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Productivity and Export Market Participation: Evidence from Colombia

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Abstract:
We study the relationship between total factor productivity (TFP) and exporting decisions for Colombian manufacturing firms during 2005–2013. We find that productivity increases a firm's probability of being an exporter, and that exporters have higher productivity, with a premium as high as 85 percent. These findings are robust to several TFP measures. Moreover, we find that not all exporters are equal: firms that export continuously, that export a greater number of products, and/or that export to a larger number of destinations tend to be more productive. We do not find, however, any relationship between productivity and the *type* of destination or exported product. Finally, we find evidence that future exporters have an ex ante productivity advantage, and (weaker) evidence of TFP increasing after a firm becomes an exporter.

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1 Overview

Total factor productivity (TFP) and access to foreign markets are usually considered to be two critical ingredients driving economic growth; see, for example, Edwards (1998) and Wacziarg and Welch (2008). In this paper, we study the relationship between firms' productivity and their export market participation decisions. Understanding the link between these two variables is critical for the study and the design of policies aimed at achieving high and sustainable economic growth in the long run.

In our analysis, we combine two firm-level datasets that allow us to observe detailed data on sales, inputs, and exports of Colombian manufacturers during the years 2005–2013. We proceed in two steps. First, we use the data on production and inputs to recover the firm's unobserved productivity, following several methodologies proposed, alternatively, by Ackerberg, Caves, and Frazer (2006), Gandhi, Navarro, and Rivers (2013), and Levinsohn and Petrin (2003). Second, we combine our estimated firm-level productivity measures with customs data on firms' exporting decisions. Specifically, we link a firm's TFP level with its corresponding exporter status, export intensity, and number and types of destination markets and goods exported.

Our findings can be summarized as follows. First, productivity appears to be strongly associated with a higher probability of a firm's being an exporter.[1] Second, and consistent with the previous finding, we find that exporters have a productivity premium (that is, higher TFP) over nonexporters: depending on the methodology used to recover productivity, the estimated average premium can be as high as 85

[1] Although the bulk of our results rely on TFP estimations following Ackerberg, Caves, and Frazer (2006), we also show that our qualitative results are robust to alternative TFP specifications.

percent. Third, we also find that there are significant differences *within* the group of exporters—for example, the premium for firms that export in every single year is above 100 percent, while for those firms that stop exporting at some point the premium is negligible (and even negative). Fourth, we show that there is a positive relationship between productivity and the *number* of export destinations, and with the *number* of products exported by the firm. Nonetheless, we do not find any relationship between the firm's productivity and the *type* of destination reached or of the good exported. Finally, we find evidence that future exporters may have higher productivity before exporting, and we find weak evidence of "learning by exporting" in the relationship between a firm's productivity and its exporter status.

The paper is related to the literature intersecting industrial organization and international trade. Methodologically, it is related to the literature on the structural estimation of production functions and unobserved total factor productivity. Our strategy for estimating firm-level productivity relies both on the *proxy* methods proposed by Olley and Pakes (1996), Levinsohn and Petrin (2003), and Ackerberg, Caves, and Frazer (2006), and on the inverse share equation method proposed by Gandhi, Navarro, and Rivers (2013). These papers provided the groundwork to recover estimated firms' unobserved productivity while correcting for the simultaneity bias.

Our paper is also related to the vast literature that explains a firm's decision to export and, particularly, to studies of the relationship between a firm's productivity and its participation in international markets. Several studies find a positive correlation between TFP and exporting status. For instance, using data from Slovenia, De Loecker (2007) finds that firms that decide to export become

more productive. Similar results are found using data from Taiwan and Korea (Aw, Chung, and Roberts 2000), data from Chile (Pavcnik 2002), and data from sub-Saharan Africa (Van Biesebroeck 2005).[2]

Finally, our paper also relates to a series of papers that have focused specifically on the Colombian manufacturing sector. In the case of Colombia, empirical evidence points in a direction similar to the findings for other countries mentioned above. Clerides, Lach, and Tybout (1998) studies the causal relationship between a firm's productivity and its export intensity, and finds that the more efficient firms self-select into being exporters. Following the model presented by Clerides, Lach, and Tybout (1998), López (2006) finds that exporters are more productive ex ante, and that the productivity of exporting firms increases with their exposure to international markets. Meléndez and Seim (2006) studies the impact of trade liberalization policies on productivity, and finds an increase in productivity for the manufacturing sector as a whole as a result of the reallocation of production toward firms in highly productive sectors and of the entry of new, more productive plants. Similarly, Echavarría, Arbeláez, and Rosales (2006) finds that total factor productivity increased with trade liberalization, since liberalization allowed for the technological progress of firms participating in foreign markets. Other studies that analyze the causes of this positive relationship between productivity and export status include Fernandes and Isgut (2005), Eslava et al. (2004), and Parra Oviedo (2003).

Despite the vast literature supporting the hypothesis of exporters' productivity premium, Rivers (2010) states that this premium depends on the estimation strategy followed to recover the unobservable productivity. Following the method-

[2]Our focus is on studies that estimate productivity at the firm level using structural models. For an extensive review of the literature on the relationship between trade and productivity with nonstructural productivity estimations, see Wagner (2007).

ology proposed by Gandhi, Navarro, and Rivers (2013), he estimates the TFP of Colombian manufacturing firms in the apparel sector for the period between 1981 and 1991, and finds that, once the simultaneity and unobserved prices biases are corrected, the difference between exporters and nonexporters is not statistically different from zero. It is worth noting, however, that his estimates cover a period previous to the trade liberalization, and that his results are specific to one manufacturing sector.

The rest of the paper is organized as follows. Section 2 describes how the data are collected and presents the basic features of our estimation sample. In Section 3 we discuss the productivity estimation. Section 4 studies the basic relationship between a firm's productivity and its decision to participate in the export market. Section 5 studies the differences within the group of exporters, in terms of the frequency with which they export, and the number and types of markets and products exported. Section 6 analyzes the timing of exporting decisions in relation to the firm's productivity path. Section 7 provides an assessment regarding openness to international trade and productivity. Section 8 concludes.

2 Data

2.1 Data Sources

In our analysis, we combine two different firm-level datasets: one contains detailed balance sheet and operational information, while the other has information on firms' foreign market participation. Next, we describe each of our two datasets.

Our data on firms' production and input consumption come from "Superintendencia de Sociedades," the agency in charge of supervising corporations. Specif-

ically, the data come from the "Sistema de Información y Riesgo Empresarial" (SIREM) database. The data are at an annual frequency and are self-reported by the firms. We have access to public information such as balance sheets, as well as to confidential data included in the annexes filed by the firms.[3] Thus, we are able to observe a great many details about each firm that are not usually available in other datasets. These variables include the income obtained from the sales of each product, the use of raw materials, investments, and the capital stock. Additionally, we observe the number of employees and the payroll, broken down by type (executive, administrative, and production workers) and tenure (permanent or temporary). We can also distinguish whether the firm is a standalone firm, an affiliate, a headquarters (HQ) with affiliates, or part of a conglomerate, and the firm's location.[4]

The data on international trade come from the customs agency (DIAN), and the department of statistics (DANE). We access the data through a system called "Serankua" at the Banco de la República. These data, which we aggregate to the annual level, include the exporting firm's tax identification number, the 10-digit product code (according to the Nandina classification system, based on the Harmonized System), the value exported (in U.S. dollars), and the country of destination, among other details.

2.2 Data Description

The data from SIREM include information on firms from several industries. Throughout the paper, we focus only on manufacturing firms, excluding manufacturers of

[3]We obtained access to the confidential data through the Banco de la República.

[4]The variables listed above are those we use in our empirical work. The dataset also includes several other variables, like detailed financial information, that we plan to use in future work.

coke, refined petroleum products, nuclear fuel, and basic metals (which include metals such as gold, silver, platinum, and nickel).[5] Our data cover the period 2005–2013.

Given our focus on the manufacturing sector, the first step prior to estimation was to define precisely which firms would be considered manufacturers. This step was relevant for multi-product firms that are not limited to manufacturing. In applying this definition, we took advantage of the rich data on income, reported by firms at the product level.[6] For our estimations, we consider as manufacturing firms only firms that report having positive income from manufacturing products in all the years they appear in the sample.

In the presence of multi-product manufacturing firms, the second step was to decide how to allocate each firm to a specific manufacturing sector.[7] Once again, we used the information on income by product, and we assigned each firm to the sector that includes the product that generated the most income throughout the sample period. Specifically, we added up the income per product (deflated) for 2005–2013, and assigned the firm to the manufacturing sector with the highest share.

With the subset of manufacturing firms clearly defined, the final step was to clean the data, given that the raw data from SIREM contains a large number of missing values and inconsistencies. The cleaning process included removing

[5]It is usual in the literature to focus on manufacturing firms since these are the ones producing noncommodity, tradable goods. We cannot consider sectors such as services and construction because (obviously) they do not have the possibility of exporting. The agricultural and mining sectors do export, but since they are commodity producers, their dynamics are probably different from those of the manufacturing firms. For this same reason, we exclude the firms classified in the two manufacturing sectors mentioned in the body of the text above.

[6]In the operational income annex, products are defined according to the ISIC classification (Revision 3.1), at the 4-digit level.

[7]By sector we mean, specifically, a 2-digit industry based on the ISIC classification. See Table 1 for the description of all manufacturing sectors considered. In the paper we use the terms 'sector' and 'industry' interchangeably.

observations with exorbitant annual growth rates (perhaps confusing thousands with millions of Colombian pesos, or number of employees with payroll), as well as occasional value interpolation when a particular variable was missing for a single year.[8]

Once we exclude those observations for which there were missing values for any variable, the resulting dataset contains 26,132 firm-year observations, corresponding to over 4,000 firms. This is the sample we used in all of our estimations.

Table 2 presents some basic statistics of our SIREM sample. In the first column we observe that, on average, we have around 2,900 manufacturing firms per year. The next column presents the share of firms that were exporters, which ranged from 46 to 52 percent. In the remaining columns we report, for the average firm in our sample, the income, capital stock, value of raw materials used, number of workers employed, and the share of these that were production workers. Thus, the average firm had an average annual income of 29.5 billion Colombian pesos of 2005, an average capital stock of 16 billion, used raw materials worth 12.7 billion, and employed 160 workers, of whom 55 percent were production workers.[9]

In Table 3 we present the analogous statistics, broken down by industry and averaged over time.[10] From the table it is clear that there is great heterogeneity across sectors; moreover, we find no clear relationship between a sector's average income (or number of workers) and its share of exporting firms. For instance, manufacturers of food products and beverages (ISIC 15) and motor vehicles (ISIC 34) have a similar average income, but the share of exporters is twice as large in

[8] See Appendix A for details on the data cleaning process.

[9] The values for income, capital, and raw materials are expressed in billions of Colombian pesos of 2005. Each variable was deflated using a variable-specific deflator.

[10] There are three industries for which we only have very few observations: ISIC 16 (tobacco), ISIC 30 (office and computing), and ISIC 32 (radio, television and communication equipment). In order to avoid disclosing confidential information, we do not report statistics for these industries.

the latter industry. Further, ISIC 20 (wood products) also has around a third of its firms exporting, but this is the sector with the lowest average income. In a similar fashion, sectors ISIC 15 (foods and beverages) and ISIC 21 (paper) have workforces of similar sizes, but, in the former, fewer than 30 percent of firms are exporters while, in the latter, exporters account for over 60 percent of firms—a share similar to that in ISIC 36 (furniture), an industry that hires fewer than half as many workers.

2.3 Representativeness of the Data

We now benchmark our SIREM data against data from other sources in order to evaluate its representativeness. This is particularly important given the novelty of our dataset and the fact that the data from SIREM are neither census-based nor from a random survey. Still, as we show next, we are able to capture a large share of the universe of Colombian manufacturing firms.

