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TRADING ACTIVITIES, PRODUCTIVITY AND MARKUPS: EVIDENCE FOR SPANISH MANUFACTURING

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Abstract.

This work analyses the firms' internationalization strategies of importing intermediates and exporting output, and the potential rewards of these activities in terms of total factor productivity (TFP), as a proxy for marginal costs, and markups. It further deepens into the study of the relationship between internationalization strategies and markups by disentangling whether it operates through affecting firms' marginal costs and/or firms' prices. The panel database employed in this paper is the Spanish Survey on Business Strategies (ESEE) for the period 2006-2014. Results in the paper distinguish between SMEs and large firms and indicate that there is high persistence in the performance of these activities and in firms' TFP and markups. For SMEs, we obtain rewards from importing inputs as well as exporting output in terms of TFP and markups. For large firms, we obtain rewards in TFP from the importing activity and rewards in markups from the exporting activity. Finally, we find evidence that the effects of internationalization strategies on markups are due to both a price channel and a marginal cost channel.

Keywords: Exports, imports of intermediates, total factor productivity, markups, output prices, manufacturing, firm-level data

JEL classification: D24, F14, F61, L11

1. Introduction.

The liberalization of international trade has had an important impact on firms' internationalization strategies and on the internationalization of production processes through the incorporation of imported goods in the value chain. These trends mean an impulse to the intensification of exports and to the improvement of local production through imports of intermediate inputs, which could enhance firms' productivity and profits ultimately.

This paper aims to contribute to the international trade literature by exploring firms trading strategies and their impact on firms' productivity and markups. In particular, we focus on firms' imports of intermediates and export strategies, and analyse the dynamic links between them and their impact on productivity and markups.[1]

Thus, the first strand of the international trade literature we seek to contribute is the analysis of the dynamic linkages between firms' imports of intermediates and export decisions. On the one hand, exporters with previous knowledge and experience operating in international markets may find it easier to incorporate foreign inputs in their production process. Moreover, they may feel the competitive pressure of other traders that incorporate higher quality inputs. On the other hand, if importers of intermediates profit from the diffusion of new technologies and knowledge embodied in the imported inputs and produce higher quality products, this may facilitate their exports.

A crucial point in the analysis of the dynamic linkages between importing intermediates and exporting is the recognition that both activities may imply costs that are sunk in nature. For

[1] Henceforth, it should be understood that when we speak about exports, we refer to exports of the final product of the firm (that could be an intermediate input for other firms); and, when we speak about imports of intermediates, we refer to imports of intermediate inputs.

instance, exporters have to research foreign demand and competition, establish marketing and distribution channels, and adjust their product characteristics to meet foreign tastes and/or fulfil quality and security legislation of other countries. Further, importers need to invest resources to find the international suppliers that better meet their needs both in terms of costs and quality. Acknowledging the existence of sunk costs implies that current exports and imports depend on past exports and imports trajectories, and, more interestingly, that transitory changes in trade policy or conditions may lead to permanent changes in trade status, that is, sunk entry or exit costs produce hysteresis in trade flows.[2] Nevertheless, it is important to note that although persistence in exporting and/or importing might be caused by sunk costs, there might be other competing sources of persistence, such as underlying (either observed or unobserved) firm heterogeneity.

In our analysis of the dynamic linkages between firms' imports of intermediates and export decisions, we explicitly recognize the role that importing/exporting sunk costs might play. In particular, we estimate a maximum likelihood dynamic model of the firms' joint strategy of importing intermediates and exporting in which we allow firms' past import (export) decisions to affect not only future import (export) decisions but also export (import) decisions, since the performance of one activity can enhance expected gains of the performance of the other. Furthermore, when controlling for competing sources of persistence in a given trading status, we devote special attention to the role of past productivity, as it will allow exploring possible self-selection/continuation effects into importing of intermediates and/or exporting (Aw et al., 2011; Máñez et al., 2015).

[2] The first attempt to test for the sunk cost hysteresis hypothesis in exporting is Roberts and Tybout (1997), for Colombian manufacturing. More recent empirical evidence is Bernard and Jensen (2004) for the U.S., and Campa (2004) and Máñez et al. (2008) for Spain.

The second strand of the international trade literature we aim to contribute is related to the link between firms' trading activities and productivity. The relationship between exports and productivity has been comprehensively studied.[3] The empirical evidence suggests that exporters are more productive than non-exporters (see Bernard and Jensen, 1999, among others). This could be the result of a process of self-selection of the more productive firms into foreign markets (Melitz, 2003) and/or may arise from potential productivity gains that stem from export participation (learning-by-exporting hypothesis, LBE henceforth). Productivity gains from exporting are usually related to growth of sales that allows firms profiting from economies of scale, knowledge flows from foreign customers or increased competition in foreign markets that forces firms to behave more efficiently. Whereas there is widespread empirical evidence on self-selection, the evidence on LBE is mixed and far from conclusive. There are studies that do not find any evidence of LBE, and among those that do find evidence in favour of it, the findings differ both in the magnitude and in the duration of the LBE effect.[4]

De Loecker (2013), however, argues that most previous tests for LBE could be flawed. The usual empirical strategy is to look at whether a productivity estimate, typically obtained as the residual from a production function estimation, increases after firms become exporters. Within the framework of the control function approach to estimate productivity (Olley and Pakes, 1996; Levinsohn and Petrin, 2003), De Loecker (2013) suggests that a proper test for the LBE hypothesis requires to move from the standard assumption that productivity is governed by an exogenous Markov process to assuming a more general (endogenous) Markov process in which past export experience might influence future productivity. Some recent papers following this

[3] See Greenaway and Kneller (2007), Wagner (2007, 2012) and ISGEP (2008) for thorough reviews of this literature.

[4] Silva et al. (2010) provide a detailed survey on the LBE literature. Further, Martins and Yang (2009) provide a meta-analysis for 33 empirical studies. Singh (2010) concludes that studies supporting self-selection overwhelm studies supporting learning-by-exporting.

approach are De Loecker (2007, 2013), De Loecker and Warzyniski (2012), Manjón et al. (2013) and Máñez et al. (2014, 2015).

In recent years, there is an increasing interest in the analysis of the impact of importing intermediate inputs on productivity. Special attention has been paid to test the hypothesis of learning-by-importing (LBI, henceforth), i.e. to test whether importing intermediates results in an increase in firms' productivity. If importing firms have access to a wider variety of intermediate inputs and/or to higher quality inputs and, therefore, may benefit from the diffusion and adoption of new technologies and knowledge embodied in imported inputs, this can result in productivity increases. The empirical evidence for the LBI hypothesis, using firm-level data, is mixed. Van Biesebroeck (2003) using Colombian data finds that productivity growth is correlated more strongly with firm's export status than with the use of imported inputs; and, similarly, Muendler (2004) finds a small contribution of foreign materials and investments goods on output for Brazil. In contrast, Kasahara and Rodrigue (2008),[5] Amiti and Konings (2007) and Halpern et al. (2015) find that importing intermediates has a positive effect on firms' productivity for Chile, Indonesia and Hungary, respectively.[6]

Only a few empirical studies examine simultaneously the effects of importing intermediates and exporting on productivity at the micro-level. Among them, it is worth mentioning Kasahara and Lapham (2013), who devise a model with heterogeneous final good producers who simultaneously choose whether to export their output and to use imported intermediates. They estimate a structural model with Chilean plant-level data that confirms that there are aggregate productivity and welfare gains due to trade in both final goods and intermediates.

[5] Kasahara and Rodrigue (2008), when estimating total factor productivity consider an endogenous Markov process for the law governing the evolution of productivity in which past import experience may affect future productivity.

[6] There are other studies (using cross-country data) that find that importing intermediate goods (that embody technology) increases firm productivity, such as Coe and Helpman (1995) and Coe et al. (1997).

We aim to contribute to this strand of the international trade literature carrying out a joint robust test both for the LBE and LBI hypotheses. To fulfil this task, we follow De Loecker (2012) to estimate total factor productivity (TFP henceforth). We use a procedure based in the control function approach framework to estimate TFP, although we consider a more general law of motion of productivity as we allow past export and import experience to affect future productivity. Then, we use this estimated TFP as dependent variable of an equation in which we test for LBI and LBE while explicitly recognising the existence of state dependence (persistence) on productivity.

As mentioned above, the third strand of the literature we aim to contribute is on the analysis of the impact of firms' trading strategies on markups (defined as the ratio of price to marginal cost). Both importing intermediates and exporting may have an impact on firms' markups through the *marginal cost* and/or the *price channel*. As for the *marginal cost* channel for exports, if the LBE mechanism operates (so exporting firms become more efficient) and there is not full pass through to prices of the marginal cost reduction, the result will be an increase in markups. Furthermore, if a necessary condition to be competitive in international markets is the production of higher quality differentiated products, this may result in a potential reduction in the demand price elasticity of the exporters' portfolio of products that will allow them to increase prices and enjoy higher margins (*price channel*). With respect to the *marginal cost channel* for imports, if importing inputs allows reducing production costs and there is not full pass-through to output prices, the result will be an increase in markups. Moreover, if firms importing intermediates have access to higher quality inputs with superior embodied technology, the incorporation of these inputs into production could result in higher quality products that would allow firms to charge higher prices with the consequent increase in markups (*price channel*).

The empirical literature exploring the effects of firms' trading activities on their markups is scarce. Very likely, the most relevant reference in this line of research is De Loecker and

Warzynski (2012). They introduced a method that allows estimating firms' specific markups using just production data and under mild assumptions on firms' behaviour: they only require firms to be cost minimisers; and, to use at least one variable factor on production. They use these firms' specific markups in a regression analysis to demonstrate that exporters enjoy a positive markup premium.[7] As for the relationship between imports of intermediates and markups, Moreno and Rodriguez (2011) find no differences between the markups of importers of intermediates and non-importers for Spanish manufacturing firms for the period 1990-2005. Finally, to the best of our knowledge, there is only one paper that jointly explores the impact of importing intermediates and exporting on markups. This is the recent paper by Hornok and Muraközy (2019) for Hungary. In this study, they find that importing intermediates increases firms' markups but exporting does not have a significant impact once controlling for imports.

Our contribution to this stream of the literature consists in the estimation of firm specific markups, using De Loecker and Warzynski (2012) methodology, to use them as the dependent variable of an equation that pursues to analyse the impact of both importing inputs and exporting on markups. In addition, we explore whether the possible effects of importing intermediates and/or exporting operate through the price and/or the marginal costs channels.

In our different levels of analysis in this paper, we consider the possible mediating role of firm size and allow for differentiated effects of our variables of interest between small and medium enterprises (SMEs hereafter) and large firms.[8] SMEs are more often financially constrained, enjoy less internal funds (see, for instance, Máñez et al., 2014, or Damijan and Kostevc, 2011) and are usually more risk averse. Thus, for SMEs to pay upfront costs associated to start importing intermediates or exporting might imply a higher hurdle than for their larger counterparts.

[7] However, with a different methodology and for the 1990s decade in Spain, Moreno and Rodriguez (1994) find that markups in export markets are smaller than in domestic markets.

[8] It should be considered that Spanish manufacturing SMEs represent around 90% of the total number of manufacturing firms.

Moreover, Bernard et al. (2007), Eaton et al. (2008) and Damijan et al. (2011) show that SMEs usually export to one or two countries and a small number of products, being more vulnerable to the adverse evolution of these markets than large firms with a larger portfolio of countries and products.

To anticipate our main results, the joint analysis of the firm's decisions of importing intermediates and exporting suggests a high degree of persistence (consistent with the presence of sunk costs) in both trading activities and both for large firms and SMEs. Furthermore, for SMEs we find that past export experience encourages imports of intermediates activities and *vice versa*. Nevertheless, for large firms only past export experience has an impact on future import strategies. Lastly, our results support the existence of a self-selection/continuation mechanism of the more productive firms into both importing intermediates and exporting.

The analysis of the impact of imports and export strategies on productivity indicates that whereas SMEs obtain rewards in terms of higher productivity both from exporting and importing, large firms obtain productivity rewards only from importing. Therefore, whilst for SMEs we find evidence both of LBE and LBI for large firms we only find evidence of LBI.

Finally, from our markups analysis, we find evidence suggesting positive rewards from importing and exporting for SMEs. Furthermore, this positive effect of importing intermediates and exporting on markups operates through both the price and the marginal costs channels. For large firms, only exporting pays higher rewards in markups, and this positive effect accrues only through the price channel.

The remainder of the paper is organized as follows. Section 2 describes the data and presents some relevant descriptive statistical analysis. Section 3 is devoted to introduce the empirical modelling. Section 4 presents the main results of the paper. Finally, section 5 concludes.

