Exporting and Plant-Level Efficiency Gains: It's in the Measure*

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Abstract

Gains from trade due to exporting can result from the reallocation of resources to more productive producers, or from productivity increases of exporters over time ("learning by exporting"). While there is strong evidence for the former, the latter typically receives little support in the data. Previous research has documented minuscule or no efficiency gains within exporting plants. This result is derived from revenue productivity measures and thus also reflects variation in prices. Using a census panel of Chilean manufacturing, we derive product-plant level marginal cost and use it as an efficiency measure that is not affected by prices. We find that marginal costs drop substantially when plants begin to export – on average by 15-30%. However, prices drop by the same order of magnitude (while volume grows). Since exporting firms plants initially charge lower prices, revenue-productivity measures underestimate efficiency gains from exporting.

JEL: D24, F10, F14, L25, L60

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1 Introduction

While exporting plants are on average significantly more productive than their non-exporting counterparts, empirical studies typically find that new exporters do not increase their productivity over time. This suggests that selection of the most productive firms into exporting, rather than learning-by-exporting within plants, is responsible for aggregate productivity gains from trade competition. The selection effect across plants has received strong theoretical and empirical support (c.f. Melitz, 2003; Pavcnik, 2002; Bloom, Draca, and van Reenen, 2012). On the other hand, within-plant productivity gains after export entry are typically found to be small and insignificant (c.f. Clerides, Lach, and Tybout, 1998; Bernard and Jensen, 1999; Wagner, 2012).[1] This non-result is surprising, given that exporters can learn from international buyers and have access to larger markets to reap the benefits of innovation or investments in productive technology.

In this paper, we show that the missing evidence on within-plant productivity growth after export entry is an artefact of the measure: Previous studies have typically used revenue-based productivity, which is affected by changes in prices. If gains in physical productivity are passed on to buyers in the form of lower prices, then revenue-based productivity will be downward biased. However, measuring physical productivity directly is difficult. For example, changes in product quality make physical units of output incomparable – even within products from given plants. Thus, meaningful results can only be derived for physically homogenous products (Foster, Haltiwanger, and Syverson, 2008) – a small subset of all exported goods. To bypass this issue, we first apply the method pioneered by De Loecker and Warzynski (2012) to derive plant-product level markups in a rich panel of Chilean establishments. Second, because our dataset comprises physical units as well as revenues for each product-plant pair, we can calculate product prices (unit values). Finally, dividing these by the corresponding markups allows us to identify marginal costs. This procedure is flexible with respect to the underlying price setting model and the functional form of the production function (e.g., allowing for different degrees of returns to scale).[2] In standard production functions, marginal costs (MC) are directly (inversely) related to physical productivity, and are thus a good candidate for analyzing the within-firm effects of exporting on quantity productivity.

We find that gains from exporting are substantial: Marginal costs within plant-product categories drop by approximately 15-30% during the first three years after export entry. At the same time, in line with previous findings, *revenue* productivity does not change within exporting plants.

[1]The exception are two articles in somewhat special empirical settings – De Loecker (2007) for Slovenia and Van Biesebroeck (2005) for sub-Saharan Africa.

[2]De Loecker, Goldberg, Khandelwal, and Pavcnik (2012) use a similar methodology to analyze how trade liberalization in India affected prices, markups, and marginal costs.

This is due to prices falling by a similar magnitude as marginal costs – new exporters pass physical productivity gains on to their customers. Our results hold for multi- and single-product plants. They are also very similar when using propensity score matching to construct a 'control group' of plant-products that had an a-priory comparable likelihood of entering the export market, but continued to be sold domestically only. Finally, we show that we obtain quantitatively similar results when using reported (average) cost measures at the plant level, suggesting that our results are not an artefact of the methodology used to calculate marginal costs.

To guide the discussion of possible drivers behind our results, we provide a stylized framework that combines the flexible supply-demand structure from Foster et al. (2008) with heterogeneous returns to technology investment as in Lileeva and Trefler (2010). We discuss four main channels that may drive export entry: (i) a shock to foreign demand, (ii) a productivity shock, (iii) learning by exporting, and (iv) investment opportunities in new technologies that become profitable in combination with access to larger markets. Since we find *falling* prices associated with export entry, demand shocks (i) are an unlikely driver. On the other hand, the supply-side mechanisms (ii)-(iv) are all in line with the empirical observation that marginal costs fall upon export entry. However, they imply different causal effects. Productivity shocks as in (ii) mean a selection effect – firms enter the export market as a consequence of higher productivity, as in Melitz (2003), and causality runs from productivity to export entry. The opposite is true in case (iii), where plants enter the export market because they anticipate learning effects. Finally, case (iv) reflects a complementarity between investment in new technology and export entry – the up-front fixed cost can only be recovered in a large-enough market.[3]

We provide some suggestive evidence that the learning-by-exporting and the complementarity effects are the most likely drivers of our results. The fact that export entry goes hand-in-hand with a steep decline in marginal costs in the same period suggests that investment complementarity may be important – since we control for pre-trends, it is unlikely that this pattern is driven by productivity shocks before export entry. In addition, the observation that marginal costs keep falling in the years after entry is in line with learning-by-exporting. However, we cannot completely disentangle the three supply mechanisms (ii)-(iv). For example, if productivity shocks (ii) are unrelated to pre-trends, and if export entry occurs immediately (in the same period as the shock), then we cannot differentiate between (ii) and (iv).[4] That being said, our main result does not depend on which exact mechanism is at play. We find that there are substantial productivity gains associated

[3]Strictly speaking, the mechanism is not causal in this case, because the investment in new technology would have risen productivity regardless of export status. However, since the investment is not profitable in the domestic market alone, export entry and productivity increases are closely associated.

[4]Similarly, if learning-by-exporting lowers marginal costs immediately after export entry, then we cannot differentiate (iii) and (iv).

with export entry, and that these gains have previously not been identified because the literature has used revenue-based productivity measures.

Why do new exporters pass on most productivity gains to customers in the form of lower prices? One explanation is that export entrants do not yet have a customer base in foreign markets. Thus, they may charge low prices to attract buyers, as implied by the model of Fishman and Rob (2003).[5] Foster, Haltiwanger, and Syverson (2012) provide evidence that supports such models of demand capital' building. They show that by selling more today, firms shift out their future demand. This reflects the expansion of buyer-supplier relationships, for example via customer learning. We document evidence that is in line with this explanation: the decline in prices for newly exported products goes hand-in-hand with a strong increase in volume (see Figure 1).[6]

Our findings relate to a substantial literature on gains from trade in general, and on within-plant productivity increases due to export entry, more specifically. Olley and Pakes (1996) paved the road for consistent plant-level production function estimates, accounting for the relationship between unobserved productivity and plant shutdown, as well as the simultaneity of productivity and input choice. The subsequent research revealed substantial heterogeneity of productivity across plants within industries, suggesting that trade-induced competition can contribute to the reallocation of resources from less to more efficient producers. Bernard, Eaton, Jensen, and Kortum (2003) and Melitz (2003) introduce the reallocation mechanism in trade theory, based on firm-level heterogeneity. The empirical evidence on this mechanism is vast, and summarizing it would go beyond the scope of this paper.[7] Wagner (2007, 2012) provides comprehensive reviews.

