generate higher returns from export.

On the other hand, export activities can help firms to improve their knowledge base and boost their innovative capacities. This is because exporting firms are more exposed to knowledge inputs and new technologies that are not available in the domestic market (Alvarez & Robertson, 2004; Aw et al., 2011) and can learn from interactions with foreign competitors (Esteve-Pérez & Rodríguez, 2013). This so-called "learning-by-exporting" principle (henceforth LBE), outlined initially by Pack (1992), Hobday (1995) and Levy (1999), has been supported by a number of empirical studies (see, among others, Salomon & Shaver, 2005a; Girma et al., 2008; Aw et al., 2011; Golovko & Valentini, 2011; Neves et al., 2016).

Another possible mechanism is related to cost reduction and productivity gains. Naturally, export comes with various costs. Consider, for example, packaging costs, adjustment of product qualities to local standards and regulations, the establishment of market channels and the collection of information about the demand for these products or services as well as administrative and shipping costs (Roberts & Tybout, 1999; Golovko & Valentini, 2011). To compensate for these costs, exporting companies have to be more productive. A higher productivity can be achieved through innovation (for example making processes more efficient), thus creating a positive relationship between the two activities (Golovko & Valentini, 2011). Similarly, Aghion et al. (2018) find that high-productivity French firms increase their patent activity in response to positive export shocks, while low productive firms decrease their patenting.

Export can also mitigate any financial restrictions that a firm faces for investments in R&D. Investments in innovation, including R&D, imply the deployment of financial resources in the short term with the expectation of positive returns in the future (Golovko & Valentini, 2011). When external financing is unavailable or too costly, companies are limited to internal cash flows to finance their investments. Firms with limited or varying availability of cash flows, therefore, might avoid the risk of investing in innovation, because this entails an uncertain return. Exporting companies often have relatively stable access to their own resources, because a "bad economy" in one country can be offset by a "good economy" in another (Salomon & Shaver, 2005b), provided that the company has a geographically diversified export portfolio. In addition, exporting companies tend to have cheaper access to external financing, because external lenders often have more confidence in their liquidity (Shaver, 2011).

To sum up, R&D and export can reinforce each other in different ways. It is however difficult to explore these mechanisms separately, since they can occur simultaneously. Moreover, there could also be reasons why the export and R&D activities affect each other in a negative sense. For instance, due to the rival use of limited organizational resources mentioned above (Roper & Love, 2002). In the case of German manufacturing plants, Roper & Love (2002) find that there is a strategic trade-off between increasing innovation activity and export: such plants are facing a choice to focus on product development specifically for the home market, or to allocate fewer resources to innovation and more to developing new export markets.

The primary goal of our study is therefore to explore the direction and magnitude of the interaction between the two strategic decisions: to invest in R&D and to export. Moreover, we explore the potential heterogeneity in this interaction across different groups of firms (such as high and low productive, and small versus large), and the nature of the trade flow.

3. Data and model estimation

3.1 Econometric model and estimation

We model the interrelationship between innovation and exports via a system of two simultaneous equations. One equation describes the innovation activities of a firm, while the other equation describes firm-level exports, both controlling for additional firm-level characteristics. To test the relationship between exports and R&D, we include the dependent variable of one equation as an explanatory variable in the other equation and vice versa.

As this system of simultaneous equations represents two contemporaneous decisions of the same firm, there will be a possible correlation between the error terms of both equations, due to common unobserved factors influencing both decisions. Hence, a 3SLS estimator controlling for possible correlation between the error terms of the two equations is preferred. In particular, we estimate the equation using a 3SLS-GMM estimator, which has the advantage over standard 3SLS estimation that it allows the use of different instruments in subsequent equations of the system, while the standard 3SLS estimator assumes the same IV-set applied to every equation in the system. In addition, the 3SLS-GMM approach does not impose homoscedasticity, so that more efficient estimation is possible in the presence of heteroscedasticity (Wooldridge, 2002, chapter 8).
We estimate the following two firm-level equations:

$$R\&D_{it} = \gamma_0 + \gamma_1 EXP_{it} + \gamma_2' X_{1,it} + \varepsilon_{1,it}$$
$$EXP_{it} = \delta_0 + \delta_1 R\&D_{it} + \delta_2' X_{2,it} + \varepsilon_{2,it}$$

In these equations, $R\&D_{it}$ refers to the log of R&D expenditure of firm i in year t, and EXP_{it} refers to the log exports of firm i in year t. The vectors $X_{1,it}$ and $X_{2,it}$ contain control variables that represent firm characteristics which influence exports and innovation respectively. These variables are discussed below. The idiosyncratic errors of the equation are denoted as ε_{it}. We allow for contemporaneous correlation between the errors ε_1 and ε_2.

These covariances of the errors are also very important for the analysis because they illustrate the importance of common shocks across elements of the relationship between exports and R&D. In line with previous studies (e.g. Aw et al., 2011; Esteve-Pérez & Rodríguez, 2013; Maican et al., 2020) we consider total factor productivity (TFP) as an endogenous variable that enters as a firm characteristic in the system. Aw et al. (2011) argue that productivity evolution is endogenous, being affected positively by both R&D investment and exporting. In addition, firm-level productivity can also represent the feedback from firm performance to both innovation and export activities. Omitting TFP from the model or considering it as an exogenous variable would therefore bias our results. We instrument the endogenous variables in our estimating equations (export, R&D, and TFP) with a set of control variables from the system that can be assumed to be exogenous (to be discussed below).