2. Data and descriptive analysis.

2.1. The data.

The data used in this work have been drawn from the ESEE for the period 2006-2014. The ESEE is an annual panel database sponsored by the Spanish Ministry of Industry and carried out by the SEPI Foundation that is representative of Spanish manufacturing firms classified by industry and size categories. In particular, the ESEE provides information about firms' strategies, i.e., decisions firms take regarding their competitive environment. The questionnaire covers information on firm's activity, products and manufacturing processes, customers and suppliers, costs and prices, markets, technological activities, foreign trade, and accounting data.

The sampling procedure of the ESEE is as follows. Firms with less than 10 employees were excluded from the survey. Firms with 10 to 200 employees (SMEs) were randomly sampled, holding around 5% of the population in 1990. All firms with more than 200 employees (large firms) were requested to participate, obtaining a participation rate around 70% in 1990. Important efforts have been made to minimise attrition and to annually incorporate new firms with the same sampling criteria as in the base year, so that the sample of firms remains representative over time.[9]

To start with, we have a sample of 16,917 observations corresponding to 2,977 firms. From this initial sample, to estimate TFP and analyse the impact of export and import strategies on TFP, we sample out those firms that fail to supply relevant information in any given year. Further, as our TFP estimation method requires that firms supply information for at least three

[9] See http://www.fundacionsepi.es/investigacion/esee/en/svariables/indice.asp for further details.

consecutive years, we remove all firms that do not accomplish with this criterion. After cleansing the data, we end up with a sample of 8,776 observations corresponding to 1,867 firms.

The ESEE provides information about whether the firm exports its production and/or imports intermediates.[10] In particular, we use the following question: "Indicate whether the firm, either directly, or through other firms from the same group, has imported intermediates/exported during this year (including imports/exports from/to the European Union)". In Table 1, we report for SMEs and large firms the cross-sectional distribution of exporting, importing and performing both activities, averaged over all years in the analysis.

[Table 1 about here]

In Figures 1 and 2 we plot the evolution over 2006-2014 of the proportion of SMEs and large firms only exporting, only importing, both exporting and importing and neither exporting nor importing.

[Figure 1 about here]

[Figure 2 about here]

For SMEs (see Figure 1), we observe that the proportion of firms only exporting (around 27%) or only importing (around 7%) is quite stable for the period analysed. However, we observe that the proportion of firms that both export and import has increased over the period (from 23.53% in 2006 to 38.03% in 2014) and the percentage of firms that are neither exporters nor importers has diminished (from 41.24% in 2006 to below 30% in 2014).

For large firms (see Figure 2), there is evidence that the combination of both activities is the most important state, as on average for the whole period we have that almost 68% of large firms perform both activities. The second most important status for large firms is only export, with

[10] The year 2006 is the first year in the survey to include a question about imports of intermediates.

an average of 24.47% over the period. Finally, the percentages of neither exporting nor importing and only importing intermediates are less than 5%.

High percentages of firms that undertake both activities support the idea that exporting and importing are related activities. This is especially relevant for large firms, what indicates that a majority of large firms tend to export its production and import intermediates at the same time.

2.2. Some descriptive statistics.

In this section, we present some descriptive statistics for the main variables in our analysis, distinguishing between SMEs and large firms (see Table 2). We report the mean value (and standard deviation) for the following variables: product and process innovation (as the percentage of firms declaring a product or a process innovation); age (in number of years); employment (as the number of employees); hours worked (measured as the number of total hours actually worked in the firm, in thousands); the participation of foreign enterprises in the firm's capital (measured as a dummy variable equal to 1 if the firm's capital is participated by a foreign enterprise, and 0 otherwise); market share (measured as a dummy variable equal to 1 if the firm asserts to account for a significant market share in its main market, and 0 otherwise); expansive demand (measured as a dummy variable equal to 1 if the firm declares to face an expansive demand, and 0 otherwise); skilled labour (measured as the proportion of high skilled labour -engineers and graduates-, and med skilled labour -technical engineers, experts and qualified assistants-, in the firm's labour force); labour productivity (measured as output in real terms over employment); production (output in real terms); materials (intermediate materials used in production in real terms); capital (measured as capital stock in real terms constructed using the perpetual inventory method and based on current replacement value net of depreciation and adjusted by capacity utilization); capacity utilization (percentage of the firm's capacity utilized); the proportion of firms

exporting; the proportion of firms importing intermediates; export intensity for exporters (calculated as the proportion of exports over firm's sales); import of intermediates intensity for importers (calculated as the proportion of imports of intermediates over firm's intermediate inputs); and, the output price variation (measured as the percentage change in sales prices from one year to the next).[11] An important advantage of our dataset is that it is possible to construct firm level price indices for output and materials.[12] In Table 2, we observe that large firms are more innovative than small firms, they are older, have more skilled labour, are more productive in terms of labour productivity, have larger market share, face more likely an expansive demand and increase more their output prices. Furthermore, the proportion of large firms participated by foreign firms is higher than that of SMEs. Additionally, large firms are also more involved in international markets, both in terms of the proportion of firms exporting and importing and in terms of intensities. Finally, large firms use more intermediate materials, have higher capital and use more the production capacity of the firm than their smaller counterparts.

[Table 2 about here]

We also identify some stylized facts about exporters and importers (using a simple regression analysis) that are reported in Table 3. The objective of these regressions is to explore the link between both trade decisions (exporting only, importing only or both) and some basic firm's characteristics related to its production function. In particular, we estimate the following equation:

$$\log(y_{it}) = \beta_0 + \beta_1 Export_{it} + \beta_2 Import_{it} + \beta_2 Both_{it} + controls_{it} + e_{it} \quad (1)$$

[11] More detailed definitions of all the variables are presented in Table A.1. in the Appendix.

[12] Output and materials in real terms are computed using firm-specific price indexes for output and materials, respectively. The price indexes, of the Paasche-type, are constructed starting from the percentage price changes on output and the percentage price changes on materials reported by the firm in the ESEE. Capital in real terms is obtained by deflating capital at current replacement values by a price index of investment. For more details, see Table A.1. in the Appendix.

where the dependent variable y_{it} is alternatively employment, labour productivity, capital per worker and materials per worker. As regressors, we include the firm trade status and some controls. Thus, $Export_{it}$ is equal to one if firm *i* only exports in *t* (and zero otherwise), $Import_{it}$ is equal to one if firm *i* only imports intermediates in *t* (and zero otherwise), and $Both_{it}$ is equal to one if firm *i* both exports output and imports intermediates in *t* (and zero otherwise). The reference category is performing none of the two activities. We also control for size using the employment variable (except in the first regression), industry and year dummies.

The differences (in %) between firms with different exporting/importing strategies for each of the four considered firms' characteristics are computed from the estimated coefficients β as $100(\exp(\beta)-1)$. In the upper part of Table 3 we report the results for SMEs. As regards employment, we find that firms that only export, only import or undertake both activities simultaneously are larger than firms that neither import nor export. Furthermore, firms both exporting and importing are larger than firms only importing or only exporting. In addition, firms only exporting are larger than firms only importing. As for the other variables, we can conclude that SMEs that export, import or both, have higher labour productivity and are more capital and materials intensive than SMEs that neither import nor export. Moreover, firms performing both activities have higher values on the three variables.

In the bottom part of Table 3 we report the results for large firms. There are fewer significant differences across types of large firms. For this size group, statistical differences are mainly found for firms performing both internationalization strategies as regards all the other types of firms. In particular, they are more productive and more capital and materials intensive.

[Table 3 about here]

3. Empirical modelling.

We structure this section in three subsections to present the empirical modelling for the three main issues considered in this paper: the analysis of the joint decisions of importing intermediates and exporting output; the influence of firms' experience importing intermediates and exporting on the evolution of productivity; and, the exploration of the impact of firms' imports of intermediates and exports on firms' markups.

3.1. Importing and exporting decisions.

We frame our empirical model of the joint likelihood of exporting output and importing intermediates using a specification in terms of sunk costs and a set of variables that proxy for the payoffs of each activity. In what follows, we explain the rationale behind this specification.

Firms face sunk costs both when entering export markets and when deciding to import intermediate inputs. Exporting sunk costs are related to questions such as the need of researching foreign demand and competition, establishing marketing and distribution channels, and adjusting own product characteristics to meet foreign tastes and/or fulfil other countries quality and security legislation. As for the sunk costs associated to importing intermediates, firms invest resources to access to a wider range of foreign inputs, to higher quality inputs, or to foreign technology incorporated in imported inputs (Bustos, 2011). The existence of sunk costs linked to importing intermediates and exporting implies that the firm's past import and export activities should be considered as state variable in the company's import and exports decisions, respectively.

Within the framework of firms' dynamic import and export decisions, a firm will decide to import intermediates (export) in year *t* whenever the current increase to gross operating profits associated with the decision to import (export) plus the discounted expected future returns from being an importer (exporter) in year *t* exceed sunk costs.

Since the value function of a firm that decides to export can be affected by its optimal import decision and *vice versa*, our joint likelihood will include the firm's past import status when explaining the current probability to export, and past export status when explaining the probability to import intermediates. This is the case when there are non-negligible sunk exporting (importing) costs and/or exporting (importing) affects productivity. If the firm's current productivity depends on the past exporting and importing experience, the firm's payoffs from exporting (importing) positively depend on the extent to which past exporting (importing) raises current productivity (this aspect is explicitly recognised when modelling productivity in the next section where we will consider an endogenous Markov process for the law of motion of productivity). Thus, in our model, the net benefit from exporting output and importing intermediates is growing in productivity. This argument endogenizes the well-known self-selection mechanism in the literature: should past firm's import/export choices increase future productivity, they will increase the likelihood of firms' self-selecting or continuing in such activities in the future.[13] Thus, our joint model of the firm's decision to import intermediates and export includes firm's total factor productivity.

Moreover, to properly identify the role of sunk costs and past export (import) decisions, beyond productivity one needs to control for other variables potentially influencing the payoffs associated to importing intermediates and exporting, and so affecting firms' importing and exporting decisions. Thus, we control for observable firm/market characteristics, for macro conditions (including a vector of time dummies μ_t) and for industry specific effects (including a vector of industry dummies, s_j). We also include an error term (ε_{it}) that allows for the potential existence of unobserved individual heterogeneity.

The vector of firm/market control variables (Z_{it}) includes firm's size, age, foreign participation, demand conditions, market share, and firm's complementary assets such as the

[13] I.e., the most productive firms are more likely to export and import.

intensity of skilled labour or the performance of innovative activities (measured by the introduction of product and process innovations). We lag this set of control variables one period to avoid potential simultaneity problems. Finally, we assume that the error term, ε_{it}, has two components, a permanent firm-effect, α_i, and a transitory component, u_{it}.

In econometric terms, the empirical model we estimate is a dynamic model for the (joint) decisions to export and import, and these decisions are conditioned on the previous vector of variables in year *t*-1:

$$\begin{aligned} X_{it} &= \gamma_0^X + \gamma_1^X X_{it-1} + \gamma_2^X M_{it-1} + \gamma_3^X TFP_{it-1} + \beta^X Z_{it-1} + \mu_t^X + s_j^X + \varepsilon_{it}^X \\ M_{it} &= \gamma_0^M + \gamma_1^M M_{it-1} + \gamma_2^M X_{it-1} + \gamma_3^M TFP_{it-1} + \beta^M Z_{it-1} + \mu_t^M + s_j^M + \varepsilon_{it}^M \end{aligned} \quad (2)$$

In the system of equations (2), positive and significant estimates for the parameters γ_1^X and γ_1^M should be interpreted as evidence in favour of the existence of sunk costs related to exporting output and importing inputs, respectively. The parameters γ_2^X and γ_2^M account for cross effects, i.e., the fact that importing enhances the probability of exporting and *vice versa*. Further, the parameters γ_3^X and γ_3^M allow testing for the existence of a self-selection/continuation mechanism of the more productive firms into exporting and importing inputs, respectively. In this respect, notice that for new entrants they measure the typical self-selection mechanism in the trade literature. However, for firms that were already exporters and/or importers, they measure an endogenous self-selection (continuation) mechanism that works when previous firm's internationalization decisions affect future productivity and, therefore, the future continuation of firms in the implementation of these activities.