In contrast, another prominently discussed channel has received astonishingly little empirical support: On balance, exporting does not appear to have important effects on productivity *within* firms or plants. Such gains are expected because exporters face tougher competition, have stronger incentives to innovate since they serve a larger market, and because they have access to expertise from international buyers (Grossman and Helpman, 1991). Clerides et al. (1998, for Colombia, Mexico, and Morocco) and Bernard and Jensen (1999, using U.S. data) were the first to analyze the causal impact of exporting on plant efficiency. Both document no (or quantitatively weak)

[5]When consumers have different search costs, Fishman and Rob's (2003) model implies that low-cost firms charge low prices in order to attract more flexible (low search cost) customers who currently buy from high-price firms.

[6]While our results imply (almost) complete pass-through of productivity gains to customers in the form of lower prices, De Loecker et al. (2012) find incomplete pass-through in Indian firms after import-driven productivity increases. Since their estimates are derived for *existing* products (with an established customer base), they are compatible with ours.

[7]Two influential early papers are Bernard and Jensen (1999) and Pavcnik (2002), who analyze U.S. and Chilean plants, respectively. More recently, Eslava, Haltiwanger, Kugler, and Kugler (2013) have used Colombian data to show that a quantity-based TFP measure yields larger aggregate efficiency gains from reallocation than the usual revenue-based productivity measures.

empirical support for this effect, while reporting strong evidence for selection of productive firms into exporting. The same is true for numerous papers that followed: Aw, Chung, and Roberts (2000) for Taiwan and Korea, Alvarez and López (2005) for Chile, and Luong (2013) for Chinese automobile producers.[8] The survey article by ISGEP (2008) compiles micro level panels from 14 countries and finds nearly no evidence for within-plant productivity increases after entry into the export market. The exception are the papers by Van Biesebroeck (2005) and De Loecker (2007), which document evidence for learning-by-exporting. Both derive their results in potentially unrepresentative environments: Sub-Saharan Africa and Slovenia during its transition from communism to a market economy.[9]

The general paucity of evidence for productivity growth after export entry is in stark contrast to what case studies typically suggest. Rhee, Ross-Larson, and Pursell (1984) surveyed 112 Korean exporters, out of which 40% reported to have learned from buyers in the form of personal interactions, knowledge transfer, or product specifications and quality control. The importance of knowledge transfer from foreign buyers to exporters is also highlighted by the World Bank (1993) and Evenson and Westphal (1995). López (2005) summarizes further case study evidence that points to learning-by-exporting via foreign assistance on product design, factory layout, assembly machinery, etc. Finally, in a more systematic fashion, Bustos (2011) shows that rising export revenues – driven by exogenous changes in tariffs – foster firms' investment in new technology.

In sum, there is a striking discrepancy between case studies documenting strong micro-level evidence for export-driven productivity growth within firms or plants, and econometric studies failing to detect it. Our main contribution is suggesting a solution to this puzzle – revenue-based productivity measures will fail to detect learning-by-exporting if productivity gains are passed on to buyers in the form of lower prices. To bypass this issue, we derive product-plant-specific marginal costs under a general set of conditions following De Loecker et al. (2012) and use it as an indicator for productivity changes. This measure implies substantial gains after export entry in a panel of Chilean plants, while the same data confirm the usual non-result when using a standard revenue productivity measure. We also provide suggestive evidence for the underlying mechanism: Export entry does not affect markups, so that there is complete pass-through of productivity gains to customers. One explanation is that new exporters seek to attract customers by low prices – which is supported by our data, where the drop in price after export entry goes hand-in-hand with

[8] Alvarez and López (2005) use an earlier version of our Chilean plant panel. They conclude that "Permanent exporters are more productive than non-exporters, but this is attributable to initial productivity differences, not to productivity gains associated to exporting." [p.1395]

[9] In Van Biesebroeck's findings, exporting lifts credit constraints and thus allows sub-Saharan African firms to grow and profit from scale economies. Syverson (2011) questions whether these results reflect heterogenous treatment effects, with firms that gain most from scale economies sorting into exporting.

strong increases in quantity and a sizeable increase in revenues.

The rest of the paper is organized as follows. Section 3 illustrates our empirical framework to identify product-plant specific revenue productivity and marginal costs. Section 4 describes our dataset, and Section 5 presents our empirical results. Section 6 concludes.

2 Export Entry and Plant-Level Productivity Gains: A Stylized Framework

In this section, we provide a stylized theoretical framework that allows us to differentiate between various drivers of export entry, and their effects on prices and quantity productivity. Entry into export markets is driven by demand- and supply forces. The former reflect the size of and access to foreign markets, while firm productivity is an important factor in the latter. To differentiate between idiosyncratic technology and demand effects, we build on the framework by Foster et al. (2008). In order to further differentiate between alternative supply-side channels, we combine this setup with the model by Lileeva and Trefler (2010). In particular, export entry can be affected by initial productivity differences (as in Melitz, 2003) or by a complementarity between exporting and investment in new technology (c.f. Constantini and Melitz, 2007; Atkeson and Burstein, 2010; Bustos, 2011). In addition, anticipated learning-by-exporting will also raise the odds of export entry. Our stylized theoretical framework allows us to differentiate between these supply-side drivers, while distinguishing technology from demand effects.

Building on the quasi-linear consumer preferences with quadratic subutility in Foster et al. (2008), we derive (see Appendix 2) the profits associated with product i as a function of market size M, a demand shifter δ_i, and the marginal cost *before* export entry, $MC_{i,0}$.[10]

3 Empirical Framework

In this section, we explain the calculation of our productivity measures. Our first measure of efficiency is plant-level *revenue-based* total factor productivity (TFPR) – the standard efficiency measure in the literature that analyzes productivity gains from exporting. We discuss why this measure may fail to detect such gains, and show how we calculate TFPR at the plant level. Our second measure of efficiency is the marginal cost of production, which can be derived from plant-level production data under a set of non-restrictive assumptions following De Loecker et al. (2012). The marginal cost is directly (negatively) related to physical productivity in most production functions; we thus use it as a proxy for quantity-productivity. Finally, as a consistency check, we also use

[10]Market size M is specific to the industry pertaining to product i. It comprises several parameters related to industry output, the number of producers in the industry,

reported expenditure data to calculate average costs at the plant-product level.

3.1 Revenue and Physical Total Factor Productivity

Revenue-based total factor productivity (TFPR) is the most widely used measure for efficiency. It is calculated as the residual between total revenues and the estimated contribution of production factors (labor, capital, and material inputs).[11] This measure has an important shortcoming: it combines physical (or quantity-) productivity (TFPQ) with prices (P): $\ln(\text{TFPR}) = \ln(\text{P}) + \ln(\text{TFPQ})$. If prices are unrelated to productivity, using TFPR as a proxy for TFPQ merely introduces noise. In this case, TFPR is an unbiased proxy for physical productivity. However, when prices respond to productivity, TFPR is biased. For example, when facing downward-sloping demand, firms typically respond to efficiency gains by expanding production and reducing prices. This generates a negative correlation between prices and TFPQ, so that TFPR will underestimate physical efficiency gains.

