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, proxy for marginal costs) and markups. It further deepens the study of the relationship between internationalization strategies an 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 indicate that there is high persistence in the performance of these activities and also in firms' TFP and markups. Further, the internationalization strategies are especially relevant for SMEs, since it is for this group of firms for which we obtain rewords of the two activities both in terms of TFP and markups. The main results in the paper distinguish between SMEs and large firms. Finally, it is also for them that we find that these strategies allow them charging higher output prices.

1. Introduction.

The liberalization of international trade together with the improvements in technology have had an important impact on firms' internationalization and on the internationalization of production processes through the incorporation of imported goods into 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 would enhance firms' productivity and profits ultimately.

The relation between exporting and productivity has been comprehensively studied.[1] Less extended is the analysis on their effects on firms' markups. Using data at the micro level from many countries, researchers have regularly discovered that exporting firms are commonly more productive than non-exporters. This empirical outcome could be the result of a process of self-selection of the more productive firms into foreign markets (Melitz, 2003) and/or may come from potential productivity gains that exporters obtain from international markets (*learning-by-exporting*).[2] That is, exporters may exhibit efficiency gains from economies of scale, knowledge flows from foreign customers, and from increased competition in export markets forcing them to become more efficient. Empirical evidence also suggests that importing intermediates and the incorporation of them in firms' production is also important for explaining differences in plant performance (*learning-by-importing*).[3] This is so as importers have access to a wider variety of intermediate inputs or to higher quality inputs and, therefore, may benefit from the diffusion and adoption of new technologies and knowledge embodied in imported inputs. Therefore, firms importing intermediates are expected to enjoy higher productivity.

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

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

[3] See Amiti and Konings (2007), Halpern et al. (2006), and Kasahara and Rodrigue (2008) for evidence of a positive relationship between importing inputs and productivity.

As regards why firms' trading strategies can affect also firms' markups, we argue that, on the one hand, if exporting firms become more efficient and there is not a full pass-through to prices of reductions in marginal costs, there is an increase in markups through a *Marginal Cost Channel*. Furthermore, if the exporting strategy affects directly prices because of higher quality products, more differentiated, and makes firms to face different demand conditions, this also justifies an increase in markups through a *Price Channel*. On the other side, focussing this time on the importing intermediates activity, if imported inputs are for instance cheaper and there is not a full-pass through to a decrease in output prices, firms will enjoy an increase in markups (*Marginal Cost Channel*). Finally, if access to imported inputs means access to higher quality inputs with superior incorporated technology, firms' products are also expected to be of higher quality and, hence, via output prices there will be also an increase in markups (*Price Channel*)

There are few empirical studies that simultaneously take into account both firms' exporting and importing strategies when studying productivity, and even fewer in the study of markups. This could be problematic if exposure to exports and imports are correlated. In the TFP literature, some exceptions are Bernard et al. (2009), who provide empirical evidence regarding both importers and exporters in the U.S., and Kasahara and Lapham (2013), who devise a model with heterogeneous producers of final goods that simultaneously choose whether exporting their output and using imported intermediates. They estimate a structural model with Chilean plant data that confirms that there are aggregate productivity and welfare gains due to trade in both final goods and intermediates. In the less extended markups literature, we have the work by Hornok and Murakozy (2015) for Hungary.

We aim at contributing to this final strand of the literature that jointly considers the effects of both firms' trading strategies on productivity and markups using data from the Spanish Survey on Business Strategies (ESEE) for the period 2006-2014. For this purpose, and in a first stage, we estimate a maximum likelihood dynamic model for the firms' joint strategy of importing

intermediates and exporting output, in which we allow for the past export and import experience to affect future firms' trading choices. To control for the self-selection mechanism of the more productive firms into these activities, we also include among regressors the preceding firms' TFP level. To estimate TFP, we depart from the traditional control function approach estimation methods in Olley and Pakes (1996) and Levinshon and Petrin (2003), by considering a more general process driving the law of motion of productivity in which we recognise the potential role that both exports and imports past experience might have in shaping firms' future productivity. Moreover, in the specification of the production function we acknowledge that firms with different export and import strategies may have different demands for intermediate inputs (materials). Further, we incorporate these features into the generalized method of moments (GMM) framework proposed by Wooldridge (2009) for TFP estimation.

The joint estimation of exporting and importing equations obeys to the thought that these two activities are linked. On the one hand, exporters are in contact with other traders in other markets who might be using a variety of productivity enhancing inputs, or feel the competition of other traders who incorporate better inputs. So, exporters might find it easy to start importing intermediary inputs. On the other hand, importers may produce improved products, which would facilitate in many cases firm's exports.

In a second stage of this study we estimate a series of models explaining firms' TFP and markups. In these specifications we consider both whether the firm is an exporter and/or it imports intermediate inputs. Hence, we allow for the *learning-by-exporting* and *learning-by-importing* effects that have been studied in the trade literature on TFP and extend them to the study of rewards of these activities in terms of markups. Hence, this paper deepens in the understanding about the impact of international trade on firm-level TFP and markups by studying how firms' trading strategies affect TFP and markups dynamics.

Finally, in a third stage we run an output price variation regression to see whether the internationalization strategies affect firms' capacity to increase output prices. If this was the case, by combining obtained results from the TFP (proxy for marginal costs), the markups and the prices regressions, we can infer whether the effects of importing intermediates and exporting output not only affect markups through the *Marginal Cost Channel*, but also through the *Price Channel*.

In the equations explaining firms' importing and exporting strategies and in the TFP, markups and output prices variation equations, we allow for differentiated effects between SMEs and large firms in the main variables for our analysis. Spanish manufacturing SMEs represent more than 90 percent and there can exist some handicaps for SMEs in the performance of these internationalization activities, such as the availability of less internal funds, higher likelihood of being financially constrained, superior risk aversion, etc., which makes them to be in an inferior position to pay upfront costs required by the internationalization strategies. Our results, summarized in what follows, indicate that there are some common results regardless size group and others that only apply to a particular size group.

From the dynamic joint system explaining the importing and exporting behaviours, we obtain, first, high persistence in the performance of these activities (consistent with the presence of sunk costs). Second, for SMEs we find that each activity encourages also the subsequent performance and intensity of the other one. For large firms, only the increase in export intensity seems to require a future deepening in intermediate imports intensity. Third, we confirm the sample-selection of the previously more efficient firms only into exports (and with higher export intensity). Finally, being a large firm *per se* justifies a higher propensity to perform both activities but not necessarily with a higher intensity.

As regards the regression analysis for TFP and mark-ups, we obtain that there is a high degree of persistence in the evolution of TFP over time, although it decreases when controlling

for markups among regressors in the TFP equation, indicating that part of the estimated persistence was not due to persistence in physical TFP but due to persistence in firms' prices. In this equation it also decreases (although still relevant and statistically significant) when the econometric method allows for individual firm's effects to be correlated with the regressor capturing persistence (i.e. past TFP). Additionally, in the TFP regressions, only SMEs seem to obtain rewards from exporting and importing activities in terms of TFP, being they larger for the exporting activity. Being a large firm *per se* allows enjoying higher TFP levels. The results from markups specifications also indicate high persistence of this variable at the firm-level and that are SMEs the ones enjoying rewards of exporting output and importing intermediates in terms of markups. Also being a large firm *per se* allows enjoying higher markups.

Finally, the results obtained from the output prices variation equation indicate that for SMEs exporting and importing strategies increase prices, probably linked to the fact that higher quality inputs and higher quality outputs allows this size group of firms to charge higher prices. Hence, we confirm for SMEs that the analysed internationalization strategies affect firms' markups both through affecting efficiency (TFP as a proxy for marginal costs, the *Marginal Cost Channel*) and through affecting prices (the *Price Channel*).

From a policy point of view, and since both importing and exporting activities have been confirmed to be self-fuelled activities once started, policy makers should facilitate entry of SMEs into these activities to put into work the dynamic process that moves firms' productivity and markups over time. Our results have uncovered that not only SMEs are less likely to perform these activities (probably indicating higher difficulties in paying upfront-costs or more risk aversion) but also that are precisely SMEs the group of firms that enjoys clear returns both from exporting and importing activities in terms of TFP, markups and output prices.