3.2. The production function and firms TFP estimation, imports of intermediates and exports.

We assume that firms produce using a translog technology:

$$\begin{aligned} y_{it} = {} & \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_{l2} l_{it}^2 + \beta_{k2} k_{it}^2 + \beta_{m2} m_{it}^2 + \\ & \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{km} k_{it} m_{it} + \beta_{dm} dm_{it} + \mu_t + \omega_{it} + \eta_{it} \end{aligned} \quad (3)$$

where y_{it} is the natural log of production of firm *i* at time *t*, l_{it} is the natural log of labour (measured by hours worked), k_{it} is the natural log of capital, m_{it} is the natural log of intermediate materials, and μ_t are time effects. By calculating the corresponding derivatives, the parameters with *k*, *l* and *m* subscripts measure the contribution of capital, labour and materials to production; ω_{it} is productivity (not observed by the econometrician but observable or predictable by firms) and η_{it} is a standard i.i.d. error term that is neither observed nor predictable by the firm. Following Kasahara and Rodrigue (2008) and Halpern *et al.* (2015), we have augmented the production function to include as a shifter in equation (3) the term *dm* (ratio of imports of intermediates to total intermediate inputs –imported intermediates intensity), which coefficient, following Kasahara and Rodrigue (2008) terminology, represents and captures the *static* contribution of imported inputs to firms' production. The intuition is that firms importing intermediate inputs have access to a wider variety of intermediate inputs and/or to higher-quality inputs, what could potentially result in an increase in output for a given total spending on intermediate inputs.

Under the assumption that capital is a state variable, whereas labour and intermediate materials can be adjusted when the firm faces a productivity shock (i.e. they are variable factors),[14] Olley and Pakes (1996) show how to obtain consistent estimates of the production function using a semiparametric procedure (see Levinsohn and Petrin, 2003, for a closely related estimation strategy). In this paper we follow Wooldridge (2009) that argues that both Olley and Pakes (1996) and Levinsohn and Petrin (2003) can be reconsidered as consisting of two equations that can be jointly estimated by GMM: the first equation tackles the problem of endogeneity of variable inputs; and, the second equation deals with the issue of the law of motion of productivity.

[14] The law of motion for capital follows a dynamic process according to which $K_{it} = (1-\delta)K_{it-1} + I_{it-1}$. Thus, it is assumed that the capital a firm uses in period *t* was actually decided in period *t*-1. Labour and materials (unlike capital) are chosen in period *t*, the period they actually get used and, therefore, they can be considered a function of ω_{it}.

To solve the problem of endogeneity of the variable inputs, both Olley and Pakes (1996) and Levinsohn and Petrin (2003) use a control function approach to proxy for ''unobserved'' firm productivity, by using investment and materials, respectively. Furthermore, the proxy variable demand function, $m_t(\cdot)$, that in our case is the materials demand function (as in Levinsohn and Petrin, 2003), is assumed to have a unique unobservable among its arguments (*scalar unobservable assumption*) and to be strictly monotonic in unobserved productivity. Thus, given that in equilibrium the demand of materials only depends on state variables, we can write this demand function as $m_{it} = m_t(k_{it}, \omega_{it})$.

Notice that, when estimating productivity using the standard Olley and Pakes (1996) and Levinsohn and Petrin (2003) methods, in a sample where some firms do not participate in foreign markets whereas others do, it is assumed that the demand of intermediate materials for the different types of firms (according to their exporting and importing statuses) is identical. However, heterogeneity in these firm's strategies may influence the demand of intermediate inputs. Thus, we consider that the demand of intermediate materials depends not only on k_{it} and m_{it} but also on import intensity of intermediates (dm_{it}) and export intensity (dx_{it}).[15] Thus, we write the demand for materials as:

$$m_{it} = m_t(k_{it}, \omega_{it}, dm_{it}, dx_{it}) \tag{4}$$

Under the scalar unobservable and the monotonicity assumptions, the demand for materials can be inverted to generate:

$$\omega_{it} = m_t^{-1}(k_{it}, m_{it}, dm_{it}, dx_{it}) = h_t(k_{it}, m_{it}, dm_{it}, dx_{it}) \tag{5}$$

where h_t is an unknown function in its arguments. Then, substituting expression (5) into the production function (3) we get our first estimation equation:

[15] Export intensity and import intensity are defined as the ratio of exports to sales and the ratio of imports of intermediates to total intermediate inputs, respectively.

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_{l2} l_{it}^2 + \beta_{k2} k_{it}^2 + \beta_{m2} m_{it}^2 + \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{km} k_{it} m_{it} + \beta_{dm} dm_{it} + h_t\left(k_{it}, m_{it}, dm_{it}, dx_{it}\right) + \mu_t + \eta_{it} \quad (6)$$

Since the unknown function h_t in (6) is proxied by a third-degree polynomial in its arguments, the parameters β_0, β_k, β_m, β_{k2}, β_{m2}, β_{km} and β_{dm} are not identified from this equation. This is achieved by the inclusion of a second equation in the GMM system that deals with the law of motion of productivity:

$$\omega_{it} = E[\omega_{it} | \omega_{it-1}] + \xi_{it} = f(\omega_{it-1}) + \xi_{it} \quad (7)$$

where $f(\cdot)$ is an unknown function that relates productivity in *t* to productivity in *t-1* and ξ_{it} is an innovation term uncorrelated by definition with k_{it}. However, this expression neglects the possibility that firms' previous importing and exporting experience affects future productivity. Consequently, here we consider a more general Markov process in which previous import of intermediates and export intensities may influence the dynamics of productivity:

$$\omega_{it} = E[\omega_{it} | \omega_{it-1}, dm_{it-1}, dx_{it-1}] + \xi_{it} = f(\omega_{it-1}, dm_{it-1}, dx_{it-1}) + \xi_{it} \quad (8)$$

Furthermore, using (5) we can rewrite (8) as:

$$\omega_{it} = f\left[h_{t-1}\left(k_{it-1}, m_{it-1}, dx_{it-1}, dm_{it-1}\right), dm_{it-1}, dx_{it-1}\right] + \xi_{it} = g_t\left(k_{it-1}, m_{it-1}, dm_{it-1}, dx_{it-1}\right) + \xi_{it} \quad (9)$$

Lastly, plugging (9) into the production function (3) our second estimation equation is given by:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_{l2} l_{it}^2 + \beta_{k2} k_{it}^2 + \beta_{m2} m_{it}^2 + \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{km} k_{it} m_{it} + \beta_{dm} dm_{it} + g_t(k_{it-1}, m_{it-1}, dm_{it-1}, dx_{it-1}) + \mu_t + u_{it} \quad (10)$$

where g_t is an unknown function of k_{it-1}, m_{it-1}, dm_{it-1} and dx_{it-1}, proxied by a third-degree polynomial in its arguments, and $u_{it} = \xi_{it} + \eta_{it}$ is a composed error term.

Wooldridge (2009) proposes to estimate jointly the system of equations (6) and (10) by GMM using the appropriate set of instruments and moment conditions for each equation. This

joint estimation strategy has the advantages of increasing efficiency relatively to two-step procedures and making unnecessary bootstrapping for the calculus of standard errors. Using this method, we obtain for each of the twenty industrial sectors (*s*) considered,[16] both the estimates of the production function and firms' productivities as the residuals of these estimations (the mean estimated industry specific input elasticities and the shifter coefficient in equation 3 are shown in Table A.2 in the Appendix; the mean estimated productivities are shown in Table A.3):[17]

$$\begin{aligned}\hat{\omega}_{it}^{s} = y_{it}^{s} - \hat{\beta}_{l}^{s} l_{it} - \hat{\beta}_{k}^{s} k_{it} - \hat{\beta}_{m}^{s} m_{it} - \hat{\beta}_{l2}^{s} l_{it}^{2} - \hat{\beta}_{k2}^{s} k_{it}^{2} - \hat{\beta}_{m2}^{s} m_{it}^{2} \\ - \hat{\beta}_{lk}^{s} l_{it} k_{it} - \hat{\beta}_{lm}^{s} l_{it} m_{it} - \hat{\beta}_{km} k_{it} m_{it} - \hat{\beta}_{dm}^{s} dm_{it} - \hat{\mu}_{t}\end{aligned} \tag{11}$$

The estimated industry specific shifter coefficients in equation 3 ($\hat{\beta}_{dm}^{s}$), which when statistically significant have a positive sign, are statistically significant for the following sectors: Leather and shoes, Timber, Chemical products, Non-metallic mineral products, Industrial and agricultural machinery, and Furniture. For these sectors, firms currently importing (or with a larger import share) *versus* firms currently only using domestic intermediates (or with a smaller import share) enjoy an increase in output for a given total spending on intermediate inputs.

Having in our dataset firm level price indexes is an important advantage over traditional TFP measures ("revenue" TFP) that deflate nominal variables with industry level price indexes. Using these TFP estimates (obtained from estimations at the industry level), we aim to recover, for the full sample of firms, the implicit parameters in the endogenous Markov process in (9) to check for the convenience of considering a more general Markov process, in which we allowed past export and import experiences to affect productivity. Therefore, combining expressions (10) and (11) above, we get:

[16] The ESEE provides 20 industrial sectors in manufacturing according to the NACE classification.

[17] Taking into account all sectors, the average elasticity for materials (βm) is 0.622, for labour (βl) 0.257 and for capital (βk) 0.073.

$$\hat{\omega}_{it}^{s} = y_{it}^{s} - \hat{\beta}_{l}^{s} l_{it} - \hat{\beta}_{k}^{s} k_{it} - \hat{\beta}_{m}^{s} m_{it} - \hat{\beta}_{l2}^{s} l_{it}^{2} - \hat{\beta}_{k2}^{s} k_{it}^{2} - \hat{\beta}_{m2}^{s} m_{it}^{2} - \hat{\beta}_{lk}^{s} l_{it} k_{it} - \hat{\beta}_{lm}^{s} l_{it} m_{it} - \hat{\beta}_{km}^{s} k_{it} m_{it} - \hat{\beta}_{dm}^{s} dm_{it} - \hat{\mu}_{t} = \beta_{0} + g_{t}(k_{it-1}, m_{it-1}, dm_{it-1}, dx_{it-1}) + u_{it} \quad (12)$$

Moreover, linearly specifying (as in Aw et al., 2011) the conditional expectation in (8), we get our final regression of interest to analyse the dependence of TFP on past export and import intensities:

$$\hat{\omega}_{it}^{s} = \beta_{0} + \alpha_{1}\hat{\omega}_{it-1} + \alpha_{2} dm_{it-1} + \alpha_{3} dx_{it-1} + s_{j} + \tau_{it} \quad (13)$$

where τ_{it} is an error term that allows for the potential existence of unobserved individual heterogeneity. We have explicitly included in estimation a set of industry dummies, s_j, to acount for the fact that in the regression analysis we pool TFP estimates for all industries.[18] Furthermore, in our empirical specification we add a vector of firms' characteristics (Z_{it}), which may also affect firms' productivity beyond internationalization strategies, that includes: size, age, foreign participation, demand conditions, market share, and firm's complementary assets such as the intensity of skilled labour or the performance of innovative activities such as the introduction of product and process innovations.[19] Finally, we also add in estimation year dummies that are common to all industries (δ_t).Therefore, our final estimation equation is:

$$\hat{\omega}_{it}^{s} = \beta_{0} + \alpha_{1}\hat{\omega}_{it-1} + \alpha_{2} dm_{it-1} + \alpha_{3} dx_{it-1} + \gamma Z_{it-1} + s_{j} + \delta_{t} + \tau_{it} \quad (14)$$

We estimate two different specifications of (14): in the first one, we proxy past import/export experience with dummy variables, indicating whether or not the firm imported intermediate inputs and/or exported in *t*-1; and, in the second one, we use import of intermediates

[18] With the linearization of the Markov process for TFP in (13), we aim to obtain an estimate of the impact of firms importing intermediates and exporting strategies on productivity for the full sample of firms that pools all sectors in a unique estimation that controls for industry dummies. Notice that we carry out the productivity estimation separately for each of the two-digit industries in which the ESEE classifies firms.

[19] We lag this set of control variables one period to avoid potential simultaneity problems.

and export intensities as defined above. Positive and significant estimates for α_2 and α_3 should be considered as evidence of *learning-by-importing* and/or *learning-by-exporting,* respectively. In addition, a positive estimate for α_1 would suggest that current productivity will carry forward to the future. Following Kasahara and Rodrigue (2008) terminology, α_2 and α_3 capture the *dynamic* effects of the use of imported materials.

3.3. Markups estimation, imports of intermediates and exports.

We calculate firm specific markups following the methodology proposed by De Loecker and Warzynski (2012), who build on Hall (1988). This was the first work using data on production to estimate markups. The main advantage of De Loecker and Warzynski (2012) method is that it allows deriving an expression for calculating markups under two mild assumptions. The first is that producers are cost-minimizers; and, the second is the existence of at least one variable input of production. According to them, one can compute the estimated markup for firm *i* in period *t* (MK_{it}) as:

$$MK_{it} = \frac{e_{it}^{j}}{share_{it}^{j}} \tag{15}$$

where e_{it}^{j} is the output elasticity of variable input *j* for firm *i* in year *t* and $share_{it}^{j}$ is the corresponding revenue share of variable input *j* (defined as the ratio of the total cost of that input over firms' total output). The intuition behind (15) is that under perfect competition, prices are equal to marginal costs and, hence, input choices of cost minimiser firms will make the revenue share equal to the output elasticity for the variable input considered. Nevertheless, under imperfect competition, the revenue shares are lower than the output elasticities, which implies markups above one (price above marginal costs). However, in empirical applications of this methodology we are not interested in the level of the markup *per se* but in its between and within variation among firms with different strategies (De Loecker and Warzynski, 2012).