We compare our SIREM dataset with two alternative sources. First, we compare it with national accounts data, containing the official aggregate estimates for the manufacturing sector. Second, we compare it with the annual survey of manufactures, called EAM ("Encuesta Anual Manufacturera"), conducted by the Colombian National Administrative Department of Statistics (DANE). The EAM database contains a rich set of variables that characterize firm behavior and is, in practice, a truncated census, since all manufacturing firms above a certain threshold are obliged to respond.[11]

In Table 4 we benchmark our data against data from these two alternative

[11]The downside of EAM data, for our purposes, is that they cannot be linked to the detailed data on firm export-market participation.

data sources.[12] Given that each database contains a different set of variables, we can only compare the levels of (real) income and of permanent workers.[13] Still, these two variables are probably the most important ones for our purposes. As can be seen, with our sample we cover more than half of all manufacturing income according to the national accounts, and almost two-thirds of the production from EAM. In terms of employment, for which we can only compare our SIREM data with the EAM data, our sample covers on average over 90 percent of the permanent workers in the EAM data. Thus, based on the information contained in Table 4 we conclude that our data provide a fairly comprehensive picture of the overall Colombian manufacturing sector.

3 Productivity Estimations

The first step in estimating firm-level TFP is to estimate the firm's production function. This function relates inputs to outputs, and productivity is generally understood as a measure of output per units of inputs consumed. However, production function estimations have a fundamental difficulty: if the unobserved productivity shocks are correlated with the firm's input choices, then standard econometric techniques will yield biased estimates of the production function coefficients, affecting the resulting TFP estimates as well.

Two potential methods of controlling for this endogeneity problem are fixed

[12] In our comparisons, we use information on all manufacturing sectors (including ISIC 23 and 27, coke, refined petroleum products, and nuclear fuel, and basic metals) because there is not a one-to-one correspondence between the ISIC codes and the sector codes used in the national accounts data. Therefore, we cannot exclude only these two sectors from the industry totals. When we keep firms from these sectors, our sample increases to 26,887 observations (4,990 firms).

[13] In the case of income, we are specifically comparing the estimated value of output of the complete manufacturing sector (national accounts), the value of output (EAM), and operational income (SIREM). In all cases, the variables are expressed in billions of pesos of 2005.

effects and instrumental variables. These approaches, however, have not yielded satisfactory results (see Ackerberg et al. 2007 for a review). More recently, two alternative algorithms have been proposed. The first one, originally proposed by Olley and Pakes (1996), starts from a model of firm behavior that determines both input demand and shutdown decisions, and develops an estimator that uses a firm's (observed) input demand as a proxy for (unobserved, to the econometrician) productivity shocks. By inverting the input demand function, it is possible to express productivity as a function of only observable variables, and to control for the endogeneity in the production function. This approach is extended by Levinsohn and Petrin (2003) and by Ackerberg, Caves, and Frazer (2006). The second algorithm, proposed by Gandhi, Navarro, and Rivers (2013), uses the information implicit in the firm's optimization problem.[14] By transforming the first-order condition to express the intermediate input's revenue share as a function of capital, labor, and intermediate inputs, it is possible to estimate the underlying production function parameters while removing the productivity term from the estimation procedure.

In this paper, we follow Ackerberg, Caves, and Frazer (2006), Levinsohn and Petrin (2003), and Gandhi, Navarro, and Rivers (2013) to obtain different estimates for the firm-level TFP. For most of our empirical exercises, we use the estimations obtained under the Ackerberg, Caves, and Frazer (2006) method. We chose this method as our baseline, since it is the only one that allows us to estimate sector-specific coefficients with precision.[15] However, we repeat the main exercises using the results we obtain with all estimation methods with an aggregate specification that groups together all manufacturing sectors included in our baseline

[14]Either profit maximization or cost minimization.

[15]We are able to estimate separate production functions for all sectors, except 16, 32, 33, and 35—the smallest ones. We group sectors 29–31 in a big "machinery and equipment" sector, since we cannot always recover precise estimates for the labor coefficient for sector 31 (and sector 30 is too small to be included on its own).

estimation.[16] As we show in the following sections, the main conclusions of our paper are robust to the different productivity estimates.

In Figure 1 we plot the evolution of estimated TFP for the overall manufacturing sector (solid, black line) and for those industries with the largest number of firms (thinner, patterned lines). From the firm-level estimates, we take averages, weighing by the corresponding firm-level income, in order to obtain the aggregate measures. We then normalize the resulting estimates so that the value of the TFP index for the overall manufacturing sector equals 100 in 2005. From Figure 1 we can see that there is great heterogeneity across sectors. For instance, the TFP values for apparel (ISIC 18) were systematically above the overall value, while for other industries, like foods and beverages (ISIC 15), and chemicals (ISIC 24), the TFP values were systematically below the overall level. Further, the values for rubber and plastic products (ISIC 25) were very close to the aggregate level throughout our sample period, starting below the manufacturing average in 2005 but overtaking it by the end of the period.

Before we turn to our analysis of exporting decisions, we want to make a couple of remarks regarding our productivity estimates. First, since we do not observe physical units of outputs or inputs, our productivity measure is actually what is often referred to as "revenue productivity." Although it cannot be directly interpreted as the physical productivity that often comes to mind (that is, how many shirts a firm can produce with a given amount of cloth, hours of labor, and machinery), it is still a measure of a firm's performance. Second, some of our estimations use value added as the measure of output in the production function (namely, when using Ackerberg, Caves, and Frazer's and one version of Levinsohn

[16] In the case of Levinsohn and Petrin's method we estimate the TFP twice, using both gross output and value added as our measure of output in the production function.

and Petrin's methods). As documented by Gandhi, Navarro, and Rivers (2013), when the production function coefficients are estimated with a value-added specification, the heterogeneity of productivity will be overstated.[17] In this sense, part of the heterogeneity observed in Figure 1 (and in the results presented in the following sections) may be the result of our methodological choice.

We now turn our analysis to a firm's export market decisions, and how these are related to its productivity level.

4 Export Market Participation

In this section, we use the TFP measures just estimated to assess the relationship between a firm's productivity and its exporting decisions. As mentioned in the introduction, there is a vast literature that finds that exporters are indeed more productive than nonexporters. This fact can be rationalized within the context of a Melitz model of international trade, where heterogeneous firms select themselves into international markets: only those firms that are sufficiently productive expect to export an amount large enough to cover the fixed costs entailed in accessing foreign markets. Formally, it is assumed that the profits of exporting (π_x) are increasing in productivity (ω), so firm i will export if its productivity is above a certain threshold $\hat{\omega}$ defined as

$$\hat{\omega} : \pi_x(\omega) - f_x = 0, \tag{1}$$

[17] In a value-added specification, we control for the variation of *some* inputs (K and L), but part of the observed output heterogeneity across firms will be the mechanical result of including (heterogeneous) intermediate inputs on the left-hand side of the production function.

where f_x is the fixed cost of exporting. Thus, the most productive firms self-select into the export market.

Therefore, a good starting point to check the reliability of our results so far, is to look for any systematic differences between the exporting firms and the nonexporting firms. This is what we do next.

4.1 Are Exporters Any Different?

Before starting our analysis of firm productivity and export status, we briefly consider whether exporting firms are systematically different from nonexporters. That is, we compare both types of firms across several key variables.

In particular, we follow Bernard and Jensen (1999) and run the following type of regressions:

$$X_{it} = \beta_0 + \beta_1 EXP_{it} + Industry + Year + \epsilon_{it}, \tag{2}$$

where X measures, alternatively, (log of) value-added per worker, wages (payroll) per worker, income per worker, capital per worker, and investment per worker; whereas EXP_{it} is a dummy variable that takes a value of 1 if firm i exports in year t and zero otherwise.

The results are presented in Table 5. From the table it is clear that, in line with the literature, the exporting firms in our data are larger and more capital intensive than nonexporting firms. For instance, we find that exporters pay wages 30 percent higher than nonexporters, and their value added and income per worker are, respectively, 41 and 36 percent higher than those of nonexporters. Likewise, exporters' capital and investment per worker are 35 and 45 percent higher than nonexporters.'

The findings from Table 5 suggest that, indeed, exporters are very different from nonexporters along several firm characteristics—although all of these variables are choice variables from the firm's perspective. Thus, in the next subsection, we focus on the productivity of the exporters relative to the nonexporters—the so-called exporters' productivity premium.

4.2 Exporters' Premium: Informal Evidence

In Figure 2 we plot the evolution of the ratio of average TFP for exporters to average TFP of nonexporters, aggregated for the manufacturing firms in our sample, over the period 2005–2013.[18] This ratio is equal to the exporters' productivity premium plus one. From the figure, it is clear that exporters have a higher level of productivity than nonexporters. Indeed, we find that, over the period considered, exporters were between 1.4 and 2.2 times as productive as nonexporters, with the premium averaging 85 percent.[19]

In Figure 3, we exploit the cross-sectoral variation of our data, plotting the exporters' TFP to nonexporters' TFP ratio across the various 2-digit manufacturing industries, after averaging over years. Interestingly, we find a very large degree of heterogeneity. While exporters are almost twice as productive as nonexporters in industries like the manufacture of apparel (ISIC 18), exporters are only slightly more productive than nonexporters in the case of manufacturing of foods and beverages (ISIC 15) and of rubber and plastic products (ISIC 25), and they

[18] We use weighted averages to aggregate from the firm level. The results are qualitatively similar if we use simple averages instead.

[19] These findings are in contrast to those of Rivers (2010), who looks at Colombian data for 1981–1991 and finds, after estimating a gross output production function, an average TFP premium of 5 percent. However, the results are not strictly comparable due to differences in the time frames considered and in the methodologies employed in the two papers. See Section 4.4.1 for a detailed comparison across different methodologies.

are actually less productive than nonexporters in sectors like the publishing and printing of recorded media (ISIC 22) or the manufacture of motor vehicles (ISIC 34).

Based on the evidence presented in Figures 2 and 3 and consistent with the vast majority of the literature, we find that exporters are (unconditionally) associated with higher levels of productivity, but that there is substantial variation across sectors. Next, we examine this relationship in a more rigorous way.

4.3 Baseline Specification

In order to study in a more formal fashion the relationship between a firm's productivity and its exporting status, we begin by recalling the dummy variable EXP_{it}, that takes a value of one if firm i exported in year t and zero otherwise. Next, we conjecture that the probability of exporting depends, among other things, on productivity. In particular, we consider the following Probit model:

$$EXP_{it} = F\left(TFP_{it}, size_{it}, age_{it}, legal_{it}\right), \tag{3}$$

where *TFP* is the log of the productivity estimated in the previous section; *size* refers to five dummy variables (*very small, small, medium, large, very large*) resulting from assigning firms to different quintiles based on their assets; *age* is the firm's age; *legal* refers to three dummy variables, depending on whether firm i is a headquarters with affiliates, is itself an affiliate, or is part of a conglomerate. In addition, we also include year, industry, and geographical location (department) fixed effects.

The results are presented in Table 6, where the number of controls included in the specification increases from left to right. From the table it is clear that

a higher productivity level is associated with a higher probability of being an exporter: the coefficient on productivity is estimated to be positive and significant across all models considered. It is also worth mentioning that larger and/or older firms are also more likely to be exporters (a positive estimated coefficient for the size dummies and *age*). Similarly, firms that are HQ (that is, firms that have other firms as affiliates) are also more likely to be exporters. In contrast, being an affiliate or being part of a conglomerate has no statistical effect on the odds of exporting.[20]

Additionally, we estimate analogous specifications using lagged productivity values. The results are presented in Table 7, and it is clear that our findings remain practically unchanged. Moreover, in Table 8 we conduct the same exercise but including as a regressor the lagged value of the dependent variable, following the methodology proposed by Arellano and Bond (1991). Given the hysteresis that usually characterizes exporting decisions, one would expect the lagged value of the exporting dummy to be the main driver of the results—and we find that this is indeed the case. Still, from Table 8 we can see that the coefficient on productivity, while not as precisely estimated, is still positive and statistically significant.

