The productivity and export spillovers of the internationalisation behaviour of Belgian firms

Working Paper Research

by Michel Dumont, Bruno Merlevede,
Christophe Piette and Glenn Rayp

October 2010 **No 201**

National Bank OF BELGIUM
Eurosystem

Editoral

On October 14-15, 2010 the National Bank of Belgium hosted a Conference on "*International trade: threats and opportunities in a globalised world*".

Papers presented at this conference are made available to a broader audience in the NBB Working Paper Series (www.nbb.be).

Statement of purpose:

The purpose of these working papers is to promote the circulation of research results (Research Series) and analytical studies (Documents Series) made within the National Bank of Belgium or presented by external economists in seminars, conferences and conventions organised by the Bank. The aim is therefore to provide a platform for discussion. The opinions expressed are strictly those of the authors and do not necessarily reflect the views of the National Bank of Belgium.

Orders

For orders and information on subscriptions and reductions: National Bank of Belgium,
Documentation - Publications service, boulevard de Berlaimont 14, 1000 Brussels.

Tel +32 2 221 20 33 - Fax +32 2 21 30 42

The Working Papers are available on the website of the Bank: http://www.nbb.be.

ISSN: 1375-680X (print)
ISSN: 1784-2476 (online)

The productivity and export spillovers of the internationalisation behaviour of Belgian firms

Michel Dumont (Federal Planning Bureau and UA);
Bruno Merlevede (UGent and HUBrussel);
Christophe Piette (National Bank of Belgium);
Glenn Rayp (UGent, Sherppa)

September 27, 2010

Abstract

This paper analyses to what extent the decision to start exporting may be subject to spillovers of the internationalisation behaviour of other (foreign and domestic) firms. We distinguish between two possible channels: effects on productivity and effects on the perceived level of sunk costs of exporting. For both channels, we consider geographical and activity or industry-based linkages between firms. For a sample Belgian firms we find evidence of significant spillovers on productivity as well as productivity-independent spillovers on the decision to start exporting. Spillovers seem more substantial in the geographical dimension than in terms of competitor, client or supplier links, except for the impact of multinationals on the productivity of domestic firms.

JEL Classification: F2,
Keywords: Export, FDI, spillovers, sunk cost, region

1 Introduction

For the last 30 years the number of firms expanding their activities beyond national boundaries has increased dramatically. Internationalisation can take different forms such as serving the foreign market through exporting, setting up a subsidiary, or a combination of both. With respect to the export decision Melitz (2003) shows that firms will export if their productivity exceeds a certain threshold. In his model this is subject to a random draw: firms will export if they are lucky in productivity. However, one may ask what may constitute the causal determinants of the export decision. In this paper we consider possible spillover effects of the internationalisation of other firms on the decision to start exporting by a non-exporting domestic firm. The basic intuition of Melitz (2003) suggests two possible channels for spillover effects. The first channel is a productivity effect. The internationalisation of other firms could affect domestic firms' productivity. Provided the effect is positive and sufficiently large, it will lift productivity over a certain threshold and the non-exporting firm will start to export. A second channel is the impact of the internationalisation of other firms on the threshold itself. By extending the information set available to domestic firms, spillovers could lower the perceived level of sunk costs of exporting and may therefore induce a non-exporter to start exporting. Although there is related work on each channel separately, most research focuses on a single aspect. In order to get an comprehensive view on the importance of spillovers from internationalisation, we test for both i) productivity spillover effects and ii) threshold spillover effects. Our data on Belgian manufacturing firms allow us to analyse these threshold spillovers at the firm, the firm-destination, and the firm-product-destination level. The data further enable us to shed some light on the regional and the supply chain dimension of productivity and threshold spillovers from internationalisation in Belgium.

With respect to productivity spillover effects, there is ample research focusing on spillovers from multinational presence in the domestic economy that is largely focused on developing and transition countries (see Görg and Greenaway, 2004, and Meyer and Sinani, 2009). In this literature spillover variables are introduced as additional 'inputs' to explain a measure of domestic firms' productivity. The size and significance of the resulting coefficients in a regression analysis are then taken as evidence of spillovers. The literature distinguishes between spillovers to firms in the same industry (horizontal spillovers) and spillovers to firms in other industries linked to the foreign firm through the supply chain (vertical spillovers). Spillover variables are typically measured as the share of foreign firms in industry output or employment. There is a variety of theoretical transmission channels that may lead to either positive or negative spillover effects (see Crespo and Fontoura (2007) for an overview). The rationale underlying possible FDI spillovers is that multinationals use more advanced technology, set higher standards, *etc.* that may benefit (or hurt) domestic firms' productivity levels. Likewise, exporters emerge from many datasets as being on average larger and more productive than their domestic counterparts. Studies on spillovers from exporters to domestic firms' productivity are more scarce and most of these studies focus exclusively on foreign-owned exporters. Using data for Chilean manufacturing plants from 1990 to 1999, Alvarez and Lopez (2008) find evidence that both foreign-owned and domestic exporting plants improve productivity of local suppliers. Horizontal spillovers from exporting are mainly generated by plants with foreign ownership. For a panel of Colombian plants Clerides et al. (1998) find that regional spillover variables tend to be associated with cost reductions both for exporters and domestically oriented producers.

If spillover variables affect the probability to start exporting when controling for productivity, threshold spillover effects emerge. These spillover effects have received somewhat less attention in the literature. Clerides et al. (1998) find some evidence in favour of both geographic and sectoral spillovers on the export status for Colombian plants and Aitken et al. (1997) find that the presence of multinational exporters in the same industry and state increases the probability of being an exporter for a cross-section of Mexican firms. In a more recent study covering about 15 years of UK firm-level data, Greenaway and Kneller (2008) find that regional and industry agglomeration are relevant to successful entry of new exporters. They find strong and positive spillover effects from exporters in the same industry and a similar (independent) effect from exporters in the same region. The number of exporters in a different region and a different industry has no statistically significant impact. While the aforementioned studies are at the firm level, Koenig et al. (2010) consider local export spillovers at the firm-product-destination level on the decision to start (rather than participate in) exporting. They find that spillovers are stronger when they are product and destination-specific and that they exhibit a spatial decay in France. Not all papers are consistent with the existence of spillovers, however. Using relatively aggregated measures of agglomeration (regions are measured by US states and industries at the 2 digits level) Bernard and Jensen (2004) find no role for geographic spillovers, nor for export activity of other firms in the same industry for their panel of large US plants. For a panel of Spanish firms, Barrios et al. (2003) find no indication of spillover effects through the presence of other exporters or multinationals.

The spillover effects from international activities can thus be linked to several channels and may entail a regional dimension. We test whether domestic firms' productivity and/or their perceived level of sunk costs are affected by spillovers. We try to identify where and how spillovers occur. Our findings suggest an important geographical dimension. Firm productivity increases with the presence of exporting firms in the same region as well as with supplying to multinational firms. There are indications of negative within-industry spillover effects, which may be linked to a competition or input crowding out effect. At the firm level the decision to start exporting seems to be driven merely by the firm's productivity level and not by threshold spillovers. However, we do find significant threshold spillover effects at both the destination and the product-destination levels. Similar to the productivity spillovers, the geographical dimension is important. Our results thus show that not only information spillovers on the perceived level of sunk costs matter, but so do productivity spillovers.

The remainder of the paper is organised as follows. Section 2 describes the dataset, section 3 defines the spillover variables and the estimation framework. In section 4 we present the results from our analysis and section 5 concludes.

2 Data

Our dataset was built using four databases made available by the National Bank of Belgium (NBB): the annual accounts data, the Crossroads bank, the foreign trade data and results of a survey on foreign direct investment. The annual accounts filed by Belgian non-financial companies with the Central Balance Sheet Office (CBSO) constitute the cornerstone of the dataset. They provide measures for the value added, the turnover, the intermediate consumption, the employment expressed in full-time equivalent and the capital stock. The latter encompasses all types of tangible assets, i.e. land, buildings machinery, equipments, furniture, vehicles, etc. As all the amounts taken from the annual accounts are expressed in current prices, we converted them into volumes using deflators at the NACE 2 digits level from the Belgian national accounts. In the database used for this paper, flow variables (i.e. value added, turnover and intermediate consumption) were realigned on the calendar year for those firms that did not close their accounts on the 31st of December. This realignment is carried out by means of the annual accounts of two consecutive years. It must be noted that annual accounts data are not available for all Belgian companies as enterprises with unlimited liability, as well as natural persons conducting trade activities, do not file accounts with the CBSO. The database does not include financial companies either, which must submit their accounts using another scheme. Consolidated accounts are also excluded from the database in order to avoid double counting. Depending on their size, firms must either use a full or an abridged format for their annual accounts. Large firms[1], which use the full format,

[1]In 2005, a firm was considered as large either if it employed at least 100 persons, or if it crossed at least two out of the three following thresholds: (a) yearly average number of employees of 50 persons; (b) turnover of 7,300,000 euro; (c) balance sheet total of 3,650,000 euro.

must report more items, such as turnover and consumption of intermediates, that are only optional in the abridged format filled out by smaller firms.

The foreign trade data are based on information collected via the Belgian customs and through the Intrastat inquiry. They not only allow to identify a firm's export status, but als oconvey more detailed information such as the product and the destination. By means of declarations filled in by exporters and importers, Belgian customs collect information on transactions related to trade in goods with countries outside the European Union. Besides the values and the quantities of the traded commodities, firms have also to declare their country of destination or origin, assign a product code (using the 8 digits combined nomenclature) to each transaction, as well as a category related to its nature (e.g. transactions with change of ownership, goods sent abroad for repairs or processing, etc.). These declarations are sent to the NBB, which uses them to compile extra-community trade statistics. The purpose of the Intrastat inquiry is to collect the same kind of information directly from Belgian firms in order to compile intra-community trade statistics. Contrary to the extra-community trade data received from the customs, whose coverage is almost exhaustive[2], the scope of the Intrastat inquiry concerns only a limited number of firms. Indeed, a firm has to report its exports to or its imports from other EU Member States only if their annual amounts cross a certain threshold. The inquiry is conducted by the NBB since 1995, but unfortunately reporting thresholds were raised in 1998 and in 2006, thereby restricting the coverage of the inquiry. Therefore, in order to preserve the time consistency of firms' exporting status, we decided to limit the sample period to 1998-2005[3]. Furthermore, for the purpose of the empirical investigation, we simplified the foreign trade data in two ways before merging it with the annual accounts. First, we only considered transactions related to changes in ownership. Second, we reduced the number of product categories by collapsing the data to the 4 digits nomenclature.

Lastly, establishments of foreign firms and Belgian multinationals are identified by means of the results of the NBB survey on foreign direct investment. Conducted on a yearly basis since 1998, this survey makes a census of firms involved in foreign direct investment relations with non residents, either through direct or indirect ownership links. This includes companies holding at least 10% of the social capital of foreign firms and those of which at least 10% of the shares are owned by foreign investors. Within this framework, firms are required to report their FDI situation at the 31st December of the previous year. The scope of this survey is however limited to firms whose investment relations with non-residents involve

[2]Customs declarations concern all transactions whose value exceeds 1,000 euro or whose weight is higher than 1,000 Kg.

[3]During this period, firms had to report their export flows to other EU countries if their yearly total value exceeded 250,000 euro. The same threshold held also for import flows.

Table 1: Population of manufacturing firms in 2005

	Total population	Firms with less than 5 employees[1]	Firms with at least 5 employees[1]	Firms with TFP estimates based on the index method[2]	Firms with TFP estimates based on the ACF method[3]
Number of firms	24,027	15,250	8,777	6,114	5,202
Number of exporters	5,632	1180	4,452	3,324	3,162
Number of foreign firms	642	28	614	460	601
of which exporters	*572*	*11*	*561*	*429*	*549*
Number of Belgian multinationals	177	17	160	133	155
of which exporters	*146*	*3*	*143*	*123*	*140*
Sum value added (millions of euro)	47,058	1,402	45,656	35,950	42,487
Sum exports (millions of euro)	92,208	2,672	89,536	73,801	86,608
Average number of export destinations	7.6	3.0	8.8	9.2	10.4
Average number of exported products	11.7	4.3	13.7	14.1	16.3

Sources: Central Balance Sheet Office, Survey on foreign investment and foreign trade data.
'1 On average over 1998-2005.
'2 Firms with 5 employees or more, which reported their tangible fixed assets. Outliers - i.e. TFP estimates falling outside an interval defined by the interquantile range multiplied by 3 - were left aside.
'3 Firms with 5 employees or more, which reported both their tangible fixed assets and their turnover.

substantial amounts; only companies that cross some thresholds in terms of financial assets, equity and balance sheet total are taken into account.