It is important to note that, unlike in the Cobb-Douglas production function setup, in which markups variation is completely attributed to variations in revenue shares, when dealing with a *translog* production function, variation in markups depends both on revenue shares and on firms' specific elasticities. This is the reason why we have chosen a *translog* production function when estimating productivity.

In this paper, we base our markups calculations on the elasticity of intermediate inputs (materials), since labour (the other factor considered as variable) could be subject to more frictions. In the *translog* production function (3) the output elasticity of intermediate inputs varies across firms and is given by $e_{it}^{m} = \delta y_{it} / \delta m_{it} = \beta_m + 2\beta_{m2} m_{it} + \beta_{lm} l_{it} + \beta_{km} k_{it}$. The revenue share of intermediate inputs ($share_{it}^{m}$) is calculated as the share that the cost of intermediate inputs represents over firms' total output. Thus, the markup of firm *i* in period *t* is calculated as $MK_{it} = e_{it}^{m} / share_{it}^{m}$.[20]

Since, as we already mentioned above, we are not interested in the level of markups *per se* but on the effect of firms export and intermediate input strategies on these markups, in a similar fashion to De Loecker and Warzinsky (2012) we estimate the following reduced form dynamic equation relating firms markups to export and intermediate import strategies:

$$\ln MK_{it} = \beta_0 + \beta_1 \ln MK_{it-1} + \beta_2 dx_{it-1} + \beta_3 dm_{it-1} + \gamma Z_{it-1} + s_j + \delta_t + u_{it} \qquad (16)$$

where $\ln MK_{it}$ is the natural log of the markup of firm *i* in period *t* and $\ln MK_{it-1}$ is log markup lagged one period; dx_{it-1} and dm_{it-1} are either dummies catching whether the firm exported and/or imported intermediates in *t*-1 or the firm export and import of intermediates intensities. Z_{it-1} is a

[20] In Table A.3. in the Appendix, we present information about our mean markups estimates by industry. Figures in this table show some variation in markups across industries. For instance, we find the largest mean markups for Office machines, Electrical and electronic machinery and material, Motors and vehicles, Other transport equipment, and Leather and shoes.

vector of firm level variables other than export and import experience that may affect markups. Finally, we control for macro conditions and for the possible cyclicality of markups including a vector of time dummies (δ_t), and for industry specific effects (including the vector of industry dummies, s_j). Finally, we also include an error term (u_{it}) that allows for the potential existence of unobserved heterogeneity.

It is important to note that the aim of estimating a dynamic equation is to analyse the possible state dependence of markups. Moreover, it does not preclude the analysis of the possible cyclicality behaviour of markups (Hall, 1986) that should be captured by the set of time dummies.

To get a flavour of the evolution of TFP and markups, in Figures 3 and 4 we plot the evolution of these two estimated variables, respectively. We distinguish between SMEs and large firms. In both cases, we observe that large firms, as expected, have on average, higher TFP and higher markups than SMEs. Furthermore, we also observe that during the crisis years markups fall for both groups of firms.

[Figure 3 about here]

[Figure 4 about here]

4. Estimation results.

4.1. Import of intermediates and export decisions.

We estimate two specifications of equation (2), whose results are reported in Table 4. In Specification 1, we assume that the variable X_{it} (M_{it}) is a dummy variable taking value 1 if the firm *i* exports (imports intermediates) in year *t*. As we aim to consider the (potential) correlation between the firms' decisions to import intermediates and export, we estimate a bivariate probit model of the firm's simultaneous decisions of importing intermediates and exporting.

In the second specification (Specification 2), we consider that the variables X_{it} and M_{it} are export and import of intermediates intensities, respectively. To account for the simultaneity of firms' decisions on these intensities, we estimate jointly these two equations. Hence, we allow for correlated error terms between the export and the import of intermediates intensity equations.

The estimation of equation (2), both in Specifications 1 and 2, poses an "initial conditions" problem as we do not observe prior choices of X_{it} and M_{it} for the first year the firm is in the dataset. To solve this problem, we control for correlated unobserved individual heterogeneity using the fixed effects approach developed by Blundell et al. (1999, 2002). Following their approach, the pre-sample means of the dependent variables ($\overline{X}_{i0}$ and $\overline{M}_{i0}$) are sufficient statistics for the unobserved fixed effects (α_i).[21] We use as pre-sample years 2006 and 2007. The correlated effects method is, in case of discrepancy of estimators, our preferred estimation technique, as it allows for correlation between individual unobserved heterogeneity and regressors. Furthermore, to account for selection in the estimation of Specification 2, we add as an additional regressor a *Heckman's lambda* sample selection term obtained from the probit estimation of Specification 1.[22, 23]

The positive and significant estimated correlation of the error terms (ρ coefficients) for both specifications, see bottom of Table 4, confirms the simultaneity of firms' import of intermediates and export strategies, and that the joint estimation of the two equations is the correct estimation strategy. As for the selection correction in the estimation of Specification 2, the positive and significant estimated λ's in both equations indicate that unobservable factors

[21] Blundell et al. (1999) suggest that the permanent effects might be captured by the entry pre-sample means of the dependent variables.

[22] The Heckman's lambda (also known as inverse Mill's ratio) is calculated dividing the density function by the distribution function of a normal distribution: $\lambda(X\beta)=\varphi(X\beta)/\phi(X\beta)$ where the argument $X\beta$ generically represents the estimated index function of a probit model with generic explanatory variables X.

[23] Both specifications 1 and 2 are estimated using the Stata command *cmp* (Roodman, 2011) by pseudo-simulated maximum likelihood.

affecting positively the firms' export and import decisions also affect their respective intensities. This confirms the convenience of correcting for sample selection in Specification 2.

In what follows, we discuss in detail our estimation results on the main variables of interest (see Table 4): persistence, cross effects from exporting to importing intermediates and *vice versa*, and selection/continuation effects related to productivity. First, our estimations (both in Specification 1 and 2) suggest high persistence in import of intermediates and export activities, which is consistent with the presence of sunk costs related to these activities (the coefficients of X_{it-1} and M_{it-1} are positive and significant in the exports and imports equations, respectively). Moreover, the role of persistence is reinforced by the positive and highly significant estimates of the pre-sample means (capturing their permanent effect through firms' individual effects). Second, the positive and significant estimates for lagged exports (imports of intermediates) in the import of intermediates (exports) equation suggest that past exports (imports) experience affects positively imports of intermediates (exports) payoffs. Third, the positive and significant estimates for lagged TFP both in the export and import equations in Specification 1 should be interpreted as evidence of a process of self-selection/continuation of the more efficient firms into exporting and importing intermediates. Likewise, results in Specification 2 suggest that firms that are more productive show a higher exposure to international markets, as both their import of intermediates and export intensities are higher.

As for the results on the set of control variables, we find that large firms, older firms and firms that are foreign participated show higher propensities and intensities for both exports and imports. The positive effect of firms' size suggests that SMEs very likely face constraints that hinder their ability to export output and import intermediates in comparison to large firms. Such constraints may come from restrictions to access financial markets, higher risks in the performance of these activities, and the difficulty to afford the initial costs involved in the exporting and importing decisions. Foreign participated firms may enjoy larger internal financial resources

and have easier access to financial markets, which could contribute to alleviate financial constraints. Furthermore, they may profit from the knowledge and expertise of the parent company about external markets. Moreover, firms that declare a significant market share in its main market also have higher propensities and intensities for both imports and exports. This variable could be capturing positive effects on firms' internationalization strategies of reduced competition in output markets. Our estimation results also indicate that firms facing an expansive demand also show a higher propensity to export and higher export and import intensities but not higher probability to import.

Finally, as regards variables controlling for complementary firms' assets to the exporting/importing activities our estimations suggest that: i) the introduction of product innovations only affects the probability of importing; ii) process innovations affect both imports and exports intensities and export propensity but not import propensity; iii) once we account for the role of process and product innovations, the proportion of skilled labour employed by the firm only has a positive and significant effect on import propensity and export intensity. The joint consideration of results i) and ii) sheds light on the different role of process and product innovations to explain export and import decisions. On the one hand, they suggest that process innovations increase firms' international competitiveness and ease participation in international markets. On the other hand, the fact that the introduction of product innovations increases import propensity indicates that when producing new products firms could rely more on the use of imported inputs.

[Table 4 about here]

Table 5 shows the estimation results of a widened version of equation (2), in which we allow the effects of lagged export (import) decisions (related to sunk costs), the cross effects of past exporting (importing) decisions on the probability of importing (exporting), and the effects of

lagged TFP to differ between large firms and SMEs. Therefore, we estimate different γ_1, γ_2 and γ_3 coefficients for SMEs and large firms in equation (2).

Our estimates confirm high persistence in export and import activities for both large firms and SMEs (the coefficients of X_{it-1} and M_{it-1} are positive and significant in the exports and imports equations for both size groups, respectively). Again, this is consistent with the existence of sunk costs related to these activities. Nevertheless, firm size mediates cross effects. For SMEs, the positive and significant estimates for lagged export (imports of intermediates) in the import of intermediates (exports) equation suggest that past exports experience affects positively the import of intermediates payoffs and *vice versa*. For large firms, regardless of whether we analyse export and import decisions or intensities, past export experience seems to have a positive effect on import profitability. But, past imports do not seem to affect export profitability (and so the probability of exporting or its intensity). This could be signalling that knowledge on international markets acquired through importing is a factor easing exporting activities for SMEs but not for their large counterparts. Finally, past TFP affects positively both export and import propensities and intensities. This result for Specification 1 provides evidence in favour of the operation of a self-selection/continuation mechanism both for large firms and SMEs. In Specification 2, it suggests that firms that are more productive show a higher exposure to international markets (i.e. higher export and imports of intermediates intensities).

As for the rest of variables, once we introduce the interactions described above, the size variable loses its significance, except in the import decision equation. It seems that it is the interaction of firm size with past TFP, past export and import experience, and with cross effects from export experience to import experience and *vice versa,* what really matters. Estimates of all other control variables do not change with the introduction of the interaction terms.

[Table 5 about here]

4.2. Import of intermediates, exports and productivity.

In order to analyse the impact of past import of intermediates and exports on productivity we estimate equation (14). These estimates are reported in Table 6. Analogously to the former section, we consider two specifications of equation (14): in Specification 1 (columns 1 and 2 of Table 6), dm_{it-1} and dx_{it-1} are dummy variables (that take value 1 if the firm exported or imported in t-1, respectively); and, in Specification 2 (columns 3 and 4 of Table 6), dm_{it-1} and dx_{it-1} are import of intermediates and export intensities, respectively.

For each specification, we present two sets of estimations that correspond to two alternative methods to deal with the likely presence of unobserved heterogeneity (firms' individual effects). In the first set of estimations (columns 1 and 3 of Table 6), we use a panel data random effects estimator, which should estimate with an upward bias the persistence parameter (i.e. the parameter of ω_{it-1}, TFP), as by construction ω_{it-1} also depends on the firm's individual effect. In the second set of estimations (columns 2 and 4 of Table 6), we use a panel data estimator that treats the "initial conditions" problem by means of controlling for the existence of correlated individual effects. Following Blundell et al. (1999, 2002) this requires including as an additional regressor the pre-sample mean of ω_{it} (we consider as pre-sample periods 2006 and 2007). In comparison with the random effects estimators, this second method allows firm's individual effects to be correlated with the regressors in equation (14) and, in case of discrepancy, it will be our preferred estimator.

Regardless of the estimation method and both for Specifications 1 and 2, our estimates suggest a high degree of persistence in the evolution of productivity over time (the estimates for ω_{it-1} are always positive and highly significant). Furthermore, all the coefficient estimates for the variables proxying firms' past imports and exports strategies are positive and significant pointing to positive rewards of exporting and importing in terms of productivity. This should be interpreted as evidence suggesting that both LBE and LBI effects are in operation.

As for the results for the set of control variables, neither the size variable nor the age variables are significant. Estimates for the foreign participation dummy are always positive and significant, suggesting that firms belonging to a foreign group are more productive than domestically owned firms. Nevertheless, neither firms that enjoy a significant market share in its main market nor firms facing an expansive demand enjoy higher productivities (the market share variable is never significant and the expansive demand variable is only significant at a 10% level in the correlated effects estimation of Specification 1).