Given these shortcomings, why has the literature not used TFPQ to analyze productivity gains from exporting? One practical caveat is the lack of information on physical quantities.[12] While some corrections to the estimation of production functions have been proposed, only a few studies have derived TFPQ directly.[13] Foster et al. (2008) obtain TFPQ, using product-level information on physical quantities from U.S. census data for a subset of manufacturing plants that produce homogeneous products.[14] They find a negative correlation between prices and TFPQ. This is consistent with more efficient businesses having lower marginal costs and, in turn, charging lower prices. As a consequence, TFPR understates true efficiency gains.

Even if quantities are known so that TFPQ can be calculated, the measure is problematic. Product quantity cannot readily be compared because quality may change. As Foster et al. (2008) recognize, it is essentially impossible to isolate changes in quality from TFPQ. This is the reason why these authors restrict their analysis to a set of homogeneous products that are arguably not sub-

[11] Some authors have used labor productivity – i.e., revenues per worker – as a proxy for efficiency (for a recent survey see Wagner, 2007, 2012). This measure is affected by the use of non-labor inputs and is thus inferior to TFP when different plants combine inputs in different proportions (see Syverson, 2011).

[12] Data on physical quantities have only recently become available for some countries (c.f. De Loecker et al., 2012; Kugler and Verhoogen, 2012, for India and Colombia, respectively).

[13] Melitz (2000) and De Loecker (2011) discuss corrections to the estimation of the production function to account for cross-sectional price heterogeneity in the context of a CES demand function. Gorodnichenko (2012) proposes an alternative procedure for estimating the production function that models the cost and the revenue functions simultaneously and accounts for unobserved heterogeneity in productivity and factor prices symmetrically. Katayama, Lu, and Tybout (2009) show that revenue-based output can lead to productivity mismeasurement and incorrect interpretations of how heterogeneous producers respond to shocks.

[14] Hsieh and Klenow (2009) also recover TFPQ using a model of monopolistic competition for India, China and the United States.

ject to significant changes in quality.[15] An additional problem emerges for multiple-product firms. Since the use of inputs is typically not disaggregated for individual products, the computation of TFPQ requires to aggregate quantities for these firms. Two practical problems prevent aggregation. First, products are usually measured in different units, and the correspondence between units are often non-trivial. For example, wine producers may report their production in "bottles" and "liters" within the same year. Second, the goods produced by multi-product plants may differ importantly in their physical and functional attributes. For example, if a furniture manufacturer produces both tables and chairs, the sum of the two does not provide a meaningful index of quantity.

To circumvent these issues, we use marginal cost as a measure of efficiency, following the methodology by De Loecker et al. (2012). For most production functions, marginal cost is directly (inversely) related to TFPQ. In addition, since we recover marginal cost at the product level, we avoid the aggregation issues for multi-product plants.

3.2 Productivity Estimates and Marginal Cost

In order to compare our results with the literature, we first calculate TFPR and then continue with the derivation of marginal cost.

TFPR Estimation

To compute TFPR, we first have to estimate the production function. We follow Ackerberg, Caves, and Frazer (2006, henceforth ACF), who extend the framework of Olley and Pakes (1996, henceforth OP) and Levinsohn and Petrin (2003, henceforth LP). This methodology controls for the simultaneity bias that arises because input demand and unobserved productivity are positively correlated.[16] The key insight of ACF over the previous literature lies in their strategy for identifying the labor elasticity, which they show is in most cases unidentified by the two-step procedure of OP and LP.[17] We modify the canonical ACF procedure, specifying an endogenous productivity process, where past export-status is allowed to impact current productivity. This reflects the correction suggested by DeLoecker (2013); if productivity gains from exporting also lead to more investment

[15]The products included in their analysis are bread, carbon black, coffee, concrete, flooring, gasoline, black ice, processed ice, and plywood.

[16]We follow OP and LP in using investment and material inputs, respectively, to control for the correlation between input levels and unobserved productivity. Our approach for estimating the production function is explained in detail in Appendix A.2.

[17]The main technical difference lies in the timing of of the choice of labor. While in OP and LP labor is a freely adjustable and chosen in t, ACF assume that labor is chosen at $t - b$ ($0 < b < 1$), after capital is known in $t - 1$, but before materials are chosen in t. In this setup, the choice of labor is unaffected by unobserved productivity shocks between $t - b$ and t, but a plant's use of materials now depends on capital, productivity, and labor. In contrast to the OP and LP method, this implies that the coefficients of capital, materials, and labor are all estimated in the second stage.

(and thus a higher capital stock), the standard method would overestimate the capital coefficient in the production function, and thus underestimate productivity (i.e., the residual).[18] Finally, we also include an export dummy as an additional input in the production function to allow exporters to produce under a different technology (following De Loecker and Warzynski, 2012).

We estimate a translog production function with labor (l), capital (k), and materials (m) as production inputs:

$$\begin{aligned} q_{it} &= \alpha d^x_{it} + \beta_l l_{it} + \beta_k k_{it} + \beta_m m_{it} + \beta_{ll} l^2_{it} + \beta_{kk} k^2_{it} + \beta_{mm} m^2_{ijt} \\ &\quad + \beta_{kl} l_{it} k_{it} + \beta_{mk} m_{it} k_{it} + \beta_{lm} l_{it} m_{it} + \beta_{lmk} l_{it} m_{it} k_{it} + \omega_{it} + \varepsilon_{it} \end{aligned} \tag{1}$$

where all lowercase variables are in logs; i and t are indexes for plants and years, respectively; ω_{it} represents plant-level productivity, d^x_{it} is an export dummy, and ε_{it} represents measurement error as well as unanticipated shocks to output. While the translog specification nests the typically used Cobb-Douglas function, it has the advantage that it is flexible enough to allow for varying degrees of economies of scale and complementarities between the inputs. Since we estimate (1) using a revenue-based production function, q_{it} are real revenues. We follow De Loecker et al. (2012) in assuming that the production function is product-specific rather than plant-specific, and use the subset of single-product plants to identify the coefficients in (1).[19]

Once the coefficients are estimated, productivity is computed as

$$\hat{\omega}_{it} = \hat{q}_{it} - \hat{f}_j(k_{it}, m_{it}, l_{it}) \tag{2}$$

where $\hat{f}(\cdot)$ represent the estimated contribution of the production factors to total output.[20] Note that the estimated production function allows for returns to scale, so that the residual $\hat{\omega}_{it}$ is not affected by increasing or decreasing returns. Thus, a scale effects due to exporting will be reflected as productivity increases.

Marginal Cost

To construct a measure of marginal production cost, we follow a two-step process. First, we derive the product-level markup for each plant, following the methodology outlined by De Loecker and

[18] On a related point, Roberts and Tybout (1997) show that due to sunk costs, prior exporting experience can have a substantial impact on a firm's present decision to export.

[19] The reason for these assumptions is that in our data we do not observe how inputs are allocated across outputs within a plant, which makes the estimation of (1) unfeasible for multiple-product plants. However, for the set of single product plants no assumption on the allocation of inputs to outputs is needed and the estimation of (1) can be performed with standard plant level information.

[20] For multiple-product plants we use the coefficients that corresponds to the product category of the largest product produced by the plant.