Table 1 gives an overall view of the sample obtained on the basis of these data sources for the year 2005. In all, 24,027 manufacturing firms filed annual accounts with the CBSO. A lot of firms are micro firms with less than 5 employees. Only a very small fraction of these small firms is involved in foreign trade and an even smaller proportion in FDI relations. In our empirical analysis we will focus on a sample of firms with at least 5 employees on average. The values of the spillover variables described in the following section are therefore calculated on the basis of the population of firms employing at least 5 persons, which concentrate most of the value added and trade flows in manufacturing. For the year 2005, this concerns 8,777 firms, of which 4,452 exporters. Some of these firms cannot be included in the regressions as they did not report all the items needed to obtain a TFP measure.

Finally, our data are complemented by information taken from the Crossroads bank, i.e. the registry of Belgian enterprises. The Crossroads bank conatins information on the date on which firms started their activities, enabling us to determine their age. More importantly, the Crossroads bank also mentions the address(es) of firms and that of their establishments. These addresses are used to determine whether a firm owns a plant in a given region. This information will allow us to deal with multi-plant firms in the calculation of spillover variables (cf. infra). As a unit of geographical observation we focus on the NUTS 3 level. The NUTS (Nomenclature of territorial units for statistics) classification is a hierarchical system for

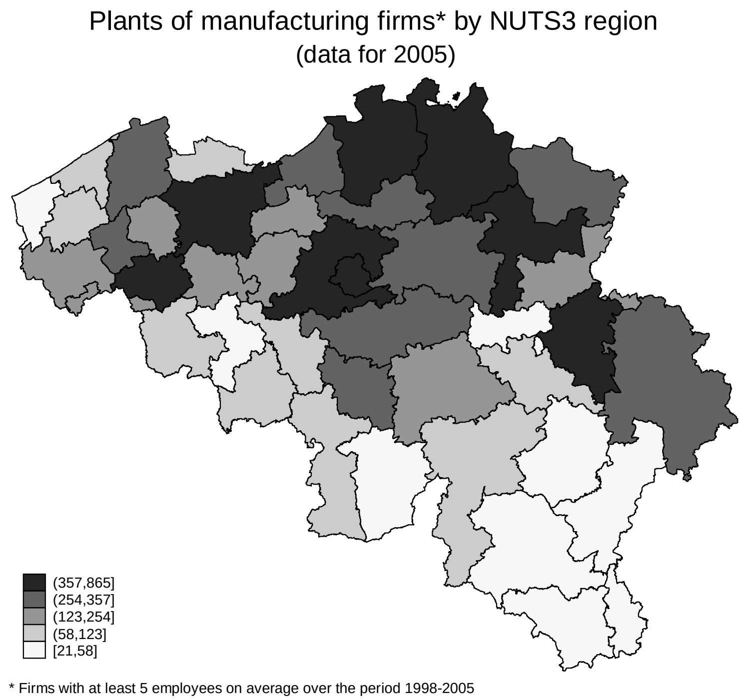

Figure 1: Geographical distribution of manufacturing firms

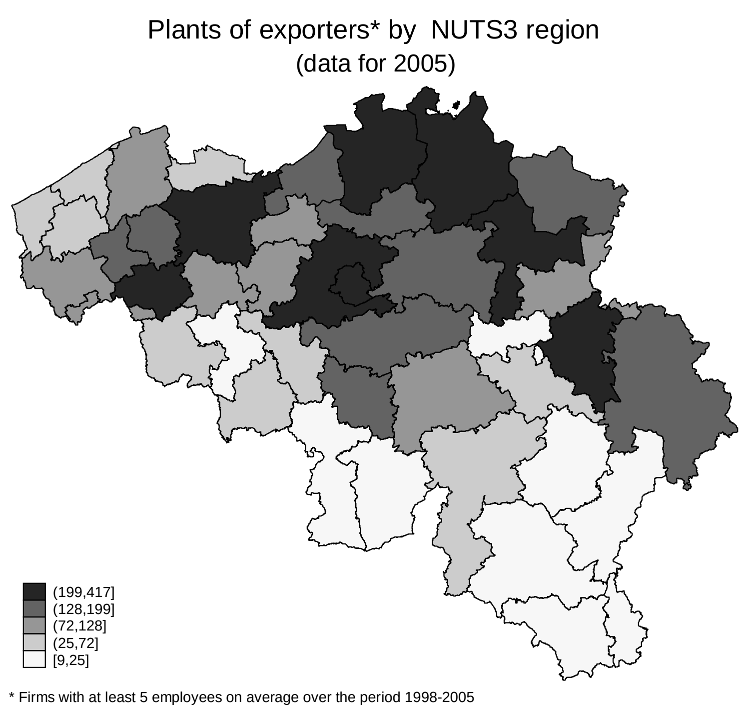

Figure 2: Geographical distribution of exporting manufacturing firms

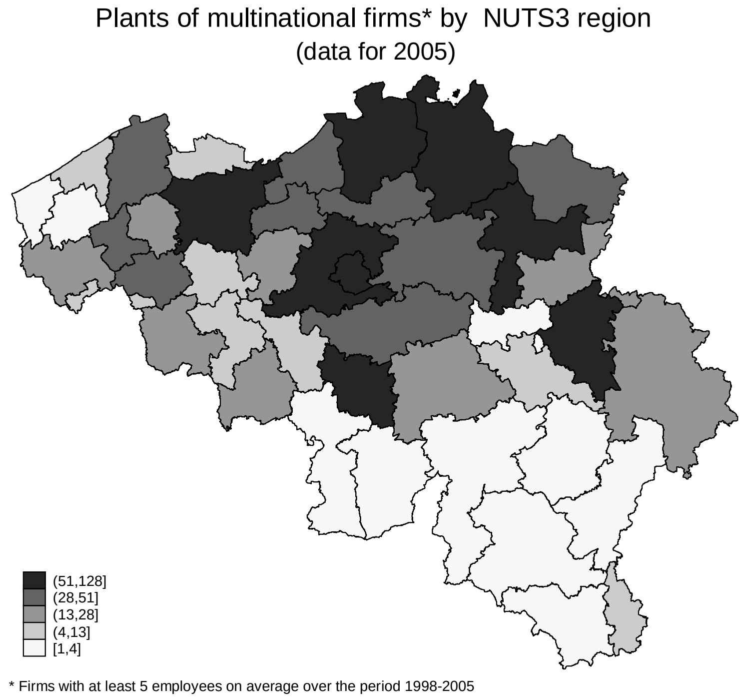

Figure 3: Geographical distribution of multinational firms (in manufaturing)

dividing up the economic territory of the EU. NUTS 3 regions are defined as 'small regions for specific diagnoses' (population between 150,000 and 800,000). At this level Belgium is divided in 43 districts. The use of region or location in the remainder of the paper always refers to the NUTS 3 classification, unless explicitly mentioned otherwise. The geographic distribution of manufacturing firms among the Belgian NUTS 3 regions is represented in Figure 1. Figures 2 and 3 depict the distribution of exporters and multinational firms respectively. The overall picture coming out from these figures is a certain concentration of trade activities and foreign investment. While it might provide some indication about the existence of possible geographic spillovers in terms of international involvement, this also reflects to a large extent the general concentration of economic activity.

3 Estimation and spillover measurement

3.1 Testing for internationalisation spillover effects

With respect to productivity spillover effects we follow the established approach in the FDI spillover literature. In (1) we relate an indicator of total factor productivity for firm i in industry j in year t to different spillover effects ($\Psi_1 f\left(TFPspill\right)$), which are discussed below, a set of control variables at the firm and industry level (X_{it} and Y_{jt}), and firm effects. Because we are specifically interested in whether spillovers could lift domestic firms' productivity enough to cover the sunk costs of becoming an exporter, we focus on the specific subsample of domestic non-exporters. For the estimation specification (1) is first differenced and industry, region, and time effects, γ_j, γ_r, and γ_t are introduced to account for industry, region, and time specificities affecting tfp growth. This results in (2) which is estimated by OLS. As control variables we include lagged tfp growth, lagged import status, firm age, and first differenced lagged industry competition (measured by a Herfindahl index at the NACE 2 digits level).

$$tfp_{it} = \gamma_i + \Psi_1 f\left(TFPspill_{t-1}\right) + \gamma_2 X_{it} + \gamma_3 Y_{jt} + \varepsilon_{it} \quad (1)$$

$$\Delta tfp_{it} = \Psi_1 \Delta f\left(TFPspill_{t-1}\right) + \gamma_2 \Delta X_{it} + \gamma_3 \Delta Y_{jt} + \gamma_t + \gamma_j + \gamma_r + \varepsilon_{it}^{'} \quad (2)$$

With respect to threshold spillover effects, we model the firm's decision to start exporting (rather than its export status) in (3) as a logit model (see e.g. Aitken et al., 1997, Roberts an Tybout, 1997, and Greenaway and Kneller, 2008). Since we focus on the decision to start exporting, we create a dummy variable indicating the "new exporter" status on the basis of a firm's export status. We consider a firm as a new exporter in year t if the firm exports in t but was not exporting in $t-1$ and $t-2$. Table 2 gives an example of how the value for the "new exporter" variable is derived from the export status. This definition implies that firms that always export are not part of the estimation sample, whereas that firms that never export (i.e. with zeros over the whole period) are because they face the decision to start exporting or not. Note that the definition implies a two year burn-in period, reducing the time span of the logit estimation sample to the period 2000-2005. Although this definition allows for multiple start spells, less than two percent of firms that start to export, start more than a single export spell. This holds both at the firm, the destination and the product-destination level. As indicated above the unit of observation in our dataset is the firm(-product-destination)

Table 2: Creation of the "new exporter" variable for the estimation of the probability to start exporting

	1998	1999	2000	2001	2002	2003	2004	2005
export status dummy	0	0	0	0	1	1	1	1
new exporter dummy	.	.	0	0	1	.	.	.

level. Nevertheless, we are able to discriminate between single and multi-plant firms. In the estimation sample only single-plant firms are included, but for the calculation of spillover variables we do take multi-plant firms into account (*cf. infra*). Our sample thus consists of all single-plant firms that face the decision whether or not to start exporting (product p to destination d) in year t. (3) is written down for an estimation at the firm level, but we also present results for a similar model at the firm-destination ($\Pr(EXP_{idt} = 1)$) and the firm-product-destination ($\Pr(EXP_{ipdt} = 1)$) level.

$$\begin{aligned} \Pr(EXP_{it} = 1) &= \Omega_1 f\left(Thresholdspill_{t-1}\right) + \beta_2 V_{it-1} + \beta_3 tfp_{it-1} \\ &\quad + \beta_j + \beta_t + \beta_r + \left(\beta_d + \beta_p\right) + \upsilon_{it} \end{aligned} \tag{3}$$

Participation decisions are determined by a combination of firm productivity (tfp) and sunk costs. By including tfp as a control in (3), we can interprete the sign and significance of Ω_1 as evidence of threshold spillover effects since tfp will capture possible productivity spillover effects. As common in the literature we use lagged tfp to avoid reverse causality issues. V_i is a vector of firm-level controls**.** Our threshold spillovers are also suspect to simultaneity and reverse causality issues. If a firm's export behaviour depends on other firms' export behaviour, then other firms' export behaviour obviously depends on the former's export behaviour as well. Therefore, following Bernard and Jensen (2004), we lag -in addition to tfp- all other righthandside variables one year. Since a region with more export favourable infrastructure will host more exporters, we need to account for regional differences in export-supporting institutions because this effect will otherwise be picked up by our spillover variables. Therefore we control for region fixed effects β_r. Finally β_j and β_t, are industry and time dummies. Depending on the level of analysis we further include destination and product dummies, β_d and β_p.