The remainder of the paper is organized as follows. Section 2 summarizes related literature. Section 3 describes the data, presents some relevant descriptive analysis and explains

the process for firms' TFP and markups estimation. Section 4 presents the main results of the paper. Finally, Section 5 concludes.

2. Related literature.

The theoretical framework in this study draws from several streams of the literature: the microeconomic literature that analyses the relationship between exporting and productivity or markups, the stream that studies the relationship between imports and productivity or markups, and the more recent literature that investigates altogether the linkages among imports, exports and productivity and/or markups.

Regarding exports, the empirical evidence suggests that the relatively more productive firms are more likely to export. See, for example, Alvarez and Lopez (2005), Aw et al. (2011), Bernard and Jensen (1999), Bernard et al. (2003), Clerides et al. (1998) and Eaton et al. (2004). This is the well-known self-selection hypothesis. Differently, the learning-by-exporting hypothesis (LBE henceforth) implies that firm-level productivity increases after firms enter a foreign market by exporting (Clerides *et al.*, 1998). These potential productivity gains can arise for various reasons: growth in sales that allows firms to achieve economies of scale, knowledge flows from international customers that provide information about innovations reducing costs and improving quality, or from increased competition in export markets that force firms to become more efficient. However, in spite of the amount of studies analysing this hypothesis, evidence on LBE is far from conclusive. There are papers that do not find any evidence of LBE, but among those that do find evidence in favour of LBE, the findings differ both in the magnitude and the duration of the LBE effect.[4]

[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.

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 of a production function estimation, increases after firms become exporters. LBE implies that past export experience affects future productivity. Yet some previous studies (implicitly) assume that the productivity term in the production function specification is just an idiosyncratic shock (Wagner, 2002, Hansson and Lundin, 2004, Greenaway and Kneller, 2004, 2007, 2008, Girma *et al.*, 2004, and Máñez *et al.*, 2010), while others assume that this term is governed by an exogenous Markov process (Arnold and Hussinger, 2005, and Serti and Tomassi, 2008). These assumptions, often critical to obtain consistent estimates (Ackerberg *et al.*, 2006), render these tests for LBE internally inconsistent. The solution to this flaw comes from allowing that past export experience may impact future productivity in the estimation of productivity. Some recent papers following this approach are De Loecker (2007, 2013), De Loecker and Warzyniski (2012), Manjón *et al.* (2013) and Máñez et al. (2014, 2015).

As regards the relationship between importing intermediate inputs and productivity, the literature points out that those countries more open to trade, and with better access to improvements in technology by importing intermediate goods and imitation of imported technologies, can take advantage in terms of productivity. In addition, there is evidence for a positive dynamic effect from the use of imported intermediates, i.e. the past import experience has a positive impact on current productivity, which is called *learning-by-importing*. Among the empirical works with cross-country data that find that importing intermediate goods (that embody technology) increases the productivity of firms, we have Coe and Helpman (1995) and Coe et al. (1997). Within the studies discussing the impact of foreign intermediate inputs on productivity at the micro-level is worth to mention Van Biesebroeck (2003), Muendler (2004), Amiti and Koenings (2007), Halpern et al. (2015), and Kasahara and Rodrigue (2008). However, the empirical findings in the literature are mixed. Van Biesebroeck (2003) finds that firms using more

advanced inputs imported in Columbia do no enjoy productivity improvements; and, similarly, Muendler (2004) finds a small contribution of foreign materials and investment goods on output for Brazil. In contrast, Amiti and Konings (2007) find that the productivity gains arise from reducing input tariffs especially for importing firms, during a trade reform for Indonesia, which is consistent with the finding of Kasahara and Rodrigue (2008). Halpern et al. (2015) use a panel of Hungarian firms to assess two different mechanisms through which foreign intermediate inputs may have an effect on firms' productivity: one related to the quality of intermediates and the other with the variety of inputs. They find that importing inputs increases firms' productivity.

Finally, few empirical studies simultaneously examine both exports and imports at the micro-level. A couple of exceptions are Bernard et al. (2009), who provide empirical evidence regarding both importers and exporters in the U.S., and Kasahara and Lapham (2013), who devise a model with heterogeneous final goods producers who simultaneously choose whether to export their output and whether to use imported intermediates. Kasahara and Lapham (2013) estimate a structural model with Chilean plant data that confirms that there are aggregate productivity and welfare gains due to trade in both final goods and intermediates.

As regards the literature that studies the effects of firms' internationalization strategies and markups, this is much less extended than the analysis on TFP. For instance, about the relationship between exports and markups, we find the works by Moreno and Rodríguez (2004) for Spain in the 90's and the one by De Loecker and Warzynski (2012) for Slovenia. Even scarcer are the papers jointly considering imports and exports. One exception in the literature is the recent work by Hornok and Murakozy (2015) for Hungary, in which they find that importing intermediates increases firms' markups but exporting output is non-significant once controlling for imports.

As to uncover the effects on productivity of exporting and importing strategies could be problematic if both activities are interrelated at the firm level, we also aim to disentangle whether

they are effectively interrelated by analysis these two decisions simultaneously. This links to another strand of literature that considers the existence of sunk costs in the performance of these activities. One might think that firms face costs associated with entering foreign markets that may be sunk in nature. For 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 fulfill quality and security legislation of other countries. Further, importers need to research the best suppliers of intermediates they use, and negotiate special characteristics for the specific inputs of their production process.

Acknowledging the existence of sunk costs implies that current exports and imports depend on past export and import trajectories and, more interestingly, that transitory changes in trade policy or conditions may lead to permanent changes in market structure, that is, sunk entry or exit costs produce hysteresis in trade flows. It is important to note that although persistence in the exporting/importing status might be caused by sunk costs, it might also be due to either underlying (observed and unobserved) firm heterogeneity. Therefore, in order to identify the role of sunk costs one needs an econometric framework controlling for competing sources of persistence. The first attempt to test the sunk-cost hysteresis hypothesis in exporting is Roberts and Tybout (1997), who directly analyze entry and exit patterns for Colombian manufacturing. More recent empirical evidence is Bernard and Wagner (1998) for Germany, Bernard and Jensen (2004) for the U.S., and Campa (2004) and Mañez et al. (2008), for Spain.

Within this literature it is also important to consider that large firms and SMEs are different as regards foreign strategic decisions such as exporting or importing. SMEs and large firms exporting prospects differ as, for example, this is a costly activity (start-up costs, and others) that requires an important amount of financial resources (internal and/or external). Increasing difficulties to access international markets may endanger export and import participation for SMEs and so the growth of trade. Damijan and Kostevc (2011) discuss that large firms have

more internal funds than SMEs and have better access to financial markets, since the volume of funds they can borrow is higher and the cost of these funds is lower. Further, SMEs are usually more risk averse, i.e. are more reluctant to take external debt for enhancing the ability to export and import intermediates. Bernard et al. (2007, 2009), Eaton et al. (2008) and Damijan et al. (2011) show that small firms usually export to one or two countries and a small number of products, being more vulnerable to foreign markets. Máñez et al. (2014) find that there are differences between small and large firms. They examine the effect of financial constraints for the decision to export and find that SMEs are more financially constrained, which implies a lower probability of exporting. Following all the above arguments, in this paper the main variables in our analysis are allowed to vary between SMEs and large firms, in the equations explaining firms' importing and exporting strategies, explaining TFP and markups, and in the specification explaining firms' output prices variation.

3. Data, descriptive analysis, and firms TFP and mark-ups estimation.

3.1. Data.

The data used in this work have been drawn from the ESSE for the period 2006-2014. The ESSE 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 competition 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.[5]

To start with, we have a sample of 16,959 observations corresponding to 2,977 firms. From this initial sample, to estimate TFP and to 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 consecutive years, we remove all firms that do not accomplish with this criterion. After cleansing the data, we end up with a sample of 9,274 observations corresponding to 2,150 firms.

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

[Table 1 about here]

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

[Figure 1 about here]

[5] See http://www.fundacionsepi.es/esee/sp/svariables/indice.asp for further details.

[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 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, both within SMEs and large firms, supports 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.