Warzynski (2012). Second, we divide product-plant level output prices (observed in the data) by the calculated markup to obtain marginal cost.[21]

The methodology for deriving marginal costs follows the production approach proposed by Hall (1986) and recently revisited by De Loecker and Warzynski (2012). This approach computes markups without relying on detailed market-level demand information; it only requires standard plant-level information on input use and output. The main assumption is that at least one input is fully flexible and that plants minimize costs. The first order condition of the plant's cost minimization problem with respect to the flexible input V can be rearranged to obtain the markup:[22]

$$\underbrace{\mu_{ijt}}_{Markup} \equiv \frac{P_{ijt}}{MC_{ijt}} = \underbrace{\left(\frac{\partial Q_{ijt}(\cdot)}{\partial V_{ijt}} \frac{V_{ijt}}{Q_{ijt}}\right)}_{\text{Output Elasticity}} \cdot \underbrace{\left(\frac{P^V_{ijt} \cdot V_{ijt}}{P_{ijt} \cdot Q_{ijt}}\right)^{-1}}_{\text{Revenue Share}}, \tag{3}$$

where P (P^V) denotes the price of output (input V) and MC is marginal cost.[23] According to equation (3), the markup of product j produced by plant i at time t can be computed as the ratio between the elasticity of product j with respect to the flexible input and the share of the flexible input in the sales of product j. We use materials as the flexible input to compute the output elasticity, based on our estimates of (1).[24] The second component needed in (3) – the expenditure share for material inputs – is observed directly in our data. Appendix A.3 provides further detail on the estimation of marginal costs.

4 Data

Our data are from a Chilean plant-level panel, the *Encuesta Nacional Industrial Anual* (Annual National Industrial Survey – ENIA) for the period 1996–2005. Data for ENIA are collected annually by the Chilean National Institute of Statistics (INE), with direct participation of Chilean manufacturing plants. ENIA covers the universe of manufacturing plants according to the International Standard Industrial Classification (ISIC), revision 2, with 10 or more workers. It contains detailed information on plants' characteristics, such as sales, spending on inputs and raw materials, em-

[21] De Loecker et al. (2012) use the same approach to derive marginal costs in a panel of Indian firms and analyze the cost- and price responses to import liberalization.

[22] More precisely, the first order condition with respect to V is $\frac{\partial \mathcal{L}}{\partial V} = P^{\nu} - \lambda \frac{\partial Q(\cdot)}{\partial V} = 0$, where the Lagrange multiplier λ equals the marginal cost of production. Rearranging this expression yields (3).

[23] In terms of our previous notation, note that $q = \log Q$.

[24] In principle, labor could be used as an alternative. However, in the case of Chile, labor being a flexible input would be a strong assumption due to its regulated labor market. A discussion of the evolution of job security and firing cost in Chile can be found in Montenegro and Pagés (2004).

ployment, wages, investment and exporting status. ENIA contains information for approximately 4,900 manufacturing plants per year with positive sales and employment information. Out of these, about 20% are exporters. Approximately two third of the plants are small-sized (less than 50 workers), while medium (50-150 workers) and large-sized (more than 150 workers) plants represent 20 and 12 percent, respectively.

In addition to aggregate plant data, ENIA provides rich information for every good produced by each plant, reporting the value of sales, its cost of production, the number of units produced and sold, and the fraction of production that is exported. Products are defined according to an ENIA-specific classification of products, the *Clasificador Unico de Productos* (CUP). This product category is comparable to the seven digit Second Revision International Standard Industry Classification (ISIC).[25] Using CUP categories, we identify 2,169 products in the sample. In the following, we briefly discuss how we deal with inconsistent product categories, units of output, and other issues of sample selection.

4.1 Sample Selection and Data Consistency

In the following, we explain sample selection and how we ensure consistent product-plant categories in our panel. First, we drop plant-year observations when there are signs of unreliable reporting. In particular, we exclude plants that have missing or zero values for total employment, investment, demand for raw materials, sales, and product quantities. Second, given that we use unit values to proxy for prices, we restrict our sample to the set of plant-product-year observations with strictly positive sales and quantities. Third, whenever our analysis involves quantities of production, we have to carefully account for possible changes in the unit of measurement. For example, wine producers change in some instances from "bottles" to "liters." Total revenue is generally unaffected by these changes, but the derived unit values (prices) have to be corrected. This procedure is needed for about 1% of all plant-product observations; it is explained in Appendix B.1. Finally, a similar correction is needed because the product identifier in our sample changes in the year 2001. We use a correspondence provided by the Chilean Statistical Institute to match the new product categories to the old ones (see Appendix B.1 for detail). After these adjustments, our sample consists of 109,210 plant-product-year observations.

4.2 Entry to Export Markets

In our empirical analysis, we investigate gains from exporting after export entry. The time of entry to export markets is thus crucial. We observe the exporting history for each plant-product pair

[25] For example, the wine industry (ISIC 3132) is disaggregated by CUP into 8 different categories, including "Sparkling wine of fresh grapes", "Cider", "Chicha", and "Mosto", among others.

from 1996 to 2005. If a product was exported in 1996, we do not have enough information to label it as an export entry, because we cannot determine if this is the first year in which the product was exported. We thus do not classify any plant-products as export entrants in 1996. Starting from there, we impose three requirements for considering product j produced by plant i as an entry at time t: (i) product j is exported for the first time at t in our sample, (ii) product j is sold domestically for at least one period before entry into the export market, and (iii) product j is the first product exported by plant i. The last requirement rules out that spillovers from other, previously exported products affect our estimates. Under this definition we find 671 export entries.[26]

4.3 Validity of the Sample

Before turning to our empirical results, we check whether our data replicate previously established stylized facts – that exporters are different from non-exporters. Following Bernard and Jensen (1999) and others, we run the regression

$$y_{it} = \alpha + \gamma d_{it}^{exp} + \delta l_{it} + \alpha_{jt} + \varepsilon_{it} \ , \tag{4}$$

where y_{it} denotes several characteristics of plant i in period t, d_{it}^{exp} is an export dummy equal to one when the plant is exporting and zero otherwise, l_{it} is the logarithm of employment and α_{jt} denotes sector-year fixed effects.[27] We control for sector-year effects, where subscripts j and t run through the number of sectors and years, respectively. The coefficient δ reports the percentage-point difference of the dependent variable between exporters and non-exporters.

Table 1 shows that our sample replicates previously established stylized facts:[28]. Exporting plants within are more productive (measured as revenue productivity), larger both in terms of employment and sales, pay higher wages, and are more capital intensive.[29]

[Insert Table 1 here]

[26]In section 5.4 we study the sensitivity of our main results using a more conservative entry definition: we require products to be sold domestically for two consecutive periods before entry. Using this definition we detect a total of 299 entries. Our main results stay qualitatively unchanged when we use this stricter entry definition.

[27]We define sectors using the product category of the most important product (in terms of sales) manufactured by the plant. In particular, we define 10 sectors: Food and Beverages, Textiles, Apparel, Wood, Paper, Chemicals, Plastic, Non-Metallic Manufactures, Basic and Fabricated Metals and Machinery and Equipment.

[28]See Bernard and Jensen (1999) for the United States, Bernard and Wagner (1997) for Germany, and De Loecker (2007) for Slovenia among others.

[29]The regression does not control for size when the dependent variable is the log of total employment.