(1) and (3) both include internationalisation spillover effects. The literatures with respect to productivity spillover effects and threshold spillover effects have, however, proposed a different basis to measure spillover variables. Clerides et al. (1998) indicate that the number of exporters is more likely to affect the prevalence of knowledge about foreign technologies

and markets, while volumes produced and sold more likely affect the size and efficiency of supplying industries. A similar reasoning can be applied to domestic multinationals and foreign firms in the domestic economy. Therefore with respect to productivity spillover effects, our basis of the spillover variables -also in line with the FDI spillover literature (see Görg and Greenaway, 2004, and Meyer and Sinani, 2009)- is the share in output produced by firms that are internationally active. The share in output also proxies the probability of having business relationships with internationalised firms since it likely increases with their share in total transactions. For threshold spillover effects that are linked to the knowledge about foreign markets, we use the number of internationally active firms as a basis for the spillover variables (see e.g. Koenig et al., 2010, and Greenaway and Kneller, 2008). This type of information spillovers likely varies only little with firms' 'intensity' of internationalisation.

3.2 The measurement and identification of spillover effects

Griliches (1992) points out that the main problem in measuring (R&D) spillover effects is the adequate definition of proximity between firms. Firms can be expected to borrow different amounts of knowledge from different sources according to their distance from these sources. The definition of distance regarding spillover effects from internationalisation behaviour can at least be twofold, either referring to physical distance or to economic distance. The latter is determined by the intensity of purchases and sales of internationally active suppliers and customers or the presence of internationally active competitors. Within a customer-supplier framework, spillover effects may result from exporting clients who demand higher quality inputs, which (provided the demand is met) allows the supplier firm to increase its productivity and export as well. Similarly, exporting suppliers may provide a firm with higher quality or lower cost inputs, which enables their clients to enter foreign markets. This distinction is also relevant for more 'disembodied' spillover effects such as demonstration effects that may either originate from physically neighbouring firms or 'economic' proximate firms (i.e. suppliers, competitors, or clients).

In terms of the spillover effects we analyse in (2) and (3), we discriminate among several possible spillover effects according to the type of 'distance' between domestic firms and internationalised firms. We will allow for the following types of relationships: geographical neighbours (clustering), within industry competitors and between industry suppliers or clients, i.e. we consider both spillovers that are linked to economic or geographic distance. We will also allow for interaction between different types of distance.

3.2.1 Spillovers and geographical distance

In line with previous studies such as Clerides et al. (1998), Aitken et al. (1997), Greenaway and Kneller (2008) and most recently Koenig et al. (2010), we investigate the impact of internationalisation behaviour of geographically nearby firms. Based on the literature on FDI spillovers, we then construct productivity spillover variables in NUTS 3 region r at time t as follows:

$$REGPR_{rt}^{EXP} = \frac{\sum_{i\in r} F_{it}^{EXP} * Y_{it}}{\sum_{i\in r} Y_{it}} \tag{4}$$

$$REGPR_{rt}^{FDI} = \frac{\sum_{i\in r} F_{it}^{FDI} * Y_{it}}{\sum_{i\in r} Y_{it}} \tag{5}$$

where Y_{it} represents value added[4], F_{it}^{FDI} and F_{it}^{EXP} are dummy variables that are set to one for exporters and multinationals respectively. Productivity spillover variables are thus constructed as the share of exporters or multinationals in total regional value added. In our dataset, value added is available only at the firm level, not at the plant level. Therefore, when dealing with multi-plant firms established in several regions, we computed these spillover variables so as to avoid double counting the value added produced by other multi-plant firms located in the same areas.[5] To simplify, we do not discriminate between Belgian MNEs and foreign MNEs and we do not discriminate between exporting and non-exporting MNEs. The sum of the coefficients on the export spillover variable and the MNE spillover variable. can therefore be interpreted as th total spillover from MNEs.

The threshold spillover variables, by contrast, are defined as counts of the number of firms in (6) and (7). This follows the approach in Greenaway and Kneller (2008) and Koenig et al. (2010).

$$REGTH_{rt}^{EXP} = \# \text{ exporters in region } r \text{ in year } t \tag{6}$$

$$REGTH_{rt}^{FDI} = \# \text{ multinationals in region } r \text{ in year } t \tag{7}$$

For the analysis at the firm-destination or firm-product-destination level, threshold spillover variables are adjusted accordingly. For the estimations we first add 1 and then take logarithms of these count variables. We do so because we believe that the impact of an additional

[4]A considerbale number of firms do not report their turnover. E.g. of the firms in our trimmed dataset that did report value added, only about 60 percent of them reported turnover (for the year 2005).

[5]Financial and export/import data are provided at the firm level. By firm, we know how many plants it has and where they are located. If a firm is exporting we consider all plant-locations as possible transmitters of spillovers.

exporter in spillover terms is decreasing in the number firms that is exporting.

3.2.2 Spillovers and economic distance

Economic distance linked spillovers occur through the internationalisation behaviour of competitors in the same industry and through the internationalisation behaviour of suppliers and clients that are upstream or downstream in the supply chain. Similarly to the location definitions above we follow the approaches in the productivity spillover and threshold spillover literatures and construct two types of variables.

In the estimation of the spillover effects on total factor productivity, the spillover variable is defined as follows :

$$HRPR_{jt}^{EXP} = \frac{\sum_{i\in j} F_{it}^{EXP} * Y_{it}}{\sum_{i\in j} Y_{it}} \quad (8)$$

$$HRPR_{jt}^{FDI} = \frac{\sum_{i\in j} F_{it}^{FDI} * Y_{it}}{\sum_{i\in j} Y_{it}} \quad (9)$$

where Y_{it} again represents value added of firm i in sector j, F_{it}^{FDI} and F_{it}^{EXP} are dummy variables that are set to one for exporters and multinationals respectively. We further define vertical spillovers as effects between firms in different but supply chain linked industries. The backward spillover effect is defined as the impact of supplying goods to an internationalised firm. In line with the FDI spillover literature we propose the following definitions (10) and (11) of variables to capture spillover effects from contacts with downstream clients.

$$BK_{jt}^{EXP} = \sum_{k \;if\; k\neq j} \gamma_{jkt} * HRPR_{k,t}^{EXP} \quad (10)$$

$$BK_{jt}^{FDI} = \sum_{k \;if\; k\neq j} \gamma_{jkt} * HRPR_{k,t}^{FDI} \quad (11)$$

γ_{jkt} is the proportion of industry j's output supplied to industry k at time t. γs are calculated using the input-output (IO) tables for intermediate consumption.[6] $HRPR$ is the measure for exporter or MNE presence in industry k at time t. In the calculation of γ, inputs sold within the firm's own industry are excluded ($k \neq j$) because this is captured by $HRPR$. By

[6] We have three input-output tables for the Belgian economy, i.e. for the years 1995, 2000, and 2005. The 1995 technical coefficients are used for the years 1995-97; the technical coefficients derived from the 2000 IO table are used for the period 1998-2002; the remainder of our sample period uses information from the 2005 IO table. The industry classification is at the Nace two digit level.

using the share of industry output sold to downstream domestic markets k with some level of $HRPR$, we avoid a possible endogeneity problem that arises when exporters or foreign firms choose more productive domestic firms as their suppliers. The fact that exporters or foreign firms cannot easily switch industries where they buy their inputs should rule out an endogeneity bias. In the same spirit, forward spillover variables are defined as in (12) and (13). These FW-variables intend to capture the impact from the relationship between domestic firms and their internationalised suppliers (i.e. domestic firm i in industry j buying inputs from an internationalised firm in upstream industry l). Here the IO tables reveal the proportion δ_{jlt} of industry j's inputs purchased from upstream industries l. Inputs purchased within the industry ($l \neq j$) are again excluded.

$$FW_{jt}^{EXP} = \sum_{l \ if \ l \neq j} \delta_{jlt} * HR_{l,t}^{EXP} \quad (12)$$

$$FW_{jt}^{FDI} = \sum_{l \ if \ l \neq j} \delta_{jlt} * HR_{l,t}^{FDI} \quad (13)$$

For threshold spillover effects we create two within industry spillover variables as the number of exporters and the number of multinationals in the same NACE two digit industry in (14) and (15). Forward and backward spillovers measures are then constructed using the same formulas as in (10)-(13).

$$HRTH_{jt}^{EXP} = \# \text{ exporters in industry } j \text{ in year } t \quad (14)$$

$$HRTH_{jt}^{FDI} = \# \text{ multinationals in industry } j \text{ in year } t \quad (15)$$

With respect to our alternative sample constellations (firm/firm-destination/firm-product-destination) our measure for the presence of exporters in the industry change accordingly to the number of exporters (of product p) to destination d in industry j in year t.

3.3 Productivity measures

The different methods that have been proposed to derive a measure of productivity at the firm level are all known to have advantages as well as limitations and no single method appears to dominate under all circumstances (e.g. Van Biesebroeck, 2007, and Basu et al. 2009). Total factor productivity can be computed or otherwise estimated as a residual from a production function regression. Computing total factor productivity using the index number approach has the obvious advantage that it does not impose a specific form on the production function and thereby acknowledges possible cross-firm differences in production technology. However, some of the rather strong assumptions that are imposed call for caution in the interpretation of index-based TFP growth, as a measure of technical efficiency.

For the estimation of TFP using a production function regression, semi-parametric methods (e.g. Olley and Pakes, 1996; Levinsohn and Petrin, 2003) seem to have become more popular than generalized method of moments (e.g. Blundell and Bond 2000). These procedures take into account the endogeneity bias that would occur in Ordinary Least Squares estimation if part of the residual is known to the management of firms but not to the researcher who estimates the production function. The endogeneity problem is presumed to result in overestimation of the labour coefficient of the production function and -although to a lesser extent- underestimation of the capital coefficient. Ackerberg et al. (2006) have questioned the validity of the control function estimation proposed by Olley and Pakes(1996) and Levinsohn and Petrin (2003), arguing that both suffer from a collinearity problem. They propose an alternative estimation procedure that alleviates the collinearity problem.

Melitz (2000) pointed out that the omitted output price bias, a problem which in addition to the endogeneity bias had already been recognized by Marschak and Andrews (1944), has been largely ignored in most empirical work. Griliches and Mairesse (1995) argued that in order to address the endogeneity problem, researchers appear to have exacerbated other (data) problems and misspecifications. They called for better data, e.g. on product prices at the firm level and for better behavioural theories that could explain substantial firm heterogeneity. Due to a lack of data on output (product) prices, deflated revenue (turnover) often substitutes for real output in most estimations of firm-level productivity. As turnover depends on supply (e.g. competition) and demand (e.g. consumer preferences), productivity is likely to be biased if the firms that are considered do not produce the same single product for the same market. Melitz (2000) proposed a way to account for this bias by imposing a market demand structure (Dixit-Stiglitz) which he acknowledged to be restrictive but in his view less restrictive than the demand structure that is implicitly imposed when deflated turnover is used to proxy real output. Foster et al. (2008); Katayama et al. (2009) and De Loecker (2009) have proposed alternative ways to control for differences between firms in output prices. De Loecker (2009) found, in support of Klette and Griliches (1996), that ignoring potential differences in output prices within the same industry, results in the underestimation of the input coefficients and the returns to scale. As the endogeneity bias and the omitted output price bias run in the opposite direction, it is not possible beforehand to know the sign of the sum of both biases.