We should emphasize that our empirical work does not imply a causal relationship between a firm's productivity and its exporting status. With this in mind, we also look at an alternative specification where we reverse the dependent and

[20]Since the TFP we use in the right-hand side is not observed but, rather, estimated in the first stage of our paper, one may be concerned about the so-called generated regressors problem (see Pagan 1984). In particular, if the standard errors from the first stage (TFP) estimation are not taken into account, one may underestimate the standard errors of the second stage. For this reason, the standard errors presented in Table 6 are obtained using a bootstrap procedure, to account for this additional variation. As expected, after this correction the standard errors are higher, but the TFP coefficients remain statistically significant. Therefore, we are confident in the results we obtain when we use our TFP estimate as a regressor.

independent variables. Specifically, we consider the following specification:

$$TFP_{it} = \beta_0 + \beta_1 EXP_{it} + size_{it} + age_{it} + legal_{it} + \epsilon_{it}, \tag{4}$$

where the variables are defined as in equation (3). Note that, in this case, we run a linear (as opposed to Probit) regression and we do not have the potential problem of a generated regressor. In fact, this specification is completely analogous to equation (2) so the coefficient β_1 estimates the productivity premium of exporting firms.

We present the results in Table 9. From the first column we see that the unconditional exporters' productivity premium is over 45 percent. As we add controls in the remaining columns, the premium is reduced to the 12–14 percent range. Still, in all cases the estimated productivity premium is estimated to be positive and statistically significant.

4.4 Robustness Checks

4.4.1 Alternative TFP Estimations

While the results presented above seem quite conclusive, they are obviously dependant on the TFP estimation of the first stage. Recall that for our baseline results, we estimated TFP using the methodology proposed by Ackerberg, Caves, and Frazer (2006) with industry-specific coefficients for the production function. As mentioned in Section 3, the use of value-added as the measure for output increases the heterogeneity of the estimated productivity across firms. This issue is particularly relevant when analyzing the exporter premium, since this is a measure of TFP dispersion between exporters and nonexporters. In order to assess how sensitive

our results are to the different production function estimation methodologies, in this subsection we repeat the exercises presented in Tables 6 and 9, replacing our baseline TFP estimations with those obtained with alternative estimation procedures. Specifically, we use the TFP estimates we obtain using the methodologies of Ackerberg, Caves, and Frazer (2006), Gandhi, Navarro, and Rivers (2013), and Levinsohn and Petrin (2003) (using both firms' income and value added), while grouping all manufacturing sectors to get common production function coefficients across industries.

Table 10 is analogous to Table 6. Consistent with our previous findings, the results presented in Table 10 imply that higher firm productivity is associated with a higher probability of the firm participating in export markets. It is worth noting that this result holds for every TFP estimation methodology, and across all our probit specifications.[21]

Table 11 is analogous to Table 9, except for the differences in the procedure employed for the TFP estimation. Interestingly, we find that there is a positive and statistically significant productivity premium for exporters across all the methodologies considered. Moreover, we also find that there are differences in the levels of the export productivity premium; as expected, the premium is generally larger when the TFP is estimated with a value-added production function than when it is estimated using a gross output (revenue) specification. In particular, we find that the estimated premium is highest when using the TFP *à la* Levinsohn and Petrin (2003) with value added (averaging 39 percent across specifications), followed by the same methodology but using firms' income instead (27 percent). In contrast, the premium is significantly lower when TFP is estimated using Ackerberg, Caves,

[21]For this table, we again bootstrap the standard errors to take into account the additional variation introduced by having our estimated TFP (a generated regressor) as an explanatory variable.

and Frazer (2006) (17 percent) and, especially, Gandhi, Navarro, and Rivers (2013) (10 percent).[22] These findings are also in line with Gandhi, Navarro, and Rivers (2013) who find a similar pattern.

We think that these findings provide very strong support to the results presented above.

4.4.2 Export Intensity

We now focus on the importance of exports in a firm's total sales. That is, instead of looking at a firm's binary decision to export vs. not to export, we look at the share of a firm's income that is derived from exports—its *export intensity*. We begin by describing how this alternative measure looks in the data and, then, we assess whether our previous findings are modified if we substitute the export dummy variable with export intensity.

In Table 12 we report the ratio of exports to total income, averaging across all exporting firms within a sector. We see that there are sectors like ISIC 35 (manufacture of other transport equipment) for which exports are almost nil, while for sectors like ISIC 21 (paper and paper products) exports account, on average, for over a third of their sales. At the same time, sectors differ greatly in the evolution of the export shares over the period between 2005 and 2013. For instance, the share of exports remained relatively unchanged for ISIC 24 (chemicals and chemical products), while it more than halved for ISIC 29 (machinery and equipment) and, after the trade collapse of 2009–2010, it grew steadily for ISIC 31 (electrical machinery).

Table 13 reports the results of conducting the same exercise as in Table 6 but

[22] It is also worth highlighting that the estimated premia (and their disparity) are significantly reduced once we control for year, sector, and size.

using export intensity as the dependent variable. As can be seen, we still find a positive coefficient for the TFP variable across all our specifications. Similarly, Table 14 is the analog of Table 9. Once again, we always find positive coefficients for export intensity. However, once we control for age, the estimates become statistically insignificant.

5 Different Types of Exporters

5.1 Frequency of Exporting

The findings from the tables just discussed are quite assertive in suggesting that firms with higher productivity are more likely to export, and that exporters are more productive than nonexporters. However, within the group of exporting firms, one can distinguish firms that are continuous exporters from those firms that have only begun to export, or those that have stopped exporting, or even those firms that export only occasionally. The rationale for exporters being more productive expressed in equation (1) is inherently static. In contrast, in our data, a firm's exporting status as well as our estimated TFP vary over time. It follows that the distinction between the different types of exporters could potentially be relevant.

With this in mind, we now introduce four distinct groups within the set of exporting firms. "Always exporter" includes those firms that export in every year of our sample. "Entrant exporters" are those firms that did not export during the first year(s) of our sample but, once they entered the export market, continued exporting for the remainder of the sample. "Exit exporters" are those firms that exported during the first year(s) of our sample, then dropped out and stayed out of the export markets. Finally, we give the name "occasional exporters" to the

remaining firms that exported in at least one year t, but did not fall into any of the previous categories.

In Table 15 we present the classification of firms into the types just described. We see that 40 percent of (1,969 firms) our sample never export, while another 30 percent (1,477 firms) export every year in the period 2005–2013. Likewise, 825 firms (17 percent) are occasional exporters, 419 firms (9 percent) are "exit exporters," and 189 firms (4 percent) are "entrant exporters."

In Figure 4 we plot the ratio of exporters' TFP to nonexporters' TFP for the different types of exporters. This ratio is equal to one plus the productivity premium of each group, relative to nonexporters. From the figure we see that there is a clear difference between the different groups of exporters. Indeed, we find that the premium of the "always exporters" is systematically above the rest (with exporters being, on average, 163 percent more productive than nonexporters), while the group of "exit exporters" actually have no premium, on average, over nonexporting firms.

In order to assess the importance of the differences, we include a dummy variable for each exporter type in our equation (4). The results are presented in Table 16. We find that the dummy variables for "always" and "occasional" are associated with higher TFP values—in contrast, the other dummy variables are most times statistically insignificant. Additionally, note that we still estimate a positive and significant productivity premium from the coefficient of the export dummy variable EXP.

Next, we run a multinomial logit regression where the dependent variable can take five possible values, depending on whether the firm is a nonexporter, or any of the four types of exporters. In order to highlight the differences between the

different types of exporters, we report the marginal effects in Table 17. From the table it is clear that higher TFP is associated with a higher probability of being an "always exporter," while it has no clear effect on the other types of exporters (except for the decrease in the odds of being an "exit exporter" under some specifications).

These findings provide strong evidence supporting the idea that the different types of exporters are indeed quite dissimilar in terms of their TFP. Next, we dissect the group of exporters along alternative criteria such as the export destinations and the products exported.

5.2 Export Destinations

Exporters also differ in the markets they reach with their exports. That is, we can expect that a firm exporting to just one foreign market may be different from another firm exporting to several dozen countries. Likewise, firms exporting to developed countries might differ from those exporting just to Colombia's neighboring countries. In this subsection, we explore precisely these issues.

In Table 18 we present the average number of export destinations by industry and year. The average exporter in our sample reached 6.1 countries. While this average appears to be fairly stable across years, it masks great cross-sector heterogeneity. For instance, firms that manufacture wood products (ISIC 20) export to, on average, 3.4 destinations. In contrast, firms that manufacture medical, precision, and optical instruments (ISIC 33) export to, on average, 14.5 countries—four times as many.

To assess the role of the number of export destinations, we adapt our equation (4) to include the number of destinations reached by the firm as an additional

control. Table 19 presents our results. From the table it is clear that there is a positive relationship between a firm's productivity and the number of foreign markets accessed. Indeed, the estimated coefficient is strongly significant across all the specifications considered. Moreover, note that the estimated productivity premium by exporting firms is (still) also precisely estimated.

Additionally, we evaluate the geographical dimension of exports by comparing the type of countries to which a firm exports. The first column of Table 20 presents the average (across years) percentage of exporters that export to a given country or region. Thus, we find that over 79 percent of the Colombian exporters reached countries in South America. At the same time, 53 percent of Colombian exporters accessed OECD (Organisation for Economic Co-operation and Development) markets. Moreover, the two countries reached by the largest fraction of exporters are neighboring Ecuador (60 percent) and Venezuela (49 percent). In the second column, we present the fraction of the total export values directed to each market and find a similar pattern. Together, these facts combined suggest that the data are consistent with a gravity argument, that is, the distribution is biased towards neighboring countries.

Finally, we check whether a firm's productivity is somewhat related to the type of countries reached by its exports. To do so, we keep those firms that export only to the OECD and those firms that export only to the Andean Community (composed of most of Colombia's closest South American neighbors). In this way, the former group exports only to developed markets, while the latter group exports only to emerging markets. In Table 21 we present the results of regressing TFP on a dummy variable that takes a value of 1 if the firm exports to the OECD and zero otherwise. As can be seen, once we introduce our usual set of controls, the

dummy variable is statistically insignificant. This finding suggests that there are no systematic differences in productivity conditional on the type of country a firm exports to.

5.3 Products Exported

In this subsection, we analyze how exporters differ in terms of the products they export. Given the richness of our data, we observe the goods exported at a high level of disaggregation, enabling us to define a product at the 10-digit level.

Table 22 presents the average number of products exported across sectors and years. The average exporting firm exported 9.8 products. As with the number of destinations, this average is stable across years but there is great heterogeneity across sectors. For instance, exporters in sector ISIC 35 (other transport equipment) export, on average, over 20 different products; in contrast, firms in sector ISIC 20 (manufacture of wood products) only export an average of 4.4 products.

Next, we adjust equation (4) to include the number of products exported as an additional control. The results are presented in Table 23. We find that the variable *Products* has a positive and significant effect across all the specifications considered. That is, the data indicate that the larger the number of products exported, the higher the firm's productivity. Additionally, note that we still find that exporters have a positive productivity premium.

Finally, we break down the exported goods into different types of goods, according to their end-use classification (CUODE, by their acronym in Spanish). Thus, we are able to distinguish whether a firm exports consumer, capital, or intermediate goods.

In Table 24 we present their corresponding shares. In the first column we

observe that almost two-thirds of the exporting firms export consumer or intermediate goods; in contrast, only 43 percent of exporters export capital goods. In terms of export value, consumer and intermediate goods have shares of 43 and 44 percent, respectively, while capital goods comprise almost 13 percent of exports.

In order to compare the productivities of firms according to the type of goods they export, we keep only those observations where firms export one type of good only. We define two dummy variables, each taking a value of 1 if the good exported is either an intermediate or a capital good, and zero otherwise. We then run TFP on these dummy variables and our usual set of controls. The results are presented in Table 25. We find that neither dummy variable is statistically significant once we add basic controls, suggesting that there is no systematic relationship between the type of good exported and the productivity of the exporting firm.

6 Timing of Productivity Differences

6.1 Productivity *After* Exporting

In this subsection we look once more at the differences in the frequency of exporting. In contrast to our previous analysis, we are particularly interested in what happens to the productivity of the "entrant exporters" before and after they enter the export market.