5 Empirical Results

In this section we present our main empirical results. We first show the dynamics of revenue productivity (TFPR) and marginal costs (MC) within plants, before and after export entry. While this illustrates our main findings, it is subject to concerns of selection and pre-exporting trends. To address these, we present a second set of results, using propensity score matching to construct, for each new exporter, a control group of plant-products that had a-priori a similar likelihood of entering the export market.

5.1 Within Plant Trajectories

We begin by analyzing the trajectories for price, marginal cost, markups and revenue productivity for the sub-sample of new export entrants. For each plant i producing good j in period t, we estimate the following regression:

$$y_{ijt} = \alpha_{jt} + \alpha_i + \underbrace{\sum_{s=-2}^{-1} T_{ijt}^{s}}_{Pre-Trend} + \underbrace{\sum_{s=0}^{S} E_{ijt}^{s}}_{Entry-Effect} + \delta X_{ijt} + \varepsilon_{ijt} \ , \tag{5}$$

where y_{ijt} refers to the characteristic of product j – either price, marginal cost, markup or TFPR – produced by plant i at time t, α_{jt} are product-unit-year effects (at the 4-digit level), α_i are plant fixed effects and X_{ijt} represents a vector of control variables.[30] In equation (5) we include two sets of year-plant-product specific dummy variables to account for the trajectory of each variable y_{ijt} before and after entry into export markets. First, we include T_{ijt}^{s} to control for potential pre-entry trends in the two periods before exporting. Second, to study the post-entry trajectory of the dependent variable we include E_{ijt}^{s}, which takes value one if product j is exported s periods after entry.

Table 2 reports the results of estimating (5) for the sample of entrants, and Figure 2 shows these graphically.[31] The figure shows the point estimates and the respective confidence intervals of +/- one standard deviation for the trajectories of TFPR (left panel), price, marginal cost and markup (right panel).[32] On the horizontal axis we plot a time scale which is normalized at zero for

[30]Product fixed effects at the 4-digit level correspond to approximately 200 products. Note that for TFPR, the product index j in y_{ijt} is irrelevant since it is defined at the plant level.

[31]For the construction of this figure we use the benchmark definition of entry defined in section 4.2. In the online appendix we show a similar figure using a more conservative entry definition that requires 2 pre-entry periods selling the product domestically.

[32]Standard errors are clustered at the product level (measured in the same units), because most of the variation in prices and marginal cost comes from the product dimension.

the entry period. The left panel of Figure 2 shows that TFPR within plants is virtually unaffected by exporting. This result is in line with the previous literature: there are no apparent efficiency gains when TFPR is used as a measure of efficiency. The right panel of Figure 2 shows a radically different pattern. After entry into the export market, price and marginal cost decline markedly, while markups remain relatively unchanged. The point estimates suggest that prices and marginal cost are about 13% lower at the moment of entry, as compared to pre-exporting periods. This difference seems to widen in time: one period after entry the difference is almost 20%, and after 2 periods, almost 30%.

[Insert Figure 2 here]

Figure 2 also shows that price and marginal cost of new exported products decline before entry occurs. This pre-trend is problematic for interpreting our results. For example, price and marginal cost could have declined even in the absence of entry. This would results, for example, if plants invest in new technology before entering export markets. In the next section we present our approach for dealing with this potential issue.

5.2 Matching Results

In the following, we attempt to distinguish between selection into exporting and a causal effect of export activity on technology improvements. We apply propensity score matching (PSM) in the spirit of Rosenbaum and Rubin (1983), and further developed by Heckman, Ichimura, and Todd (1997).[33] This approach attempts to isolate the causal effect of exporting by comparing the productivity of newly exported products with products that had a-priori a similar likelihood of being exported, but that continued to be sold domestically only. Once the comparable control group is identified, the average effect of the treatment on the treated plant-products (ATT) can be obtained by computing the average differences in outcomes between the two groups.

We define treatment export entry, following the criteria in section 4.2, and obtain the control group from the pool of plants producing the same products as new exporters, but for the domestic market only.[34] The PSM approach requires to choose a set of control variables such that, conditional on the propensity score, the distribution of treated and control units does not differ significantly. To estimate the propensity score we consider a flexible specification that is a function of plant and product characteristics. In particular, we include the lagged and differential marginal cost ($\Delta MC_t, MC_{t-1}$) of the product, the lagged plant-level revenue productivity ($TFPR$), the

[33] De Loecker (2007) applies this technique to analyze learning by exporting in a Slovenian firm panel.

[34] Note that products that are already exported in the first year of the sample enter neither the treatment nor the control group.

capital stock of the plant (k), and a vector of other control (Z).[35] Appendix A.4 provides further detail.

Once we have determined the control group, we use the difference-in-difference (DID) methodology to evaluate the impact of exporting on TFPR, prices, cost and markups. As Blundell and Dias (2009) suggest, using DID can improve the quality of matching results because all remaining initial differences between treated and control units are removed. Since all variables are expressed in logarithms, the DID estimator reflects the difference in growth between newly exported products and their counterfactuals. Given that we evaluate the effect of exporting for multiple time periods, all our results are reported in terms of growth with respect to the pre-entry period.

In Table 3 we show the results for TFPR, price, marginal cost and markup. We report the average difference in growth of treated and control from the entry year ($t = 0$) to three periods after entry.[36] Our matching results confirm the main pattern: Changes in TFPR after entry (first row of Table 3) are quantitatively small, statistically insignificant, and change sign in $t = 1$. Price and marginal cost, on the other hand, both decrease after entry into export markets (rows 2 and 3). Interestingly, the marginal cost follows closely the price trajectory, which reflects the fact that there is no significant markup difference after entry (row 4) between treated and controls for almost all horizons.[37] The main difference with respect to the previous subsection is the timing of the decrease in marginal cost and price. While we found significant difference at entry for within-plant trajectories (and some evidence for pre-trends), the PSM results show no initial differences. In terms of magnitudes, the difference in price (marginal cost) relative to the control group falls by 11% (15%) one period after entry, and to almost 50% (62%) three periods after entry.

[Insert Table 3 here]

5.3 Reported Average Costs

One potential concern for our marginal cost results is that they rely heavily on a correct estimation of the markup for each plant-product. If the procedure outlined in section 3.2 provides a poor identification for actual markups, then the resulting marginal cost would follow prices even if the

[35]Other controls include product sales,number of employees, import status of the plant and the ratio of blue- to white-collar workers. Following Abadie, Drukker, Herr, and Imbens (2004), we use the five nearest-neighbors. Our results are very similar when using 1, 3 or the 10 nearest neighbors instead.

[36]In Appendix Table A.2 we confirm that the means of the covariates and outcome variables are statistically insignificant for the treated and the control units in period $t = -1$. Therefore, any posterior differences should not be attributed to pre-exporting differences between treated and controls.

[37]Although markups are statistically positive three periods after entry, we attribute this finding to the low number of observations that are left three periods after entry.

actual marginal cost had a different trajectory.[38] We can address this concern using data reported by plants in ENIA, which allow us to compute an alternative cost measure. Plants covered by ENIA report the total production cost *per product* and the number of units produced. Total cost per product is defined as the product-specific sum of raw material costs and direct labor involved in production. It excludes transportation and distribution costs, as well as potential fixed costs. With this information we compute the average cost per product, produced by a given firm in a given year. Using this alternative cost-based measure of efficiency, we use propensity score matching to show that our results are not an artifact of the estimated markups.