3.2 Data sources and variables

The data used in this research come from different surveys and registers from Statistics Netherlands. These data contain information on firms across all economic activities in the Dutch business sector.[3] Table 3.2.1 provides an overview of all data sources, which were linked using a unique firm-identifier. The observational unit is the enterprise, also termed business unit, which can be thought of as the economic actor in the production process and to which we shall sometimes refer to as a 'firm'.[4] Most sources cover almost the entire population of firms. However, the R&D and production surveys are based on sampling (see Table 3.2.1). This means that larger firms are always included in the survey (although there might be non-response), but smaller firms (up to 50 persons employed) are sampled according to firm size and industry classification. Moreover, there is a lower threshold of 10 persons employed per year for firms to be included in surveys. Thus, the estimation sample is essentially given by the overlap between the R&D and Production Statistics (PS) samples, resulting in an unbalanced panel dataset with almost 19 thousand firm-year observations for the period 2013-2018. Due to the nature of the R&D and production data sampling, larger firms are overrepresented in the linked data, which should be kept in mind in the interpretation of the results. This may however not be a big issue for the relevance of the results, as it is known that most R&D and export are carried out by larger firms (Esteve-Pérez & Rodríguez, 2013). In addition, we provide separate results for SMEs and large firms in our sample, as part of our robustness checks.

Table 3.2.1 lists the variables used in the econometric analyses, along with the data source, unit, and definition. All variables are recorded on an annual basis. The R&D measure captures total R&D investments (in thousand euros) made by the firm in a given year, both intra- and extramural. An advantage of the current data is that they allow to estimate the model for both R&D and non-R&D performers. The R&D investment reported in the survey by a particular firm can, in some cases, refer to the (consolidated) R&D investments of the enterprise group of which the firm is part. Most firms however do not belong to a group (see table 4.1.2). We investigate whether this issue affects our results in the heterogeneity analyses by estimating our model based on the selection of firms that are not part of an enterprise group. Moreover, when a firm is part of a group, at the very least our results can be interpreted as the relation of exports of the firm to the innovative activity in its group.

From the administrative data we observe the export and import totals (in euro) for all firms exporters in a given year. This information can also be broken down to export of goods and services; export of Dutch domestically produced goods and re-export; intra-EU and extra-EU trade (and other country groups). Firms that are not

[3] The R&D sector (NACE code 72) has been discarded as the nature and goals of R&D in this sector, and its relation to exports, is likely to be different than in other sectors.

[4] The Eurostat definition is as follows: an enterprise is an organizational unit producing goods or services which has a certain degree of autonomy in decision-making. An enterprise can carry out more than one economic activity and it can be situated at more than one location. An enterprise may consist out of one or more legal units, https://ec.europa.eu/eurostat/statistics-explained/index.php?title=Glossary:Firm.

covered in the trade data can be safely assumed to be non-exporters or non-importers.
The continuous measures of R&D investment and export are used in logarithms in the regression analyses, to take into the account the skewness of the distributions. Moreover, we correct both variables for price changes using the consumer price index (CPI).[5] For non-R&D and/or non-exporting firms, the value of the log R&D and export variables is set to 0, to be able to include these observations in the analysis.

3.2.1 Data sources and variables

Variable	Unit	Definition	Source
R&D	1000s euro	total expenditure (intra- and extramural)	R&D-survey
Total value of import of goods	1000s euro	total value	ITGS
Total value of export of goods	1000s euro	total value	ITGS
Total value of export of services	1000s euro	total value	ITSS
Turnover	1000s euro	total value	PS and tax
Value added	1000s euro	total value	PS and tax
Foreign direct investments (FDI)	Binary	1 if FDI, 0 otherwise	FDI
Foreign-owned	Binary	1 if foreign-owned, 0 otherwise	IFATS
Firm size	headcount of persons employed	quarterly average by year	BDK
R&D tax credit	Binary	1 if received, 0 otherwise	WBSO
Secondary activities	Binary	1 if yes, 0 if not	ABR
Capital-labour ratio	1000s euro per person employed	depreciation cost by persons employed	PS and tax (derived)
Total factor productivity (TFP)		Solow residual (see main text)	PS (derived)

Note: PS= Production statistics; ITGS/ITSS = International Trade in Goods/Services Statistics; Tax= Profit and VAT tax information (Dutch: Vpb and BTW); FDI= Information of foreign affiliates from profit tax data (Dutch: Vpb); IFATS= Inwards Foreign Affiliate Statistics; BDK= Business demography statistics; WBSO= R&D tax credit data; ABR= Business register

[5] See 'Consumentenprijzen; prijsindex' https://opendata.cbs.nl/statline/#/CBS/nl/dataset/83131ned/table?fromstatweb

Control variables
To account for any other factors that might affect R&D and export activities, we include a number of control variables. Firstly, Dutch firms with foreign investments appear to be more likely to export and sell their goods to these countries, especially if these investments are made in low-income countries (van den Berg et al., 2018). Therefore, we include a dummy variable for firms with foreign affiliates. In line with Neves et al. (2016), we control also for foreign-owned firms, since such firms may have better access to financial resources, knowledge and technology (Esteve-Pérez & Rodríguez, 2013) and foreign participation can also influence the process of becoming an exporter (Basile, 2001).

We control for size and competition using respectively the total turnover of an firm, as well as its employment share, measured by the number of employees relative to the industry in which it is active (NACE Rev. 2 two-digit classification). The size of the firm in terms of sales appears to be positively related to exports (see e.g. Calof, 1994)[6] and to investment in R&D (see e.g. Cohen & Klepper, 1996). The assumption that firm size is positively associated with exports and innovation is often taken for granted, and public policy focuses on finding ways to improve these activities for small firms. The employment share is a proxy for the market power of a firm, which is likely to be positively related to exports and R&D, although too much market power could also weaken the incentives to innovate (Aghion et al., 2005).