In a similar spirit to De Loecker and Warzynski (2012), we run the following regression

$$TFP_{it} = \beta_0 + \beta_1 Entrant_{it} + \beta_2 Exit_{it} + \beta_3 Always_i + Controls + \epsilon_{it}, \quad (5)$$

where *Entrant* is a dummy variable that takes a value of 1 if the firm becomes an

exporter and 0 otherwise, *Exit* is another dummy variable that takes a value of 1 while the firm exports and 0 once it exits, and *Always* is a dummy variable for those firms that are in the "always exporter" group.[23]

The results are presented in Table 26. As expected the coefficient on *Always* is always estimated to be positive (and significant). Interestingly, we find that the coefficient on *Entrant* is always positive, and in the first three columns statistically significant, implying that export entry is associated with significant productivity gains. However, once we control for firm size, β_1 looses all statistical significance.[24]

As an alternative way to address this issue, we compare those firms that only exported in 2013 with those firms that also exported in other years. Specifically, we run a cross-sectional Probit regression, where the estimated coefficient measures the ex post productivity advantage of those firms that were *early* exporters relative to those firms that started exporting in 2013.[25] We present the results in Table 27. As can be seen, the coefficient on productivity is in general not statistically different from zero. This suggests that exporter status does not seem to increase per se the productivity of a firm. In other words, this finding is evidence against the learning by exporting argument and moderates the findings from Table 26.

6.2 Productivity *Before* Exporting

In this subsection, we look at whether future exporters have an ex ante productivity advantage over nonexporters. That is, we study the differences in productivity between those firms that originally were not exporting and ended up becoming

[23]Following De Loecker and Warzynski (2012) we do not include the "occasional exporters" in our estimating sample.

[24]Note that β_2, the coefficient on exiting firms, behaves similarly.

[25]The analysis presented in the next two tables is analogous to that of Greenaway, Guariglia, and Kneller (2007), who study the effects of financial health variables on exporting status.

exporters by the end of our sample, and those firms that were always nonexporters during our sample period. We are interested in determining whether those firms that were to become exporters enjoyed some productivity advantage, relative to nonexporters, *before* (ex ante) they started exporting.

In Table 28 we present the results of comparing those firms that exported only in 2013 with those firms that never exported during our sample period. In particular, the regressions include those firms that did not export during 2005–2012. The dependent variable is simply $EXP_{i,2013}$, while the regressors are cross-sectional after averaging over all years except 2013.[26] Once again, we find that productivity has a positive and significant effect on the probability of exporting.

The results from Table 28 suggest that future exporters had slightly higher productivity levels than nonexporters even *before* they became exporters; this is consistent with previous findings in the literature (Bernard and Jensen 1999; Clerides, Lach, and Tybout 1998).

7 Trade Openness and Productivity Growth

In the previous sections we documented that those firms that have higher productivity are more likely to participate in foreign markets via exports. A very important policy question naturally arises: does a trade liberalization process help to increase overall TFP?[27] The answer is very important since higher aggregate

[26]Given that the number of observations is greatly reduced for this exercise (and the one in the following section), we were unable to control with department fixed effects as in the previous specifications.

[27]There are several theoretical reasons to believe that trade liberalization policies would lead to an increase in TFP. First, within a Melitz context, lower trade costs lead to an expansion of the most productive firms via intra-industry reallocation of resources. Additionally, easier access to export markets may lead to higher TFP through a learning process. Finally, trade liberalization may also make available better (foreign) technologies, thereby increasing TFP.

TFP results in higher economic growth and real wages. Economic policy cannot affect productivity directly. It can, nonetheless, affect the environment in which the firms operate, and, in particular, firms' ease of access to foreign markets. Thus, we can observe the aggregate consequences of incentivizing the most productive (exporting) firms. In this section, we provide some insights into the relationship between commercial policies and productivity growth.

In recent years, Colombia has liberalized its economy. We can observe this by looking at the declining average tariffs Colombia imposes on its imports. In Figure 5 we plot Colombian tariffs averaged over all goods (dashed, blue line) and over manufactured goods only (dotted, green line). We observe that, indeed, tariffs were reduced in the latter part of the period considered. Figure 5 also plots the TFP estimated in Section 3. Interestingly, we find that tariffs and TFP are clearly negatively related, implying that lower tariffs are associated with higher productivity levels.

A similar pattern emerges if, instead of looking at the tariffs imposed by Colombia, we look at the tariffs imposed on Colombian goods by its trading partners. In Figure 6, we plot TFP against the average foreign tariff faced by Colombian exporters of all goods (dashed, blue line) and by Colombian exporters of manufactures only (dotted, green line). Once again, we observe that lower foreign tariffs are associated with higher Colombian productivity levels.

Alternatively, instead of tariffs, we can look at the level of openness of the manufacturing sector. That is, the ratio of the value of total trade (exports plus imports) in manufacturing to the total value of manufacturing output. In Figure 7 we plot our measure of openness against TFP and find that the degree of openness is positively related to TFP, implying that as the manufacturing sector becomes

more deeply interconnected with the rest of the world, there is an increase in estimated productivity.

While by no means conclusive, these findings are consistent with the claim that the trade liberalization process resulted in an increase in the overall productivity of the manufacturing sector. Some of the possible reasons for this increase include the reallocation of resources toward the most productive firms, broader access to better technologies, and the entry of new, more productive firms. Assessing the importance of these (and other possible) causes is beyond the scope of this paper, and is left for future research.

8 Conclusion

In this paper, we study the Colombian manufacturing sector during the period 2005–2013. We combine two firm-level data sources: operational information from SIREM and customs data from DIAN and DANE. This combination allows us to estimate firm-level total factor productivity and to link it to the firm's exporting status.

We find that TFP is strongly associated with a higher probability of being an exporter. In fact, we find that exporters enjoy a productivity premium over nonexporters. We show that this finding is robust to alternative methodologies of recovering the firm's TFP. Still, we also find that there are large differences within the group of exporting firms, with those that export in every year enjoying a large premium and those that have exited foreign markets having an almost negligible premium. Moreover, we find a positive relationship between firm productivity and the number of products exported, and the number of foreign markets reached. Further, we find that future exporters have a productivity advantage even before

becoming exporters, but we find only weak evidence of learning by exporting in the relationship between productivity and exporter status. Finally, we argue that the evidence is consistent with the existence of a positive relationship between trade liberalization and TFP.

Our analysis can be extended in several directions. First, one could also assess how productivity affects the process of internationalization of a firm. That is, one could characterize the process by which a firm accesses international markets. For example, one could explore whether there is a systematic pattern regarding which and in what order foreign markets are accessed. Similarly, one could also explore whether there is a sequential order in the products a firm exports: whether firms start by exporting a single or multiple products, or whether they expand their export portfolio with new products similar to those already being exported. Finally, our work could also be extended by looking not just at exports but also at the import decisions of the firm. There is evidence that most exporting firms are also importers; however, the relationship between productivity and being an importer remains to be understood.

Appendix

A Data Cleaning

The original SIREM dataset includes over 223,000 firm-year observations for the period 2005–2013, with an average of around 25,000 firms per year. In this appendix, we describe how we cleaned the data to construct our dataset.

In order to select manufacturers, we started by looking at the data on income by product. Out of the 223,623 observations, 203,096 have data on income, and 43,068 report income from a manufactured product. As mentioned in Section 2.2, we defined as manufacturers those firms with a positive income from manufactured products for *every* year they appear in our sample. This selection criterion left us with 36,968 observations, corresponding to 5,760 firms.

Once we defined the subset of manufacturing firms clearly, we proceeded to clean the data in several steps, and we reduced our sample to those firms for which we had complete, consistent information for all the variables we need for our TFP estimation (operational income, capital stock, value of the raw materials used by each firm, and number of workers).

First, we eliminated the firms for which we had no information on capital or raw materials. (Given the way we selected manufacturing firms, we had complete information for income, by construction). We eliminated 2,456 observations corresponding to those firms that did not have information on raw materials throughout the sample, and 38 additional observations that did not have information on capital stock.

Next, we identified firms with exorbitant annual growth rates (500 percent or more) for income, capital, and/or raw materials. Firms are requested to report

these variables in thousands of pesos. However, an informal look at the database suggests that, in some cases, firms might have been mixing reporting units: sometimes they appear to have reported these variables in pesos or in millions of pesos, thereby introducing noise to our sample. By looking at firms with growth rates above this threshold, we were able to identify observations that seemed to mix reporting units. In these cases, we either multiplied or divided the reported value by 1,000 (or the appropriate number) to make it comparable to the observations for the same firms in different years. Overall, we changed 58 income observations, 147 raw materials observations, and 66 capital observations (in some cases to zero, when it was not clear how to "fix" a suspicious observation).

Next, if a firm was missing information for a single year for any of these three variables (but not all), we filled the gaps by interpolating the information of the adjacent years. We were able to approximate 382 missing values for raw materials, six for capital, and two for income.[28] Of course, this approach is not valid if we are missing values for the first or the final years of a firm. In these cases, we eliminated 2,349 observations due to missing information on raw materials, and 82 observations due to missing information on the capital stock. In addition, we dropped 323 observations for which the information gaps were longer than two years, such that we were unable to approximate the value of capital or raw materials (four were missing information for capital, and 319 were missing information for raw materials).

The calculation of growth rates for the number of employees allowed us to identify a different kind of mix-up for labor variables: in some cases, the number of employees and the value of wages seemed to be transposed. We identified 171 observations for which this seemed to be a problem, and interchanged the values

[28]The two zeros in the income series were the result of changes made in the previous step.

manually. We did this for every category (male/female, permanent/temporary, and production/administrative/executive workers). For some of these 171 observations, we had to fix more than one labor variable.

After cleaning labor variables, we calculated the total number of employees per firm-year and eliminated those observations with zero workers. We did not attempt to fill one-year gaps by interpolating this variable, since we do not have a clear way of distributing employees into the different categories used in our estimations. In this step, we eliminated 4,813 observations.

In addition to these fixes, we identified eight firms with inexplicably high growth rates for some variable, but for which it was not clear that there is a problem with the reporting unit, nor it was clear how to properly interpolate to obtain plausible values for all variables. We dropped the corresponding 18 observations.

This cleaning process left us with 26,889 observations, corresponding to 4,990 firms. If we eliminate all the observations from firms classified as manufacturers of coke, refined petroleum products, and nuclear fuel (ISIC 23), or as manufacturers of basic metals (ISIC 27), we are left with 26,132 observations, corresponding to 4,879 firms. This is the sample we use throughout the paper for our estimations.