3.2. Some descriptive statistics.

In this section, we present some descriptive statistics for the main variables used in our analysis, distinguishing between SMEs and large firms (see Table 2 below). We report the mean values (and standard deviations) for the following variables: performing R&D (measured as a dummy variable equal to 1 if the firm invests in R&D, and 0 otherwise); age (in years), employment (as the number of employees); 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, an 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); skill labour (measured as the proportion of high skill labour, engineers and graduates, and med skill labour, technical engineers, experts and qualified assistants, in the firm's labour force); and, labour productivity (measured as output over employment). In Table 2 we observe that large firms have larger values, as expected, than SMEs for all the variables reported.

[Table 2 about here]

Further, 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 relationship between both trade decisions (exporting only, importing only or both) and some basic firm's characteristics. In particular, we estimate the following reduced form equation:

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

where the dependent variable y_{it} is alternatively employment (as measured by the number of employees), production, capital and intermediate materials per worker. As explanatory variables, we include the firm trade status and some controls. Thus, $Export_{it}$ is equal to one if the firm *i* only exports in *t* (and zero otherwise), $Import_{it}$ is equal to one if the firm *i* only imports intermediates in *t* (and zero otherwise), and $Both_{it}$ is equal to one if the firm *i* both exports and imports intermediates in *t* (and zero otherwise). We also control for size using employment (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(β)-1). In Table 3 we only report the results for SMEs, as we find no significant differences across types of firms for large firms. 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. Further, firms both exporting and importing are larger than firms only importing or only exporting. And 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. Further, firms performing both activities have higher values on the three variables.

[Table 3 about here]

3.3. The production function, firms TFP and markups estimation.

To model the production function, we assume that firms produce using a trans-log technology:

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

where y_{it} is the natural log of production of firm i at time t, l_{it} is the natural log of labour, k_{it} is the natural log of capital, m_{it} is the natural log of intermediate materials, and μ_t are time effects. As for the unobservables, ω_{it} is the 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.

It is also assumed that capital evolves following a certain law of motion that is not directly related to current productivity shocks (i.e. it is a state variable), whereas labour and intermediate materials are inputs that can be adjusted whenever the firm faces a productivity shock (i.e. they are variable factors).[6]

[6] 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 the firm uses in period t was actually decided in period t-1 (it takes a full production period for the capital to be ordered, received and installed by the firm before it becomes operative). Labour and materials (unlike capital) are chosen in period t, the period they actually get used (and, therefore, they can be a function of ω_{it}). These timing assumptions make them non-dynamic inputs, in the sense that (and again unlike capital) current choices for them have no impact on future choices.

Under these assumptions, Olley and Pakes (1996, hereafter OP) show how to obtain consistent estimates of the production function coefficients using a semiparametric procedure. See also Levinshon and Petrin, (2003, hereafter LP), for a closely related estimation strategy. However, here we follow Wooldridge (2009), who argues that both OP and LP estimation methods can be reconsidered as consisting of two equations which can be jointly estimated by GMM: the first equation tackles the problem of endogeneity of the non-dynamic inputs (that is, the variable factors); and, the second equation deals with the issue of the law of motion of productivity. Next, we consider each in detail.

We start considering first the problem of endogeneity of the non-dynamic inputs. Correlation between labour and intermediate inputs with productivity complicates the estimation of equation (2), because it makes the OLS estimator biased and the fixed-effects and instrumental variables methods generally unreliable (Ackerberg *et al.*, 2006). Both OP and LP methods use a control function approach to solve this problem, by using investment in capital and materials, respectively, to proxy for "unobserved" firm productivity.

In particular, the OP method assumes that the demand for investment in capital, $i_{it}=i(k_{it}, \omega_{it})$, is a function of firms' capital and productivity. To avoid the problem of firms with zero investment in capital, the LP method uses the demand for materials (intermediate inputs), $m_{it}=m(k_{it}, \omega_{it})$, instead, as a proxy variable to recover "unobserved" firms productivity. Since we follow this last approach, we concentrate on the demand for materials hereafter.[7]

Therefore, when estimating productivity using these general versions of OP and LP 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

[7] Both the capital investment demand function and the demand for intermediate materials are assumed to be strictly increasing in ω_{it} (in the case of the capital investment this is assumed in the region in which $i_{it}>0$). That is, conditional on k_{it}, a firm with higher ω_{it} optimally invests more (or demands more materials).

exporting and importing statuses is identical. However, heterogeneity in these firms' strategies may influence the demand of intermediate inputs.

Thus, we consider different demands of intermediate materials for only exporters (X), only importers (M), performers of both activities (BOTH) and non-performers (NP); and, we write the demand for materials as:

$$m_{it} = m_J(k_{it}, \omega_{it}) \tag{3}$$

where we include the subscript *J* to denote different demands of intermediate inputs for the different firms strategies (categories) according to exporting and importing statuses (*J=X, M, BOTH, NP*). Since the demand of intermediate materials is assumed to be monotonic in productivity, it can be inverted to generate the following inverse demand function for materials:

$$\omega_{it} = h_J(k_{it}, m_{it}) \tag{4}$$

where h_J is an unknown function of k_{it} and m_{it}. Then, substituting expression (4) into the production function (2) we get:

$$\begin{aligned} y_{it} = {} & \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_{l2} l_{it}^2 + \beta_{k2} k_{it}^2 + \beta_{m2} m_{it}^2 + \\ & \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{km} k_{it} m_{it} + \mu_t + h_J(k_{it}, m_{it}) + \eta_{it} \end{aligned} \tag{5}$$

Thus, our first estimation equation for the production function can be written as:

$$y_{it} = \beta_l l_{it} + \beta_{l2} l_{it}^2 + \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \mu_t + \sum_{j=NP,X,M,BOTH} a_j H_J(k_{it}, m_{it}) + \eta_{it} \tag{6}$$

where a_j is an indicator function that takes on value one if a firm follows the imports/exports strategy *j* and zero otherwise.[8] Further, the unknown functions *H* in (6) are proxied by third-degree polynomials in their respective arguments.

With the specification in equation (6), the difference in the inverse demand function of firms with different productivity enhancing strategies arises not only from differences in the coefficients of k_{it} and m_{it} but also by the fact that each inverse demand function includes a dummy

[8] Notice that $\sum_{j=NP,X,M,BOTH} a_j H_J(k_{it}, m_{it}) = \beta_0 + \beta_k k_{it} + \beta_m m_{it} + \beta_{k2} k_{it}^2 + \beta_{m2} m_{it}^2 + \beta_{km} k_{it} m_{it} + h_j(k_{it}, m_{it})$.

variable capturing the corresponding firm's strategy or combination of strategies. This is not equivalent to introduce the set of dummies identifying different strategies as additional inputs in the production function, as each one of these dummies is interacted with all the terms k_{it} and m_{it} in its corresponding polynomial. For example, introducing an import-only dummy as an input in the production function will cause at least two problems. First, an identification problem, as we will need another estimation step to identify the parameter associated to that variable. Second, it implies that a firm can substitute any input with only-importing at a constant unit elasticity (see De Loecker, 2007, 2013, for similar arguments applied to export dummies).

Notice, however, that we cannot identify β_k, β_m, β_{k2}, β_{m2} and β_{km} from (6). This is achieved by the inclusion of a second estimation equation in the GMM-system that deals with the law of motion for productivity.