Further, in the R&D equation, we consider whether the firm has received an R&D tax credit, a government subsidy aimed to support R&D activities of firms, using information from the R&D tax incentive register (in Dutch 'Wet Bevordering Speur- en Ontwikkelingswerk', WBSO). Firms receiving such a credit are likely to have more R&D investment (Mohnen et al., 2017), which should not be attributed to exports or something else. R&D as well as exports are related to economies of scope on the grounds that innovation and exports may spill over to different projects (for example, Piga & Vivarelli, 2004). We proxy scope economies by engagement of a firm in any secondary economic activities.
We also control for the capital intensity of the production process, proxied by depreciation cost by the number of persons employed in full-time equivalents???; depreciation cost being a major component of capital services and likely to be proportional to the firm's capital stock.

Last but not least, we control for the total factor productivity (TFP). As explained in section 3.1, we consider TFP as an endogenous determinant of R&D and export. We derive TFP as the Solow residual from a Cobb-Douglas production function, assuming constant returns to scale. Denoting Y as real value added, L as labour input (fte?), and K as capital inputs (proxied by depreciation cost), we have

$$Y = A \cdot L^{\alpha} K^{(1-\alpha)}$$
$$\leftrightarrow TFP \equiv A = \frac{Y}{L^{\alpha} K^{(1-\alpha)}}$$

[6] Calof (1994) combines two dimensions of firm size: sales and number of employees. See also other references in this study.

We log-linearize the TFP expression and measure the output elasticity α by the labour cost share. We express TFP in relative terms, normalizing it with respect to its median value by sector and year. This benchmarking of firm-level TFP mitigates the issue that we do not observe capital input cost, and basically assumes that the latter is proportional to depreciation cost, so that the ratio of these cost for two firms is a good approximation for the relative capital inputs.[7]

[7] To determine the shares, total production cost is proxied by the sum of labour and depreciation cost. To the extent that there are any other significant costs of capital, the share of capital will be underestimated in this way. However, we argue that depreciation cost is the major component of capital cost, and the resulting TFP measure should be highly correlated with a measure that would consider other types of capital cost.

4. Descriptive statistics

Before turning to the estimation results, we give an overview of the dataset in terms of descriptive statistics. This overview serves to present the total sample size and to indicate how many firms conduct R&D and/or export activities, or both.[8] Firms that have R&D expenditures conduct R&D activities either by themselves, or outsource these activities to third parties in the Netherlands or abroad. Firms that conduct exports have either exported goods or services, or both. It should be noted that re-exports (i.e. exports of goods that are sold in the same condition in which they were both) are also part of export activities. In section 6, we provide results based on a breakdown between domestically produced goods and re-exports.
On average, 40 percent of firms in the sample had R&D expenditure in the period 2013-2018. This is depicted in Table 4.1.1. On average, 82 percent were involved in exports of either goods or services[9]. It is possible that firms conduct both activities. In this period, 16 percent of firms neither did exporting activities, nor spent on R&D activities.

4.1.1 Firms (firm-year) with and without R&D investment and export activities

Year	Firms with R&D investments	Exporting firms	Firms without R&D and export	Total number of firms[10]
2013	781	1511	281	1832
2014	714	1637	266	1927
2015	1470	2981	600	3699
2016	1628	3219	625	3978
2017	1537	3142	659	3919
2018	1391	2848	576	3533
Observations	7521	15338	3007	18888

Table 4.1.2 presents the summary statistics of the sample. The average R&D expenditure in the sample is slightly above 2 million euro. For firms with R&D investments (7,521 in total) the average R&D expenditure is however more than 5 million euro. The mean of the export value in the sample is 55 million euro.

[8] See also the correlation matrix for variables used in the model in Appendix.
[9] The high share of exporters in our data (compared to the share in the whole firm population, see CBS, 2020) can be explained by the fact that the linked sample contains relatively many larger firms (in terms of the number of employed persons), and that we consider any export value different from 0 as a sufficient criterion for being an exporter, while in other studies 5000 is used as a lower bound.
[10] Note, groups 'Firms with R&D investments' and 'Exporting firms' can have overlapping observations.

4.1.2 Summary statistics

	Mean	Std. Dev.
R&D and Export as binary measures		
Firms with R&D investments	0.398	0.490
Exporting firms	0.812	0.391
R&D and Export as continue measures		
R&D expenditure (thousand euro)	2007	28607
(R&D expenditure of firms with R&D investments, obs. 7 521)	5040	45167
	55	337
Export value of goods and services together (thousand euro)	153	573
	67	373
(export value of exporting firms, obs. 15 388)	918	451
of goods	41	287
	499	023
of services	13	167
	654	029
Other firm characteristics		
Import value (thousand euro)		
	50	383
of goods and services together	501	482
of goods	36	267
	521	010
of services	13	252
	980	225
	176	820
Turnover (thousand euro)	972	507
	37	139
Value added (thousand euro)	207	569
Foreign investments (=1)	0.465	0.499
Foreign-owned firms (=1)	0.382	0.486
Employment share (fte)	0.016	0.041
R&D tax credit (=1)	0.339	0.473
Secondary activities (=1)	0.143	0.350
	23.59	206.41
Capital-labour ratio: fixed assets/fte (thousand euro)	1	0
Total factor productivity (TFP)	-0.05	0.94
Single firm within an enterprise group	0.643	0.479
Manufacturing firms	0.368	0.482
Service firms	0.523	0.499
Small firms (less than 50 fte)	0.221	0.415
Medium firms (50-250 fte)	0.442	0.497
Large firms (more than 250 fte)	0.336	0.472
Observations	18888	