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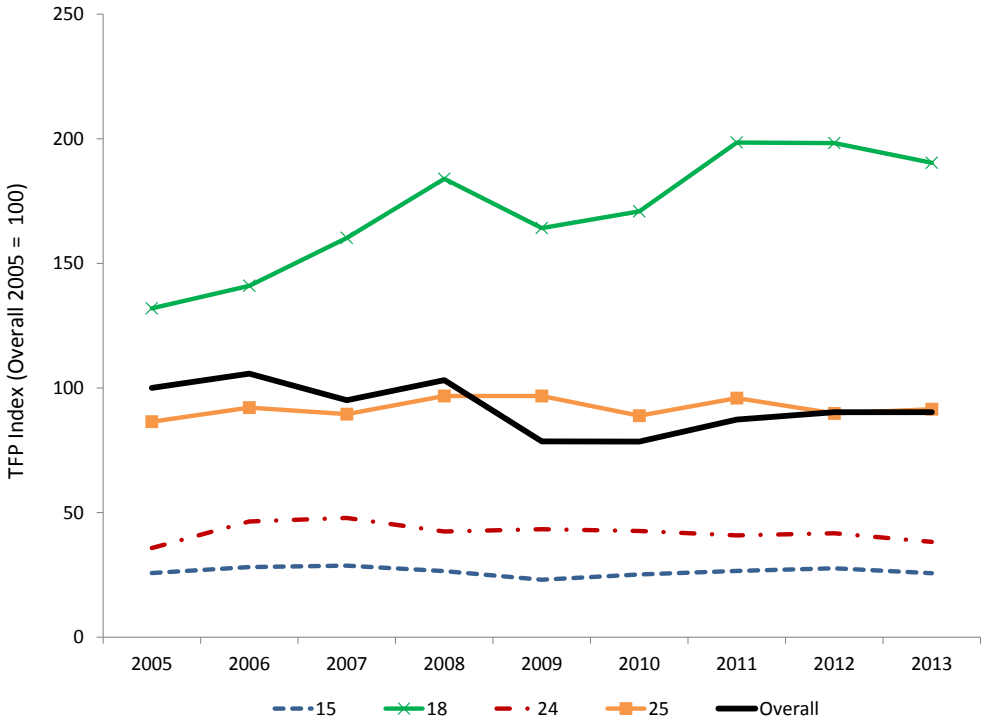
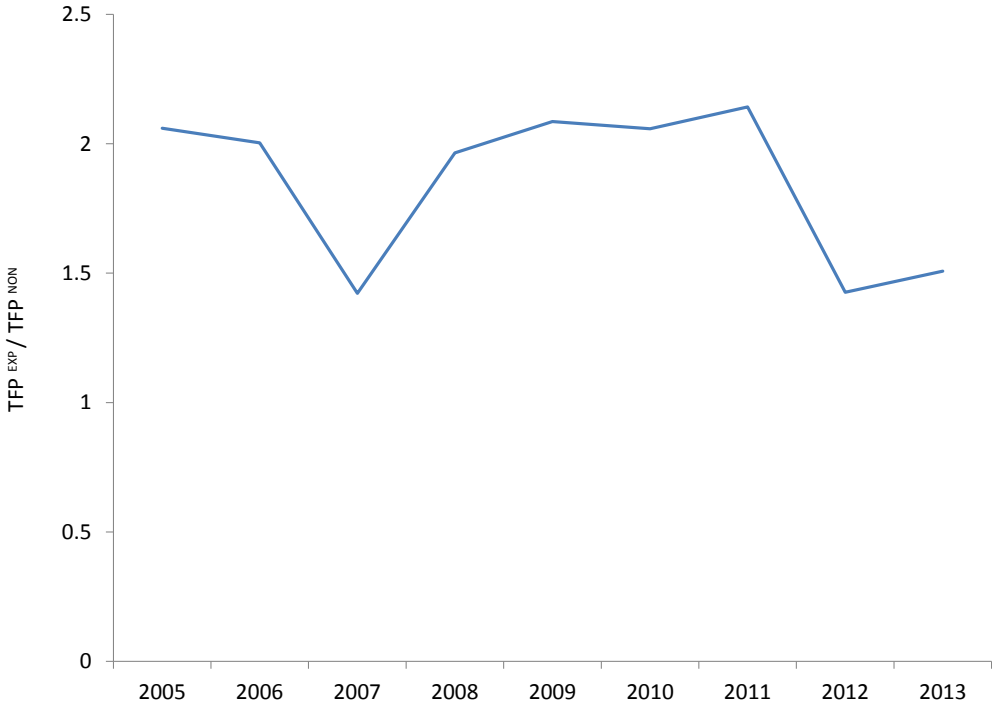
Figure 1: TFP: Overall Manufacturing and Selected Industries



Source: Authors' calculations based on data from SIREM.

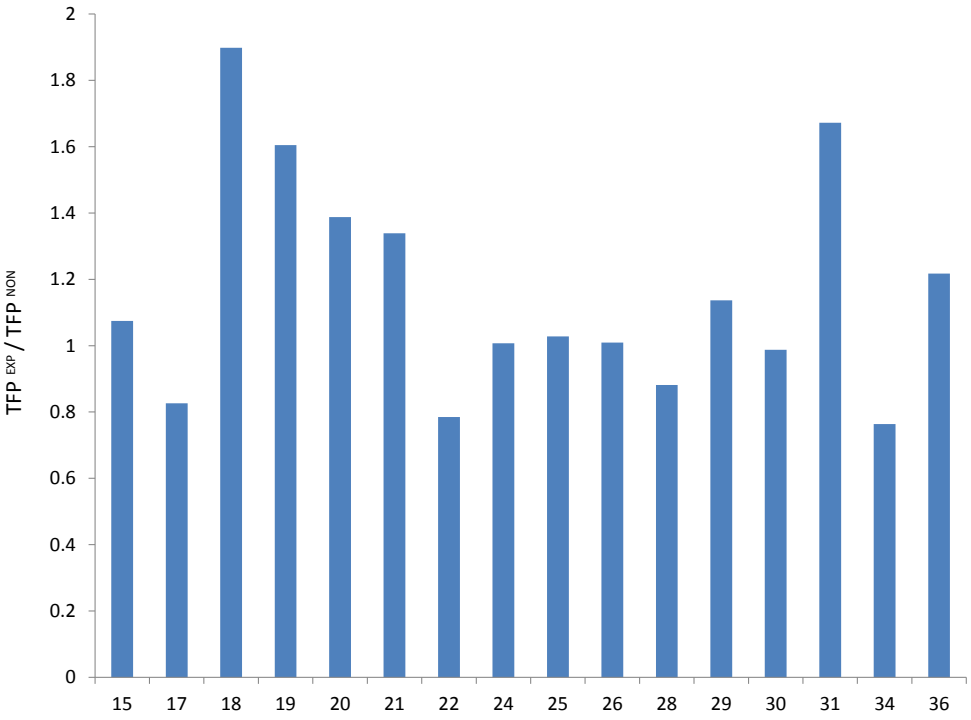
Notes: The graph plots the estimated TFP following the methodology of Ackerberg, Caves, and Frazer (2006). The thick, solid line measures TFP for the overall manufacturing sector. Each of the thinner lines plots TFP for a selected industry. See Table 1 for the corresponding industry codes. The data were normalized to have the overall TFP index equal 100 in 2005 .

Figure 2: Ratio of Exporters' TFP to Nonexporters' TFP



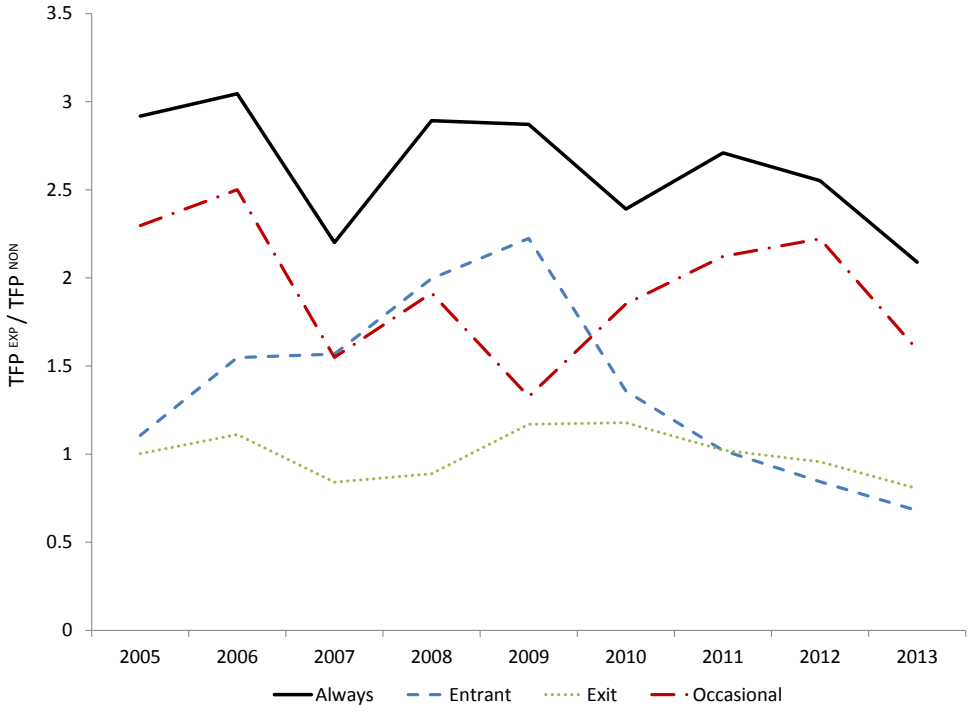
Source: Authors' calculations based on data from SIREM and DIAN/DANE.
Notes: The vertical axis measures the ratio of exporters' TFP to nonexporters' TFP, which is equal to one plus the productivity premium experienced by exporters over firms selling only in the domestic market. The data include firms from all manufacturing sectors, except ISIC 23 (manufacture of coke, refined petroleum products, and nuclear fuel) and ISIC 27 (manufacture of basic metals).

Figure 3: Ratio of Exporters' TFP to Nonexporters' TFP, by Sector



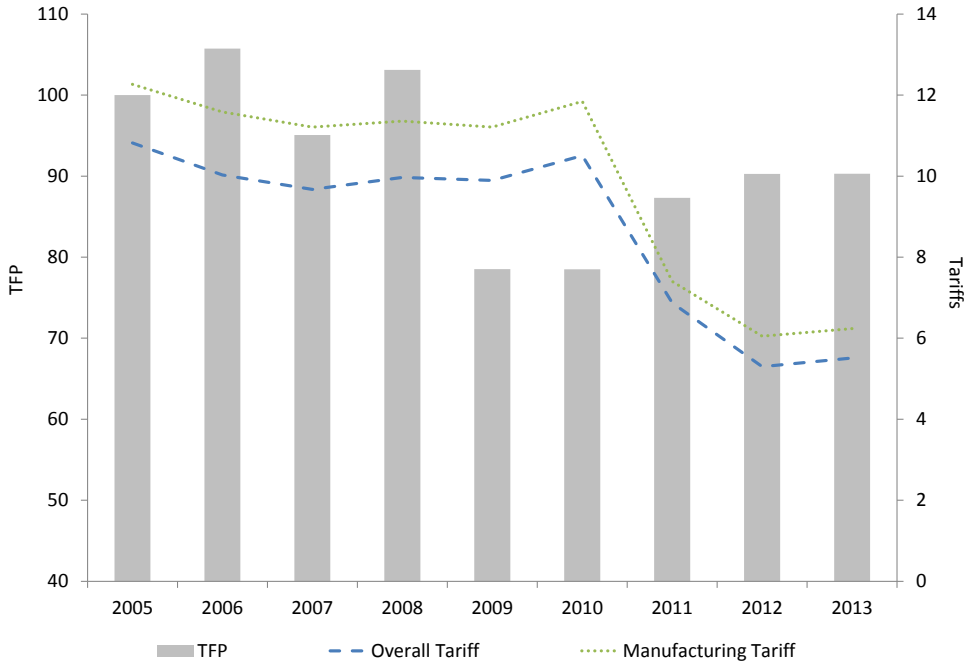
Source: Authors' calculations based on data from SIREM and DIAN/DANE.
Notes: The vertical axis measures the ratio of exporters' TFP to nonexporters' TFP, which is equal to one plus the productivity premium experienced by exporters over firms selling only in the domestic market. The horizontal axis indexes the different manufacturing sectors. The data were averaged over 2005–2013.

Figure 4: Ratio of Exporters' TFP to Nonexporters' TFP, by Type of Exporter



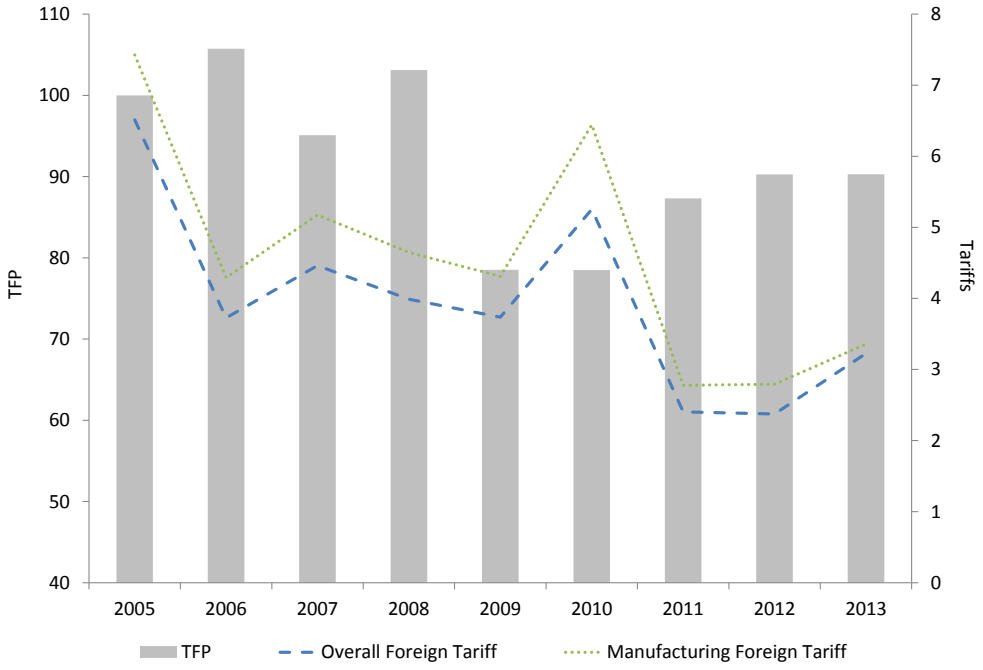
Source: Authors' calculations based on data from SIREM and DIAN/DANE.
Notes: The vertical axis measures the ratio of exporters' TFP to nonexporters' TFP, which is equal to one plus the productivity premium experienced by the different types of exporters: "always," "entrant," "exit," and "occasional." The data include firms from all manufacturing sectors, except ISIC 23 (manufacture of coke, refined petroleum products, and nuclear fuel) and ISIC 27 (manufacture of basic metals).