Row 5 of Table 3 shows that average costs decrease after export entry, closely following the trajectory that we identified for marginal cost. Similar to our previous estimates, export entry is followed by a decline in average costs of 15% one period after entry to 54% three periods after entry. This confirms that the procedure in section 3.2 yields sensible estimates of production efficiency.

5.4 Robustness

In this subsection we address some potential concerns for the validity of our results. We test if our results could be affected by: (i) products exiting export markets, (ii) the assumed rule for input allocation, and (iii) the chosen matching technique.

Balanced Sample of Entrants

One potential explanation for our results would be plants charging lower prices before exiting the international markets in an attempt to remain competitive. If this were the case, we should observe shrinking markups over time after entry, because a subset of entrants will eventually exit. However, markups do not appear to change over time. An additional check is to exclude plant-products that exit the export market within 3 periods after entry, i.e., constructing a balanced sample of exporters.

Table 4 shows the results, using propensity score matching as above. The main patterns is unchanged – TFPR results are quantitatively small and statistically insignificant, while both prices and marginal costs drop markedly after export entry. The same is true for average costs. The main difference with Table 3 is that price, marginal and average cost are now significantly lower already at the time of export entry ($t = 0$).[39] In addition, the drop in costs and prices is now more stable over time. This makes sense, given that we only focus on successful export entrants. It may also

[38] For example, suppose that prices actually fall because markups shrink upon export entry, but that noisy production data lead to quantitatively small estimates of markups in section 3. Then we would wrongly attribute the observed decline in prices after export entry to a decline in marginal cost. That is, we would identify declining marginal cost where the actual driver were falling markups.

[39] Since the matching procedure equalizes the pre-entry averages of price, marginal and average cost, differences in these variables at entry are attributed to the entrance into export markets.

help to explain why in our full sample, effects tended to increase over time: as the least productive firms exit the export market, the remaining ones will show larger differences relative to the control group. In sum, the results from the balanced sample confirm our full sample estimates.

[Insert Table 4 here]

Single-Product Plants

A second possibility is that our results are affected by the assumption that we had to make to identify product-specific marginal costs in multi-product firms – that inputs are allocated across products in proportion to their sales revenues. To test if our results are driven by this assumption, we compute in panel B of Table 4 the trajectories for the sub-sample of single-product plants. For these plants, no allocation rule is needed to to compute markups and marginal costs. This robustness check comes at a cost: Single-product entrants represent only about one-forth of the total number of entries in our sample. Correspondingly, the results are somewhat noisier than before. Nevertheless, the main pattern is confirmed: as in our main sample, there is no significant increase in TFPR after entry, while price and marginal cost decrease after export entry.

Alternative Matching Specifications

Finally, in Table A.3 and A.4 we study whether our results could be attributed to our choice of number of neighbors or the size of the caliper.[40] The results in Table A.3 suggest that the patterns in Table 3 does not change qualitatively if 1, 3 or 10 neighbors are assumed instead of 5. The results stay relatively similar across all three panels, with the main difference that as we consider fewer neighbors, the magnitudes tend to be larger but less significant. In Table A.4 we show results assuming tighter (.005) and wider (.020 and .050) calipers than in our benchmark results. Results are qualitatively similar.

5.5 Spillovers to Domestic Products

The previous evidence points to a decrease in price and marginal cost after plant-entry into export markets, which we interpret as efficiency gains. Are there spillovers of these gains to the remaining goods produced by the plant? To answer this question, we analyze at the trajectories of the remaining, non-exported goods produced by entrant plants. If efficiency gains from exporting are exclusively experienced in the goods that are exported, then the trajectories of price and cost for the remaining non-exported goods should not change after export entry. We compare the non-exported products of export-entry plants to similar goods produced by other non-exporting plants.[41]

[40]The caliper denotes the maximum distance between export entrants and controls in terms of propensity scores (which vary between 0 and 1).

[41]The control group is selected using the same specification as for the propensity score of newly exported products.

Table 5 shows the results of this exercise. As in Table 3 for the case of new exported products, the point estimates for the trajectories of price and costs of the remaining products are all negative. However, we see no permanent decreases in either price or cost. The decrease in marginal cost is only significant two periods after entry, while the estimate for price is significant in the periods of entry and two periods after entry. Importantly, the magnitude of price and marginal cost declines is markedly smaller than in previous estimates. In sum, our results provide some evidence for spillovers within plants from newly exported products to those produced for the domestic market. However, the direct productivity gains of exported products is substantially larger.

6 Conclusion

Over the last two decades, case studies and contributions in the management literature have provided strong suggestive evidence for within-firm productivity gains from exporting. A large number of papers has sought to pin down these effects empirically, using firm- and plant-level data from various countries in the developed and developing world. With less than a handful of exceptions, the overwhelming number of studies has failed to identify such gains. We point out a reason for this discrepancy, and offer a methodology to correct empirical estimates. Almost all previous studies have used revenue-based productivity measures, which will be downward biased if new entrants charge relatively low prices. A number of studies suggests that this is indeed the case, since new entrants typically lack connections with customers, whom they seek to attract by charging prices close to marginal costs (c.f. Foster et al., 2012, and the papers citet therein).

In order to avoid the effect of lower prices on the productivity measure, we use marginal cost, which is directly (negatively) associated with quantity-productivity in standard production functions. We estimate marginal costs at the plant-product level following the approach by De Loecker et al. (2012) – by first calculating markups under an unrestrictive set of assumptions and then deriving marginal costs as the ratio of price over markup. We implement this procedure using a detailed Chilean plant-level panel over the period 1996-2005. As a first step, we show that with the standard approach used in previous studies (revenue-based productivity), we do not find evidence for productivity gains after export entry. Next, we turn to marginal costs.

Our main results show that export entry is followed by a substantial decline in marginal costs – approximately 15-30%. Prices follow a similar trajectory after export entry, suggesting that new exporters pass on most of the productivity increases to their customers. We confirm these results using product-specific production costs that plants report. Our results thus suggest that productivity gains from exporting are substantial, and that most of them are passed on to customers during the first years after export entry, which explains why previous revenue-based studies have failed to identify these gains.