Furthermore, the summary statistics show that 37 percent of firms are active in manufacturing and 52 are active in the services sector.[11] Lastly, 64 percent of firms in the sample do not belong to an enterprise group. As mentioned above, for firms that are part of an enterprise group, the R&D figure may reflect the investment of the entire group, rather than only of the firm itself. This measurement issue could make the results of those firms qualitatively different from single-unit firms. We address this issue in the heterogeneity section by estimating the model separately for the latter group.

[11] A small share of firms belongs to neither manufacturing nor service sectors.

5. Estimation results

Table 5.1.1 presents the results of the 3SLS-GMM estimation of the system of equations presented in section 3.1. . The model estimates the relationship between the two activities for all firms, meaning that firms that do not invest in R&D and/or are not exporters are also included in the regression. The null hypothesis of the Sargan overidentification test (Sargan, 1958), implying that all instruments in our model are valid, cannot be rejected. Therefore, the overidentifying restrictions are valid. As in the traditional 3SLS setting, we assume all control variables in the export and R&D equation to be exogenous, with the exception of relative TFP.

The coefficient estimates suggest that a 1 percent increase in the total export value (goods and services) positively affects R&D expenditure by 0.11 percent, and vice versa a one percent increase in R&D expenditure raises the firm’s export value by 0.30 percent. First, this suggests that there is complementarity between R&D and export activities. Second, the channel from R&D to exports appears to be stronger than in the opposite direction. This implies that the R&D returns, or benefits in terms of exporting, are higher than the export returns in terms of investing in R&D. In addition, if R&D and export are thought of as productivity enhancing activities, these results also confirm the difference in beneficial returns of engaging in both R&D and exporting versus only in either or none of the activities.[12]

The coefficients of TFP are positive and statistically significant, which is in line with previous studies (see e.g. Aw et al., 2011; Esteve-Pérez & Rodríguez, 2013). It appears that the effect of TFP on doing export and investing in R&D is of a comparable order of magnitude. The positive coefficients of relative TFP suggest that firms that are more productive will conduct more exports., The findings are in line with the theoretical predictions of the Melitz (2003) model and Maican et al. (2020) and the empirical findings of amongst others, Bernard and Jensen (2004). We also find that more productive firms invest more in R&D, suggesting that more productive firms, possibly as a result of innovations, will continue to invest in R&D because it pays off. Starting from Schumpeter (1934) the importance of internal efficiency to finance innovation projects has been commonly emphasised.

[12] In van Roekel et al. (2020), we conducted a transition matrix analysis leading to similar conclusions. We find that the probability of a firm exporting in year t-1, to engage in R&D in year t is 6 p.p. higher than for a non-exporter, and the probability of an R&D firm in year t-1 for being engaged in exports in year t is 11 p.p. higher compared to a firm that does not do R&D in year t-1. These results also suggest that R&D is a more important driver for exports than the other way around. We note that these results are based on a larger but similar dataset of firms.

5.1.1 Export value and R&D investment as continuous measures

	Log R&D	Log Exports
Export value of goods and services (real, log)	0.107***	
	(0.009)	
R&D expenditure (real, log)		0.301***
		(0.010)
TFP	0.532***	0.689***
	(0.118)	(0.135)
Turnover (real, log)	0.010**	-0.008
	(0.005)	(0.007)
Foreign investments (=1)	-0.171***	0.884***
	(0.038)	(0.047)
Foreign-owned firms (=1)	0.084**	0.264***
	(0.039)	(0.047)
Employment share (fte)	7.547***	-3.410***
	(0.588)	(0.632)
Secondary activities (=1)	0.111**	0.025
	(0.046)	(0.056)
Capital-labour ratio (log)	0.086***	0.137***
	(0.014)	(0.016)
R&D tax credit (=1)	4.277***	
	(0.046)	
Import value of goods and services (real, log)		0.733***
		(0.011)
Observations	18 888	18 888
Rho: 0,209 (standard error: 0,041)		
LR test rho=0, chi2(1)=21,499		

Note: Instruments: foreign investments, foreign-owned firms, firm size, R&D tax credit, import value, secondary activities, capital-labour ratio. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1. Rho gives the correlation between the error term between export and the R&D equation. Using the Arellano-Bond test we find that there is no serial correlation in disturbances.

Relying on our estimates, firms that were granted the R&D tax credit from the Dutch government increase their R&D investments by 66 times compared to R&D active firms that were not granted such tax credit.[13] Our results therefore imply

[13] The coefficient is 4.277 meaning that the impact on R&D investments will be: exp(4.277) – 1 = 65.68%. This high coefficient can be partially explained by the fact the R&D is skewed and that a relatively large sample of non-R&D performers is included in the sample. As we can see from Table 4.1.2, the mean value in R&D investments (in thousands) is equal to 5,040 from the R&D active sample (7,521 firms) with a standard deviation of 45,177 euro. When we consider a subsample of only R&D > 0 performers, the R&D tax coefficient reduces to about 1.

that the R&D increase due to the tax credit indirectly also benefits the export activities of these firms. The results further suggest that a firm’s turnover is positively related to R&D expenditure; this is consistent with the Schumpeter's (1942) claim about the advantages of large firms (in terms of sales) in R&D competition. Also, Cohen & Klepper (1996) find that firms with large business unit sales have an advantage in R&D because of the larger output over which they can apply the results of their R&D expenditures.
We find a positive relationship between the employment share and R&D investment. This is also in line with some of the empirical studies that find a positive effect of employment share on R&D spending (see Vancauteren et al., 2017). In line with our expectation, capital intensity is positively related to R&D investments.