For the estimation of TFP spillovers, firm-level TFP growth computed with the index number approach will be used as a benchmark. Van Biesebroeck (2007) concluded that for

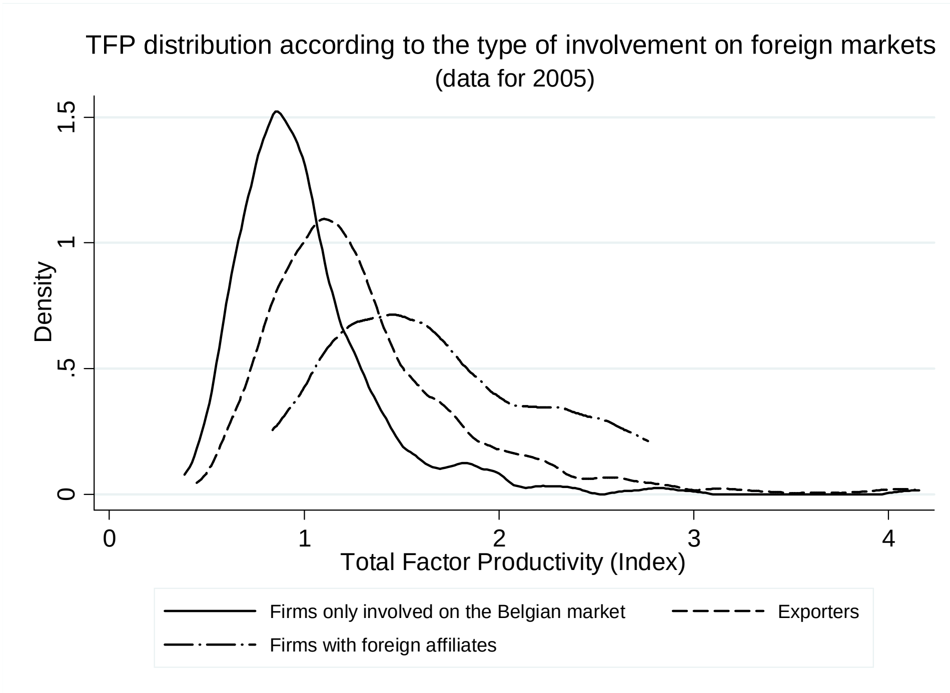

Figure 4: Distribution of TFP calculated with (16) according to the type of involvement on foreign markets for the year 2005 (the last percentile of the distribution is not represented in the graph)

TFP growth, this approach provides consistently accurate estimates, if the measurement errors of the data are not too substantial. Given the relatively high level of aggregation at which productivity needs to be estimated, substantial differences in technology between firms seem rather likely. Specifically, firm-level TFP indices are computed following the formula proposed by Good et al. (1996), which combines the chained Divisia approach with the representative firm index proposed by Caves et al. (1983), resulting in the unambiguous comparison of firm-level productivity:

$$tfp_{it} = \left[\left(y_{it} - y_t^*\right) + \sum_{s=2}^{t} \left(y_s^* - y_{s-1}^*\right) \right] - \left[\frac{1}{2} \sum_{j=1}^{n} \left(S_{ijt} + S_{jt}^*\right) \left(x_{ijt} - x_{jt}^*\right) + \sum_{j=1}^{n} \sum_{s=2}^{t} \frac{1}{2} \left(S_{js}^* + S_{j,s-1}^*\right) \left(x_{js}^* - x_{j,s-1}^*\right) \right] \tag{16}$$

y_{it} denotes log value added of firm i in period t, S the share of each of the n production factors in total costs and x_{ijt} the log of the quantity factor j used in the production of firm i in period t. Variables indicated with an asterisk refer to the representative firm, e.g. y_t^* is the log output of the representative firm in period t. Following Caves et al. (1983), the values of the variables for the representative firm equals the mean of that variable over all firms in a given year. The index contains a component reflecting the change in TFP of a firm relative to the productivity of the representative firm (i.e. efficiency) and a component reflecting the evolution in the productivity of the representative firm over time (technological change). Figure 4 plots the distribution of TFP obtained by the index method for the year 2005. The figure shows the usual ranking with MNEs being the most productive firms, followed by exporters and the domestic firms.

Firm-level TFP estimates from an Ordinary Least Squares regression of a production function are used to verify the robustness of the results of the TFP spillover estimation. As Ordinary Least Squares estimation may result in biased estimates, TFP estimates from the Ackerberg et al. (2006) procedure, combined with the procedure proposed by De Loecker (2009) to control for unobserved output prices and demand shocks, are also considered. The disadvantage of the latter approach is that it results in the substantial loss of observations (some 60% of the observations, obtained with the index approach or the Ordinary Least Squares estimation, are lost), which hampers the robustness check. Moreover, the estimates of the production function coefficients obtained with the Ackerberg et al. (2006) estimation procedure are somewhat problematic in that they suggest, over the period considered, consistently decreasing returns to scale in a number of Belgian industries.

4 Results

4.1 Productivity spillover effects

Table 3 presents the results for the estimation of the impact of spillover variables on total factor productivity. Specification (2) is estimated by OLS. The dependent variable is log tfp growth based on (16). All explanatory variables are lagged one period. Results in Table 3 are based on a sample of non-exporting domestic firms, except those in the last column that are based on a sample of non-exporting domestic firms that never start to export in the estimation period.

We find a positive and significant impact of the number of exporters in the region in column (1). The importance of multinationals in the region does not additionally affect domestic firm productivity. But since nearly all multinationals are exporters, the contribution to tfp of multinational presence in the region is still positive though not different from domestic exporters. Spillover effects from exporters seem regional as we find no impact of the presence of exporters in the same industry, nor in industries linked through the supply chain.

Table 3: Productivity spillover effects

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
productivity measure	index	OLS	ACF	TFPQ1	TFPQ2	TFPQ3	TPFQ4	micro	small	medium & large	index
exporters' share in region va	0.130***	0.099**	-0.028	0.142*	0.084	0.053	0.278***	0.190***	0.094*	-0.253**	0.092**
	[0.038]	[0.041]	[0.067]	[0.080]	[0.084]	[0.072]	[0.087]	[0.055]	[0.057]	[0.122]	[0.045]
MNEs' share in region va	-0.026	-0.017	0.023	-0.056	0.002	-0.014	-0.047	-0.059**	-0.002	0.104**	-0.017
	[0.017]	[0.018]	[0.029]	[0.035]	[0.031]	[0.032]	[0.041]	[0.027]	[0.023]	[0.049]	[0.020]
exporters' share in industry va	-0.105	-0.064	0.014	0.062	-0.108	0.112	-0.476	-0.120	-0.081	-0.201	0.054
	[0.147]	[0.185]	[0.381]	[0.315]	[0.253]	[0.291]	[0.313]	[0.233]	[0.197]	[0.521]	[0.182]
IO weighted exporters' share in client industries va	-0.133	0.015	0.140	-0.350	0.304	-0.297	-0.188	-0.144	-0.073	-0.498	-0.171
	[0.123]	[0.146]	[0.250]	[0.239]	[0.225]	[0.246]	[0.269]	[0.186]	[0.168]	[0.403]	[0.150]
IO weighted exporters' share in supplier industries va	-0.164	0.255	0.494	0.004	0.141	-0.889**	0.167	-0.410	0.028	-0.553	-0.405*
	[0.177]	[0.229]	[0.386]	[0.344]	[0.329]	[0.372]	[0.383]	[0.307]	[0.232]	[0.633]	[0.216]
MNEs' share in industry va	-0.145*	0.005	0.242	-0.263	-0.166	-0.255	0.155	-0.236	-0.094	-0.137	-0.278***
	[0.083]	[0.131]	[0.285]	[0.184]	[0.147]	[0.170]	[0.190]	[0.144]	[0.109]	[0.320]	[0.107]
IO weighted MNEs' share in client industries va	0.449***	0.318*	0.189	0.657**	0.104	0.421*	0.625***	0.488***	0.366**	0.998**	0.474***
	[0.124]	[0.172]	[0.299]	[0.298]	[0.200]	[0.218]	[0.232]	[0.166]	[0.180]	[0.480]	[0.173]
IO weighted MNEs' share in supplier industries va	-0.271*	-0.664***	-0.654*	-0.421	0.011	0.330	-1.052***	-0.179	-0.248	-0.733	-0.069
	[0.156]	[0.197]	[0.355]	[0.294]	[0.295]	[0.323]	[0.339]	[0.256]	[0.212]	[0.486]	[0.189]
Observations	13053	14919	5690	3213	3495	3393	2875	5829	6716	508	9003
R-squared	0.061	0.076	0.067	0.102	0.070	0.060	0.077	0.069	0.060	0.177	0.068

Dependent variable is log TFP growth according to the index-methodology, except for columns (3) and (4) that use OLS and ACF TFP respectively; standard errors are clustered at industry-region level; *** p<0.01, ** p<0.05, * p<0.1; spillover variables are lagged one period; regressions include time, region, and industry dummies as well as firms' lagged productivity growth, age, import status and industry competition; industries are defined at Nace 2-digit level (IO table classification); regions are defined at NUTS 3 level; the estimation sample consists of all non-exporting firms in a given year except for column (11) that restrict the sample to firms that never export

There are some indications that in industries with a higher importance of MNEs, domestic non-exporters are less productive. This may indicate a negative competition effect. Supplying inputs to multinationals in client industries is beneficial to domestic firms' productivity. This is a common finding in the spillover literature on developing and transition countries. Being downstream of industries with more multinational presence, by contrast, seems to be associated with lower productivity levels. The literature suggests that inputs bought from MNEs may be more expensive or simply too complicated for domestic firms to benefit from upstream MNEs. Introducing the different spillover measures one by one (not reported) does not suggest any potential collinearity problems and confirms the result on regional exporter presence and backward spillover effects. Columns (2) and (3) repeat the same specification using tfp measures obtained using simple OLS estimates of the production function and the Ackerberg et al. (2006) methodology. Note that the number of observations decreases considerably due to lack of sufficient data for the latter estimation algorithm. The OLS result suggests that the estimated impact of exporter presence in the region is robust. The backward spillover effect is still positive and significant but only at the 10% level though. Buying inputs from MNEs is associated with lower productivity levels. The latter result is the only one that still (marginally) holds when using the ACF measure. The considerable reduction in the number of observations makes it difficult to compare results, however.

In line with Békés et al. (2009) who show that firms' size and productivity are potential drivers of the intensity of spillover effects, we allow productivity spillover effects to differ according firm size and firm level productivity as an indicator of absorptive capability. Absorptive capability refers to the ability of firms to assimilate outside knowledge and technology. Kokko *et al.* (1996) find that horizontal spillovers are positive and significant only for plants with small or moderate technology gaps relative to foreign firms. Findlay (1978) on the other hand constructs a model of technology transfer through FDI from developed to developing countries. His model stresses a 'scope' argument and suggests that spillovers are a negative function of the level of technology, while the absorptive capacity interpretation suggests a positive relation. In columns (4)-(7) we estimate separate regressions for four quartiles of period average tfp.[7] Results suggest that spillovers are especially present in the upper and -to a lesser extent- in the lower quartile of the tfp distribution. This suggest that both scope and absorptive capability are at work. Firms in the middle quartiles probably have too little scope for easy-to-implement spillovers and too little capability for absorbing more advanced spillovers. For firms in the lower quartile the scope for productivity improvements is important, while the already high productive firms have sufficient absorptive capacity to make the most of possible spillover effects. Strangely, being downstream of industries with more multinational presence is apparently associated with lower productivity levels is driven by these firms. With respect to firms size as a potential determinant of spillover effects, we define the following size classes: micro firms (empl. ≤ 10), small firms ($10 <$ empl. ≤ 50), medium and large firms (empl.> 50). Results are largely confirmed for micro and small firms that dominate our sample. There is only a limited number of medium and large firms that is not always exporting throughout our sample period. The spillover pattern for these firms is quite different. They seem to benefit only from MNE presence with a considerable backward spillover. For these firms tfp seems to be lower in regions with more exporter presence.

If firms invest in productivity to become an exporter, our spillover effects may still to some extent pick up threshold spillover effects. As the perceived level of sunk costs decreases through information spillovers, more firms would be induced to pursue productivity increasing investment and this would show up as a significant spillover effect. Therefore column (11) estimates spillover effects for firms that do not start exporting in our sample. Our results from column (1) are confirmed, providing an additional indication that our results suggest the existence of pure productivity spillover effects.

[7]Note outliers were removed from the tfp distribution by excluding all firms falling outside an interval defined as the interquantile range multiplied by 3.