The standard OP/LP approaches consider that productivity evolves according to an exogenous Markov process:

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

where f is an unknown function that relates productivity in t with productivity in t-1 and ξ_{it} is an innovation term uncorrelated by definition with k_{it}. However, this assumption neglects the possibility of previous exporting and importing experience to affect productivity. Consequently, here we consider a more general (endogenous Markov) process in which previous import of intermediates intensity and export intensity (*intX* and *intM*, respectively) may influence the dynamics of productivity: [9]

$$\omega_{it} = E[\omega_{it} \mid \omega_{it-1}, \text{int}X_{it-1}, \text{int}M_{it-1}] + \xi_{it} = f(\omega_{it-1}, intX_{it-1}, intM_{it-1}) + \xi_{it} \tag{8}$$

Let us now rewrite the production function in (2) using (8) as:

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

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_{l2} l_{it}^2 + \beta_{k2} k_{it}^2 + \beta_{m2} m_{it}^2 + \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{km} k_{it} m_{it} + \mu_t + f(\omega_{it-1}, intX_{it-1}, intM_{it-1}) + u_{it} \quad (9)$$

where $u_{it} = \xi_{it} + \eta_{it}$ is a composed error term. Further, since $\omega_{it}=h_J(k_{it},m_{it})$, we can rewrite $f(\omega_{it-1},\text{int}X_{it-1},\text{int}M_{it-1})$ as:

$$f(\omega_{it-1},\text{int}X_{it-1},\text{int}M_{it-1}) = f\left[h_j(k_{it-1},m_{it-1}), intX_{it-1}, intM_{it-1}\right] = F_J(k_{it-1},m_{it-1}) \quad (10)$$

Finally, substituting (10) into (9), our second estimation equation for the production function is given by:

$$y_{it} = \beta_0 + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_{l2} l_{it}^2 + \beta_{k2} k_{it}^2 + \beta_{m2} m_{it}^2 + \beta_{lk} l_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{km} k_{it} m_{it} + \mu_t + F_J(k_{it-1},m_{it-1}) + u_{it} \quad (11)$$

Wooldridge (2009) proposes to estimate jointly the system of equations (6) and (11) by GMM using the appropriate instruments and moment conditions for each equation. Wooldridge (2009) argues that both OP and LP estimation methods can be reconsidered as consisting of two equations which can be jointly estimated by GMM in a one-step procedure. 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 one of the 9 considered industries,[10] both the estimates of the production function coefficients and firms' productivity estimates as:

$$\hat{\omega}_{it}^s = y_{it} - \hat{\beta}_l l_{it} - \hat{\beta}_k k_{it} - \hat{\beta}_m m_{it} - \hat{\beta}_{l2} l_{it}^2 - \hat{\beta}_{k2} k_{it}^2 - \hat{\beta}_{m2} m_{it}^2 - \hat{\beta}_{lk} l_{it} k_{it} - \hat{\beta}_{lm} l_{it} m_{it} - \hat{\beta}_{km} k_{it} m_{it} - \hat{\mu}_t \quad (12)$$

where $\hat{\omega}_{it}^s$ is the estimated log of the TFP for firm *i* belonging to industry *s* at time *t*.

We aim to recover the implicit parameters in the endogenous Markov process in (8) to check whether our assumption of considering a more general Markov process, in which we allow

[10] Following Doraszelski and Jaumandreu (2013) we group the 20 industries in which the ESEE classifies firms into 9 industries. The aim is to get enough observations to carry out industry-by-industry estimations.

past export and import experience to affect future productivity, holds. Therefore, combining expressions (9) and (12) above, we can write:

$$\hat{\omega}_{it}^{s} = y_{it} - \hat{\beta}_{l} l_{it} - \hat{\beta}_{k} k_{it} - \hat{\beta}_{m} m_{it} - \hat{\beta}_{l2} l_{it}^{2} - \hat{\beta}_{k2} k_{it}^{2} - \hat{\beta}_{m2} m_{it}^{2} - \hat{\beta}_{lk} l_{it} k_{it} - \hat{\beta}_{lm} l_{it} m_{it} - \hat{\beta}_{km} k_{it} m_{it} - \hat{\mu}_{t} = \beta_{0} + f(\omega_{it-1}, intX_{it-1}, intM_{it-1}) + u_{it} \quad (13)$$

And linearly specifying the conditional expectation in (8) we get our final estimation equation of interest for TFP:

$$\hat{\omega}_{it}^{s} = \beta_{0} + \alpha_{1}\omega_{it-1} + \alpha_{2} intX_{it-1} + \alpha_{3} intM_{it-1} + s_{i} + \tau_{it} \quad (14)$$

where $\tau_{it} = u_{it} + e_{it}$ is a composite error term. We have explicitly included in estimation a set of industry dummies, s_i, to account for the fact that in the regression analysis we pool all industries' TFP estimates. Positive estimates for α_1 and α_2 should be interpreted as evidence of *learning-by-exporting* and/or *learning-by-importing*. Furthermore, a positive estimate for α_1 implies that current productivity will carry forward to the future. Equation (14) will be also estimated substituting firm intensity variables by their corresponding dummy (export and import) variables indicating the yes/no performance of these activities.

To check the robustness of our results on *learning-by-exporting* and *learning-by-importing* to different pricing patterns according to the firms' export/import strategies we estimate an augmented version of equation (14) that includes estimated firm specific mark-ups (defined as the ratio of the price over the marginal cost). We estimate firm's specific mark-ups following De Loecker and Warzynski (2012) as:

$$MK_{it} = \frac{e_{it}^{j}}{share_{it}^{j}} \quad (15)$$

where MK_{it} is he mark-up, e_{it}^{j} is the output elasticity of variable input *j* (obtained for each one of the 9 considered industries) and $share_{it}^{j}$ the revenue share of variable input *j*. The revenue share of variable input *j* is defined as the total cost of that input over firm's total output. We base our mark-ups calculations on the elasticity of intermediate materials, although using the other variable

factor (labour) we obtain similar results.

When firms' mark-ups are estimated using the variable factor elasticities obtained from the estimation of a Cobb-Douglas production function, the only source of mark-ups variability across firms belonging to the same industry comes from differences in revenue shares. However, when estimating a trans-logarithmic production function, the variable factors elasticities are firm-specific (e.g. $\delta y_t / \delta m_t = \beta_m + 2\beta_{m2} m_{it} + \beta_{lm} l_{it} + \beta_{km} k_{it}$). Therefore, variation of mark-ups across firms depends both on variable factors elasticities and revenue shares differences.

To get a flavour of the evolution of TFP and mark-ups, in Figure 3 and Figure 4 we plot the evolution of these two 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 mark-ups than SMEs. Further, we also observe that during the crisis years mark-ups fall for both groups of firms and TFP lessened its growth.

[Figure 3 about here]

[Figure 4 about here]

4. Estimation results.

4.1. Dynamic importing and exporting decisions.

We specify our empirical model of the joint likelihood of exporting and importing intermediates using a specification in terms of sunk costs and a reduced-form set of variables proxying 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 they take the decision of starting to import intermediate inputs. On the one hand, entering export markets implies facing costs that may be sunk in nature, as in order to start exporting, firms 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. On the other hand, there can also be sunk costs associated to importing intermediates as firms need to incur in a searching process and investments required to access to a wider range of foreign inputs, to higher quality inputs, or to foreign technology incorporated in imported inputs (Bustos, 2011). These arguments imply that the firm's past export and import activities should be considered as state variables in the firm´s export and import decisions, respectively.

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

As 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. Notice that if productivity evolves endogenously depending on past exporting and intermediate import decisions, the firm' payoffs from exporting (importing) depend positively on how much past exporting (importing) increases future productivity (this aspect is explicitly recognised in equation 14). Therefore, in our framework, the net benefit from exporting and importing intermediates is increasing in productivity. This argument endogenizes the well-known self-selection mechanism[11] in the literature, given that import/export firm's choices increase future productivity and, therefore, would positively influence the likelihood of firms' being self-selected or continuing in such activities in the

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

future. This is why we also include the firm's estimated productivity in our specification of the joint likelihood of exporting and importing intermediates.

Furthermore, to properly identify the role of sunk costs and past export (import) decisions on current import (export) decisions, it is required to control for other variables potentially affecting the payoffs associated to exporting and importing intermediates, and so determine firms' exporting and importing decisions. Thus, we control for observable firm/market characteristics, for macro conditions (including a vector of time dummies μ_t), for industry specific effects (including the vector of industry dummies, s_i) and include an error term (ε_{it}) that allows for the potential existence of unobserved heterogeneity.

Among the set of possible observable firm characteristics, we believe that deserve special attention productivity, ω_{it-1}, lagged one period, as it will allow testing for self-selection. The remaining set of firm/market control variables (Z_{it}) includes size, age, foreign participation, demand conditions, market share, and firm's complementary assets such as the intensity of skill labour or the performance of R&D activities. We lag this set of control variables one period to avoid potential simultaneity problems. Finally, we assume that error term, ε_{it}, has two components, a permanent firm-effect, α_i, and a transitory component, u_{it}.