We also find that foreign-owned firms are more likely to invest in innovation than domestic firms. Our explanation is that firms which are part of an enterprise group may have easier access to both internal and external capital in a world of capital market imperfections. On the other hand, firms with foreign investments appear to have lower R&D expenditures than those without. This could be related to the fact that these firms more often outsource their R&D activities to their foreign affiliates.

Looking at export, we first see that it is positively affected by the size of imports. This is also in line with the fact that the majority of the exporting firms also import (CBS, 2020). In line with what we expected, we also find that being a firm with foreign investments and/or being a foreign-owned firm appears to increase exports. In addition, capital intensity of the firm is also positively related to exports. However, the employment share negatively impacts export values indicating that smaller firms export more. Our explanation is that those firms will export to enlarge their market and escape domestic competition. We also note that the size of the firm in terms of turnover is not statistically significant.

6. Heterogeneity analyses

6.1 Heterogeneity

In this section, we employ the same empirical model to analyse the simultaneous relationship between R&D and exports, but using sample splits and different breakdowns of selected variables that we have defined in the model. Table 6.1.1 reports these results for both the R&D and export coefficients for each variant. Generally, our results confirm our overall results of a complementary relationship between R&D and exports. Moreover, the returns from R&D in terms of exporting of goods are stronger than the other way around in each of the estimations, except when we solely consider exports of services. The relationship between R&D and export is reversed in this case. This suggests that the mechanism of LBE works more profoundly for the export of services than for the export of goods.

6.1.1 Heterogeneity effects[14]

	Log R&D equation Coefficient: Export value of goods and/or services (real, log)	Log exports equation Coefficient: Expenditure on R&D (real, log)
Heterogeneity across firm characteristics		
TFP above median versus TFP below median		
TFP above median (9 512 obs.)	0.166***(0.019)	0.419***(0.033)
TFP below median (9 376 obs.)	0.115***(0.012)	0.282***(0.015)
Large firms versus SME's		
Large firms (6 353 obs.)	0.183***(0.022)	0.314***(0.018)
SME (12 535 obs.)	0.100***(0.008)	0.290***(0.012)
Single firm versus multiple firms per one enterprise group		
Single firm per enterprise group (12 150 obs.)	0.067***(0.014)	0.315***(0.012)
Multiple firms per enterprise group (6 738 obs.)	0.126***(0.013)	0.256***(0.017)

[14] We have also looked at the difference between the manufacturing and services sectors, but these are small and we decided not to report them explicitly.

Heterogeneity across firm characteristics		
Export of services versus export of goods (export>0)		
Export value of services (real, log) (15 338 obs.)	0.811***(0.147)	0.034**(0.016)
Export value of goods (real, log) (15 338 obs.)	0.117***(0.013)	0.290***(0.014)
Goods produced in the Netherlands versus re-export (export of goods>0)		
Export value of goods produced in the Netherlands (real, log) (13 607 obs.)	0.144***(0.018)	0.365***(0.013)
Re-export value of goods (real, log) (13 607 obs.)	0.102***(0.011)	0.195***(0.018)
Export value to EU versus to non-EU (export>0)		
Export value to EU countries (real, log) (15 338 obs.)	0.130***(0.014)	0. 183***(0.009)
Export value to non-EU countries (real, log) (15 338 obs.)	0.139***(0.014)	0.366***(0.014)
Export by destination economies (export of goods >0)		
Export value to advanced economies (real, log) (11 029 obs.)	0.107***(0.014)	0.316***(0.014)
Export value to emerging and middle-income economies (real, log) (11 029 obs.)	0.152***(0.019)	0.377***(0.016)
Export value to low income economies (real, log) (11 029 obs.)	0.240***(0.030)	0.172***(0.018)

6.2 Heterogeneity across firm characteristics

High TFP versus low TFP
Turning to the results, we begin by splitting the main sample into two subsamples to analyse whether high-productive firms with (TFP higher than the (industry) median) have a different relationship between R&D investment and export compared to low-productivity firms (with TFP lower than the median). The coefficients suggest that firms with TFP above median display a stronger degree of complementarity between R&D expenditure and export. The effect of R&D

expenditures on export value for such firms is especially substantial, compared to firms with TFP lower that the median. This is in line with the idea that both R&D and exports have a positive impact on productivity, and that through the mutual complementarity of these strategies, doing more of both reinforces these positive effects.

Larger firms versus smaller firms
In a similar vein, we also perform a sample split based on the SME versus large firms, which yields similar conclusions. Being part of a group or increasing its scale, enables firms to have a larger endowment for doing R&D and to be involved in export activities. With regards to the coefficients, the difference between the estimated elasticities of R&D and exports become slightly smaller once we allow for these size splits, but the R&D coefficient in the export equation is still significantly larger than the export coefficient in the R&D equation.