The results for firms' complementary assets suggest that whilst the introduction of process innovations in *t*-1 positively contribute to firms' current productivity, the introduction of product innovations in *t*-1 has a negative effect on firms' productivity in *t*. This negative effect of product innovations is very likely related to the need of readjusting production processes to produce new products. Lack of experience producing new products can entail transitory negative effects on productivity. Some literature has found that there exists a certain degree of substitution of old products by new ones inside the firm, that new products are initially produced less efficiently, and that process innovation increases efficiency mainly in the production of old products in the firm (see Rodríguez-Moreno and Rochina-Barrachina, 2019; Monge-González et al., 2011; Crespi and Tacsir, 2012; de Ejalde et al., 2011, 2015). Finally, the use of skilled labour has a positive impact on firm productivity.

Furthermore, it is worth noting that the pre-sample TFP means in the correlated individual effects estimations are positive and significant both in Specifications 1 and 2 (columns 2 and 4, respectively). As expected, using an "initial conditions" approach results in a reduction of the estimated coefficient for ω_{it-1} (from 0.848 to 0.796 and from 0.848 to 0.795, respectively), confirming that the random effects estimator suffers from an upward bias in the estimation of the persistence parameter.

[Table 6 about here]

Table 7 shows the estimation results of a widened version of equation (14) in which we allow the effects of lagged productivity and lagged export and import strategies on current productivity to differ between large firms and SMEs. Therefore, we estimate different α_1, α_2 and α_3 coefficients for SMEs and large firms.

Our estimation results confirm for both large firms and SMEs the existence of a high degree of persistence in the evolution of productivity over time (both in Specifications 1 and 2 and for each of the estimation procedures, since the estimated coefficients of ω_{it-1} are positive and significant and quite similar in size). Moreover, past import experience (both in Specifications 1 and 2 and for the different estimators) has a positive reward in terms of productivity for large firms and SMEs. Nonetheless, whilst in the estimation using dummies to proxy past import strategies the estimated coefficient is larger for SMEs than for large firms (suggesting larger productivity rewards), in the estimation using intensities the estimates corresponding to large firms and SMEs are quite similar. Lastly, once we control for the effect of past import strategies, our estimates suggest that only SMEs obtain positive productivity rewards from past exporting. Therefore, whilst for SMEs we find evidence both of LBE and LBI, for large firms we only find evidence of LBI. The fact that exporting becomes non-relevant for large firms' productivity once controlling for imports might be related to the fact that while 30% of SMEs carry out both activities, this percentage rises to 70% for large firms (see Table 1).

Finally, it is important to note that results on our control variables are not affected by the introduced interaction effects analysed above.

[Table 7 about here]

4.3. Import of intermediates, exports and markups.

In order to analyse the impact of past import of intermediates and exports on markups we estimate equation (16), reported in Table 8. Analogously to the former section, we consider two

specifications of equation (16): in Specification 1 (columns 1 and 2 of Table 8), dm_{it-1} and dx_{it-1} are dummy variables (that take value 1 if the firm exported or imported in t-1, respectively); and, in Specification 2 (columns 3 and 4 of Table 8), dm_{it-1} and dx_{it-1} are import of intermediates and export intensities, respectively.

Also, as in the analysis of the effects of exporting and importing strategies on productivity, we present two sets of estimations. The first one, in columns 1 and 3 of Table 8, corresponds to a panel data random effects estimator. The second one, in columns 2 and 4 of the same table, corresponds to a panel data correlated effects estimator. For the same reasons explained in the former section, we expect the random effects estimator to introduce an upward bias in the persistence parameter (i.e., the parameter of $\ln MK_{it-1}$). For this reason, the correlated effects method is again our preferred estimation technique as it allows for correlation between individual unobserved heterogeneity and regressors.

Our estimation results suggest the existence of a high degree of persistence in the evolution of markups over time (the coefficient estimates for $\ln MK_{it-1}$ are positive and significant both in Specifications 1 and 2 and regardless of the estimation method).[24] Moreover, all the estimated coefficients for the variables proxying for import and export strategies (dm_{it-1} and dx_{it-1})

[24] As we already mentioned in the methodological section above for markups estimation, persistence over time in the firm's markup might be compatible with a possible cyclicality behaviour of markups (Hall, 1986) for Spanish manufacturing. In this respect, and paying attention to our two more preferred estimation results in Table 8 (that correspond to the correlated individual unobserved effects estimators, columns 2 and 4), we obtain that all time dummy estimated coefficients are statistically significant and with a negative sign in the markups equation (results not reported in the paper for the sake of brevity). Furthermore, the negative value of these coefficients gets larger until 2012, and the following years, although still negative, the magnitude of the coefficients decreases. As shown by the descriptive temporal pattern of average markups in Spanish manufacturing in Figure 4, 2012 is the worst year in terms of markups.

are positive and significant suggesting that both exporting and importing have a positive impact on firms markups.[25]

As for the control variables, both in Specifications 1 and 2 and based on the results from the correlated effects estimator, our estimates suggest that large firms and firms that face an expansive demand enjoy higher markups. Nevertheless, older firms seem to enjoy lower markups.[26] Furthermore, neither firms with foreign participation nor firms that declare a significant market share in the firm's main market seem to enjoy higher markups. Finally, and in relation to firms' complementary assets, our results imply that introducing process innovations has a positive effect on markups (very likely through an increase in efficiency and a reduction of the cost of production). Nevertheless, neither introducing product innovations nor using a higher proportion of skilled labour seems to affect markups.

Furthermore, it is interesting to note that the estimates for the pre-sample markups means in the correlated individual effects estimations are positive and significant both in Specifications 1 and 2 (see columns 2 and 4, respectively). As expected, using an "initial conditions" approach results in a reduction of the coefficient estimates for $\ln MK_{it-1}$ (from 0.756 to 0.574 and from 0.757 to 0.574, respectively), confirming that the random effects estimator suffers from an upward bias in the estimation of the persistence parameter.

[Table 8 about here]

[25] The estimates for dm_{it-1} are significant only when using the correlated effects estimator, our preferred estimation technique.

[26] Notice that this sign is obtained after controlling for many things in this equation, among which we find that large firms and firms that face an expansive demand enjoy higher markups. Hence, the effect of the age variable cannot be capturing the fact that the firm faces good demand conditions (captured by the expansive demand variable) or that the firm is larger (captured by the size variable). Therefore, after controlling for other factors, we can only think about this variable proxying (in the markups regression) for exhaustion of opportunities of older firms related to maturity of their markets and/or of their products life cycle (as we also control in estimation for the level of innovativeness of the firm).

Table 9 shows the estimation results of a widened version of equation (16) in which we allow markups persistence and the effects of past import and export strategies to differ between large firms and SMEs. Therefore, we estimate different β_1, β_2 and β_3 coefficients for SMEs and large firms in equation (16).

As for markups persistence, we confirm the results obtained in the full sample estimation, i.e., markups are highly persistent both for large firms and SMEs (in Specifications 1 and 2, the estimated coefficients of $\ln MK_{it-1}$ are positive and significant, and larger for large firms). As for the effects of past export and import strategies, the results differ between large firms and SMEs. For SMEs both exporting and importing pay rewards in terms of higher markups.[27] However, for large firms a conservative interpretation of our results suggests that only exporting pays rewards in terms of higher markups, as the past importing experience for this size group is only significant when it is proxied by the past import intensity (and not by the dummy variable) under the correlated effects estimator (see column 4 in Table 9).

The results for control variables in Table 9 are similar to those obtained in Table 8, except for size, which is not significant any longer.

[Table 9 about here]

Finally, we aim to deepen into the analysis of whether the estimated effects of importing intermediates and exporting on markups accrue through the marginal cost channel, the price channel or from both of them, exploring possible differences between SMEs and large firms.

The analysis of the marginal cost channel stems directly from section 4.2 where we analysed the impact of past imports of intermediates and export strategies on productivity. Internationalization strategies that contribute to increase productivity should result in lower costs of production. In this line, our results suggest that: i) for SMEs both past imports of intermediates and exports contribute to increase productivity and, therefore, should result in lower marginal

[27] In specification 2, dm_{it-1} is not significant in the random effects estimator.

costs of production; and, ii) for large firms only past imports of intermediates increase productivity and so should lower marginal costs.

The availability in the ESEE of firm level data on variation of output prices allows analysing whether importing intermediates and exporting may affect markups through the price channel.[28] To explore the relationship between variation of output prices and past imports of intermediates and exports, we estimate the following equation:

$$VPV_{it} = \gamma_0 + \gamma_{1S} dx_{it-1} d_S + \gamma_{1L} dx_{it-1} d_L + \gamma_{2S} dm_{it-1} d_S + \gamma_{2L} dm_{it-1} d_L + \gamma_3 d_L + \lambda Z_{it-1} + s_j + \delta_t + u_{it} \quad (17)$$

where *VPV* is the firm's variation of output prices from period *t*-1 to *t*, dx_{it} and dm_{it} are past export and import strategies, respectively; d_S and d_L are dummy variables taking value 1 if the firm is a SME or a large firm, respectively; and, Z_{it} is a set of control variables that includes the same variables than in sections 4.1 and 4.2 (and the same as in the markups equation in 16). We also control for macro conditions using a vector of time dummies (δ_t), and for industry specific effects including the vector of industry dummies (s_j). Finally, the error term (u_{it}) allows for the potential existence of unobserved individual heterogeneity.

As in sections 4.1, 4.2 and the markups equation, we will consider two different proxies for past imports of intermediates and export strategies: past imports and exports decisions (Specification 1) and past imports of intermediates and export intensities (Specification 2). The estimation results for these two specifications of equation (17) are shown in Table 10. The results on the variables of interest exploring the price channel effects can be summarized as follows: for SMEs both importing intermediates and exporting increase prices; nevertheless, for large firms, whereas exporting results in higher prices, importing implies a price reduction.[29]

The joint consideration of the results on the productivity and on the variation of output prices analyses lets qualifying the results of the impact of past importing of intermediates and

[28] The ESEE provides information on variation of output prices but not on output price levels.

[29] For control variables in estimation, the only results worth to mention are that firms facing an expansive demand and firms that introduce product innovations obtain higher price increases.

exporting strategies on markups. For SMEs, the positive effects of importing and exporting on markups seem to operate through both the marginal cost channel and the price channel, as both past importing of intermediates and exporting imply both marginal costs reductions and larger output price increases. As for the effect of exporting on markups, our results suggest that when exporting, SMEs do not only become more efficient (*learning-by-exporting*) but also introduce very likely higher quality differentiated products (with a lower elasticity of demand), and this allows them to enjoy higher price increases. In relation to the effect of importing intermediates, access to imported inputs allows SMEs both cutting production costs and incorporating higher quality inputs into production that may result in higher quality output and, hence, higher prices.

For large firms, the positive effect of exports in markups accrue only through the price channel. Unlike what we observe for SMEs, past exporting does not increase the productivity of large firms (and so it does not result in lower marginal costs). However, it seems that exporting forces also large firms to introduce higher quality differentiated products, what allows them to increase prices. The absence of an effect of past importing of intermediates on markups for large firms may be explained by the fact that the price channel and the marginal cost channel effects operate for this size group in opposite directions. Whilst importing results in lower marginal costs, it also implies lower output price increases. It appears that large firms translate to consumers the possible reductions in costs derived from accessing cheaper imported inputs.

[Table 10 about here]

5. Concluding remarks.

In this paper, we analyse the relation between the firms' decisions to export output and/or import intermediates and productivity and markups. We jointly consider the effects of both firms' trading strategies.

For this purpose, and using data from the Spanish Survey on Business Strategies (ESEE) for the period 2006-2014, in a first step we estimate a dynamic model for the firms' joint strategy of importing intermediates and exporting output, in which we allow for the past import and export experience to affect future firms' trading choices. To control for the self-selection/continuation mechanism of the more productive firms into these activities, we also include among regressors the preceding firms' TFP. To estimate TFP, we extend the OP and LP methodologies, by considering a more general process governing the law of motion of productivity (recognising the role of both past exports and imports experience on future firms' productivity). Furthermore, we also acknowledge that firms with different export and import strategies may have different demands of intermediate inputs (materials). We incorporate these features to estimate TFP using Wooldridge (2009) generalized method of moments (GMM) framework. Once TFP estimations are available from a *translog* production function, we implement De Loecker and Warzynski (2012) methodology for markups estimation. In a second step, we estimate models explaining firms' TFP and markups that consider the effects of the firms' imports of intermediates and export strategies. In a final step, we explore whether the possible effects of importing intermediates and/or exporting in markups operate not only through the marginal costs channel (affecting efficiency) but also through the price channel (affecting firms' output prices). In all steps, we allow the main variables in our analysis to have different effects across size groups (SMEs and large firms).