Figure 5: Tariffs and Productivity



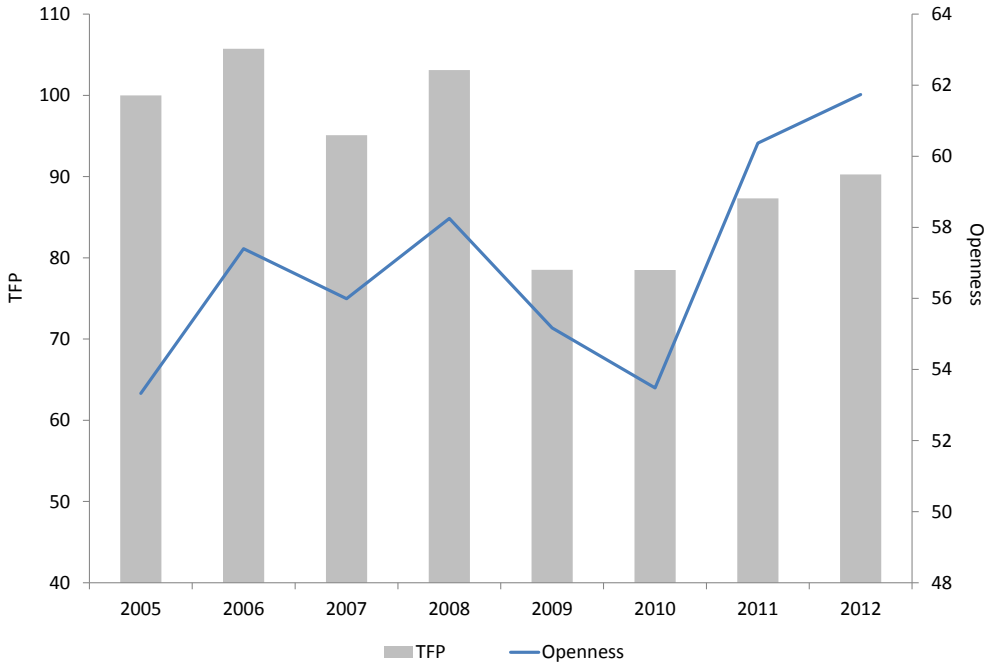
Source: Authors' calculations based on data from SIREM and TRAINS.
Notes: "TFP" stands for total factor productivity, calculated at the firm level and aggregated using firms' income as weights. "Overall Tariff" stands for the average tariff imposed on all imported goods by Colombia. "Manufacturing Tariff" refers to the average tariff imposed by Colombia on manufactured goods.

Figure 6: Foreign Tariffs and Productivity



Source: Authors' calculations based on data from SIREM and TRAINS.
Notes: "TFP" stands for total factor productivity, calculated at the firm level and aggregated using firms' income as weights. "Overall Foreign Tariff" stands for the average tariff imposed by the rest of the world on all goods exported by Colombia. "Manufacturing Foreign Tariff" refers to the average tariff imposed by the rest of the world on Colombia's exports of manufactured goods.

Figure 7: Openness and Productivity



Source: Authors' calculations based on data from SIREM and DANE.
Notes: "TFP" stands for total factor productivity calculated at the firm level and aggregated using firms' income as weights. "Openness" refers to the ratio of the value of manufacturing trade (imports plus exports) to the value of manufacturing production.

Table 1: Industry (ISIC Rev. 3.1) Codes

Code	Description
15	Manufacture of food products and beverages
16	Manufacture of tobacco products
17	Manufacture of textiles
18	Manufacture of wearing apparel; dressing and dyeing of fur
19	Tanning and dressing of leather; manufacture of luggage, handbags, saddlery, harness and footwear
20	Manufacture of wood and of products of wood and cork, except furniture; manufacture of articles of straw and plaiting materials
21	Manufacture of paper and paper products
22	Publishing, printing and reproduction of recorded media
23	Manufacture of coke, refined petroleum products and nuclear fuel
24	Manufacture of chemicals and chemical products
25	Manufacture of rubber and plastics products
26	Manufacture of other non-metallic mineral products
27	Manufacture of basic metals
28	Manufacture of fabricated metal products, except machinery and equipment
29	Manufacture of machinery and equipment n.e.c.
30	Manufacture of office, accounting and computing machinery
31	Manufacture of electrical machinery and apparatus n.e.c.
32	Manufacture of radio, television and communication equipment and apparatus
33	Manufacture of medical, precision and optical instruments, watches and clocks
34	Manufacture of motor vehicles, trailers and semi-trailers
35	Manufacture of other transport equipment
36	Manufacture of furniture; manufacturing n.e.c.

Table 2: Basic Statistics: Overall Manufacturing

	Firms (#)	Exporters (%)	Income ($)	Capital ($)	Materials ($)	All Workers (#)	Production Workers (%)
2005	2,832	51.7	25.4	11.4	11.6	146.7	58.9
2006	3,275	49.8	25.4	10.7	11.4	142.3	59.0
2007	2,860	51.1	30.1	14.6	13.3	162.3	57.9
2008	2,805	51.3	29.9	16.3	12.9	167.6	54.8
2009	3,001	48.2	26.9	15.4	11.4	150.0	54.8
2010	2,888	48.5	29.2	17.6	12.4	154.9	55.2
2011	2,979	46.1	30.2	17.9	12.7	160.3	54.3
2012	2,848	46.8	32.0	18.9	13.3	170.6	52.6
2013	2,644	48.1	35.9	21.3	14.8	179.4	51.1
Average	2,904	49.1	29.5	16.0	12.7	159.3	55.4

Source: Authors' calculations based on data from SIREM and DIAN/DANE.
Notes: Manufacturers of coke, refined petroleum products, nuclear fuel, and basic metals are not included. The sign '$' corresponds to billions of Colombian pesos of 2005.

Table 3: Basic Statistics, by Sector

Sector:	15	16	17	18	19	20	21	22	24	25
Firms (#)	500	2	154	252	76	44	61	220	349	330
Exporters (%)	27.3	-	54.8	59.9	64.3	33.1	62.0	38.3	55.6	55.0
Income ($)	50.9	-	17.8	14.0	12.2	6.7	64.0	13.9	49.4	16.9
Capital ($)	29.0	-	11.3	5.1	3.6	6.8	52.8	9.1	22.9	11.4
Raw Materials ($)	26.8	-	6.6	3.9	3.5	1.9	27.1	3.4	18.5	6.9
All Workers (#)	226.1	-	170.2	199.9	156.0	81.5	227.8	117.1	163.7	114.0
Production Workers (%)	51.7	-	71.0	59.7	62.8	65.9	57.4	36.6	39.9	64.9

Sector:	26	28	29	30	31	32	33	34	35	36
Firms (#)	137	239	94	3	53	2	15	105	11	257
Exporters (%)	38.8	49.4	69.4	-	63.0	-	51.4	66.2	56.2	53.1
Income ($)	30.2	17.1	20.0	-	30.6	-	8.4	51.8	161.3	14.4
Capital ($)	34.7	9.0	7.8	-	11.5	-	7.3	10.8	25.2	5.8
Materials ($)	8.4	9.3	8.3	-	11.5	-	2.4	26.6	53.1	6.3
All Workers (#)	165.7	100.5	152.1	-	173.9	-	108.6	181.9	489.4	102.5
Production Workers (%)	64.3	63.1	64.5	-	50.4	-	66.8	69.0	45.9	56.2

Source: Authors' calculations based on data from SIREM and DIAN/DANE.
Notes: The sign '$' corresponds to billions of Colombian pesos of 2005.

Table 4: SIREM vs. Alternative Data Sources

	Income			Permanent Workers	
	Sample ($)	% Nat. Acc.	% EAM	Sample (#)	% EAM
2005	75,560.3	49.6%	64.0%	281,992	86.2%
2006	87,711.6	54.0%	68.7%	319,693	96.0%
2007	89,467.9	51.4%	65.7%	339,697	97.4%
2008	90,213.1	51.5%	66.9%	340,276	93.6%
2009	86,234.3	51.8%	65.5%	335,443	90.9%
2010	90,680.9	53.1%	65.6%	320,843	84.8%
2011	97,606.7	54.2%	59.9%	342,733	88.8%
2012	98,048.3	54.2%	60.8%	370,510	95.7%

Source: Authors' calculations based on data from SIREM and DIAN/DANE.
Notes: In order to have comparable samples, data include firms manufacturing coke, refined petroleum products, nuclear fuel and basic metals. The sign '$' corresponds to billions of Colombian pesos of 2005.

Table 5: Differences between Exporters and Nonexporters

	Wage	Value-added	Income	Capital	Investment
EXP	0.302***	0.414***	0.359***	0.353***	0.452***
	(0.0156)	(0.0218)	(0.0239)	(0.0324)	(0.0346)
Observations	25,981	26,044	26,132	26,132	25,092

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively. The dependent variables are measured in billions of Colombian pesos of 2005 per worker. All specifications include controls of year and sector.

Table 6: Exporter Status and Productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Productivity	0.2649***	0.2645***	0.2271***	0.1352***	0.1681***	0.1673***	0.1573***
	(0.0081)	(0.0116)	(0.0089)	(0.0128)	(0.0131)	(0.0130)	(0.0131)
Small			0.5536***	0.6244***	0.5942***	0.5958***	0.6081***
			(0.0274)	(0.0288)	(0.0291)	(0.0292)	(0.0293)
Medium			0.8733***	0.9973***	0.9322***	0.9350***	0.9537***
			(0.0265)	(0.0281)	(0.0284)	(0.0284)	(0.0287)
Large			1.1889***	1.3632***	1.2588***	1.2611***	1.2936***
			(0.0273)	(0.0288)	(0.0296)	(0.0296)	(0.0304)
Very Large			1.6100***	1.9280***	1.7463***	1.7422***	1.7925***
			(0.0304)	(0.0340)	(0.0353)	(0.0377)	(0.0385)
Age					0.0121***	0.0119***	0.0102***
					(0.0007)	(0.0007)	(0.0007)
HQ						0.2515***	0.2322***
						(0.0429)	(0.0442)
Conglomerate						-0.0904	-0.0718
						(0.0399)	(0.0403)
Affiliate						-0.0094	0.0132
						(0.0352)	(0.0358)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	25,782	25,782	25,781	25,782	25,782	25,782	25,675

Notes: Bootstrapped standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 7: Exporter Status and Lagged Productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Productivity$_{t-1}$	0.260***	0.259***	0.245***	0.111***	0.145***	0.144***	0.130***
	(0.0189)	(0.0189)	(0.0255)	(0.0271)	(0.0276)	(0.0275)	(0.0275)
Small				0.616***	0.588***	0.590***	0.601***
				(0.0588)	(0.0591)	(0.0592)	(0.0595)
Medium				0.986***	0.925***	0.927***	0.949***
				(0.0619)	(0.0627)	(0.0627)	(0.0630)
Large				1.367***	1.267***	1.262***	1.292***
				(0.0644)	(0.0654)	(0.0658)	(0.0665)
Very Large				1.939***	1.761***	1.731***	1.781***
				(0.0738)	(0.0774)	(0.0814)	(0.0839)
Age					0.0121***	0.0118***	0.00986***
					(0.0016)	(0.0016)	(0.0017)
HQ						0.295***	0.273***
						(0.0833)	(0.0846)
Conglomerate						-0.0334	-0.0072
						(0.0825)	(0.0828)
Affiliate						0.0178	0.0385
						(0.0816)	(0.0819)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	19,446	19,446	19,446	19,446	19,446	19,446	19,365