Firms part of an enterprise group versus individual firms
Next, we distinguish between firms that are part of an enterprise group and those that are not. The reason we make this distinction is that for a firm belonging to a larger enterprise group, the R&D investment figure may have been consolidated and attributed to that firm, while it is in fact the R&D concerning the whole enterprise group. Conversely, for enterprises that are not part of a larger enterprise group, R&D is by definition carried out within that single firm. This measurement issue could make the results of both types of firms qualitatively different. Making this distinction, however, similar conclusions are obtained. However, the export coefficient is markedly lower in the R&D equation for the independent enterprises. This could possibly be explained by the fact that firms that are part of an enterprise group may benefit from R&D by other firms in the group as well.

6.3 Heterogeneity across export characteristics

So far, we have considered R&D and exports for firms across firm characteristics. While the literature has focused mainly on the manufacturing sector and consequently export of goods, our data allow us to distinguish between several types of export characteristics as well. These are also reported in Table 6.1.1 and discussed below.

Export of goods versus exports of services
First, we distinguish between exports of goods and exports of services. Similarly to the main results, the effect of R&D on export of goods is much stronger (0.290) than vice versa (0.117). However, this is not the case for export of services. We find a statistically significant but small effect of R&D on export of services (0.034). At the same time, the effect of export of services on R&D is substantially larger (0.811). This suggests that LBE is especially visible for the exports of services.

Domestically produced exports versus re-exports
Additionally, we make a distinction between whether exported goods are domestically produced or re-exported. Re-exported goods are by definition not

produced by the exporting firm, so that any knowledge gained from exporting does not feedback into the production process of the firm producing the good. Vice versa, firms that engage heavily in re-exporting (mostly wholesale and retail trade) can be expected to gain and engage less from R&D. Thus, the R&D-export link is expected to be weaker in the case of re-exported goods, and excluding them from the total exports is expected to strengthen the estimated relations. The table reports these results of trade excluding re-exports, and confirms these prior expectations.

Intra-EU versus extra-EU exports
Next, when distinguishing between EU and non-EU exports and thus consider the destination market, we confirm the complementarity effects between R&D and exports. The analysis is performed on the sample of exporters in order to highlight differences between EU and non-EU exports; non-exporters are thus excluded from this analysis. We find that the channel of R&D to exports is much stronger for non-EU exports. Overall, a 1 percent increase in R&D investments increase non-EU exports by 0.37 percent, double the size of the coefficient estimate in the case of EU exports (0.18 percent). This is an interesting finding, considering the fact that the vast majority of exporters trade their goods and services with both EU and non-EU countries at the same time. After splitting the sample further into exports of services and exports of goods, it appears that these differences are driven by non-EU export of goods. One possible explanation for this finding is that the total export value to non-EU countries is composed of a different set of goods than that to EU countries.[15] For example, the second largest export value, after export of 'Machinery and transport equipment' products, is generated from export of 'Mineral fuels, lubricants and related materials' in case of non-EU exports and from export of 'Chemicals and related products' in case of EU exports. Furthermore, a recent report shows that the export quality of products (based on product price) varies significantly by destination. As such, about 35 percent of Dutch export transactions with faraway countries (e.g. countries in Latin America, Asia, New Zealand and Australia) consist of high quality products. This is only 28 percent for export transactions with nearby countries (van den Berg & Mounir, 2019). Below, we also explore how the relationship between R&D and exports varies by different country groups.

Export by destination economies
In the bottom rows of Table 6.1.1, we report the results when considering export destination country groups according to low-income countries, emerging and middle-income economies and advanced economies, as defined in the Fiscal Monitor of the International Monetary Fund (IMF).[16] This analysis is only possible when exports of goods are considered, because we lack specific partner information at the country level when considering international trade of services outside of the EU. Empirical evidence suggests that per capita income levels of countries relate with the nature and quality of products that are traded. For instance, Amiti & Khandelwal (2013) document significant quality differences

[15] See CBS OpenData https://opendata.cbs.nl/statline/#/CBS/en/dataset/83926ENG/table?dl=4F9EE
[16] Note, the destination country was not always possible identify in our data. For around 20 percent of the transactions, the destination country was unknown. These observations were discarded for this analysis.

among products imported by the U.S. from countries of various income levels. Aghion et al. (2005) find evidence that foreign competition of technological advanced countries encourages innovation to sectors close to the technological frontier but discourages innovation in laggard sectors. Exports originating from the Netherlands as a high-income level country (see World Bank classification) is expected to involve a higher technological embodiment compared to trade that originated from the low-income group. Our results suggest that the channel from R&D to exports in advanced economies and middle-income economies is stronger than vice versa from exports to R&D. By contrast, for the low-income countries we find a more favourable effect from export to R&D investment. At first sight, and given the arguments set out above, it seems unexpected that the LBE effect is dominating for the low-income countries. There are however several possible explanations for this finding. First of all, the vast majority of firms that export to low-income countries export also to advanced economies (91 percent) and to middle-income economies (86 percent). The share of exporters to low-income countries among firms that export to advanced economies is much smaller, only 65 percent. Therefore, our results for low-income countries group can be partly driven by the effect of being an exporter to both country groups. If we perform the analyses for firms that export only to low-income countries (and not anywhere else) the relationship between R&D and export becomes statistically insignificant. Secondly, and as we have discussed earlier, the export quality matters. Demand for the higher export quality from low-income countries can in turn stimulate higher R&D investments. Finally, the type of products exported to high-income countries are often different than the types of products exported to low-income countries, which can be related to different R&D sector intensity.