The results we obtain from the estimation of the joint system of equations for importing and exporting support that there is a high persistence in the performance of these activities both for large and SMEs, what is consistent with the existence of sunk costs. Second, for SMEs we find that exporting and importing activities also support the subsequent performance and intensity of the opposite trade strategy. Nevertheless, for large firms only past export experience has an

impact on future import strategies. Third, we also confirm the self-selection/continuation of the previously more efficient firms into imports and exports.

In relation to the study of the determinants of TFP, our results indicate that whereas SMEs obtain rewards in terms of higher productivity both from exporting and importing, large firms obtain productivity rewards only from importing. Therefore, whilst for SMEs we find evidence both of LBE and LBI for large firms we only find evidence of LBI.

In addition, from our markups analysis, we find evidence suggesting positive rewards from importing and exporting for SMEs. Furthermore, this positive effect of importing intermediates and exporting on markups operates through both the price and the marginal costs channels. For large firms, only exporting pays higher rewards in markups, and this positive effect accrues only through the price channel.

The weaker results obtained at some points of our analysis for large firms might be related to the two following factors: i) the percentage of large firms exporting and importing is much higher than that of SMEs; and, ii) during the period of analysis there has been much more a pattern of incorporation of SMEs into these activities, since the starting point was much lower for them than for large firms. Differently, the pattern of participation has been more stable over time for large firms (see Figures 1 and 2 in the paper). These two factors make more complex the identification of effects for large firms, since they change less often their status over time as regards internationalization activities. Even though, we have been able to find some interesting results for large firms, as explained above.

From a policy point of view, our results highlight that both importing and exporting activities are self-fuelled activities once started. Hence, there is room for public policies to help firms overcoming the upfront barriers to start these activities. In this respect, very likely, large firms are in a better position to face upfront costs of required investments and suffer less from financial constraints than SMEs. Additionally, our results indicate that the performance of these

internationalization activities by SMEs is relevant for them to increase their productivity, markups and prices. Furthermore, as the evolution of productivity and markups is also highly persistent (that is, at some extent, self-fuelled), we consider that it is crucial for SMEs that the public sector facilitates the starting point of the dynamic process that moves such firms' performance indicators over time.

It is important to notice that while on average only 4.53% of large firms do not carry out any of the two internationalization strategies, this percentage is 34.40% for SMEs. In addition, 67.76% of large firms export and import simultaneously, and only 32.20% of SMEs do so. Finally, the relevance of SMEs in the Spanish manufacturing sector is evidenced by the fact that more than 90% of their firms are SMEs.

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Table 1. Firms exporting and/or importing, 2006-2014.

		Neither	Export only	Import only	Both
SMEs	Observations	4,515	3,487	896	4,226
	Percentage	34.40%	26.57%	6.83%	32.20%
Large firms	Observations	172	928	123	2,570
	Percentage	4.53%	24.47%	3.24%	67.76%

Table 2. Descriptive statistics.

		Mean value	s.e.
Product innovation	SMEs	0.140	0.347
	Large firms	0.340	0.474
Process innovation	SMEs	0.264	0.441
	Large firms	0.543	0.498
Age	SMEs	29.094	19.646
	Large firms	42.643	25.388
Employment	SMEs	52.209	49.567
	Large firms	725.487	1325.02
Hours worked	SMEs	91.960	88.719
	Large firms	1253.485	2230.654
Foreign	SMEs	0.081	0.273
	Large firms	0.421	0.494
Market share	SMEs	0.253	0.435
	Large firms	0.576	0.494
Expansive demand	SMEs	0.151	0.358
	Large firms	0.207	0.406
Skilled labour	SMEs	12.233	14.213
	Large firms	19.849	17.513
Labour productivity	SMEs	160004.5	208970.2
	Large firms	304633.9	407862.4
Production	SMEs	1.02e+07	2.01e+07
	Large firms	2.53e+08	6.41e+08
Materials	SMEs	7707403	1.81e+07
	Large firms	2.08e+08	5.92e+08
Capital	SMEs	2817163	5767679
	Large firms	5.53e+08	1.39e+08
Capacity utilization	SMEs	74.721	18.992
	Large firms	79.533	15.074
Export	SMEs	0.588	0.492
	Large firms	0.922	0.268
Import intermediates	SMEs	0.390	0.488
	Large firms	0.710	0.454

Export intensity for exporters	SMEs	30.295	49.979
	Large firms	40.253	30.276
Import intensity for importers	SMEs	15.733	17.005
	Large firms	20.841	18.822
Variation in output prices	SMEs	0.975	4.891
	Large firms	1.180	6.127

Note: Detailed definitions of all the variables in this table and their units of measurement are presented in Table A.1. of the Appendix.

Table 3. Differences across export and import strategies undertaken by firms.

	Export only	Import only	Both
SMEs			
Employment	105.511***	52.045***	235.443***
Labour productivity	49.103***	61.491***	97.086***
Capital (net value) per worker	46,089***	52,145***	76,508***
Materials per worker	69,109***	97,945***	146,591***
Large firms			
Employment	2.058	-19.873**	6.673
Labour productivity	3.883	17.116	19.760**
Capital (net value) per worker	7,583	28,028	24,248***
Materials per worker	16.627	27.987	37.822**

Notes:

1. ***, ** mean significance at the 1% and 5% levels, respectively.
2. All dependent variables are measured in logs.
3. All regressions control for industry and year dummies, and size except for the employment regression.

Table 4. Bivariate model estimations for Export and Import activities.

	Specification 1 (Dummy variables)		Specification 2 (Intensity variables)	
Variables	**Export**	**Import**	**Export**	**Import**
TFP$_{t-1}$	0.015***	0.037***	0.212***	0.573***
	(0.005)	(0.008)	(0.036)	(0.055)
Export$_{t-1}$	0.192***	0.073***	0.549***	0.064***
	(0.006)	(0.008)	(0.019)	(0.004)
Import$_{t-1}$	0.018***	0.330***	0.011***	0.304***
	(0.005)	(0.006)	(0.001)	(0.015)
Size$_{t-1}$	0.028***	0.045***	0.251***	0.570***
	(0.007)	(0.010)	(0.033)	(0.056)
Age$_{t-1}$	0.007*	0.011*	0.068***	0.170***
	(0.004)	(0.006)	(0.023)	(0.036)
Foreign participation$_{t-1}$	0.022***	0.017*	0.110***	0.563***
	(0.008)	(0.010)	(0.032)	(0.048)
Expansive demand$_{t-1}$	0.015**	0.014	0.156***	0.174***
	(0.007)	(0.010)	(0.033)	(0.055)
Market share$_{t-1}$	0.009*	0.024***	0.103***	0.345***
	(0.005)	(0.008)	(0.027)	(0.048)
Product innovation$_{t-1}$	0.003	0.017*	0.033	0.060
	(0.007)	(0.010)	(0.030)	(0.051)
Process innovation$_{t-1}$	0.009*	0.002	0.106***	0.113**
	(0.005)	(0.008)	(0.029)	(0.049)
Skilled labour$_{t-1}$	0.0002	0.001*	0.003***	-0.001
	(0.000)	(0.000)	(0.001)	(0.001)
Export Pre-sample Mean	0.081***	-	0.125***	-
	(0.006)		(0.005)	
Import Pre-sample Mean	-	0.112***	-	0.087***
		(0.009)		(0.004)
λ Export	-	-	7.371***	-
			(0.249)	
λ Import	-	-	-	6.033***
				(0.320)
N. observations	8,776		6,339	
ρ	0.217 (p-val.=0.000)		0.080 (p-val.=0.000)	
Log pseudo-likelihood	-4445.468		-15197.222	

Notes:

1. All estimations include industry and time dummies.
2. Robust *standard errors* are in parentheses.
3. We report marginal effects in Specification 1 (as the dependent variables are dummy variables).
4. ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Table 5. Bivariate model estimations for Export and Import activities.

		Specification 1 (Dummy variables)		Specification 2 (Intensity variables)	
Variables		**Export**	**Import**	**Export**	**Import**
TFP$_{t-1}$	SME	0.015***	0.037***	0.192***	0.585***
		(0.006)	(0.009)	(0.040)	(0.056)
	Large	0.016***	0.038***	0.197***	0.595***
		(0.006)	(0.009)	(0.041)	(0.057)
Export$_{t-1}$	SME	0.191***	0.075***	0.569***	0.071***
		(0.006)	(0.009)	(0.019)	(0.004)
	Large	0.208***	0.043*	0.540***	0.036***
		(0.024)	(0.026)	(0.033)	(0.009)
Import$_{t-1}$	SME	0.021***	0.321***	0.015***	0.336***
		(0.005)	(0.008)	(0.001)	(0.015)
	Large	-0.012	0.355***	-0.002	0.315***
		(0.014)	(0.016)	(0.002)	(0.015)
Size$_{t-1}$		0.023	0.073**	0.172	0.270
		(0.016)	(0.030)	(0.119)	(0.169)
Age$_{t-1}$		0.006*	0.010*	0.063***	0.172***
		(0.004)	(0.006)	(0.022)	(0.035)
Foreign participation$_{t-1}$		0.023***	0.017*	0.146***	0.595***
		(0.008)	(0.010)	(0.031)	(0.047)
Expansive demand$_{t-1}$		0.015**	0.013	0.165***	0.204***
		(0.007)	(0.010)	(0.032)	(0.055)
Market share$_{t-1}$		0.009*	0.024***	0.086***	0.361***
		(0.005)	(0.008)	(0.027)	(0.048)
Product innovation$_{t-1}$		0.003	0.017*	0.028	0.070
		(0.007)	(0.010)	(0.029)	(0.051)
Process innovation$_{t-1}$		0.010**	0.002	0.128***	0.144***
		(0.005)	(0.008)	(0.028)	(0.048)
Skilled labour$_{t-1}$		0.000	0.001*	0.003***	-0.000
		(0.000)	(0.000)	(0.001)	(0.001)
Export Pre-sample Mean	SME	0.081***	-	0.132***	-
		(0.007)		(0.005)	
	Large	0.078***	-	0.086***	-
		(0.023)		(0.016)	
Import Pre-sample Mean	SME	-	0.128***	-	0.114***
			(0.010)		(0.005)
	Large	-	0.065***	-	0.049***
			(0.020)		(0.005)
λ Export		-	-	7.643***	-
				(0.244)	
λ Import		-	-	-	6.691***
					(0.330)
N. observations		8,776		6,339	
ρ		0.217 (p-val.=0.000)		0.080 (p-val.=0.000)	
Log pseudo-likelihood		-4435.119		-15083.045	

Notes:

1. All estimations include industry and time dummies.
2. Robust *standard errors* are in parentheses.
3. We report marginal effects in Specification 1 (as the dependent variables are dummy variables).
4. ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Table 6. Effect of Export and Import strategies on TFP.

	Specification 1 *dx*: export dummy *dm*: import dummy		**Specification 2** *dx*: export intensity *dm*: import intensity	
Variables	**Rand. Eff.**	**Corr. Eff.**	**Rand. Eff.**	**Corr. Eff.**
ω_{it-1}	0.848***	0.796***	0.848***	0.795***
	(0.020)	(0.020)	(0.020)	(0.020)
dx_{t-1}	0.019***	0.022***	0.001***	0.001***
	(0.006)	(0.007)	(0.000)	(0.000)
dm_{t-1}	0.054***	0.050***	0.002***	0.002***
	(0.006)	(0.006)	(0.000)	(0.000)
Size$_{t-1}$	-0.021	-0.017	-0.021	-0.018
	(0.014)	(0.014)	(0.014)	(0.014)
Age$_{t-1}$	-0.001	0.000	-0.001	0.000
	(0.005)	(0.005)	(0.005)	(0.005)
Foreign participation$_{t-1}$	0.020**	0.018**	0.018**	0.016*
	(0.008)	(0.008)	(0.008)	(0.008)
Expansive demand$_{t-1}$	0.008	0.009*	0.007	0.008
	(0.006)	(0.005)	(0.006)	(0.006)
Market share$_{t-1}$	-0.004	-0.007	-0.004	-0.006
	(0.006)	(0.006)	(0.006)	(0.006)
Product innovation$_{t-1}$	-0.014*	-0.017**	-0.014*	-0.017**
	(0.007)	(0.007)	(0.007)	(0.007)
Process innovation$_{t-1}$	0.016***	0.016***	0.016***	0.016***
	(0.005)	(0.005)	(0.005)	(0.005)
Skilled labour$_{t-1}$	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)
TFP Pre-sample Mean	-	0.126***	-	0.127***
		(0.022)		(0.022)
N. observations	8,748	8,742	8,740	8,734
N. firms	1,861	1,860	1,861	1,860
R^2	0,999	0.999	0.999	0,999

Notes:

1. All estimations include industry and time dummies.
2. Robust *standard errors* are in parentheses.
3. ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Table 7. Effect of Export and Import strategies on TFP.