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

$$\begin{aligned} X_{it} &= \gamma_0^X + \gamma_1^X X_{it-1} + \gamma_2^X M_{it-1} + \gamma_3^X TFP_{it-1} + \beta^X Z_{it-1} + \mu_t^X + \varepsilon_{it}^X \\ M_{it} &= \gamma_0^M + \gamma_1^M M_{it-1} + \gamma_2^M X_{it-1} + \gamma_3^M TFP_{it-1} + \beta^M Z_{it-1} + \mu_t^M + \varepsilon_{it}^M \end{aligned} \tag{16}$$

We will estimate two specifications of the above expression. In Specification 1, X_{it} and M_{it} we will use the discrete choice variables yes/no for exports and imports. In Specification 2, we will use the intensity measures export and import. The main parameters of interest are γ_1 that identifies sunk costs for each one of the two considered activities, γ_2 that accounts for cross effects, i.e the fact that performing one activity enhances the likelihood of starting the other, and

γ_3 that allows for a self-selection/continuation mechanism to be in work for the more productive firms. Furthermore, as we aim to check whether sunk costs effects, cross effects from past export and import decisions and selection/continuation effects differ between large firms and SMEs, we will allow these coefficients (γ_1, γ_2 and γ_3) to differ between large firms and SMEs.

We first estimate a bivariate *probit* for the firm's simultaneous decisions of exporting and importing (Specification 1). Second, we carry out the joint estimation of a regression model for export and import intensities (Specification 2). Correlated idiosyncratic error terms between the two internationalization activities are, hence, allowed for in estimation. Both specifications are estimated with the Stata command *cmp* (Roodman, 2011) by pseudo-simulated maximum likelihood (PSML).

For the two specifications, the estimation of equation (16) poses an "initial conditions" problem as we do not observe prior period choices for *X* and *M* for the first year a firm is in the dataset. To solve this problem, we control for correlated unobserved firms' heterogeneity using the fixed effects approach developed by Blundell et al. (1999, 2002). Following their approach, the pre-sample means of the dependent variables ($\bar{X}_{i0}$ and $\bar{M}_{i0}$) are sufficient statistics for the unobserved fixed effects (α_i).[12] These "initial conditions" variables are respectively added as explanatory variables in the corresponding equation. As we use as pre-sample years 2006 and 2007 and explanatory variables in (16) are lagged one period, we carry out estimation for the period 2009-2014.

For Specification 2 of equation (16), selectivity issues are taken into account, adding as an extra regressor in the estimation a *Heckman's lambda* sample selection correction term for the export and import simultaneous decisions.[13]

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

[13] 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

Table 4 shows the bivariate estimation results. In the first two columns, we present the results for the binary choice model explaining the discrete firms' decisions to export output and import intermediates. In columns three and four, results correspond to the intensity measures.

The estimated correlations of errors between the export and import equations are always positive and statistically significant (see coefficients ρ and the tests at the bottom of Table 4 for each specification). This confirms the presence of simultaneity between export and import activities of firms and, hence, the convenience of jointly estimating the two firms' decisions. As regards selectivity corrections in the estimation of Specification 2, also at the bottom of Table 4, we can observe that the lambda terms coefficients for exporting and importing in the respective intensity equations are both positive and statistically significant. This indicates that unobservable factors affecting positively the firms' export or import decisions also affect positively to their respective intensities. Therefore, we also confirm the convenience of correcting for sample selection in the joint estimation of the two intensity equations.

Now we describe the estimation results on the variables of interest. First, the estimates suggest high persistence in export and import activities (in choices and intensities) both for SMEs and large firms, which is consistent with the presence of sunk costs associated to these activities. The role of this persistence is reinforced by the positive and highly significant effect of the pre-sample means (capturing their permanent effect through firms' individual effects). Second, for SMEs we find that past exports affect positively payoffs from exporting and vice versa: lagged exports (imports) is positive and significant in the imports (exports) equation. For large firms, this result only holds from exports to imports in the intensity equation. Third, both for large firms and SMEs, we confirm that previously more efficient firms (according to TFP_{t-1}) are the ones that self-

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estimated index function of a probit model with generic explanatory variables *X*. The employed estimated index functions for the export and import intensity equations come from the corresponding export and import yes/no decisions estimated in the previous biprobit model (Specification 1).

select into exporting and have higher export intensity. However, we do not find any evidence for self-selection of the most productive firms into importing inputs.

As for the set of controls, we find that large firms are more likely to export and import. This result suggests that SMEs very likely face constraints that hinder their ability of export and import intermediates in comparison to large firms. Such constraints may come from alternatively financial constraints to access financial markets, higher risk in the performance of these activities for SMEs, and the difficulty to afford the initial costs involved in both decisions. Further, SMEs have larger import intensity, but we do not find any significant difference in export intensity between large firms and SMEs.

The role of firms' age operates mainly through higher intensities in exports and imports. Firms that are foreign participated have higher propensities and intensities both for exports and imports. This is probably related to the opportunity of accessing the group internal capital market that alleviates financial constraints, and also due to the knowledge and expertise of the parent company about external markets. Furthermore, firm's market share, a variable that might be capturing the effects of less competition in output markets, affects positively both propensities and intensities in the performance of exports and imports. The same is true for the variable expansive market, which controls for firms' favourable demand conditions. Finally, as regards variables controlling for possible complementary firm assets for the exporting and/or importing intermediates activities, R&D also affects positively both propensities and intensities of exports and imports and, however, skill labour, once controlling for R&D, remains only statistically significant in the yes/no equation for imports and more relevant in the export intensity equation.

[Table 4 around here]

4.2. Dynamic TFP equation.

Our second estimation equation is equation (14), where we aim at disentangling the effects of the

exporting and importing strategies on firms' productivity. Notice that as in the law of motion of productivity (that we assume in our productivity estimation procedure), in equation (14) we also acknowledge that TFP is a dynamic process and, hence, TFP in period *t* depends on TFP_{t-1}.

In Tables 5 and 6, we estimate and compare the estimates resulting from estimating equation (14) by three different econometric methods to deal with the likely presence of individual unobserved heterogeneity (firm's individual effects). In Specification 1 we use a panel data random effects method, which should upward bias the persistence parameter for TFP_{t-1}, as by construction TFP_{t-1} also depends on the firm's individual effect. In Specification 2 we use a panel data random effects method that instruments TFP_{t-1} with its own difference, TFP_{t-1}-TFP_{t-2}. This estimation method would provide unbiased estimates of the persistence parameter on TFP_{t-1} as the difference TFP_{t-1}-TFP_{t-2} is by construction uncorrelated with the firm's individual effect. Finally, in Specification 3 we use a panel data estimator that treats the "initial conditions" problem controlling for the existence of correlated individual effects. Following Blundell et al., (1999 and 2002), this requires incorporating as additional regressors the pre-sample mean of TFP calculated using its value for the pre-sample years 2006 and 2007. This estimation method, as compared to the second one, allows also for firm's individual effects to be correlated with the rest of regressors in equation (14).

Similarly to section 4.1 above, we are interested in disentangling whether the rewards (in terms of productivity) from importing and exporting differ between SMEs and large firms. We also aim at checking whether SMEs and large firms show different patterns of persistence in productivity. Thus, in Tables 5 and 6 we report the estimated coefficients for TFP_{t-1}, M_{t-1} and X_{t-1} both for large firms and SMEs. The difference between Tables 5 and 6, is that in the estimations shown in Table 5 M_{t-1} and X_{t-1} are dummy variables capturing whether the firm exports and/or imports whereas in Table 6 they are import and export intensities, respectively. Furthermore, both in Tables 5 and 6 we show for each estimation method two sets of estimates. The second set of

estimates, under the heading TFP*, includes as additional regressor firms' mark-ups (see expression 15) to control for dispersion in prices among firms in the same industry, since we use revenue TFP deflated by industry-year price deflators. Including this extra regressor should potentially remove the effect of firm-year-specific prices in the estimated coefficients for the exporting and importing strategies, and also on the estimated coefficient of TFP_{t-1} (capturing TFP persistence).

Regardless of the estimation method used and whether we use dummy variables or intensities to capture trade strategies we obtain that there is a high degree of persistence in the evolution of TFP over time for both size groups. As expected, the estimated persistence parameter decreases when controlling for mark-ups in the regressions, as not controlling for them part of the estimated persistence is due to firm's prices but not to persistence in physical TFP.