7. Relationship between extensive margins of R&D and export

In the results, so far, we have examined the relationship between exports and R&D expressed as continuous measures, considering whether more R&D investment leads to more export value and the other way around. Rather, if we are interested in the export and R&D propensities (becoming an exporter and a firm with R&D investments), theoretical underpinnings refer than to the so-called extensive margin of trade or R&D.[17] The assumption is that firms are faced with different criteria between internationalization and innovation decisions compared to criteria linked to the question on how much to invest in R&D or to export. Because we are interested in an approximation of the average partial effect, we perform the GMM estimation using binary measures of R&D investment and export, where 0 in the R&D variable indicates firms without R&D investments and 0 in the export variable refers to non-exporting firms in a given year t. Due to the discrete nature of the R&D and export variables, this is not an efficient approach but nevertheless it can give a good initial idea of the simultaneous relation between the R&D and export decisions.[18]

The table lists the estimated coefficients where R&D investment and export are expressed as binary variables. With respect to the R&D and the export variables' elasticities, we find strong evidence that the R&D benefits related to the export decision are larger than export benefits originated from the R&D decision. In other words, and as opposed to the results using the continuous variables, we find a strong dominance of the LBE effect in the propensity to do R&D. Again, R&D subsidies appear to be an important driver of export.

Overall, these results highlight an important additional mechanism on how firms acquire R&D investments and become exporters. The LBE effect and any stimuli through which firms become exporters in addition to R&D tax credits is an important channel through which firms become R&D innovators. We conclude that besides the extent to which a firm exports and does R&D, as we already know from previous section, also the discrete choices of becoming an exporter and/or an R&D performer have positive mutual spillover effects..

[17] In the Appendix, we also separately present the analyses where the extensive margin of export and R&D is affected by the intensive margin.

[18] For more explanation, see Wooldridge (2010, chapter 15). Mohnen et al. (2021) apply a simulated maximum likelihood estimation approach to a similar simultaneous discrete choice model with three binary strategies (ICT, R&D, and organizational innovation) and a separate TFP-equation.

7.1.1 Export and R&D investment as binary variables

	R&D (=1)	Exports (=1)
Export of goods and services (=1)	0.283***	
	(0.019)	
R&D investments (=1)		0.104***
		(0.012)
TFP (cost shares)	-0.022	-0.506***
	(0.015)	(0.035)
Turnover (real, log)	-0.005***	0.026***
	(0.001)	(0.002)
Foreign investments (=1)	-0.035***	0.189***
	(0.007)	(0.010)
Foreign-owned firms (=1)	0.007	0.048***
	(0.006)	(0.010)
Employment share (fte)	0.483***	-1.200***
	(0.073)	(0.096)
Secondary activities (=1)	0.013*	-0.019
	(0.007)	(0.012)
Capital-labour ratio (log)	0.002	-0.042***
	(0.002)	(0.004)
R&D tax credit (=1)	0.660***	
	(0.007)	
Import value of goods and services (real, log)		0.061***
		(0.002)
Observations	18,888	18,888

GMM estimation. Instruments: foreign investments, foreign-owned firms, firm size, R&D tax credit, import value, secondary activities, capital-labour ratio. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

In addition, we have estimated in two separate probit models the effect of the lagged export (t-1) on the probability of R&D investment (t), and the other way around the effect of R&D investment in the t-1 period on export probabilities in the t-period. The results (presented in the Appendix) show a statistically significant positive effect between R&D and export in both estimations. Moreover, the effects of the export and R&D variables are similar in magnitude. This again confirms that the relationship between R&D and export needs to be analysed in a simultaneous model in order to account for contemporaneous mutual effects between the two activities.

8. Conclusion

This paper revisits, at the firm level, the simultaneous export-innovation relationship using panel data analysing almost 19 thousand firm-year observations for the period 2013-2018. We apply a three-stage least squares (3SLS) Generalized Method of Moments (GMM) estimation to empirically address the concerns of endogeneity and heteroscedasticity in this relationship.

The empirical results of this study show that there is complementarity between R&D and export activities, and are therefore in line with most previous studies in this area. More specifically, we find that returns from R&D measured by exporting is higher than the LBE effect to R&D. The coefficient estimates suggest that a one percent increase in exports positively affect R&D expenditure by 0.11 percent (and therefore supports LBE mechanism), and vice versa, a one percent increase in R&D expenditure raises the firm's export value by 0.30 percent. We find that these results are mainly driven by exports in goods. For export of services, the channel from exports to R&D is much stronger, than from R&D to exports. We also find evidence that more productive firms export more, and that they invest more in R&D. This finding is in line with already existing evidence (Aw et al., 2011; Neves et al., 2016). In addition, our results also suggest that R&D investments are strongly determined by R&D tax credits. In our context, this suggests that indirectly, the tax incentives aimed at stimulating R&D and other forms of innovation also fuels the expansion of foreign trade.

Our results have some important implications. On the one hand, policy makers and firm managers, when promoting and implementing R&D and export, should remember that there is complementarity between these activities. Therefore, investing in one domain can in turn generate benefits for another domain. On the other hand, our study has shown that this complementary relationship is not homogeneous across firm types. As such, complementarity between two activities is stronger among larger firms as well as for export of products produced in the Netherlands (compared to re-export). It also appears that dependence between exports and R&D is stronger when considering trade to non-EU countries. We also find that returns to R&D are higher from exports to low income economies, whereas investment in R&D has a much stronger effect on exports to high- and middle-income economies.

As a sensitivity check, we also examined the relationship between exports and R&D in terms of propensities (the extensive margin). We find that our results on complementarity effects are still ascertained, although, the dominating effect is now channelled through the LBE effect on R&D. We conclude that not only the extent to which a firm exports and invests in R&D, but also the choice to become an exporter or R&D performer has positive mutual spillover effects.