		Specification 1 *dx*: export dummy *dm*: import dummy		Specification 2 *dx*: export intensity *dm*: import intensity	
Variables		**Rand. Eff.**	**Corr. Eff.**	**Rand. Eff.**	**Corr. Eff.**
ω_{it-1}	SME	0.846***	0.804***	0.846***	0.804***
		(0.020)	(0.020)	(0.020)	(0.020)
	Large	0.846***	0.771***	0.846***	0.771***
		(0.020)	(0.041)	(0.020)	(0.041)
dx_{t-1}	SME	0.021***	0.022***	0.001***	0.001***
		(0.007)	(0.007)	(0.000)	(0.000)
	Large	-0.016	0.005	-0.001	0.0003
		(0.019)	(0.018)	(0.001)	(0.001)
dm_{t-1}	SME	0.059***	0.054***	0.003***	0.002***
		(0.006)	(0.006)	(0.000)	(0.000)
	Large	0.033***	0.034***	0.002***	0.002***
		(0.012)	(0.012)	(0.001)	(0.001)
Size$_{t-1}$		0.033	0.001	-0.037	-0.039
		(0.022)	(0.021)	(0.023)	(0.025)
Age$_{t-1}$		-0.001	-0.0003	-0.001	-0.0002
		(0.005)	(0.005)	(0.005)	(0.005)
Foreign participation$_{t-1}$		0.021**	0.018**	0.019**	0.017*
		(0.008)	(0.009)	(0.008)	(0.009)
Expansive demand$_{t-1}$		0.007	0.009*	0.007	0.008
		(0.006)	(0.005)	(0.006)	(0.006)
Market share$_{t-1}$		-0.005	-0.007	-0.005	-0.007
		(0.006)	(0.006)	(0.006)	(0.006)
Product innovation$_{t-1}$		-0.014*	-0.017**	-0.014*	-0.017**
		(0.007)	(0.007)	(0.007)	(0.007)
Process innovation$_{t-1}$		0.016***	0.016***	0.016***	0.016***
		(0.005)	(0.005)	(0.005)	(0.005)
Skilled labour$_{t-1}$		0.001***	0.001***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)	(0.000)
TFP Pre-sample Mean	SME	-	0.119***	-	0.119***
			(0.025)		(0.025)
	Large	-	0.153***	-	0.153***
			(0.036)		(0.036)
N. observations		8,748	8,742	8,740	8,734
N. firms		1,861	1,860	1,861	1,860
R^2		0,999	0.999	0.999	0,999

Notes:

1. All estimations include industry and time dummies.
2. Robust *standard errors* are in parentheses.
3. ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Table 8. Effect of Export and Import strategies on Markups.

	Specification 1 *dx*: export dummy *dm*: import dummy		**Specification 2** *dx*: export intensity *dm*: import intensity	
Variables	**Rand. Eff.**	**Corr. Eff.**	**Rand. Eff.**	**Corr. Eff.**
ln*MK*$_{t-1}$	0.756***	0.574***	0.757***	0.574***
	(0.029)	(0.044)	(0.029)	(0.044)
***dx*$_{t-1}$**	0.035***	0.042***	0.002***	0.002***
	(0.010)	(0.010)	(0.000)	(0.000)
***dm*$_{t-1}$**	0.007	0.011*	0.000	0.0004*
	(0.006)	(0.006)	(0.000)	(0.000)
Size$_{t-1}$	0.031***	0.019**	0.031***	0.019**
	(0.008)	(0.008)	(0.008)	(0.008)
Age$_{t-1}$	-0.004	-0.010**	-0.004	-0.011**
	(0.005)	(0.005)	(0.005)	(0.005)
Foreign particip.$_{t-1}$	0.014*	0.009	0.013*	0.008
	(0.008)	(0.009)	(0.007)	(0.009)
Expansive demand$_{t-1}$	0.005	0.011**	0.005	0.010*
	(0.006)	(0.006)	(0.006)	(0.006)
Market share$_{t-1}$	0.005	-0.003	0.004	-0.003
	(0.007)	(0.006)	(0.007)	(0.006)
Product innovation$_{t-1}$	-0.008	-0.007	-0.009	-0.008
	(0.007)	(0.007)	(0.007)	(0.007)
Process innovation$_{t-1}$	0.015***	0.016***	0.015***	0.016***
	(0.006)	(0.005)	(0.006)	(0.005)
Skilled labour$_{t-1}$	0.000	0.000	0.000	0.000
	(0.000)	(0.000)	(0.000)	(0.000)
Mark. Pre-sample Mean	-	0.390***	-	0.390***
		(0.049)		(0.050)
N. observations	8,459	8,458	8,451	8,450
N. firms	1,815	1,814	1,815	1,814
R^2	0.675	0.683	0.675	0.683

Notes:

1. All estimations include industry and time dummies.
2. Robust *standard errors* are in parentheses.
3. ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Table 9. Effect of Export and Import strategies on Markups.

		Specification 1 *dx*: export dummy *dm*: import dummy		Specification 2 *dx*: export intensity *dm*: import intensity	
Variables		**Rand. Eff.**	**Corr. Eff.**	**Rand. Eff.**	**Corr. Eff.**
ln*MK*$_{t-1}$	SME	0.734***	0.570***	0.734***	0.570***
		(0.032)	(0.046)	(0.032)	(0.046)
	Large	0.910***	0.616***	0.911***	0.616***
		(0.031)	(0.071)	(0.031)	(0.071)
***dx*$_{t-1}$**	SME	0.036***	0.042***	0.002***	0.002***
		(0.011)	(0.011)	(0.000)	(0.000)
	Large	0.031*	0.042**	0.001*	0.002**
		(0.018)	(0.020)	(0.001)	(0.001)
***dm*$_{t-1}$**	SME	0.011*	0.015**	0.0004	0.001*
		(0.006)	(0.007)	(0.000)	(0.000)
	Large	-0.004	-0.001	0.0002	0.001*
		(0.008)	(0.008)	(0.000)	(0.000)
Size$_{t-1}$		0.029	0.021	0.006	0.004
		(0.022)	(0.022)	(0.009)	(0.010)
Age$_{t-1}$		-0.005	-0.011**	-0.005	-0.011**
		(0.005)	(0.005)	(0.005)	(0.005)
Foreign particip.$_{t-1}$		0.015*	0.010	0.014*	0.009
		(0.009)	(0.009)	(0.008)	(0.009)
Expansive demand$_{t-1}$		0.005	0.011**	0.005	0.011*
		(0.006)	(0.006)	(0.006)	(0.006)
Market share$_{t-1}$		0.005	-0.003	0.005	-0.003
		(0.007)	(0.006)	(0.007)	(0.006)
Product innovation$_{t-1}$		-0.009	-0.007	-0.009	-0.008
		(0.007)	(0.007)	(0.007)	(0.007)
Process innovation$_{t-1}$		0.016***	0.017***	0.016***	0.017***
		(0.006)	(0.005)	(0.006)	(0.005)
Skilled labour$_{t-1}$		0.000	0.000	0.000	0.000
		(0.000)	(0.000)	(0.000)	(0.000)
Mark. Pre-sample Mean	SME	-	0.379***	-	0.380***
			(0.054)		(0.054)
	Large	-	0.412***	-	0.414***
			(0.065)		(0.065)
N. observations		8,459	8,458	8,451	8,450
N. firms		1,815	1,814	1,815	1,814
R^2		0.676	0.683	0.676	0.683

Notes:

1. All estimations include industry and time dummies.
2. Robust *standard errors* are in parentheses.
3. ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Table 10. Effect of Export and Import strategies on the variation in output prices (in %).

		Specification 1 *dx*: export dummy *dm*: import dummy	Specification 2 *dx*: export intensity *dm*: import intensity
Variables		**% Var. output prices**	**% Var. output prices**
dx_{t-1}	SME	0.318**	0.074*
		(0.127)	(0.042)
	Large	0.561**	0.064*
		(0.254)	(0.038)
dm_{t-1}	SME	0.308**	0.013**
		(0.130)	(0.006)
	Large	-0.462*	-0.024*
		(0.277)	(0.012)
Size$_{t-1}$		0.581	-0.641***
		(0.433)	(0.221)
Age$_{t-1}$		0.022	0.005
		(0.104)	(0.104)
Foreign participation$_{t-1}$		-0.020	-0.057
		(0.176)	(0.177)
Expansive demand$_{t-1}$		0.325**	0.307**
		(0.142)	(0.141)
Market share$_{t-1}$		-0.054	-0.059
		(0.117)	(0.118)
Product innovation$_{t-1}$		0.235*	0.224*
		(0.133)	(0.134)
Process innovation$_{t-1}$		-0.172	-0.184
		(0.124)	(0.124)
Skilled labour$_{t-1}$		0.002	0.001
		(0.004)	(0.004)
N. observations		10,780	10,772
N. firms		2,465	2,465
R^2		0.039	0.039

Notes:

1. All estimations include industry and time dummies.
2. Robust *standard errors* are in parentheses.
3. ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Figure 1. Evolution of the percentage of SMEs exporting and/or importing, 2006-2014.

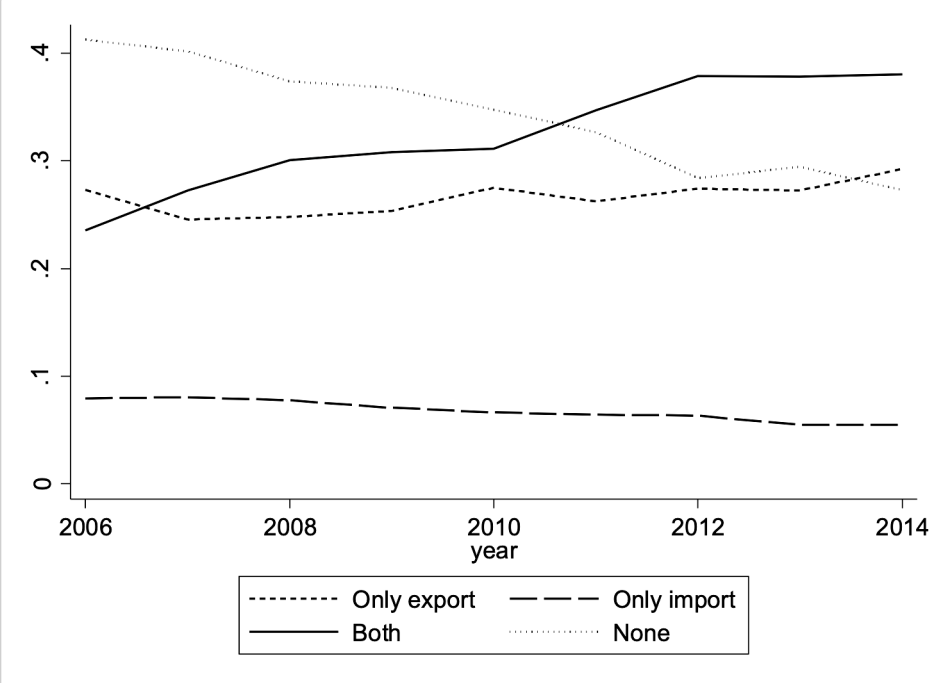


Figure 2. Evolution of the percentage of large firms exporting and/or importing, 2006-2014.

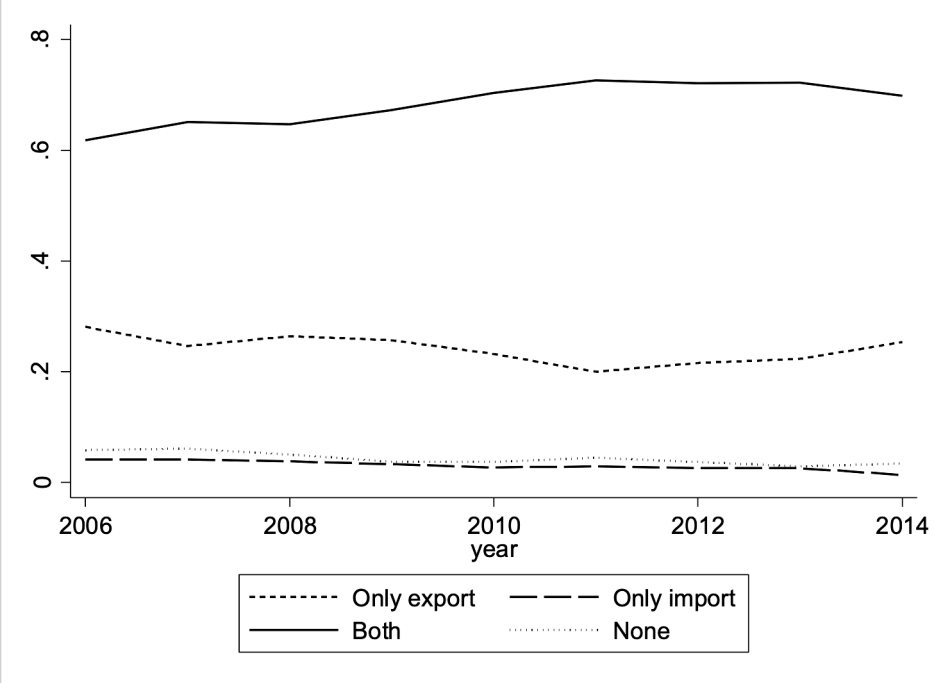


Figure 3. Evolution of TFP for SMEs and large firms, 2006-2014.