For the exporting and importing strategies, independently of the estimation method used and the way we measure them, results indicate that only SMEs obtain rewards from these activities in terms of TFP, and that these rewards seem to be larger for exporting than for importing activities. In general, the inclusion of mark-ups does not affect too much to these results. Further, the results are not very much affected by the type of econometric treatment of the model.

As regards the set of control variables, the dummy variable for large firms versus SMEs (when statistically significant) indicates that large firms enjoy higher TFP levels. However, there is not a clear pattern for the role of firm's age on TFP. Foreign participation (when statistically significant) has a negative sign, suggesting that belonging to a foreign group or company does not guarantee a superior productivity as compared to domestically own firms. Differently, for firms facing good demand conditions, productivity is higher. The variable market share (when statistically significant) renders a negative sign, which might be indicative that as the firm increases its market power, the competition it faces gets reduced as well as the firm's pressure to

increase efficiency. Finally, as for firm's complementary assets, such as R&D performance and the percentage of skill labour, there seems to be no-room for R&D directly affecting productivity once controlling for previous TFP, export and import strategies. However, skill labour is statistically significant in justifying higher productivity, but only when not controlling for mark-ups. This might suggest that probably skill labour is associated to higher quality products that have higher prices and, therefore, its role disappears on TFP when controlling for prices and market power through mark-ups.

In addition, pre-sample TFP means are positive and statistically significant when included in estimation (see the last two columns in Tables 5 and 6). Finally, we observe that the variable TFP_{t-1} is the most affected across the different econometric treatments, for unobserved individual heterogeneity (firm's individual effects). We see that the coefficients for TFP_{t-1} decrease noticeably when instrumenting this variable or when following for the "initial conditions" approach. Hence, this evidence indicates that the persistence coefficient was suffering from an upward bias in the first two columns of Tables 5 and 6 (under a simple panel data random effects estimator).

[Table 5 about here]

[Table 6 about here]

4.3. Dynamic markups equation.

In this section, we reproduce the same estimation equation than for TFP but using markups instead. For the sake of brevity and since results are qualitatively the same when using as regressors the dummy variables for internationalization strategies or the intensities counterparts, we only include results in the paper corresponding to the dummy variables. We present in column 1 of Table 7 results from panel data random effects estimation, and in column 2 from panel data correlated effects. The results obtained and displayed in this table confirm the same results found with the TFP regressions. On the one hand, our results point that there is a high degree of persistence in the evolution of markups over time for both firms' size groups. On

the other hand, for the exporting and importing strategies, and regardless of the estimation method used, results indicate that only SMEs obtain rewards from these activities in terms of markups, and that these gains seem to be larger for exporting than for importing activities. Therefore, the markups equation confirms all the above results from the TFP estimates.

[Table 7 about here]

As regards the set of control variables, neither the size or the R&D performance dummy have statistical significance in the markups regressions. The same happens to the variables age, market share and foreign participation. Differently, firms facing good demand conditions and with larger proportions of skilled labour enjoy higher markups.

In addition, pre-sample markup means are positive and statistically significant when included in estimation (see column 2 of Table 7 where we treat with pre-sample means of the dependent variable the possibility of correlated individual heterogeneity).

4.4. Variation in ouput prices.

Finally, we are also interested in disentangling whether the exporting output and importing intermediates rewards on mark-ups operate through two channels: marginal costs and prices. Since for the time being in section 4.2 and Table 6 we have already shown that exporting and importing strategies affect positively SMEs' TFP (the proxy for efficiency), and also that for this size group these internationalization strategies also affect positively markups (see section 4.3 and Table 7), what is missing in our analysis is checking whether they also affect firms' output prices. As in the ESEE firms report yearly variation on their output prices, we regress this variation on the export and import intermediates dummies or, alternatively, on their intensities. We also add the same controls than in previous stages of estimation.

The results from these regressions are reported in Table 8 and can be summarized as follows. We find that for SMEs, both exporting and importing increases prices, what might indicate

higher quality of imported inputs and higher quality of exported outputs. But, for large firms we only obtain that importing intermediate goods decreases prices, which might be related to the fact that large firms import cheaper inputs with pass-through to a decrease in output prices. As for included controls in estimation of the variation in prices regressions, only the expansive demand variable renders positive and statistical significance in explaining higher prices.

[Table 8 about here]

5. Concluding remarks

In this paper, we analyse the relation between the firms' decisions to export 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 export and import experience to affect future firms' trading choices. To control for the self-selection mechanism of the more productive firms into these activities, we also include among regressors the preceding firms' TFP. To estimate TFP, we extend the Olley and Pakes (1997) and Levinshon and Petrin (2003) methodologies, by considering a more general process driving the law of motion of productivity (recognising the role of both past exports and imports experience on future firms' productivity). Further, 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 methodology for markups estimation in De Loecker and Warzynski (2012). In a second step, we estimate models explaining firms' TFP and mark-ups that consider both whether

the firm exports and/or imports intermediate inputs. Hence, we allow for the *learning-by-exporting* and *learning-by-importing* effects that have been studied in the trade literature. In a final step, we also check whether the internationalization strategies considered enhance firms' chances to charge higher output prices. In all steps, we allow the main variables in our analysis to have different effects between SMEs and large firms.

The results we obtain from the estimation of the dynamic 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 significant of sunk costs. Second, for SMEs we find that exporting and importing activities support the subsequent performance and intensity of the opposite one. For large firms, only the increase in export intensity seems to require a future deepening in intermediate imports intensity. Third, we also confirm the self-selection of the previously more efficient firms only into exports (and with higher export intensity). Finally, being a large firm *per se* implies a higher propensity to export and import but not necessarily with a higher intensity.

In relation to the study of the determinants of TFP and mark-ups, we get a high persistence in the evolution of TFP over time, that lessens when controlling for markups, what indicates that part of the estimated persistence is due to firms' prices and not to persistence in physical TFP. Further, the results for the TFP regressions indicate that only SMEs seem to obtain rewards from exporting and importing activities in terms of TFP, being they larger for the exporting activity. Finally, being a large firm *per se* implies enjoying higher TFP levels. All these results are also confirmed in the mark-ups regressions.

Finally, from the analysis about whether exporting output and importing intermediates has rewards on mark-ups not only operating through marginal costs (TFP) but also through prices, our regressions where firms' output prices variation is the dependent variable indicate that for SMEs, both exporting and importing strategies justify an increase in prices. This may point to a

higher quality of imported inputs and to a higher quality of exported output. Results for large firms are less clear cut.

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 also suffer less from financial constraints than SMEs. Additionally, as our results also indicate that it is very relevant for SMEs the performance of these internationalization activities in order to increase productivity, markups or prices, and, furthermore, the evolution of productivity and markups *per se* is highly persistent (that is, at some extent, also self-fuelled), we confirm that it is especially relevant for SMEs that the public sector facilitates the starting point of the dynamic process that moves such firms' performance indicators over time.

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Appendix.

Table A.1. Variables definition.

TFP	Total Factor Productivity.
Export	Dummy variable taking value 1 if the firm exports, and 0 otherwise.
Export intensity	Percentage of the value of exports on total production.
Import	Dummy variable taking value 1 if the firm imports intermediates, and 0 otherwise.
Import intensity	Percentage of intermediate imports over the total value of intermediate inputs.
Size	Dummy variable taking value 1 if the number of employees in the firm is larger than 200 and 0 otherwise.
Employment	Number of employees.
Mark-up	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.
R&D	Dummy variable taking value 1 if the firm invests in R&D, and 0 otherwise.
Age	Number of years since the firm was born.
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.
Skill labour	Proportion of high skill labour (engineers and graduates) and med skill labour (technical engineers, experts and qualified assistants) in the firm's labour force.
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.