The paper opens up several avenues for further research. In particular, given our results on both the extensive and intensive margin of R&D investment and exports, it is worthwhile to explore the possibilities of merging both aspects into an integrated structural model. Moreover, with an eye on the role of productivity in these firm decisions, follow-up research could model explicitly the effects of R&D and export on productivity and vice versa. Finally, while we employ a rich dataset, a constraint is that for small firms R&D information is only scarcely available. This may tend to give some bias in the results towards larger firms. Therefore, more research could be devoted to the role of the innovation process in small firms, as well to the extent of firm-size selection bias in the estimated relation between R&D and exports.

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Appendix

A.1 Correlation matrix

	Export	Import	R&D	Turnover	Single OG-BE	Foreign investments	Foreign ownership	Empl. share	R&D tax credit	Secondary activities	Capital-labour ratio	TFP
Export	1	0,69	0,41	0,58	-0,03	0,07	0,08	0,34	0,07	0,01	0,11	0,05
Import		1	0,16	0,71	-0,02	0,03	0,08	0,22	0,02	0,01	0,09	0,04
R&D			1	0,24	-0,01	0,03	0,01	0,21	0,08	0	0,06	0,03
Turnover				1	-0,08	0,07	0,08	0,31	0,03	0	0,1	0,08
Single OG-BE					1	-0,39	0,03	-0,03	0,01	0,06	-0,05	-0,08
Foreign investments						1	-0,02	0,06	0,16	0,01	0,12	0,08
Foreign ownership							1	0,05	0,04	-0,08	0,07	0,09
Employment share								1	0,13	0	0,09	-0,02
R&D tax credit									1	-0,01	0,14	0,01

Capital-labour ratio	1	-0,02	-0,01
Secondary activities		1	-0,17
TFP			1

A.2 Export value and R&D investment as continues measures, intensive margin

	Export value above 0		R&D expenditure above 0	
	Log R&D	Log Exports	Log R&D	Log Exports
Export value of goods & services (real, log)	0.131***		0.070***	
	(0.014)		(0.012)	
R&D expenditure (real, log)		0.199***		0.801***
		(0.008)		(0.069)
TFP (cost shares)	0.751***	-0.290**	0.137	0.572**
	(0.136)	(0.118)	(0.162)	(0.244)
Turnover (real, log)	-0.021**	0.212***	0.413***	-0.323***
	(0.009)	(0.008)	(0.008)	(0.036)
Foreign investments (=1)	-0.144***	0.371***	-0.038	0.772***
	(0.042)	(0.040)	(0.042)	(0.066)
Foreign-owned firms (=1)	0.058	0.341***	0.249***	0.088
	(0.046)	(0.041)	(0.045)	(0.073)
Employment share (fte)	7.342***	-1.989***	3.430***	-5.110***
	(0.632)	(0.428)	(0.419)	(0.841)
Secondary activities (=1)	0.122**	0.003	0.046	-0.038
	(0.055)	(0.048)	(0.051)	(0.081)
Capital-labour ratio (log)	0.120***	0.033**	0.037*	0.067**
	(0.019)	(0.016)	(0.021)	(0.032)
R&D tax credit (=1)	4.372***		1.055***	
	(0.048)		(0.046)	
Import value of goods and services (real, log)		0.599***		0.776***
		(0.011)		(0.022)
Observations	15 338	15 338	7 521	7 521

Note: The dependent variable in Step 1 is Expenditure on R&D (real, log); de dependent variable in Step 2 is R&D expenditure (real, log). Instruments: foreign investments, foreign-owned firms, firm size, R&D tax credit, import value, secondary activities, capital-labour ratio. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

A.3 Export value and R&D investment as binary measures, probit estimates, using the intensive margin sample

	R&D (dummy)	Exports (dummy)
Export value of goods & services (t-1)	0.438***	
	(0.043)	
R&D expenditure (t-1)		0.445***
		(0.039)
TFP (cost shares)	0.028*	0.036**
	(0.016)	(0.017)
Turnover (real, log)	-0.007	-0.063***
	(0.010)	(0.012)
Foreign investments (=1)	-0.076**	0.681***
	(0.030)	(0.036)
Foreign-owned firms (=1)	0.052*	0.020
	(0.030)	(0.036)
Employment share (fte)	2.474***	-2.158***
	(0.443)	(0.442)
Secondary activities (=1)	0.067*	-0.043
	(0.037)	(0.042)
Capital-labour ratio (log)	0.039***	0.025***
	(0.007)	(0.007)
R&D tax credit (=1)	2.078***	
	(0.031)	
Import value of goods and services (real, log)		0.216***
		(0.006)
Constant	-1.362***	-0.101
	(0.101)	(0.114)
Observations	12 230	15 338

GMM estimation. Instruments: foreign investments, foreign-owned firms, firm size, R&D tax credit, import value, secondary activities, capital-labour ratio. Robust standard errors in parentheses, *** p<0.01, ** p<0.05, * p<0.1.

Explanation of symbols

Empty cell	Figure not applicable
.	Figure is unknown, insufficiently reliable or confidential
*	Provisional figure
**	Revised provisional figure
2017–2018	2017 to 2018 inclusive
2017/2018	Average for 2017 to 2018 inclusive
2017/’18	Crop year, financial year, school year, etc., beginning in 2017 and ending in 2018
2013/’14–2017/’18	Crop year, financial year, etc., 2015/’16 to 2017/’18 inclusive

Due to rounding, some totals may not correspond to the sum of the separate figures.

Colophon

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