Table 4: Threshold spillover effects at the firm level

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
lagged TFP (index, in logs)	0.243**	0.244**	0.234**	0.234**	0.235**	0.249**	0.233**
	[0.113]	[0.113]	[0.113]	[0.113]	[0.113]	[0.113]	[0.113]
# exporters in same region	0.033	-0.313		0.034	-0.332		
	[0.066]	[0.241]		[0.069]	[0.245]		
# MNEs in same region		0.534			0.565		
		[0.358]			[0.363]		
# exporters in same industry			0.083	0.076	-0.094		
			[0.598]	[0.598]	[0.681]		
IO weighted # exporters in client industries			0.449**	0.450**	0.632		
			[0.208]	[0.208]	[0.437]		
IO weighted # exporters in supplier industries			-0.603	-0.605	-0.482		
			[0.422]	[0.422]	[0.818]		
# MNEs in same industry					0.263		
					[0.424]		
IO weighted # MNEs in client industries					-0.225		
					[0.517]		
IO weighted # MNEs in supplier industries					-0.068		
					[1.001]		
# exporters, same industry-same region						0.118	0.035
						[0.100]	[0.085]
# exporters, other industries-same region						-0.218	0.024
						[0.229]	[0.073]
# exporters, same industry-other regions							0.108
							[0.558]
# MNEs, same industry-same region						-0.101	
						[0.093]	
# MNEs, other industry-same region						0.347	
						[0.335]	
Observations	12609	12609	12495	12495	12495	12609	12495

Dependent variable is a "new exporter" dummy that equals 1 in *t* if the firm did not export in *t-1* and *t-2* (see text for full definition); standard errors are clustered at industry-region level; *** p<0.01, ** p<0.05, * p<0.1; spillover variables are count variables, they are transformed by adding 1 and taking logs, in the regressions they are lagged one period; regressions include time, region, and industry dummies; industries are defined at Nace 2-digit level (IO table classification); regions are defined at NUTS 3 level

4.2 Threshold spillover effects

4.2.1 Firm level

Table 4 present the result of the logit estimation of specification (3) at the firm level. In this case an export starter in t is a firm that did not export in $t-1$ and $t-2$. Our dependent variable thus equals 1 if the firm starts exporting for the first time, i.e. the first product(s) to the first destination(s). Note that from Table 4 onwards spillover variables are count variables (cf. supra). Estimations only include single plant firms. The table reveals that, at the firm level, threshold spillovers are fairly limited. The main driver of the export decision seems the firm's lagged productivity level. Both regional and industry threshold spillovers do not seem to be present. If anything, columns (3) and (4) suggest some impact of having exporters in client industries, but this result is not robust to the inclusion of the number of

MNEs in client industries. Combining region and industry effects in column (7) does neither reveal any spillover effects. All in all, these results suggest that threshold spillovers seem to be rather unimportant for first time exporting.

4.2.2 Firm-destination level

Table 5 presents result of the logit estimation of specification (3) at the firm-destination level. In this case the dependent variable equals 1 if the firm starts exporting to destination d for the first time, i.e. the first product(s) exported to this specific destination d. Estimations only include single plant firms. In order to restrict the sample to feasible proportions we selected only those combinations of NACE 5 digit manufacturing industries and destinations where we observe at least 1 export starter over the period 2000-2005. This leaves us with 176 destinations in the estimation sample. Column headings in Table 5 refer to different industry aggregation levels (NACE 2-3-4 digit) for calculating the spillover variables. Regressions always include industry, time, region, and destination fixed effects.

In all regressions the tfp level is again an important driver of the decision to start exporting. The border dummy -equal to one if the firm's region is neighbouring the destination country- is never significant. The impact of the number of destinations the firm was exporting to during the previous year is always positive and highly significant. This is an indication of within-firm learning from past export experience with other destination markets. Columns (1) to (3) consider spillover from exporters in the same industry-same region, other industries-same region, and same industry-other regions. Qualitatively, the coefficient pattern is fairly stable across industry aggregations, with all three types of spillover contributing positively to the probability to start exporting. Following Greenaway and Kneller (2008), in columns (4) to (6) we split spillovers from exporters in two groups: firms that started to export to destination d last year (starters) and firms that have been exporting to d for a longer period of time (established exporters). Two general observations can be made: i) the pattern is not stable across industry aggregation levels, and ii) spillovers are not always necessarily positive. Spillovers measured at the NACE 2 digits level suggest that both more starters and established exporters to the destination d in the same region and the same industry contribute positively to the probability to start exporting to that destination d. A higher number of starters in other industries or other regions seems to imply a lower probability of becoming a starter. The negative spillover effects from starters in other industries in the same region may point to the existence of crowding out or congestion effects. The effect holds across the different levels of industry aggregation. The negative impact of in the same industry, but other regions may hint at some missed agglomeration effects. These effects seem to be present when industries are considered at the more aggregated 2 digits

Table 5: Threshold spillover effects at the firm-destination level

	(1)	(2)	(3)	(4)	(5)	(6)
NACE industry aggregation level	2-digit	3-digit	4-digit	2-digit	3-digit	4-digit
lagged TFP (index, in logs)	0.873***	0.885***	0.891***	0.820***	0.820***	0.828***
	[0.057]	[0.056]	[0.056]	[0.058]	[0.058]	[0.058]
border-dummy	-0.060	-0.087	-0.090	-0.103	-0.102	-0.109
	[0.080]	[0.081]	[0.082]	[0.081]	[0.081]	[0.082]
# other destinations the firm exports to	0.075***	0.076***	0.075***	0.075***	0.077***	0.077***
	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]	[0.003]
# exporters to d, same industry-same region	0.194***	0.206***	0.232***			
	[0.025]	[0.028]	[0.049]			
# exporters to d, other industries-same region	0.041***	0.062***	0.066***			
	[0.013]	[0.014]	[0.014]			
# exporters to d, same industry-other regions	0.196***	0.102***	0.129***			
	[0.029]	[0.024]	[0.021]			
# starters to d, same industry-same region				0.098***	0.200***	0.221***
				[0.038]	[0.057]	[0.050]
# starters to d, other industries-same region				-0.128***	-0.105***	-0.101***
				[0.024]	[0.025]	[0.027]
# starters to d, same industry-other regions				-0.147***	-0.035	-0.036
				[0.026]	[0.027]	[0.026]
# est. exporters to d, same industry-same region				0.170***	0.016	0.039
				[0.031]	[0.039]	[0.060]
# est. exporters to d, other industries-same region				0.056***	0.081***	0.086***
				[0.020]	[0.020]	[0.020]
# est. exporters to d, same industry-other regions				0.272***	0.286***	0.327***
				[0.037]	[0.037]	[0.039]
Observations	1519020	1518235	1518991	1519020	1518235	1518991

Dependent variable is a "new exporter" dummy that equals 1 if a firm exports to destination *d* in year *t* while it did not in *t-1* and *t-2* (see text for full definition); standard errors are clustered at industry-region level; *** p<0.01, ** p<0.05, * p<0.1; spillover variables are count variables, they are transformed by adding 1 and taking logs, in the regressions they are lagged one period; spillover are defined at different Nace industry classifications as indicated in column headings; regressions include time, region, industry, and destination dummies; regions are defined at NUTS 3 level

level, but not at more disaggregated levels. With spillovers measured at more disaggregated level, the positive spillovers originate from starters in the same industry and region, rather than from established exporters in the same industry and region.

4.2.3 Firm-product-destination level

The result of the logit estimation of specification (3) at the firm–product-destination level are presented in Table 6. In this case a firm is considered as an export starter of product p to destination d in year t if it exports p to d in year t while it did not in $t-1$ and $t-2$. Our dependent variable thus equals 1 if the firm starts exporting product p to destination d for the first time, i.e. the first time a specific product p exported to a specific destination d. Estimations again only include single plant firms. The sample is restricted to feasible proportions by first selecting only those combinations of destinations and 4 digits product categories that were exported by at least ten firms on average over the period 1998-2005. We

Table 6: Threshold spillover effects at the firm-product-destination level

	(1)	(2)	(3)	(4)	(5)	(6)
NACE industry aggregation level	**2-digit**	**3-digit**	**4-digit**	**2-digit**	**3-digit**	**4-digit**
lagged TFP-level (index, in logs)	0.814***	0.814***	0.813***	0.814***	0.810***	0.812***
	[0.034]	[0.034]	[0.034]	[0.034]	[0.035]	[0.035]
border-dummy	0.139***	0.140***	0.140***	0.138***	0.140***	0.139***
	[0.047]	[0.047]	[0.047]	[0.047]	[0.047]	[0.047]
# other products exported to the same destination	0.866***	0.866***	0.866***	0.867***	0.867***	0.867***
	[0.023]	[0.023]	[0.023]	[0.023]	[0.023]	[0.023]
# other destinations same product is exported to	1.009***	1.008***	1.008***	1.010***	1.008***	1.006***
	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]	[0.042]
# exporters of p to d, same industry-same region	0.176***	0.211***	0.196***			
	[0.028]	[0.033]	[0.037]			
# exporters of p to d, same industry-other regions	0.018	-0.009	-0.075***			
	[0.022]	[0.022]	[0.022]			
# starters of p to d, same industry-same region				0.077*	0.087*	0.030
				[0.045]	[0.052]	[0.056]
# starters of p to d, same industry-other regions				-0.013	-0.049*	-0.166***
				[0.024]	[0.028]	[0.032]
# est. exporters of p to d, same industry-same region				0.210***	0.260***	0.282***
				[0.033]	[0.039]	[0.044]
# est. exporters of p to d, same industry-other regions				0.063**	0.041	-0.001
				[0.026]	[0.026]	[0.026]
Observations	1685751	1685751	1685751	1683575	1675201	1670601

Dependent variable is a "new exporter" dummy that equals 1 if a firm exports product *p* to destination d in year t while it did not in t-1 and t-2 (see text for full definition); standard errors are clustered at industry-region level; *** p<0.01, ** p<0.05, * p<0.1; spillover variables are count variables, they are transformed by adding 1 and taking logs, in the regressions they are lagged one period; spillover are defined at different Nace industry classifications as indicated in column headings; regressions include time, region, industry, destination, and product dummies; industries are defined at Nace levels indicated in column headings; regions are defined at NUTS 3 level

then further reduced the sample by selecting only those combinations of NACE 5 digits manufacturing industries, destinations, and products where we observe at least 1 export starter over the period 2000-2005. The obtained reduced estimation sample includes information on 56 destinations and 266 products. Note that due to the tougher restrictions the number of destinations considerably reduced in comparison to the analysis at the destination-only level in the previous section. Column headings in table 6 refer to different industry aggregation levels (NACE 2-3-4 digits) for calculating the spillover variables. All regressions include industry, time, region, destination, and product fixed effects. Since the product and industry classification codes imply that nearly all exporters of a given product belong to the same industry, it does not make sense to consider other industries exporting the same product.[8] Our spillover variables thus only refer to either other exporters in the same industry and the same region or other exporters in the same industry but different regions.

In all regressions in Table 6, the lagged tfp level is important in explaining the decision

[8] We did add other industries-same region spillover variables for the spillover definitions at the Nace 4-digit level. These variables were not significant and did not alter the results with respect to same industry-same region, nor those for same industry-different regions.

to start exporting. The border dummy now is significant in all regressions. The results on the number of other products exported to the same destination and the number of other destinations the same product is exported to during the previous year are always significantly positive. This confirms the importance of within-firm learning from past export experience with other products and other destination markets. With respect to the spillover variables columns (1) to (3) present the results for the spillover variables defined on basis of the total number of exporters, while columns (4) to (6) report results for the split-up between starters and established exporters. The results in the first three columns now clearly suggest that spillovers are to be found in the same region, with some indication that being in the 'wrong' region for a firm's own narrowly defined industry may actually lower the probability to start exporting. Results on the split-up between starters and established exporters suggest that this might be a crowding out effect driven by recent starters. For the split-up we further find that especially the established exporters in the same region of product p to destination d generate positive spillover effects, whereas starters in the same region do not seem to generate threshold spillover effects. This differs from our results at the destination level. Therefore one should be very careful in interpreting our results on starters and established exporters. One possible explanation, however, is that the differences stem from the fact that we consider almost three times as much destinations in the previous section (176 vs. 56)[9]. These are probably also more 'exotic' destinations in the sense that less firms have exported to these destinations. New exporters then actually reveal a lot of new information about these destinations. At the product destination level, however, we restrict our sample to those product-destination combinations that are exported on average by ten firms throughout the sample period. This likely implies that new exporters are less informative. All in all our results suggest important spillovers from exporters in the same industry and the same region, both at the destination and the product-destination level.