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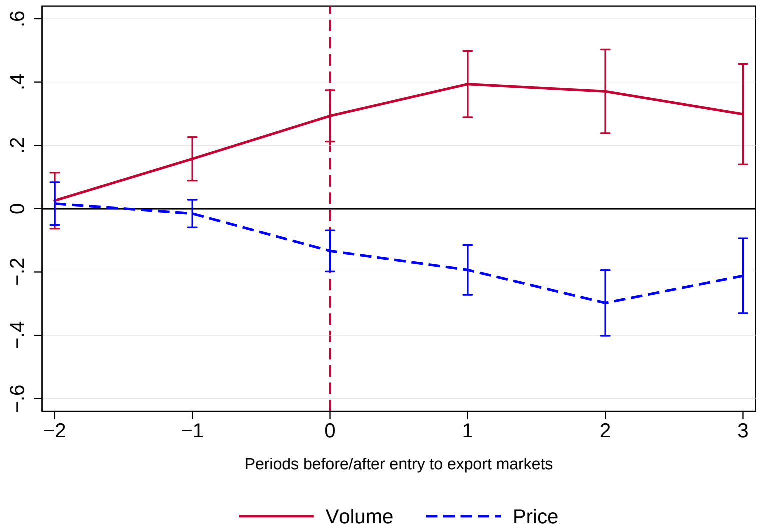
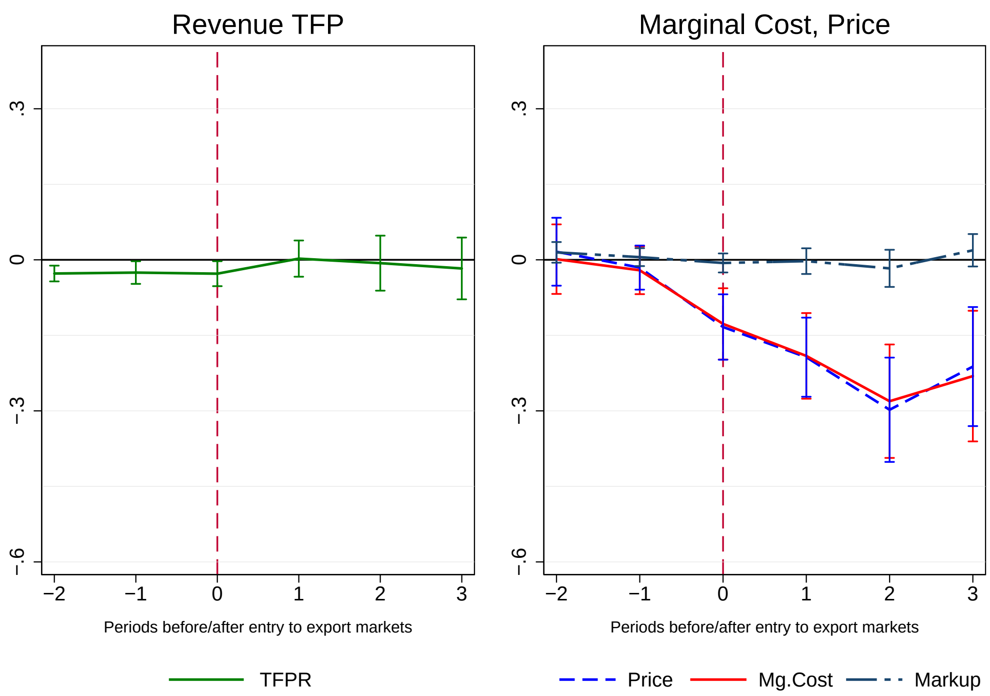
FIGURES

Figure 1: Price and Volume Trajectories for New Exported Products



Source: Author's construction. Period zero is defined as the period of entry to export markets.

Figure 2: Price, Marginal Cost and TFPR Trajectories for New Exported Products



Source: Author's construction. Period zero is defined as the period of entry to export markets. We label as entrant into export markets new exported products that have been produced for two consecutive periods before being exported.

TABLES

Table 1: Stylized Facts

	(1)	(2)	(3)	(4)	(5)
	Plant Size		Productivity	Capital Intensity	Skills
Dependent Variable	ln(Workers)	ln(Sales)	ln(TFPR)	ln(Capital/Workers)	ln(Wage)
Export dummy	1.422***	.641***	.172***	.719***	.205***
	(.083)	(.091)	(.028)	(.138)	(.031)
Sector-Year FE	✓	✓	✓	✓	✓
R^2	.27	.71	.99	.19	.30
Observations	39,611	39,324	39,583	39,611	39,608

Notes: All regressions (except for col. 1) controls for log number of workers. Clustered standard errors (at sector level) in parentheses. Key: *** significant at 1%; ** 5%; * 10%.

Table 2: Within Plant Trajectories for New Exported Products

Periods After Entry	-2	-1	0	1	2	3	Obs/R^2
A. Revenue TFP	-.0272	-.0253	-.0275	.00239	-.00663	-.0172	1,946
	(.0166)	(.0236)	(.0212)	(.0315)	(.0474)	(.0373)	0.57
B. Price	.0161	-.0155	-.133**	-.193**	-.298***	-.212*	2,558
	(.0674)	(.0438)	(.0649)	(.0786)	(.104)	(.118)	0.82
C. Marginal Cost	.00129	-.0208	-.127*	-.191**	-.281**	-.231*	2,558
	(.0691)	(.0475)	(.0707)	(.0850)	(.113)	(.130)	0.81
D. Markup	.0148	.00534	-.00625	-.00262	-.0170	.0189	2,558
	(.0205)	(.0178)	(.0189)	(.0255)	(.0369)	(.0322)	0.54

Notes: Regression output corresponds to the estimation of equation (2). The regressions for TFPR controls for sector-year and plant fixed-effects. The remaining regressions control for product-year and plant-product-unit fixed effects. All regressions includes a dummy for exit from the export market (not reported). The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: *** significant at 1%; ** 5%; * 10%.

Table 3: Within Plant Trajectories for New Exported Products: Matching Approach

Periods After Entry	0	1	2	3
A. Revenue TFP	-.0167	.0319	.0320	.0869
	(.0191)	(.0346)	(.0443)	(.0606)
B. Price	-.00207	-.113**	-.144	-.489**
	(.0319)	(.0546)	(.0871)	(.182)
C. Marginal Cost	-.000642	-.146**	-.185*	-.622***
	(.0404)	(.0725)	(.104)	(.180)
D. Markup	-.00577	-.00838	-.00953	.141*
	(.0239)	(.0449)	(.0510)	(.0739)
E. Average Cost	-.0385	-.152**	-.204*	-.538***
	(.0362)	(.0656)	(.103)	(.170)

Notes: Coefficients correspond to the differential growth of the variable with respect to the pre-entry year ($t-1$) between entrants and controls. Period t corresponds to the entry year. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: ** significant at 1%; ** 5%; * 10%.

Table 4: Within Plant Trajectories for New Exported Products: Robustness

Periods After Entry	0	1	2	3
Panel A: Balanced Sample				
A. Revenue TFP	.0671	.0442	.0978*	.0303
	(.0518)	(.0567)	(.0507)	(.0688)
B. Price	-.300*	-.425**	-.376**	-.258*
	(.157)	(.153)	(.150)	(.135)
C. Marginal Cost	-.348**	-.422***	-.547***	-.477**
	(.125)	(.138)	(.153)	(.172)
D. Markup	.0996	.0610	.0572	.149*
	(.0578)	(.0739)	(.0654)	(.0823)
Panel B: Single-Product Plants				
A. Revenue TFP	.0448	.0353	.0806	.140
	(.0444)	(.0526)	(.0631)	(.133)
B. Price	-.0876	-.155	-.654**	-.723*
	(.0782)	(.107)	(.239)	(.355)
C. Marginal Cost	-.207**	-.283**	-.769**	-.835**
	(.0999)	(.104)	(.241)	(.284)
D. Markup	.0764	.0177	.0596	.0172
	(.0566)	(.0739)	(.0696)	(.117)

Notes: Coefficients correspond to the differential growth of the variable with respect to the pre-entry year ($t-1$) between entrants and controls. Period t corresponds to the entry year. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: ** significant at 1%; ** 5%; * 10%.