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 8: Productivity and Exporter Status: Arellano Bond

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EXP_{t-1}	0.236***	0.224***	0.222***	0.220***	0.220***	0.220***	0.219***
	(0.0315)	(0.0271)	(0.0272)	(0.0272)	(0.0272)	(0.0272)	(0.0273)
$Productivity_t$	0.0161**	0.0102	0.0101	0.0119*	0.0119*	0.0120*	0.0113
	(0.0070)	(0.0069)	(0.0069)	(0.0071)	(0.0071)	(0.0071)	(0.0071)
Small			0.0118	0.0109	0.0109	0.0109	0.0129
			(0.0161)	(0.0163)	(0.0163)	(0.0163)	(0.0164)
Medium			0.0373	0.0368	0.0368	0.037	0.0413*
			(0.0247)	(0.0247)	(0.0247)	(0.0247)	(0.0248)
Large			0.0331	0.0342	0.0342	0.0341	0.0407
			(0.0294)	(0.0295)	(0.0295)	(0.0295)	(0.0297)
Very Large			0.0311	0.032	0.032	0.0314	0.0378
			(0.0336)	(0.0337)	(0.0337)	(0.0337)	(0.0340)
Age					0.0144***	0.0143***	0.0169***
					(0.0014)	(0.0014)	(0.0019)
HQ						0.0116	0.012
						(0.0157)	(0.0159)
Conglomerate						0.0162	0.0155
						(0.0180)	(0.0183)
Affiliate						0.00224	0.00319
						(0.0151)	(0.0152)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	14,665	14,665	14,665	14,665	14,665	14,665	14,561

Notes: Robust standard errors in parenthesis. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 9: Exporter Status and Productivity Premium

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EXP	0.454***	0.454***	0.225***	0.116***	0.141***	0.140***	0.129***
	(0.0275)	(0.0275)	(0.0181)	(0.0193)	(0.0192)	(0.0191)	(0.0190)
Small				0.198***	0.208***	0.207***	0.207***
				(0.0254)	(0.0251)	(0.0251)	(0.0249)
Medium				0.275***	0.306***	0.304***	0.300***
				(0.0275)	(0.0273)	(0.0273)	(0.0272)
Large				0.298***	0.355***	0.347***	0.351***
				(0.0291)	(0.0295)	(0.0297)	(0.0298)
Very Large				0.377***	0.489***	0.459***	0.470***
				(0.0336)	(0.0358)	(0.0380)	(0.0386)
Age					-0.00811***	-0.00811***	-0.00861***
					(0.0007)	(0.0007)	(0.0007)
HQ						0.0565	0.0658*
						(0.0385)	(0.0383)
Conglomerate						-0.0293	-0.0299
						(0.0345)	(0.0341)
Affiliate						0.0886**	0.103***
						(0.0366)	(0.0367)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	25,781	25,781	25,781	25,781	25,781	25,781	25,703

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 10: Exporter Status and Productivity - Alternative Methodologies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ACF	0.2554***	0.2546***	0.2029***	0.1275***	0.1592***	0.1585***	0.1483***
	(0.0113)	(0.0113)	(0.0108)	(0.0126)	(0.0127)	(0.0127)	(0.0127)
GNR	0.2706***	0.2677***	0.2577***	0.1143***	0.1542***	0.1516***	0.1371***
	(0.0137)	(0.0138)	(0.0146)	(0.0154)	(0.0154)	(0.0155)	(0.0157)
LP (GO)	0.6895***	0.7010***	0.8164***	0.2643***	0.2816***	0.2810***	0.2776***
	(0.0137)	(0.0138)	(0.0156)	(0.0203)	(0.0204)	(0.0205)	(0.0207)
LP (VA)	0.5782***	0.5833***	0.6205***	0.2527***	0.2708***	0.2701***	0.2595***
	(0.0111)	(0.0112)	(0.0122)	(0.0142)	(0.0143)	(0.0143)	(0.0144)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x

Notes: Bootstrapped standard errors in parenthesis. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively. For the estimations that follow Levinsohn and Petrin's methodology, 'GO' denotes the use of gross output as our measure of production, while 'VA' denotes the use of value-added.

Table 11: Exporter Status and Productivity Premium - Alternative Methodologies

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
ACF	0.229***	0.228***	0.179***	0.115***	0.141***	0.140***	0.129***
	(0.0182)	(0.0183)	(0.0185)	(0.0201)	(0.0200)	(0.0200)	(0.0198)
GNR	0.151***	0.148***	0.138***	0.0591***	0.0795***	0.0782***	0.0704***
	(0.0152)	(0.0152)	(0.0151)	(0.0165)	(0.0164)	(0.0164)	(0.0163)
LP (GO)	0.483***	0.486***	0.532***	0.0892***	0.0944***	0.0932***	0.0916***
	(0.0178)	(0.0178)	(0.0174)	(0.0123)	(0.0123)	(0.0123)	(0.0124)
LP (VA)	0.657***	0.660***	0.681***	0.182***	0.193***	0.192***	0.181***
	(0.0221)	(0.0221)	(0.0223)	(0.0174)	(0.0173)	(0.0173)	(0.0172)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x

Notes: Standard errors (in parenthesis) clustered by firm. ***, ** and * refer to statistical significance at the 1%, 5%, and 10% levels, respectively. For the estimations that follow Levinsohn and Petrin's methodology, 'GO' denotes the use of gross output as our measure of production, while 'VA' denotes the use of value-added.

Table 12: Share of Exports in Total Sales of Exporting Firms (%)

Sector	2005	2006	2007	2008	2009	2010	2011	2012	2013
15	14.1	13.2	12.6	13.4	9.7	9.3	9.4	9.5	9.5
17	24.4	21.1	25.0	30.3	27.0	19.8	21.0	20.7	19.7
18	42.7	40.4	35.2	36.9	25.1	22.1	19.5	17.5	14.5
19	26.1	27.4	32.1	23.3	16.5	15.6	11.0	14.0	11.0
20	24.9	21.1	17.5	15.5	16.8	13.8	7.8	10.4	10.6
21	37.1	41.1	38.6	38.0	41.3	32.7	36.5	21.4	19.0
22	14.7	12.5	11.7	12.6	11.7	7.9	8.2	5.9	5.2
24	18.9	18.6	17.9	19.3	19.0	19.5	20.5	20.8	22.0
25	18.5	19.8	20.1	20.6	24.7	23.4	20.7	19.6	21.3
26	15.7	14.1	11.5	10.3	11.6	9.3	13.0	17.1	11.1
28	25.3	27.7	26.3	26.4	25.2	20.0	18.9	19.0	16.5
29	27.4	25.0	28.1	26.9	22.4	15.3	14.0	15.3	12.4
31	19.3	20.4	29.6	21.3	28.0	9.5	12.4	15.9	24.3
33	33.9	35.4	44.6	42.3	41.3	35.1	40.9	40.6	33.4
34	24.7	22.5	32.3	20.3	14.1	13.5	13.2	11.0	20.4
35	7.5	7.9	8.6	6.7	8.9	3.0	3.4	2.3	1.0
36	31.4	39.6	42.3	34.8	22.1	17.4	23.8	20.1	19.1
Overall	21.6	21.7	22.0	20.9	18.3	15.8	16.2	15.4	15.6

Source: Authors' calculations based on data from SIREM and DIAN/DANE.

Table 13: Export Intensity and Productivity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Productivity	0.0256***	0.0253***	0.0159***	0.0058***	0.0053***	0.0051***	0.0048***
	(0.0012)	(0.0012)	(0.0018)	(0.0018)	(0.0018)	(0.0018)	(0.00180)
Small				0.0204***	0.0209***	0.0208***	0.0211***
				(0.0030)	(0.0030)	(0.0030)	(0.00300)
Medium				0.0345***	0.0356***	0.0356***	0.0364***
				(0.0033)	(0.0034)	(0.0033)	(0.00340)
Large				0.0618***	0.0636***	0.0627***	0.0628***
				(0.0032)	(0.0034)	(0.0034)	(0.0034)
Very Large				0.1273***	0.1304***	0.126***	0.1244***
				(0.0042)	(0.0047)	(0.0051)	(0.0051)
Age					-0.0002***	-0.0002***	-0.0003***
					(0.0001)	(0.0001)	(0.0001)
HQ						0.0305***	0.0293***
						(0.0064)	(0.0065)
Conglomerate						0.0187***	-0.0162***
						(0.0058)	(0.0058)
Affiliate						0.0140***	0.0166***
						(0.0053)	(0.0054)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	25,782	25,783	25,782	25,782	25,782	25,782	25,704

Notes: Bootstrapped standard errors in parenthesis. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 14: Productivity and Export Intensity

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intensity	0.795***	0.791***	0.251***	0.0938*	0.0844	0.0805	0.0754
	(0.0854)	(0.0856)	(0.0546)	(0.0532)	(0.0530)	(0.0530)	(0.0528)
Small				0.219***	0.234***	0.232***	0.231***
				(0.0252)	(0.0250)	(0.0250)	(0.0248)
Medium				0.311***	0.348***	0.346***	0.339***
				(0.0268)	(0.0269)	(0.0269)	(0.0267)
Large				0.346***	0.412***	0.403***	0.403***
				(0.0275)	(0.0284)	(0.0286)	(0.0287)
Very Large				0.439***	0.561***	0.530***	0.538***
				(0.0324)	(0.0354)	(0.0378)	(0.0383)
Age					-0.00762***	-0.00763***	-0.00824***
					(0.0007)	(0.0007)	(0.0007)
HQ						0.0639*	0.0719*
						(0.0385)	(0.0383)
Conglomerate						-0.0311	-0.0309
						(0.0347)	(0.0343)
Affiliate						0.0875**	0.102***
						(0.0367)	(0.0367)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	25,781	25,781	25,781	25,781	25,781	25,781	25,703

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 15: Firm Distribution by Export Status

Export Status	Firms	(%)
Never	1,969	40.36%
Always	1,477	30.27%
Occasional	825	16.91%
Exit	419	8.59%
Entrant	189	3.87%
Overall	4,879	

Source: Authors' calculations based on data from DIAN/DANE.

Table 16: Productivity and Exporter Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EXP	0.131***	0.126***	0.0597***	0.0369	0.0477**	0.0481**	0.0531**
	(0.0366)	(0.0366)	(0.0227)	(0.0225)	(0.0221)	(0.0221)	(0.0219)
Always	0.469***	0.474***	0.244***	0.129***	0.152***	0.151***	0.126***
	(0.0511)	(0.0512)	(0.0325)	(0.0341)	(0.0337)	(0.0338)	(0.0336)
Occasional	0.338***	0.341***	0.149***	0.0858***	0.0898***	0.0900***	0.0827***
	(0.0472)	(0.0472)	(0.0303)	(0.0301)	(0.0297)	(0.0297)	(0.0294)
Entrant	0.286***	0.289***	0.143**	0.0787	0.0685	0.0698	0.0527
	(0.0830)	(0.0830)	(0.0591)	(0.0587)	(0.0580)	(0.0582)	(0.0576)
Exit	0.229***	0.231***	0.0454	-0.0144	-0.0143	-0.0126	-0.0163
	(0.0645)	(0.0646)	(0.0390)	(0.0393)	(0.0388)	(0.0389)	(0.0389)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	25,781	25,781	25,781	25,781	25,781	25,781	25,703

Notes: Standard errors (in parenthesis) clustered by firm. '***', ** and * refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 17: Exporter Status: Marginal Effects

	(1)	(2)	(3)	(4)	(5)	(6)
Always Exporter	0.0882***	0.0883***	0.0933***	0.0377***	0.0478***	0.0472***
	(0.0067)	(0.0067)	(0.0086)	(0.0081)	(0.0082)	(0.0082)
Entrant Exporter	0.00106	0.00109	0.00121	0.00164	0.000235	0.000351
	(0.0027)	(0.0027)	(0.0040)	(0.0041)	(0.0041)	(0.0041)
Exit Exporter	-0.00191	-0.00196	-0.0119**	-0.0105**	-0.0121**	-0.0118**
	(0.0040)	(0.0040)	(0.0047)	(0.0049)	(0.0049)	(0.0049)
Occasional Exporter	0.0134**	0.0136**	0.0079	0.0108	0.00941	0.00959
	(0.0058)	(0.0058)	(0.0072)	(0.0074)	(0.0074)	(0.0074)
Year		x	x	x	x	x
Sector			x	x	x	x
Size				x	x	x
Age					x	x
Legal						x
Observations	25,781	25,781	25,781	25,781	25,781	25,781