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.
R&D	SMEs	0.238	0.426
	Large firms	0.713	0.452
Age	SMEs	29.094	19.646
	Large firms	42.643	25.388
Employment	SMEs	52.209	49.567
	Large firms	725.487	1325.02
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
Skill labour	SMEs	12.233	14.213
	Large firms	19.849	17.513
Labour productivity	SMEs	166392.3	227895.3
	Large firms	322932.4	301798.3

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

	Export only	Import only	Both
Employment	94.061***	52.348***	213.93***
Labour productivity	51.437***	62.905***	100.171***
Capital (net value) per worker	49.631***	46.668***	79.679***
Materials per worker	81.848***	106.267***	164.587***

Notes:

1. *** mean significance at the 1% level.
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. Dynamic 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	0.008**	0.008	0.136**	0.065
		(0.004)	(0.013)	(0.065)	(0.051)
	Large	0.007*	0.009	0.125*	0.067
		(0.004)	(0.013)	(0.067)	(0.052)
Export$_{t-1}$	SME	0.190***	0.079***	0.569***	0.076***
		(0.006)	(0.009)	(0.019)	(0.004)
	Large	0.208***	0.031	0.550***	0.025***
		(0.022)	(0.028)	(0.031)	(0.008)
Import$_{t-1}$	SME	0.019***	0.316***	0.014***	0.333***
		(0.005)	(0.008)	(0.001)	(0.015)
	Large	-0.002	0.357***	-0.001	0.323***
		(0.013)	(0.016)	(0.002)	(0.015)
Size$_{t-1}$		0.042***	0.084***	0.009	-0.245***
		(0.016)	(0.031)	(0.049)	(0.073)
Age$_{t-1}$		0.006*	0.005	0.062***	0.103***
		(0.004)	(0.006)	(0.022)	(0.034)
Foreign participation$_{t-1}$		0.024***	0.021**	0.163***	0.656***
		(0.008)	(0.011)	(0.030)	(0.046)
Expansive demand$_{t-1}$		0.014**	0.016*	0.163***	0.254***
		(0.006)	(0.010)	(0.032)	(0.053)
Market share$_{t-1}$		0.009*	0.021***	0.102***	0.319***
		(0.005)	(0.008)	(0.026)	(0.045)
R&D$_{t-1}$		0.029***	0.036***	0.354***	0.440***
		(0.006)	(0.009)	(0.029)	(0.051)
Skill labour$_{t-1}$		0.000	0.000*	0.002***	0.001
		(0.000)	(0.000)	(0.001)	(0.001)
Export Pre-sample Mean	SME	0.079***	-	0.130***	-
		(0.006)		(0.005)	
	Large	0.068***	-	0.074***	-
		(0.023)		(0.015)	
Import Pre-sample Mean	SME	-	0.127***	-	0.114***
			(0.010)		(0.005)
	Large	-	0.063***	-	0.049***
			(0.019)		(0.005)
λ Export		-	-	7.626***	-
				(0.238)	
λ Import		-	-	-	6.749***
					(0.326)
		N. observations: 9,274		N. observations: 6,702	
		ρ = 0.215 (p-val.=0.000)		ρ = 0.215 (p-val.=0.000)	
		Wald χ^2 test= 8736.72		Wald χ^2 test=9342.67	
		p-val.=0.000		p-val.=0.000	

Notes:

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

Table 5. Effect of Export and Import decisions on TFP.

Variables		Panel data random effects		Panel data IV-random effects for TFP_{t-1}		Panel data with correlated effects	
		TFP	TFP*	TFP	TFP*	TFP	TFP*
TFP_{t-1}	SME	0.843***	0.568***	0.261***	0.149***	0.533***	0.273***
		(0.018)	(0.033)	(0.030)	(0.025)	(0.032)	(0.028)
	Large	0.843***	0.560***	0.263***	0.126***	0.623***	0.391***
		(0.018)	(0.033)	(0.031)	(0.024)	(0.039)	(0.048)
$Export_{t-1}$	SME	0.023***	0.026***	0.074***	0.055***	0.027***	0.027***
		(0.005)	(0.006)	(0.009)	(0.008)	(0.006)	(0.006)
	Large	-0.008	-0.018	-0.049	-0.021	0.009	0.003
		(0.013)	(0.020)	(0.041)	(0.026)	(0.013)	(0.016)
$Import_{t-1}$	SME	0.009**	0.012***	0.026***	0.016**	0.009*	0.011***
		(0.005)	(0.004)	(0.009)	(0.007)	(0.005)	(0.004)
	Large	-0.005	-0.005	-0.014	-0.018	-0.001	0.001
		(0.008)	(0.009)	(0.015)	(0.013)	(0.007)	(0.007)
$Markup_{t-1}$	SME		0.413***		0.517***		0.376***
			(0.031)		(0.013)		(0.028)
	Large		0.140**		-0.515***		0.182***
			(0.055)		(0.115)		(0.041)
$Size_{t-1}$		0.037**	0.429***	0.132	0.868***	0.014	0.320***
		(0.015)	(0.068)	(0.119)	(0.047)	(0.015)	(0.055)
Age_{t-1}		-0.005	0.005	0.001	0.017***	-0.009**	-0.002
		(0.004)	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)
Foreign participation$_{t-1}$		0.000	-0.015*	-0.033***	-0.018	0.005	-0.009
		(0.005)	(0.008)	(0.010)	(0.011)	(0.005)	(0.007)
Expansive demand$_{t-1}$		0.011**	0.006	0.042***	0.020***	0.014***	0.009**
		(0.005)	(0.004)	(0.009)	(0.007)	(0.004)	(0.004)
Market share$_{t-1}$		-0.001	-0.012***	0.007	-0.020***	-0.002	-0.013***
		(0.004)	(0.005)	(0.008)	(0.007)	(0.005)	(0.004)
$R\&D_{t-1}$		0.002	0.004	0.021**	0.011	-0.004	-0.002
		(0.005)	(0.005)	(0.008)	(0.008)	(0.005)	(0.005)
Skill labour$_{t-1}$		0.000**	-0.000	0.001**	0.000	0.000*	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TFP Pre-sample Mean	SME					0.430***	0.502***
						(0.030)	(0.034)
	Large					0.341***	0.377***
						(0.039)	(0.049)
		N. observations: 9,260 N. firms: 2,144		N. observations: 8,323 N. firms: 1,880		N. observations: 9,259 N. firms: 2,143	

Notes:

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

Table 6. Effect of Export and Import intensities on TFP

Variables		Panel data random effects		Panel data IV-random effects for TFP_{t-1}		Panel data with correlated effects	
		TFP	**TFP***	**TFP**	**TFP***	**TFP**	**TFP***
TFP_{t-1}	SME	0.843***	0.568***	0.260***	0.147***	0.533***	0.273***
		(0.018)	(0.033)	(0.030)	(0.025)	(0.032)	(0.028)
	Large	0.843***	0.561***	0.262***	0.125***	0.623***	0.391***
		(0.018)	(0.033)	(0.031)	(0.024)	(0.039)	(0.049)
$Export_{t-1}$	SME	0.001***	0.001***	0.003***	0.002***	0.001***	0.001***
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Large	-0.000	-0.000	-0.002	0.001	0.001	0.000
		(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.001)
$Import_{t-1}$	SME	0.000*	0.001***	0.001***	0.001**	0.000*	0.000**
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
	Large	-0.000	-0.000	-0.001	-0.001	0.000	0.000
		(0.000)	(0.000)	(0.001)	(0.001)	(0.000)	(0.000)
Mark up_{t-1}	SME		0.412***		0.518***		0.376***
			(0.031)		(0.013)		(0.027)
	Large		0.140**		-0.500***		0.182***
			(0.055)		(0.111)		(0.041)
Size		-0.011	0.363***	-0.041	0.750***	-0.014	0.283***
		(0.008)	(0.061)	(0.078)	(0.040)	(0.009)	(0.050)
Age		-0.005	0.004	0.001	0.018***	-0.010**	-0.002
		(0.004)	(0.005)	(0.006)	(0.007)	(0.004)	(0.005)
Foreign participation		-0.000	-0.016*	-0.034***	-0.020*	0.004	-0.010
		(0.005)	(0.008)	(0.010)	(0.011)	(0.005)	(0.007)
Expansive demand		0.010**	0.006	0.042***	0.020***	0.014***	0.008**
		(0.005)	(0.004)	(0.009)	(0.007)	(0.004)	(0.004)
Market share		-0.001	-0.013***	0.006	-0.019***	-0.002	-0.013***
		(0.004)	(0.004)	(0.008)	(0.007)	(0.005)	(0.004)
$R\&D_{t-1}$		0.002	0.003	0.021**	0.009	-0.005	-0.003
		(0.005)	(0.005)	(0.008)	(0.008)	(0.005)	(0.005)
Skill labour		0.000**	-0.000	0.001**	0.000	0.000*	-0.000
		(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
TFP Pre-sample Mean	SME					0.430***	0.502***
						(0.030)	(0.034)
	Large					0.341***	0.378***
						(0.039)	(0.050)
		N. observations: 9,252 N. firms: 2,144		N. observations: 8,315 N. firms: 1,879		N. observations: 9,251 N. firms: 2,143	

Notes:

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

Table 7. Effect of Export and Import yes/no decisions on Mark-ups.