5 Conclusions

In this paper we analyse the impact of the internationalisation behaviour of domestic and foreign firms on the decision of domestic non-exporters to start exporting using firm-level data provided by the National Bank of Belgium. We consider two possible channels for spillovers to affect the decision to start exporting. On the one hand internationalised firms may have a direct impact on the productivity of domestic non-exporters, possibly to the extent of lifting them over the threshold at which firms start exporting. A second channel that we investigate is that internationalised firms may convey information to non-exporters

[9]Recall that we were less stringent in restricting the sample at destination level.

and as such decrease the latter's perceived level of sunk cost. If the decrease is large enough, non-exporters may start to export since their productivity level is now sufficient to cover the lower perceived level of sunk costs. Both productivity and threshold spillovers may stem either from geographical proximity of internationalised firms or from economic proximity, i.e. internationalised firms that are in the same industry or different industries (i.e. competitors, clients, or suppliers to the firm).

The first step in our analysis is to determine firm-level total factor productivity. The different methods that have been proposed to derive a measure of productivity at the firm level are all known to have advantages as well as limitations and no single method appears to dominate under all circumstances. For the calculation of total factor productivity, we follow the index number approach of Good et al. (1996), which results in a productivity distribution in line with the theoretically expected ranking of purely domestic, exporting and multinational firms.

Next, we estimate productivity and threshold spillover effects. In both cases we find significant effects of the export behaviour of other firms. Firm productivity increases with the presence of exporting firms in the same NUTS 3 region as well as with supplying to multinational firms. There are indications of negative within-industry spillover effects, which may be linked to a competition or input crowding out effect. We then estimate –controlling for lagged productivity levels- spillovers on the decision to start exporting at three different levels: i) firm-level, ii) firm-destination-level, and iii) firm-product-destination-level. At the firm-level, the decision to start exporting seems to be driven merely by the firm's productivity level and not by threshold spillovers. Hence, productivity spillover effects are the only channel by which the export decision as such is affected by other firms. However, we do find significant threshold spillover effects at both the destination and the product-destination levels. Similar to the productivity spillovers, the geographical dimension seems important. Our results extend the findings by Koenig et al. (2010) for France by showing that in addition to information spillovers on the perceived level of sunk costs, productivity spillovers also matter.

References

Ackerberg, D., Caves, K. and Frazer, G. (2006). Structural Identification of Production Functions, mimeo.

Aitken, B., Hanson, G., and Harrison, A. (1997). Spillovers, Foreign Investment, and Export Behavior, Journal of International Economics 43, p.103-132

Alvarez, R. and López, R. (2008). Is Exporting a Source of Productivity Spillovers, Review of World Economics, 144, p.723-749

Barrios, S., Görg, H., and Strobl, E. (2003). Explaining Firms' Export Behaviour: R&D, Spillovers and the Destination Market, Oxford Bulletin of Economics and Statistics 65(4), 475–496

Basu, S., Pascali, L., Schiantarelli, F. and Serven, L. (2009). Productivity, Welfare and Reallocation: Theory and Firm-Level Evidence, NBER Working Paper no. 15579

Békés, G., Kleinert,J. and Toubal, F. (2009). Spillovers from Multinationals to Heterogeneous Domestic Firms: Evidence from Hungary, The World Economy, 32(10), 1408-1433

Bernard, A.B. and Jensen, J.B. (2004). Why Some Firms Export, The Review of Economics and Statistics, 86(2), 561-569

Blundell, R. and Bond, S. (2000). GMM estimation with persistent panel data: an application to production functions, Econometric Reviews 19, 321-340.

Caves, D.W., Christensen, L.R. and M.W. Tretheway (1983). Productivity Performance of U.S. Trunk and Local Service Airlines in the Era of Deregulation, Economic Inquiry 21(3), 312–324.

Clerides, S.K., Lach, S. and J.R. Tybout (1998). Is Learning By Exporting Important? Micro-Dynamic Evidence From Colombia, Mexico, And Morocco, The Quarterly Journal of Economics, 113(3), 903-947

Crespo, N. and Fontoura, M.P. (2007). Determinant Factors of FDI Spillovers - What Do We Really Know?, World Development, 35(3), 410-425

De Loecker, J. (2009). Product differentiation, multi-product firms and estimating the impact of trade liberalization on productivity, mimeo.

Findlay, R. (1978). Relative Backwardness, Direct Foreign Investment and Transfer of Technology: A Simple Dynamic Model, Quarterly Journal of Economics, 92,1-16.

Foster, L., Haltiwanger, J. and Syverson, C. (2008). Reallocation, Firm Turnover, and Efficiency: Selection on Productivity or Profitability?, American Economic Review 98, 394-425.

Fox, J. and Smeets, V. (2009). Does Input Quality Drive Measured Differences in Firm Productivity?, mimeo.

Good, D.H., Ishaq Nadiri, M and R.C. Sickles (1996). Index Number and Factor Demand Approaches to the Estimation of Productivity, NBER Working Paper 5790.

Görg, H., and Greenaway, D. (2004). Much ado about nothing? Do Domestic Firms really benefit from Foreign Direct Investment, World Bank Research Observer 19, p. 171-197

Greenaway, D. and Kneller R. (2007). Firm Heterogenity, Exporting and Foreign Direct Investment, The Economic Journal 117, p. 134-161

Greenaway, D. and Kneller R. (2008). Exporting, Productivity and Agglomeration, European Economic Review 52, p. 919-939

Griliches Z. (1992). The Search for R&D Spillovers, The Scandinavian journal of Economics, 94, pp.29-47

Griliches, Z. and Mairesse, J. (1995). Production Functions: The Search for Identification, NBER Working Paper no. 5067.

Katayama, H., Lu, S., Tybout, J.R. (2009). Firm-Level Productivity Studies: Illusions and a Solution, International Journal of Industrial Organization 27, 403–413

Klette, T.J. and Griliches, Z. (1996). The Inconsistency of Common Scale Estimators When Output Prices Are Unobserved and Endogenous, Journal of Applied Econometrics 11(4), 343-361.

Koenig P., Mayeris F. and Poncet S. (2010). Local Export Spillovers in France, European Economic Review, 54(4), p. 622-641

Kokko, A., Tansini, R., and Zejan, M. (1996). Local Technological Capability and Productivity Spillovers from FDI in the Uruguayan Manufacturing Sector. The Journal of Development Studies 32(4), 602-611

Levinsohn, J. and Petrin, A. (2003). Estimating Production Functions Using Inputs to Control for Unobservables, Review of Economic Studies 70(2), 317-341.

Marschak, J. and Andrews, W. (1944). Random Simultaneous Equations and the Theory of Production, Econometrica 12, 143–205.

Meyer, Klaus E. & Sinani, Evis. (2009). When and where does foreign direct investment generate positive spillovers, Journal of International Business Studies, vol. 40(7), pp.1075-1094

Melitz. M. (2000). Estimating Firm-Level Productivity in Differentiated Product Industries, mimeo.

Melitz M. (2003). The Impact of Trade on Aggregate Industry Productivity and Intra-Industry Reallocations, Econometrica 71, p. 1695-1725.

Olley, G.S and Pakes, A. (1996). The Dynamics of Productivity in the Telecommunications Equipment Industry, Econometrica 64(6), 1263-1297.

Roberts, M., and Tybout, J. (1997). The Decision to Export in Colombia: An Empirical Model of Entry with Sunk Costs, American Economic Review, 87(4), p.545-564

Silva A., Africano A.P.,and Afonso O. (2010). Learning-by-Exporting: What We Know and What We would Like to Know, FEP Working Paper no. 364.

Van Biesebroeck, J. (2007). Robustness of productivity estimates, The Journal of Industrial Economics, 55(3), 529-569.

NATIONAL BANK OF BELGIUM - WORKING PAPERS SERIES

1. "Model-based inflation forecasts and monetary policy rules", by M. Dombrecht and R. Wouters, *Research Series*, February 2000.
2. "The use of robust estimators as measures of core inflation", by L. Aucremanne, *Research Series*, February 2000.
3. "Performances économiques des Etats-Unis dans les années nonante", by A. Nyssens, P. Butzen and P. Bisciari, *Document Series*, March 2000.
4. "A model with explicit expectations for Belgium", by P. Jeanfils, *Research Series*, March 2000.
5. "Growth in an open economy: Some recent developments", by S. Turnovsky, *Research Series*, May 2000.
6. "Knowledge, technology and economic growth: An OECD perspective", by I. Visco, A. Bassanini and S. Scarpetta, *Research Series*, May 2000.
7. "Fiscal policy and growth in the context of European integration", by P. Masson, *Research Series*, May 2000.
8. "Economic growth and the labour market: Europe's challenge", by C. Wyplosz, *Research Series*, May 2000.
9. "The role of the exchange rate in economic growth: A euro-zone perspective", by R. MacDonald, *Research Series*, May 2000.
10. "Monetary union and economic growth", by J. Vickers, *Research Series*, May 2000.
11. "Politique monétaire et prix des actifs: le cas des États-Unis", by Q. Wibaut, *Document Series*, August 2000.
12. "The Belgian industrial confidence indicator: Leading indicator of economic activity in the euro area?", by J.-J. Vanhaelen, L. Dresse and J. De Mulder, *Document Series*, November 2000.
13. "Le financement des entreprises par capital-risque", by C. Rigo, *Document Series,* February 2001.
14. "La nouvelle économie" by P. Bisciari, *Document Series*, March 2001.
15. "De kostprijs van bankkredieten", by A. Bruggeman and R. Wouters, *Document Series*, April 2001.
16. "A guided tour of the world of rational expectations models and optimal policies", by Ph. Jeanfils, *Research Series*, May 2001.
17. "Attractive prices and euro - Rounding effects on inflation", by L. Aucremanne and D. Cornille, *Documents Series*, November 2001.
18. "The interest rate and credit channels in Belgium: An investigation with micro-level firm data", by P. Butzen, C. Fuss and Ph. Vermeulen, *Research series*, December 2001.
19. "Openness, imperfect exchange rate pass-through and monetary policy", by F. Smets and R. Wouters, *Research series*, March 2002.
20. "Inflation, relative prices and nominal rigidities", by L. Aucremanne, G. Brys, M. Hubert, P. J. Rousseeuw and A. Struyf, *Research series*, April 2002.
21. "Lifting the burden: Fundamental tax reform and economic growth", by D. Jorgenson, *Research series*, May 2002.
22. "What do we know about investment under uncertainty?", by L. Trigeorgis, *Research series*, May 2002.
23. "Investment, uncertainty and irreversibility: Evidence from Belgian accounting data" by D. Cassimon, P.-J. Engelen, H. Meersman and M. Van Wouwe, *Research series*, May 2002.
24. "The impact of uncertainty on investment plans", by P. Butzen, C. Fuss and Ph. Vermeulen, *Research series*, May 2002.
25. "Investment, protection, ownership, and the cost of capital", by Ch. P. Himmelberg, R. G. Hubbard and I. Love, *Research series*, May 2002.
26. "Finance, uncertainty and investment: Assessing the gains and losses of a generalised non-linear structural approach using Belgian panel data", by M. Gérard and F. Verschueren, *Research series*, May 2002.
27. "Capital structure, firm liquidity and growth", by R. Anderson, *Research series*, May 2002.
28. "Structural modelling of investment and financial constraints: Where do we stand?", by J.-B. Chatelain, *Research series*, May 2002.
29. "Financing and investment interdependencies in unquoted Belgian companies: The role of venture capital", by S. Manigart, K. Baeyens, I. Verschueren, *Research series*, May 2002.
30. "Development path and capital structure of Belgian biotechnology firms", by V. Bastin, A. Corhay, G. Hübner and P.-A. Michel, *Research series*, May 2002.
31. "Governance as a source of managerial discipline", by J. Franks, *Research series*, May 2002.
32. "Financing constraints, fixed capital and R&D investment decisions of Belgian firms", by M. Cincera, *Research series*, May 2002.