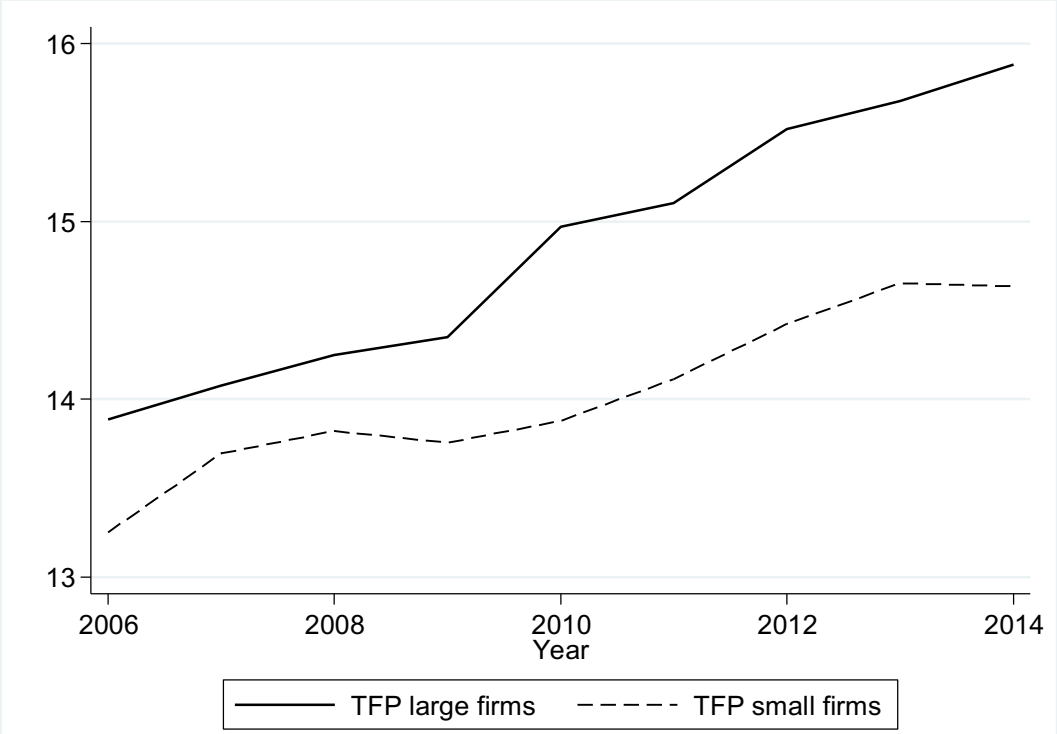
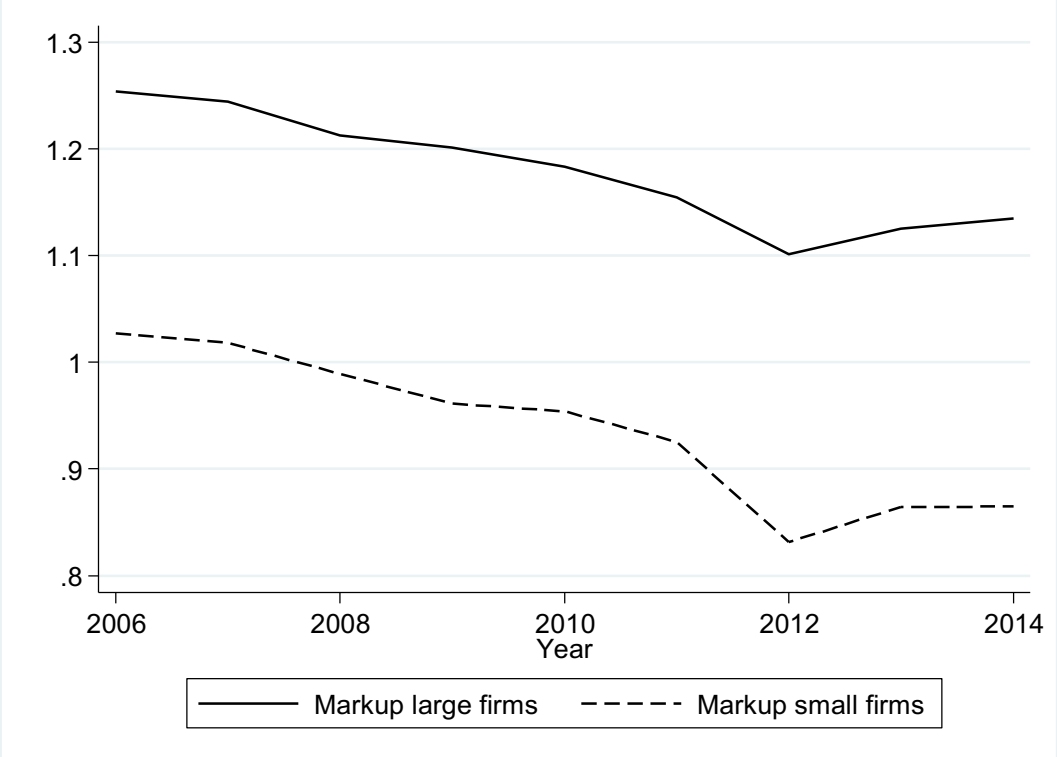


Figure 4. Evolution of Markups for SMEs and large firms, 2006-2014.



Appendix.

Table A.1. Variables definition.

Product innovation	Dummy variable taking value 1 if the firm has obtained one or more product innovations.
Process innovation	Dummy variable taking value 1 if the firm has obtained one or more process innovations.
Age	Number of years since the firm was born.
Employment	Number of employees.
Hours worked	Total effective hours of worked, in thousands of hours. They are calculated multiplying the number of employees and the hours actually worked in the year per worker. The hours worked are equal to the sum of the normal working day and the overtime hours minus the hours not worked.
Foreign	Dummy variable taking value 1 if the firm's capital is participated by a foreign enterprise and 0 otherwise.
Market share	Dummy variable taking value 1 if the firm asserts to account for a significant market share in its main market, and 0 otherwise.
Expansive demand	Dummy variable taking value 1 if the firm declares to face an expansive demand and 0 otherwise.
Skilled labour	Proportion of high skilled labour (engineers and graduates) and med skilled labour (technical engineers, experts and qualified assistants) in the firm's labour force.
Labour productivity	Output in real terms (explained bellow) over employment.
Materials	Intermediate materials used in production in real terms. Nominal materials are deflated by a firm-specific price index of materials. The price index is computed as a Paasche-type index from the firm's responses to questions about price changes during the year for materials.
Capital	Capital at current replacement values K_{it} (in euros) is computed recursively from an initial estimate and data on current investments in equipment goods I_{it} (excluding buildings, land, and financial assets). The value of the past stock of capital is updated by means of the price index of investment P_{I_t} as $K_{it} = (1-\delta)\frac{P_{I_t}}{P_{I_{t-1}}}K_{it-1} + I_{it-1}$, where δ is an industry-specific estimate of the rate of depreciation. Capital in real terms is obtained by deflating capital at current replacement values by the price index of investment as $\tilde{K}_{it} = \frac{K_{it}}{P_{I_t}}$. The price index of investment is obtained as the equipment goods component of the index of industry prices published by the Spanish National Institute of Statistics. This method has been already employed in other papers with the ESEE (see, for instance, Doraszelsky and Jaumandreu, 2013, Martín-Marcos and Moreno-Martín, 1991, and Martín-Marcos and Suárez, 1997).
Capacity utilization	Percentage of use of the company's production capacity.
Output	Production in real terms, using firm's specific deflators. The price index of output is a Paasche-type one constructed starting from the percentage price changes on output reported by the firm.
Export	Dummy variable taking value 1 if the firm exports and 0 otherwise.
Import	Dummy variable taking value 1 if the firm imports intermediates and 0 otherwise.
Export intensity	Percentage of the value of exports on total production.

Import intensity	Percentage of intermediate imports over the total value of intermediate inputs.
Price variation	Percentage change in sales prices from one year to the next.
TFP	Total Factor Productivity.
Size	Dummy variable taking value 1 if the number of employees in the firm is larger than 200 and 0 otherwise.
Markup	The output elasticity of the materials variable input divided by the revenue share of this variable input. The revenue share is defined as the total cost of that input over firm's total output.
Year dummies	Dummy variables taking value 1 for the corresponding year and 0 otherwise.
Industry dummies	Industry dummies accounting for 20 industrial sectors of the NACE-93 classification: 1. Meat; 2. Food and tobacco; 3. Beverages; 4. Textiles and clothing; 5. Leather and shoes; 6. Timber; 7. Paper; 8. Printing products; 9. Chemical and pharmaceutical products; 10. Plastic and rubber; 11. Non-metallic minerals; 12. Ferrous and non-ferrous metals; 13. Metallic products; 14. Industrial and agricultural machinery; 15. Electronics and data processing; 16. Electrical materials and accessories; 17. Motors and vehicles; 18. Other transport equipment; 19. Furniture; 20. Other manufacturing industries.

Table A.2. Estimated industry specific input elasticities from *Translog* production functions.

Industry	Labor (β_l)	Materials (β_m)	Capital (β_k)	Static effect of importing intermediates
1. Meat	0.210**	0.852***	0.065*	-0.001
2. Food and tobacco	0.172**	0.627***	0.087*	0.004
3. Beverages	0.296*	0.551***	0.127	-0.003
4. Textiles and clothing	0.303**	0.557***	0.067*	0.007
5. Leather and shoes	0.261**	0.617***	0.062	0.011*
6. Timber	0.295**	0.505*	0.155*	0.014*
7. Paper	0.311**	0.742***	0.043*	0.000
8. Printing products	0.246*	0.438*	0.051*	0.008
9. Chemical and pharmaceutical products	0.348***	0.487**	0.118*	0.009*
10. Plastic and rubber	0.326**	0.632***	0.018	0.003
11. Non-metallic minerals	0.281**	0.673***	0.062*	0.013*
12. Ferrous and non-ferrous metals	0.118	0.641***	0.142**	-0.005
13. Metallic products	0.385***	0.504***	0.029*	0.011
14. Industrial and agricultural machinery	0.261**	0.697***	0.041*	0.008*
15. Electronics and data processing	0.207	0.810**	0.062	-0.009
16. Electrical materials and accessories	0.271*	0.677***	0.050*	0.005
17. Motors and vehicles	0.98*	0.786***	0.088**	-0.002
18. Other transport equipment	0.220*	0.552*	0.218*	0.014
19. Furniture	0.270***	0.645***	0.041***	0.009**
20. Other manufacturing industries	0.317**	0.584***	0.033*	0.005
Total	0.257*	0.622***	0.073*	0.006

Note: ***, ** and * mean significant at the 1%, 5% and 10% level, respectively.

Table A.3. Estimated industry specific TFP and markups.

Industry	TFP	Markups
1. Meat industry	0.887	1.092
2. Food and tobacco	12.604	0.947
3. Beverage	15.494	0.924
4. Textiles and clothing	11.240	1.000
5. Leather and shoes	13.216	1.201
6. Timber	8.849	0.831
7. Paper Industry	0.964	1.026
8. Printing and printing products	10.776	0.723
9. Chemical products	9.113	0. 899
10. Rubber and plastic products	13.835	0.993
11. Non-metallic mineral products	11.453	1.083
12. Ferrous and non-ferrous metals	5.902	0.915
13. Metal products	15.589	1.062
14. Industrial and agricultural machinery	13.854	1.060
15. Office machines	4.664	1.222
16. Electric and electronic machinery and material	12.491	1.117
17. Vehicles, cars and motors	6.445	1.133
18. Other transport equipment	17.268	1.192
19. Furniture	15.676	1.049
20. Other manufacturing products	17.669	0.975
Total	14.871	0.999