		Panel data random effects	Panel data with correlated effects
Variables		**Markup**	**Markup**
Markup$_{t-1}$	SME	0.722***	0.446***
		(0.028)	(0.035)
	Large	0.833***	0.479***
		(0.067)	(0.052)
Export$_{t-1}$	SME	0.015**	0.020***
		(0.007)	(0.008)
	Large	-0.014	0.011
		(0.018)	(0.015)
Import$_{t-1}$	SME	0.010*	0.009*
		(0.006)	(0.005)
	Large	-0.005	-0.000
		(0.007)	(0.007)
Size$_{t-1}$		0.028	0.006
		(0.027)	(0.020)
		N. observations: 9,036	N. observations: 9,033
		N. firms: 2,098	N. firms: 2,096

Table 8. Effect of Export and Import strategies on the variation in output prices (in %)

		Dummy variables	Intensity variables
Variables		**% Var. output prices**	**% Var. output prices**
Export$_{t-1}$	SME	0.353***	0.017***
		(0.131)	(0.006)
	Large	0.108	0.011
		(0.435)	(0.019)
Import$_{t-1}$	SME	0.328**	0.014**
		(0.131)	(0.006)
	Large	-0.535*	-0.024**
		(0.284)	(0.012)
Size$_{t-1}$		0.589	-0.611***
		(0.436)	(0.222)
		N. observations: 10,759	N. observations: 10,751
		N. firms: 2,464	N. firms: 2,464

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

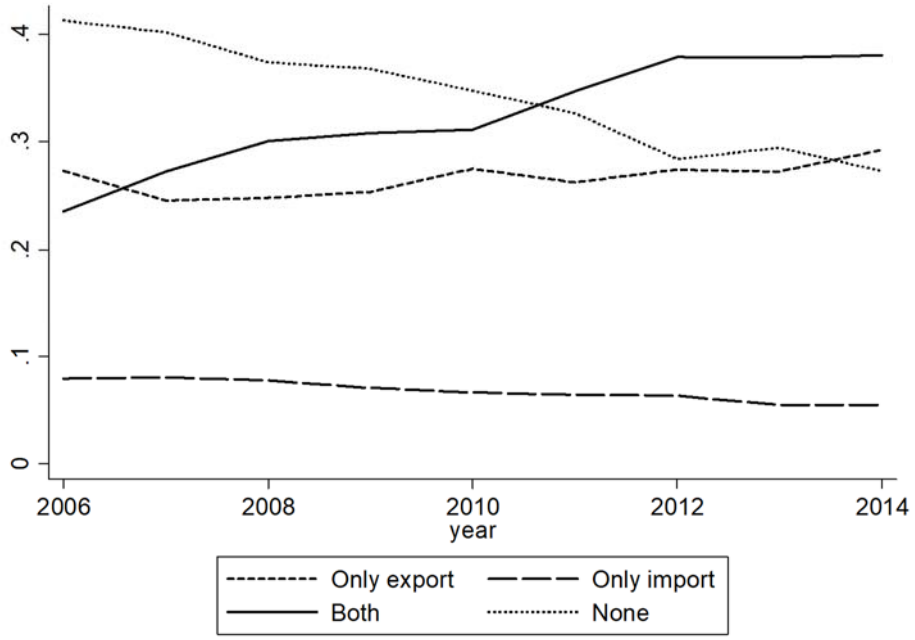

Figure 2. Evolution of the percentage of large firms exporting and/or importing, 2006-2014.

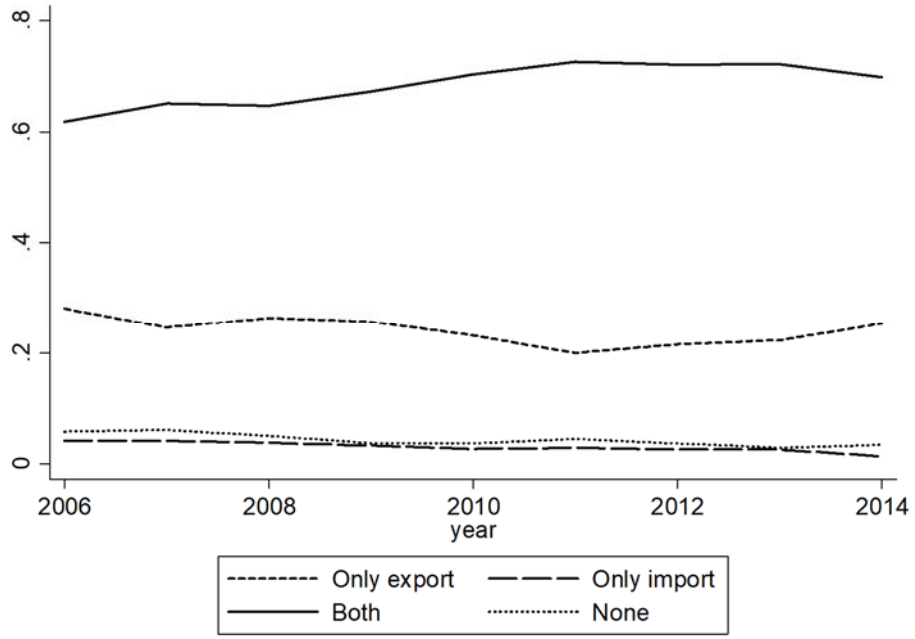

Figure 3. Evolution of TFP for SMEs and large firms, 2006-2014.

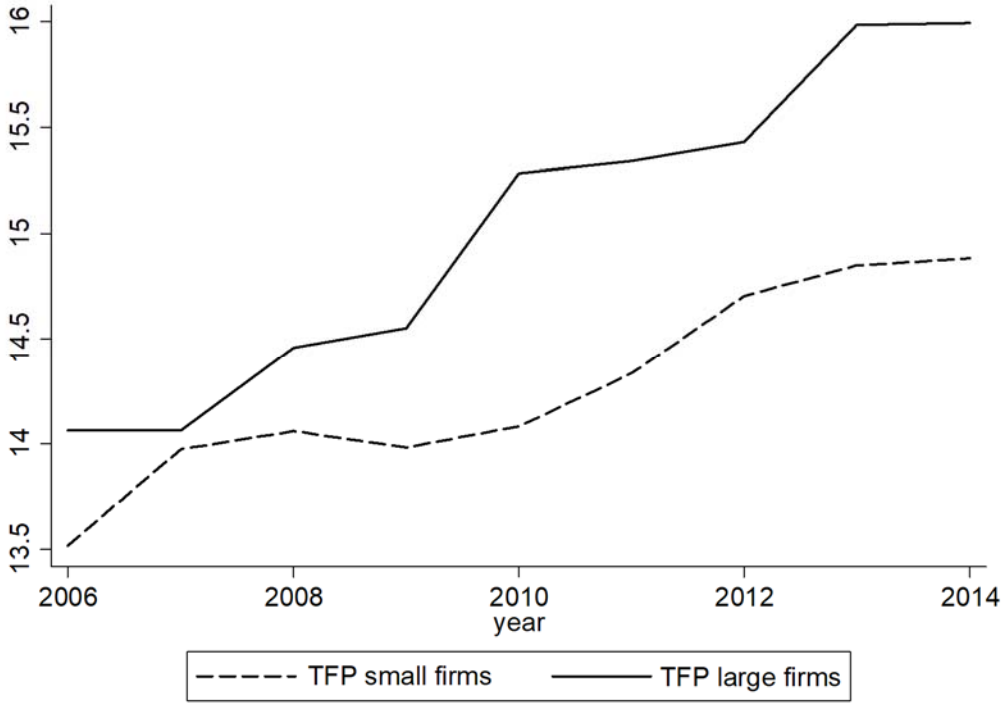

Figure 4. Evolution of Mark-ups for SMEs and large firms, 2006-2014.