33. "Investment, R&D and liquidity constraints: A corporate governance approach to the Belgian evidence", by P. Van Cayseele, *Research series*, May 2002.
34. "On the origins of the Franco-German EMU controversies", by I. Maes, *Research series*, July 2002.
35. "An estimated dynamic stochastic general equilibrium model of the euro area", by F. Smets and R. Wouters, *Research series*, October 2002.
36. "The labour market and fiscal impact of labour tax reductions: The case of reduction of employers' social security contributions under a wage norm regime with automatic price indexing of wages", by K. Burggraeve and Ph. Du Caju, *Research series*, March 2003.
37. "Scope of asymmetries in the euro area", by S. Ide and Ph. Moës, *Document series*, March 2003.
38. "De autonijverheid in België: Het belang van het toeleveringsnetwerk rond de assemblage van personenauto's", by F. Coppens and G. van Gastel, *Document series*, June 2003.
39. "La consommation privée en Belgique", by B. Eugène, Ph. Jeanfils and B. Robert, *Document series*, June 2003.
40. "The process of European monetary integration: A comparison of the Belgian and Italian approaches", by I. Maes and L. Quaglia, *Research series*, August 2003.
41. "Stock market valuation in the United States", by P. Bisciari, A. Durré and A. Nyssens, *Document series*, November 2003.
42. "Modeling the term structure of interest rates: Where do we stand?", by K. Maes, *Research series*, February 2004.
43. "Interbank exposures: An ampirical examination of system risk in the Belgian banking system", by H. Degryse and G. Nguyen, *Research series*, March 2004.
44. "How frequently do prices change? Evidence based on the micro data underlying the Belgian CPI", by L. Aucremanne and E. Dhyne, *Research series*, April 2004.
45. "Firms' investment decisions in response to demand and price uncertainty", by C. Fuss and Ph. Vermeulen, *Research series*, April 2004.
46. "SMEs and bank lending relationships: The impact of mergers", by H. Degryse, N. Masschelein and J. Mitchell, *Research series*, May 2004.
47. "The determinants of pass-through of market conditions to bank retail interest rates in Belgium", by F. De Graeve, O. De Jonghe and R. Vander Vennet, *Research series*, May 2004.
48. "Sectoral vs. country diversification benefits and downside risk", by M. Emiris, *Research series*, May 2004.
49. "How does liquidity react to stress periods in a limit order market?", by H. Beltran, A. Durré and P. Giot, *Research serie*s, May 2004.
50. "Financial consolidation and liquidity: Prudential regulation and/or competition policy?", by P. Van Cayseele, *Research series*, May 2004.
51. "Basel II and operational risk: Implications for risk measurement and management in the financial sector", by A. Chapelle, Y. Crama, G. Hübner and J.-P. Peters, *Research series,* May 2004.
52. "The efficiency and stability of banks and markets", by F. Allen, *Research series*, May 2004.
53. "Does financial liberalization spur growth?", by G. Bekaert, C.R. Harvey and C. Lundblad, *Research series*, May 2004.
54. "Regulating financial conglomerates", by X. Freixas, G. Lóránth, A.D. Morrison and H.S. Shin, *Research series*, May 2004.
55. "Liquidity and financial market stability", by M. O'Hara, *Research series*, May 2004.
56. "Economisch belang van de Vlaamse zeehavens: Verslag 2002", by F. Lagneaux, *Document series*, June 2004.
57. "Determinants of euro term structure of credit spreads", by A. Van Landschoot, *Research series*, July 2004.
58. "Macroeconomic and monetary policy-making at the European Commission, from the Rome Treaties to the Hague Summit", by I. Maes, *Research series*, July 2004.
59. "Liberalisation of network industries: Is electricity an exception to the rule?", by F. Coppens and D. Vivet, *Document series*, September 2004.
60. "Forecasting with a Bayesian DSGE model: An application to the euro area", by F. Smets and R. Wouters, *Research series*, September 2004.
61. "Comparing shocks and frictions in US and euro area business cycle: A Bayesian DSGE approach", by F. Smets and R. Wouters, *Research series*, October 2004.
62. "Voting on pensions: A survey", by G. de Walque, *Research series*, October 2004.
63. "Asymmetric growth and inflation developments in the acceding countries: A new assessment", by S. Ide and P. Moës, *Research series*, October 2004.
64. "Importance économique du Port Autonome de Liège: rapport 2002", by F. Lagneaux, *Document series*, November 2004.

65. "Price-setting behaviour in Belgium: What can be learned from an ad hoc survey", by L. Aucremanne and M. Druant, *Research series,* March 2005.
66. "Time-dependent versus state-dependent pricing: A panel data approach to the determinants of Belgian consumer price changes", by L. Aucremanne and E. Dhyne, *Research series*, April 2005.
67. "Indirect effects – A formal definition and degrees of dependency as an alternative to technical coefficients", by F. Coppens, *Research series,* May 2005.
68. "Noname – A new quarterly model for Belgium", by Ph. Jeanfils and K. Burggraeve, *Research series*, May 2005.
69. "Economic importance of the Flemish maritime ports: Report 2003", by F. Lagneaux, *Document series*, May 2005.
70. "Measuring inflation persistence: A structural time series approach", by M. Dossche and G. Everaert, *Research series*, June 2005.
71. "Financial intermediation theory and implications for the sources of value in structured finance markets", by J. Mitchell, *Document series*, July 2005.
72. "Liquidity risk in securities settlement", by J. Devriese and J. Mitchell, *Research series*, July 2005.
73. "An international analysis of earnings, stock prices and bond yields", by A. Durré and P. Giot, *Research series*, September 2005.
74. "Price setting in the euro area: Some stylized facts from Individual Consumer Price Data", by E. Dhyne, L. J. Álvarez, H. Le Bihan, G. Veronese, D. Dias, J. Hoffmann, N. Jonker, P. Lünnemann, F. Rumler and J. Vilmunen, *Research series*, September 2005.
75. "Importance économique du Port Autonome de Liège: rapport 2003", by F. Lagneaux, *Document series,* October 2005.
76. "The pricing behaviour of firms in the euro area: New survey evidence, by S. Fabiani, M. Druant, I. Hernando, C. Kwapil, B. Landau, C. Loupias, F. Martins, T. Mathä, R. Sabbatini, H. Stahl and A. Stokman, *Research series*, November 2005.
77. "Income uncertainty and aggregate consumption", by L. Pozzi, *Research series*, November 2005.
78. "Crédits aux particuliers - Analyse des données de la Centrale des Crédits aux Particuliers", by H. De Doncker, *Document series*, January 2006.
79. "Is there a difference between solicited and unsolicited bank ratings and, if so, why?", by P. Van Roy, *Research series*, February 2006.
80. "A generalised dynamic factor model for the Belgian economy - Useful business cycle indicators and GDP growth forecasts", by Ch. Van Nieuwenhuyze, *Research series*, February 2006.
81. "Réduction linéaire de cotisations patronales à la sécurité sociale et financement alternatif", by Ph. Jeanfils, L. Van Meensel, Ph. Du Caju, Y. Saks, K. Buysse and K. Van Cauter, *Document series*, March 2006.
82. "The patterns and determinants of price setting in the Belgian industry", by D. Cornille and M. Dossche, *Research series*, May 2006.
83. "A multi-factor model for the valuation and risk management of demand deposits", by H. Dewachter, M. Lyrio and K. Maes, *Research series*, May 2006.
84. "The single European electricity market: A long road to convergence", by F. Coppens and D. Vivet, *Document series*, May 2006.
85. "Firm-specific production factors in a DSGE model with Taylor price setting", by G. de Walque, F. Smets and R. Wouters, *Research series*, June 2006.
86. "Economic importance of the Belgian ports: Flemish maritime ports and Liège port complex - Report 2004", by F. Lagneaux, *Document series*, June 2006.
87. "The response of firms' investment and financing to adverse cash flow shocks: The role of bank relationships", by C. Fuss and Ph. Vermeulen, *Research series*, July 2006.
88. "The term structure of interest rates in a DSGE model", by M. Emiris, *Research series,* July 2006.
89. "The production function approach to the Belgian output gap, estimation of a multivariate structural time series model", by Ph. Moës, *Research series*, September 2006.
90. "Industry wage differentials, unobserved ability, and rent-sharing: Evidence from matched worker-firm data, 1995-2002", by R. Plasman, F. Rycx and I. Tojerow, *Research series,* October 2006.
91. "The dynamics of trade and competition", by N. Chen, J. Imbs and A. Scott, *Research series,* October 2006.
92. "A New Keynesian model with unemployment", by O. Blanchard and J. Gali, *Research series,* October 2006.
93. "Price and wage setting in an integrating Europe: Firm level evidence", by F. Abraham, J. Konings and S. Vanormelingen, *Research series,* October 2006.
94. "Simulation, estimation and welfare implications of monetary policies in a 3-country NOEM model", by J. Plasmans, T. Michalak and J. Fornero, *Research series,* October 2006.

95. "Inflation persistence and price-setting behaviour in the euro area: A summary of the Inflation Persistence Network evidence ", by F. Altissimo, M. Ehrmann and F. Smets, *Research series*, October 2006.
96. "How wages change: Micro evidence from the International Wage Flexibility Project", by W.T. Dickens, L. Goette, E.L. Groshen, S. Holden, J. Messina, M.E. Schweitzer, J. Turunen and M. Ward, *Research series*, October 2006.
97. "Nominal wage rigidities in a new Keynesian model with frictional unemployment", by V. Bodart, G. de Walque, O. Pierrard, H.R. Sneessens and R. Wouters, *Research series*, October 2006.
98. "Dynamics on monetary policy in a fair wage model of the business cycle", by D. De la Croix, G. de Walque and R. Wouters, *Research series*, October 2006.
99. "The kinked demand curve and price rigidity: Evidence from scanner data", by M. Dossche, F. Heylen and D. Van den Poel, *Research series*, October 2006.
100. "Lumpy price adjustments: A microeconometric analysis", by E. Dhyne, C. Fuss, H. Peseran and P. Sevestre, *Research series*, October 2006.
101. "Reasons for wage rigidity in Germany", by W. Franz and F. Pfeiffer, *Research series*, October 2006.
102. "Fiscal sustainability indicators and policy design in the face of ageing", by G. Langenus, *Research series*, October 2006.
103. "Macroeconomic fluctuations and firm entry: Theory and evidence", by V. Lewis, *Research series*, October 2006.
104. "Exploring the CDS-bond basis", by J. De Wit, *Research series*, November 2006.
105. "Sector concentration in loan portfolios and economic capital", by K. Düllmann and N. Masschelein, *Research series*, November 2006.
106. "R&D in the Belgian pharmaceutical sector", by H. De Doncker, *Document series*, December 2006.
107. "Importance et évolution des investissements directs en Belgique", by Ch. Piette, *Document series*, January 2007.
108. "Investment-specific technology shocks and labor market frictions", by R. De Bock, *Research series*, February 2007.
109. "Shocks and frictions in US business cycles: A Bayesian DSGE approach", by F. Smets and R. Wouters, *Research series*, February 2007.
110. "Economic impact of port activity: A disaggregate analysis. The case of Antwerp", by F. Coppens, F. Lagneaux, H. Meersman, N. Sellekaerts, E. Van de Voorde, G. van Gastel, Th. Vanelslander, A. Verhetsel, *Document series,* February 2007.
111. "Price setting in the euro area: Some stylised facts from individual producer price data", by Ph. Vermeulen, D. Dias, M. Dossche, E. Gautier, I. Hernando, R. Sabbatini, H. Stahl, *Research series,* March 2007.
112. "Assessing the gap between observed and perceived inflation in the euro area: Is the credibility of the HICP at stake?", by L. Aucremanne, M. Collin and Th. Stragier, *Research series,* April 2007.
113. "The spread of Keynesian economics: A comparison of the Belgian and Italian experiences", by I. Maes, *Research series,* April 2007.
114. "Imports and exports at the level of the firm: Evidence from Belgium", by M. Muûls and M. Pisu, *Research series,* May 2007.
115. "Economic importance of the Belgian ports: Flemish maritime ports and Liège port complex - Report 2005", by F. Lagneaux, *Document series*, May 2007.
116. "Temporal distribution of price changes: Staggering in the large and synchronization in the small", by E. Dhyne and J. Konieczny, *Research series,* June 2007.
117. "Can excess liquidity signal an asset price boom?", by A. Bruggeman, *Research series,* August 2007.
118. "The performance of credit rating systems in the assessment of collateral used in Eurosystem monetary policy operations", by F. Coppens, F. González and G. Winkler, *Research series*, September 2007.
119. "The determinants of stock and bond return comovements", by L. Baele, G. Bekaert and K. Inghelbrecht, *Research series*, October 2007.
120. "Monitoring pro-cyclicality under the capital requirements directive: Preliminary concepts for developing a framework", by N. Masschelein, *Document series*, October 2007.
121. "Dynamic order submission strategies with competition between a dealer market and a crossing network", by H. Degryse, M. Van Achter and G. Wuyts, *Research series*, November 2007.
122. "The gas chain: Influence of its specificities on the liberalisation process", by C. Swartenbroekx, *Document series*, November 2007.
123. "Failure prediction models: Performance, disagreements, and internal rating systems", by J. Mitchell and P. Van Roy, *Research series*, December 2007.
124. "Downward wage rigidity for different workers and firms: An evaluation for Belgium using the IWFP procedure", by Ph. Du Caju, C. Fuss and L. Wintr, *Research series*, December 2007.