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 18: Average Number of Export Destinations

	2005	2006	2007	2008	2009	2010	2011	2012	2013
15	6.2	6.2	6.9	7.0	6.7	7.0	6.8	7.8	7.7
17	5.3	5.5	5.5	6.0	5.7	6.2	5.9	5.4	4.6
18	5.8	5.7	5.3	5.5	5.2	5.6	5.8	6.3	6.2
19	5.6	5.6	4.9	5.8	5.7	6.1	5.3	5.0	5.0
20	3.6	3.5	4.3	3.8	3.8	2.8	3.6	3.2	1.8
21	7.2	7.8	7.8	8.5	7.7	7.8	8.9	8.9	7.7
22	6.9	6.7	5.8	6.1	5.8	5.5	6.0	5.3	4.8
24	7.2	7.2	6.9	7.0	7.1	7.5	7.4	7.2	7.2
25	5.6	5.5	5.8	5.8	5.7	5.6	5.5	5.5	5.5
26	8.3	7.6	8.2	8.5	8.1	6.8	8.1	7.6	7.2
28	6.1	5.3	6.1	5.6	5.7	5.4	4.8	5.2	5.3
29	6.3	5.6	5.6	5.8	5.1	5.3	5.7	5.6	5.3
31	7.1	7.0	7.7	7.6	7.4	6.8	6.1	6.7	8.2
33	13.0	14.4	12.6	19.8	14.6	12.2	16.2	16.5	11.1
34	4.7	5.0	4.8	4.5	4.1	4.3	4.5	4.3	4.3
35	6.4	5.3	5.1	6.8	6.8	7.2	7.4	7.3	6.4
36	5.6	5.1	5.6	5.3	5.3	5.4	5.2	5.8	5.4
Overall	6.2	6.0	6.1	6.2	6.0	6.1	6.1	6.2	6.1

Source: Authors' calculations based on data from DIAN/DANE.

Table 19: Productivity and Exporter Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EXP	0.398***	0.397***	0.162***	0.0889***	0.108***	0.110***	0.104***
	(0.0318)	(0.0319)	(0.0204)	(0.0208)	(0.0205)	(0.0205)	(0.0203)
Destinations	0.00934**	0.00935**	0.0102***	0.00568***	0.00708***	0.00659***	0.00545***
	(0.0038)	(0.0038)	(0.0019)	(0.0021)	(0.0020)	(0.0021)	(0.0021)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	25,781	25,781	25,781	25,781	25,781	25,781	25,703

Notes: Standard errors (in parenthesis) clustered by firm. ***, ** and * refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 20: Participation by Trading Partner

	Percentage of Exporting Firms	Export Value
South America	79.3	50.7
Mercosur	53.0	26.2
CAN	66.4	21.4
Venezuela	49.2	20.1
Ecuador	59.9	12.9
Central America	57.2	7.7
OECD	53.4	34.6
USA	34.6	16.9
European Union	20.7	8.3

Source: Authors' calculations based on data from DIAN/DANE.

Table 21: Productivity and Export Destination: OECD vs. CAN

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
OECD-CAN	-0.150**	-0.160**	0.000642	0.00574	-0.0208	-0.021	-0.0111
	(0.0721)	(0.0720)	(0.0476)	(0.0478)	(0.0485)	(0.0486)	(0.0478)
Small				0.112	0.127*	0.127*	0.125*
				(0.0707)	(0.0704)	(0.0704)	(0.0685)
Medium				0.118*	0.155**	0.155**	0.145**
				(0.0714)	(0.0721)	(0.0720)	(0.0709)
Large				0.166**	0.236***	0.236***	0.234***
				(0.0757)	(0.0777)	(0.0772)	(0.0766)
Very Large				0.151*	0.271***	0.273**	0.281**
				(0.0883)	(0.0982)	(0.1100)	(0.1110)
Age					-0.00738***	-0.00737***	-0.00836***
					(0.0019)	(0.0019)	(0.0019)
HQ						0.00128	0.0428
						(0.1090)	(0.1090)
Conglomerate						0.00254	0.00296
						(0.1150)	(0.1100)
Affiliate						-0.00719	0.0455
						(0.1080)	(0.1040)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	1,909	1,909	1,909	1,909	1,909	1,909	1,905

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 22: Average Number of Products Exported

	2005	2006	2007	2008	2009	2010	2011	2012	2013
15	6.9	7.7	8.1	7.5	8.1	8.7	7.5	8.2	8.3
17	9.1	9.3	10.0	10.2	9.4	9.4	8.8	8.9	9.1
18	16.3	15.3	18.4	17.9	15.6	16.2	17.9	20.0	19.6
19	7.3	7.1	5.0	6.8	7.8	8.6	9.2	4.5	7.1
20	5.9	5.3	5.6	3.8	4.8	3.3	4.1	3.9	3.0
21	7.2	7.8	8.2	7.6	7.4	7.6	7.6	9.1	7.7
22	6.1	5.3	4.7	4.5	5.0	4.4	4.0	3.7	3.6
24	13.9	13.4	14.0	14.6	15.4	15.5	16.7	16.8	16.4
25	6.7	5.4	5.5	5.5	5.2	5.2	5.3	5.6	5.3
26	7.0	6.8	7.8	6.9	7.4	6.4	6.7	6.5	6.4
28	7.6	7.3	7.6	7.0	7.2	7.1	6.7	7.7	7.5
29	13.4	11.1	11.0	12.3	12.0	10.3	11.0	11.0	11.8
31	13.4	12.7	13.2	12.4	12.3	12.3	11.0	12.8	12.9
33	9.1	10.9	10.6	13.2	10.5	8.0	11.3	13.2	9.2
34	12.8	12.9	12.0	11.5	10.2	10.0	11.4	12.2	12.7
35	22.7	21.6	21.9	18.5	24.7	27.6	27.2	26.3	23.0
36	7.9	6.6	7.7	6.2	6.6	7.0	7.4	8.6	7.8
Overall	10.0	9.4	9.9	9.7	9.6	9.4	9.8	10.3	10.1

Source: Authors' calculations based on data from DIAN/DANE.

Table 23: Productivity and Exporter Status

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
EXP	0.371***	0.370***	0.159***	0.0740***	0.0982***	0.0988***	0.0919***
	(0.0303)	(0.0303)	(0.0198)	(0.0203)	(0.0202)	(0.0201)	(0.0198)
Products	0.00855***	0.00857***	0.00710***	0.00610***	0.00627***	0.00614***	0.00565***
	(0.0018)	(0.0018)	(0.0012)	(0.0012)	(0.0012)	(0.0012)	(0.0011)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	25,781	25,781	25,781	25,781	25,781	25,781	25,703

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 24: Participation by Type of Good

	Percentage of Exporting Firms	Export Value
Consumer goods	64.8	43.0
Intermediate goods	64.7	44.3
Capital goods	43.2	12.7

Source: Authors' calculations based on data from DIAN/DANE.

Table 25: Productivity and Types of Goods

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Intermediate goods	0.0518	0.0554	0.0384	0.0137	0.0202	0.018	0.0215
	(0.0605)	(0.0606)	(0.0391)	(0.0389)	(0.0385)	(0.0386)	(0.0380)
Capital goods	0.0985*	0.103**	0.0248	0.0112	0.0175	0.0166	0.0385
	(0.0520)	(0.0523)	(0.0489)	(0.0488)	(0.0479)	(0.0480)	(0.0480)
Small				0.119**	0.150***	0.150***	0.150***
				(0.0494)	(0.0492)	(0.0492)	(0.0480)
Medium				0.225***	0.285***	0.283***	0.265***
				(0.0516)	(0.0524)	(0.0525)	(0.0515)
Large				0.221***	0.316***	0.311***	0.306***
				(0.0520)	(0.0537)	(0.0540)	(0.0528)
Very Large				0.368***	0.501***	0.481***	0.476***
				(0.0634)	(0.0662)	(0.0688)	(0.0676)
Age					-0.00868***	-0.00868***	-0.00926***
					(0.0012)	(0.0012)	(0.0012)
HQ						0.0464	0.064
						(0.0703)	(0.0688)
Conglomerate						-0.0141	-0.0112
						(0.0619)	(0.0587)
Affiliate						0.0631	0.0864
						(0.0622)	(0.0593)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Deparment							x
Observations	6,132	6,132	6,132	6,132	6,132	6,132	6,113

Notes: Standard errors (in parenthesis) clustered by firm. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 26: Export Entry and Exit

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
Always	0.563***	0.563***	0.291***	0.169***	0.201***	0.199***	0.185***
	(0.0344)	(0.0344)	(0.0231)	(0.0261)	(0.0261)	(0.0261)	(0.0260)
Entrant	0.310***	0.318***	0.149**	0.0762	0.0869	0.0899	0.089
	(0.0919)	(0.0928)	(0.0603)	(0.0604)	(0.0587)	(0.0587)	(0.0572)
Exiting	0.350***	0.342***	0.110***	0.0348	0.037	0.0369	0.0469
	(0.0687)	(0.0696)	(0.0413)	(0.0419)	(0.0413)	(0.0413)	(0.0409)
Year		x	x	x	x	x	x
Sector			x	x	x	x	x
Size				x	x	x	x
Age					x	x	x
Legal						x	x
Department							x
Observations	20,970	20,970	20,970	20,970	20,970	20,970	20,909

Notes: Robust standard errors in parenthesis. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 27: Ex-Post Productivity Advantage

	(1)	(2)	(3)	(4)	(5)
Productivity	0.0407	0.0424	-0.0872*	-0.0148	-0.0202
	(0.0327)	(0.0354)	(0.0507)	(0.0505)	(0.0506)
Small		0.345***	0.413***	0.286***	0.283***
		(0.0997)	(0.1030)	(0.1050)	(0.1050)
Medium		0.700***	0.819***	0.574***	0.555***
		(0.1000)	(0.1050)	(0.1100)	(0.1110)
Large		1.346***	1.467***	1.169***	1.107***
		(0.1070)	(0.1120)	(0.1190)	(0.1220)
Very Large		1.662***	1.848***	1.369***	1.230***
		(0.1160)	(0.1240)	(0.1320)	(0.1410)
Age				0.0235***	0.0239***
				(0.0030)	(0.0030)
HQ					-0.159
					(0.1290)
Conglomerate					0.065
					(0.1270)
Affiliate					0.418***
					(0.1270)
Sector		x	x	x	x
Size			x	x	x
Age				x	x
Legal					x
Observations	1,642	1,642	1,638	1,638	1,638

Notes: Robust standard errors in parenthesis. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.

Table 28: Ex-ante Productivity Advantage

	(1)	(2)	(3)	(4)	(5)
Productivity	0.166***	0.197***	0.152**	0.126*	0.128*
	(0.0590)	(0.0666)	(0.0725)	(0.0719)	(0.0739)
Small			0.508*	0.535*	0.533*
			(0.2940)	(0.2930)	(0.2920)
Medium			0.773***	0.816***	0.815***
			(0.2860)	(0.2840)	(0.2860)
Large			0.496*	0.548*	0.536*
			(0.3000)	(0.2960)	(0.2960)
Very Large			0.833***	0.933***	0.923***
			(0.3050)	(0.3000)	(0.2980)
Age				-0.00834	-0.00872
				(0.0060)	(0.0060)
HQ					0.313
					(0.2130)
Conglomerate					-0.0901
					(0.2540)
Affiliate					0.00916
					(0.2240)
Sector		x	x	x	x
Size			x	x	x
Age				x	x
Legal					x
Observations	1,947	1,874	1,874	1,874	1,874

Notes: Robust standard errors in parenthesis. '***', '**' and '*' refer to statistical significance at the 1%, 5%, and 10% levels, respectively.