125. "Economic importance of Belgian transport logistics", by F. Lagneaux, *Document series*, January 2008.
126. "Some evidence on late bidding in eBay auctions", by L. Wintr, *Research series*, January 2008.
127. "How do firms adjust their wage bill in Belgium? A decomposition along the intensive and extensive margins", by C. Fuss, *Research series*, January 2008.
128. "Exports and productivity – Comparable evidence for 14 countries", by The International Study Group on Exports and Productivity, *Research series*, February 2008.
129. "Estimation of monetary policy preferences in a forward-looking model: A Bayesian approach", by P. Ilbas, *Research series*, March 2008.
130. "Job creation, job destruction and firms' international trade involvement", by M. Pisu, *Research series*, March 2008.
131. "Do survey indicators let us see the business cycle? A frequency decomposition", by L. Dresse and Ch. Van Nieuwenhuyze, *Research series*, March 2008.
132. "Searching for additional sources of inflation persistence: The micro-price panel data approach", by R. Raciborski, *Research series,* April 2008.
133. "Short-term forecasting of GDP using large monthly datasets - A pseudo real-time forecast evaluation exercise", by K. Barhoumi, S. Benk, R. Cristadoro, A. Den Reijer, A. Jakaitiene, P. Jelonek, A. Rua, G. Rünstler, K. Ruth and Ch. Van Nieuwenhuyze, *Research series*, June 2008.
134. "Economic importance of the Belgian ports: Flemish maritime ports, Liège port complex and the port of Brussels - Report 2006", by S. Vennix, *Document series*, June 2008.
135. "Imperfect exchange rate pass-through: The role of distribution services and variable demand elasticity", by Ph. Jeanfils, *Research series*, August 2008.
136. "Multivariate structural time series models with dual cycles: Implications for measurement of output gap and potential growth", by Ph. Moës, *Research series*, August 2008.
137. "Agency problems in structured finance - A case study of European CLOs", by J. Keller, *Document series*, August 2008.
138. "The efficiency frontier as a method for gauging the performance of public expenditure: A Belgian case study", by B. Eugène, *Research series*, September 2008.
139. "Exporters and credit constraints. A firm-level approach", by M. Muûls, *Research series*, September 2008.
140. "Export destinations and learning-by-exporting: Evidence from Belgium", by M. Pisu, *Research series*, September 2008.
141. "Monetary aggregates and liquidity in a neo-Wicksellian framework", by M. Canzoneri, R. Cumby, B. Diba and D. López-Salido, *Research series*, October 2008.
142 "Liquidity, inflation and asset prices in a time-varying framework for the euro area, by Ch. Baumeister, E. Durinck and G. Peersman, *Research series*, October 2008.
143. "The bond premium in a DSGE model with long-run real and nominal risks", by G. D. Rudebusch and E. T. Swanson, *Research series*, October 2008.
144. "Imperfect information, macroeconomic dynamics and the yield curve: An encompassing macro-finance model", by H. Dewachter, *Research series*, October 2008.
145. "Housing market spillovers: Evidence from an estimated DSGE model", by M. Iacoviello and S. Neri, *Research series*, October 2008.
146. "Credit frictions and optimal monetary policy", by V. Cúrdia and M. Woodford, *Research series*, October 2008.
147. "Central Bank misperceptions and the role of money in interest rate rules", by G. Beck and V. Wieland*,* *Research series*, October 2008.
148. "Financial (in)stability, supervision and liquidity injections: A dynamic general equilibrium approach", by G. de Walque, O. Pierrard and A. Rouabah, *Research series*, October 2008.
149. "Monetary policy, asset prices and macroeconomic conditions: A panel-VAR study", by K. Assenmacher-Wesche and S. Gerlach, *Research series*, October 2008.
150. "Risk premiums and macroeconomic dynamics in a heterogeneous agent model", by F. De Graeve, M. Dossche, M. Emiris, H. Sneessens and R. Wouters, *Research series*, October 2008.
151. "Financial factors in economic fluctuations", by L. J. Christiano, R. Motto and M. Rotagno, *Research series*, to be published.
152. "Rent-sharing under different bargaining regimes: Evidence from linked employer-employee data", by M. Rusinek and F. Rycx, *Research series*, December 2008.
153. "Forecast with judgment and models", by F. Monti, *Research series*, December 2008.
154. "Institutional features of wage bargaining in 23 European countries, the US and Japan", by Ph. Du Caju, E. Gautier, D. Momferatou and M. Ward-Warmedinger, *Research series*, December 2008.
155. "Fiscal sustainability and policy implications for the euro area", by F. Balassone, J. Cunha, G. Langenus, B. Manzke, J Pavot, D. Prammer and P. Tommasino, *Research series*, January 2009.

156. "Understanding sectoral differences in downward real wage rigidity: Workforce composition, institutions, technology and competition", by Ph. Du Caju, C. Fuss and L. Wintr, *Research series*, February 2009.
157. "Sequential bargaining in a New Keynesian model with frictional unemployment and staggered wage negotiation", by G. de Walque, O. Pierrard, H. Sneessens and R. Wouters, *Research series*, February 2009.
158. "Economic importance of air transport and airport activities in Belgium", by F. Kupfer and F. Lagneaux, *Document series*, March 2009.
159. "Rigid labour compensation and flexible employment? Firm-Level evidence with regard to productivity for Belgium", by C. Fuss and L. Wintr, *Research series*, March 2009.
160. "The Belgian iron and steel industry in the international context", by F. Lagneaux and D. Vivet, *Document series*, March 2009.
161. "Trade, wages and productivity", by K. Behrens, G. Mion, Y. Murata and J. Südekum, *Research series*, March 2009.
162. "Labour flows in Belgium", by P. Heuse and Y. Saks, *Research series*, April 2009.
163. "The young Lamfalussy: An empirical and policy-oriented growth theorist", by I. Maes, *Research series*, April 2009.
164. "Inflation dynamics with labour market matching: Assessing alternative specifications", by K. Christoffel, J. Costain, G. de Walque, K. Kuester, T. Linzert, S. Millard and O. Pierrard, *Research series*, May 2009.
165. "Understanding inflation dynamics: Where do we stand?", by M. Dossche, *Research series*, June 2009.
166. "Input-output connections between sectors and optimal monetary policy", by E. Kara, *Research series*, June 2009.
167. "Back to the basics in banking? A micro-analysis of banking system stability", by O. De Jonghe, *Research series*, June 2009.
168. "Model misspecification, learning and the exchange rate disconnect puzzle", by V. Lewis and A. Markiewicz, *Research series*, July 2009.
169. "The use of fixed-term contracts and the labour adjustment in Belgium", by E. Dhyne and B. Mahy, *Research series*, July 2009.
170. "Analysis of business demography using markov chains – An application to Belgian data", by F. Coppens and F. Verduyn, *Research series*, July 2009.
171. "A global assessment of the degree of price stickiness - Results from the NBB business survey", by E. Dhyne, *Research series*, July 2009.
172. "Economic importance of the Belgian ports: Flemish maritime ports, Liège port complex and the port of Brussels - Report 2007", by C. Mathys, *Document series*, July 2009.
173. "Evaluating a monetary business cycle model with unemployment for the euro area", by N. Groshenny, *Research series*, July 2009.
174. "How are firms' wages and prices linked: Survey evidence in Europe", by M. Druant, S. Fabiani and G. Kezdi, A. Lamo, F. Martins and R. Sabbatini, *Research series*, August 2009.
175. "Micro-data on nominal rigidity, inflation persistence and optimal monetary policy", by E. Kara, *Research series*, September 2009.
176. "On the origins of the BIS macro-prudential approach to financial stability: Alexandre Lamfalussy and financial fragility", by I. Maes, *Research series*, October 2009.
177. "Incentives and tranche retention in securitisation: A screening model", by I. Fender and J. Mitchell, *Research series*, October 2009.
178. "Optimal monetary policy and firm entry", by V. Lewis, *Research series*, October 2009.
179. "Staying, dropping, or switching: The impacts of bank mergers on small firms", by H. Degryse, N. Masschelein and J. Mitchell, *Research series*, October 2009.
180. "Inter-industry wage differentials: How much does rent sharing matter?", by Ph. Du Caju, F. Rycx and I. Tojerow, *Research series*, October 2009.
181. "Empirical evidence on the aggregate effects of anticipated and unanticipated US tax policy shocks", by K. Mertens and M. O. Ravn, *Research series*, November 2009.
182. "Downward nominal and real wage rigidity: Survey evidence from European firms", by J. Babecký, Ph. Du Caju, T. Kosma, M. Lawless, J. Messina and T. Rõõm, *Research series*, November 2009.
183. "The margins of labour cost adjustment: Survey evidence from European firms", by J. Babecký, Ph. Du Caju, T. Kosma, M. Lawless, J. Messina and T. Rõõm, *Research series*, November 2009.
184. "Discriminatory fees, coordination and investment in shared ATM networks" by S. Ferrari, *Research series*, January 2010.
185. "Self-fulfilling liquidity dry-ups", by F. Malherbe, *Research series*, March 2010.
186. "The development of monetary policy in the 20th century - some reflections", by O. Issing, *Research series*, April 2010.

187. "Getting rid of Keynes? A survey of the history of macroeconomics from Keynes to Lucas and beyond", by M. De Vroey, *Research series*, April 2010.
188. "A century of macroeconomic and monetary thought at the National Bank of Belgium", by I. Maes, *Research series*, April 2010.
189. "Inter-industry wage differentials in EU countries: What do cross-country time-varying data add to the picture?", by Ph. Du Caju, G. Kátay, A. Lamo, D. Nicolitsas and S. Poelhekke, *Research series*, April 2010.
190. "What determines euro area bank CDS spreads?", by J. Annaert, M. De Ceuster, P. Van Roy and C. Vespro, *Research series*, May 2010.
191. "The incidence of nominal and real wage rigidity: An individual-based sectoral approach", by J. Messina, Ph. Du Caju, C. F. Duarte, N. L. Hansen, M. Izquierdo, *Research series*, June 2010.
192. "Economic importance of the Belgian ports: Flemish maritime ports, Liège port complex and the port of Brussels - Report 2008", by C. Mathys, *Document series,* July 2010.
193. "Wages, labor or prices: how do firms react to shocks?", by E. Dhyne and M. Druant, *Research series*, July 2010.
194. "Trade with China and skill upgrading: Evidence from Belgian firm level data", by G. Mion, H. Vandenbussche, and L. Zhu, *Research series*, September 2010.
195. "Trade crisis? What trade crisis?", by K. Behrens, G. Corcos and G. Mion, *Research series*, September 2010.
196. "Trade and the global recession", by J. Eaton, S. Kortum, B. Neiman and J. Romalis, *Research series*, October 2010.
197. "Internationalization strategy and performance of small and medium sized enterprises", by J. Onkelinx and L. Sleuwaegen, *Research series*, October 2010.
198. "The internationalization process of firms: From exports to FDI?", by P. Conconi, A. Sapir and M. Zanardi, *Research series*, October 2010.
199. "Intermediaries in international trade: Direct versus indirect modes of export", by A. B. Bernard, M. Grazzi and C. Tomasi, *Research series*, October 2010.
200. "Trade in services: IT and task content", by A. Ariu and G. Mion, *Research series*, October 2010.
201. "The productivity and export spillovers of the internationalisation behaviour of Belgian firms", by M. Dumont, B. Merlevede, C. Piette and G. Rayp, *Research series*, October 2010.