Table 5: Spillovers to Other Goods Produced by Entrants

Periods After Entry	0	1	2	3
A. Price	-.130***	-.163	-.320*	-.233
	(.0473)	(.0980)	(.166)	(.227)
B. Marginal Cost	-.0266	-.104	-.374*	-.200
	(.0582)	(.110)	(.210)	(.228)
C. Markup	-.0813***	-.0687	-.0663	-.201*
	(.0249)	(.0438)	(.0624)	(.104)

Notes: Coefficients correspond to the differential growth of the variable with respect to the pre-entry year ($t-1$) between non-exported products produced by entrants into export markets and controls. Period t corresponds to the entry year. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: ** significant at 1%; ** 5%; * 10%.

Table 6: Plant characteristics after export entry

Periods After Entry	0	1	2	3
A. Labor	.0555	.159***	.233***	-.0353
	(.0354)	(.0461)	(.0570)	(.115)
B. Materials	.0647***	.0762**	.133**	.162**
	(.0200)	(.0327)	(.0517)	(.0651)
C. Capital	.0611***	.0188	.0736	.130*
	(.0203)	(.0385)	(.0486)	(.0694)
D. Plant Sales	.0404*	.0972***	.207***	.127
	(.0219)	(.0292)	(.0405)	(.0895)
E. Imported Materials^{A}	.0399***	.0530***	.0572**	.0569*
	(.0109)	(.0175)	(.0221)	(.0290)
F. Wage	-.0100	-.00127	-.0751	.0582
	(.0218)	(.0351)	(.0530)	(.0798)
G. Share of White Collar Workers	.0376	.145*	.0955	.271
	(.0451)	(.0828)	(.163)	(.169)

Notes. A: percentage of total materials. Coefficients correspond to the differential growth of the variable with respect to the pre-entry year ($t-1$) between entrants and controls. Period t corresponds to the entry year. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: ** significant at 1%; ** 5%; * 10%.

Online Appendix

Exporting and Plant-Level Efficiency Gains: It's in the Measure

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A Technical Appendix

A.1 Stylized Framework's Derivation

In this appendix we provide details on the derivation of the stylized framework presented in section 3.

A.1.1 Preferences

We assume a quasi-linear utility function with a quadratic subutility as in [++Ottaviano, Tabuchi and Thisse (2002)++]:[1]

$$U = y + \int_{i \in I} (\alpha + \delta_i) q_i di - \frac{1}{2}\eta \left(\int_{i \in I} q_i di \right)^2 - \frac{1}{2}\gamma \int_{i \in I} q_i^2 di$$

where y is the quantity of the numeraire good, $\gamma \geq 0$ is an index of product differentiation, α, $\eta \geq 0$ govern substitutability with numeraire and δ_i is a variety-specific, mean-zero taste shifter.

A.1.2 Partial Equilibrium for the Differentiated Good in the Domestic Market

Given the above preferences, if income is large enough so that the demand for the numeraire is positive, demands for any differentiated good i is given by

$$p_i = \alpha + \delta_i - \gamma q_i - \eta Q \tag{A.1}$$

We can solve for the aggregate demand Q integrating the individual demands over the range of goods for which the quantity demanded is positive:

$$Q = \frac{N(\alpha - \bar{\delta} - \bar{p})}{\gamma + \eta N} \tag{A.2}$$

[1] In the derivation of the demand and profit function we follow the notation of [++Foster, Haltiwanger and Syverson (2008)++]

where N is the measure of consumed varieties and $\bar{\delta}$ and $\bar{p}$ are average taste shifter and price, respectively. Replacing this expression in the inverse demand function leads to:

$$p_i \;=\; M + \delta_i - \gamma q_i \tag{A.3}$$

where $M = \frac{1}{\eta N + \gamma}\left(\alpha\gamma + \eta N(\bar{p} - \bar{\delta})\right)$ is a variety invariant term that reflects the price at which the elasticity is driven to 0 in absence of variety-specific taste shocks.[2] We interpret this as a measure of domestic market size.

There is a mass N of plants producing the differentiated good and there is no entry or exit of plants. Plants differ in their technology, which is fixed. We assume an stylized production technology where there are not fixed production costs and the marginal cost of production is given by MC_i.[3] The marginal cost reflects both efficiency and input costs, and it might be or might be not constant. Since it does not matter for our results the particular functional form of the marginal cost, we assume that it is constant. Profit maximizing price and quantity are given by

$$p_i \;=\; \frac{1}{2}\left(M + \delta_i + MC_i\right), \qquad q_i \;=\; \frac{1}{2\gamma}\left(M + \delta_i - MC_i\right) \tag{A.4}$$

which implies that profits in the domestic market are given by

$$\pi_i \;=\; \frac{1}{4\gamma}\left(M + \delta_i - MC_i\right)^2 \tag{A.5}$$

A.1.3 Partial Equilibrium for the Differentiated Good in the External Market

Preferences in the external market share the same functional form than in the domestic market. In terms of notation, we add stars to all variables and parameters in the external market to differentiate them from the values in the domestic market. Demand for variety i is given by $p_i^* = M^* + \delta_i^* - \gamma q_i^*$ where $M^* = \frac{1}{\eta N^* + \gamma^*}\left(\alpha^*\gamma^* + \eta^* N^*(\bar{p}^* - \bar{\delta}^*)\right)$.

To sell their production in the external market plants need to pay a fixed entry cost F_E. Exports are also subject to an iceberg trade cost τ. Profit maximizing price and quantity in the external market are:

$$p_i^* \;=\; \frac{1}{2}\left(M^* + \delta_i^* + \tau MC_i\right), \qquad q_i^* \;=\; \frac{1}{2\gamma}\left(M^* + \delta_i^* - \tau MC_i\right) \tag{A.6}$$

[2] Note that the maximum price that can is consistent with non-negative demand is given by $p_{max} = M + \delta_i$.

[3] The marginal cost is expressed in unit of the numeraire good.

We define the categorical variable E that equals 1 if the plant exports. Profits are defined as

$$\pi_i^* = \underbrace{\frac{1}{4\gamma}\left(M + \delta_i - MC_i\right)^2}_{\equiv \text{Profits in Domestic Market}} + E \underbrace{\left[\frac{1}{4\gamma\tau}\left(M^* + \delta_i^* - \tau MC_i\right)^2 - F_E\right]}_{\equiv \text{Profits in External Market}} \tag{A.7}$$

In this context, plants (initially) do not export if the profits they obtain exporting (i.e., $E = 1$) are lower than the profits they would obtain if they only sell their products domestically:

$$\begin{aligned} \pi_i^0(E=1) &\leq \pi_i^0(E=0) \\ \Leftrightarrow MC_i &\geq \underbrace{\frac{1}{\tau}\left(M^* + \delta_i^* - 2\sqrt{F_E\gamma^*\tau}\right)}_{\text{Exporting Threshold}} \end{aligned} \tag{A.8}$$

Note that for a given marginal cost, the probability that a plant exports is higher the higher is the external market size M^* or the idiosyncratic demand for the good produced by plants i, the lower are the fixed and variable export cost F_E and τ, and the lower is the degree of product differentiation γ^*.

For non-exporting plants, we redefine the export entry condition in terms of ε, which we interpret as the relative export entry wedge:

$$MC_i = (1+\varepsilon)\left[\frac{1}{\tau}\left(M^* + \delta_i^* - 2\sqrt{F_E\gamma\tau}\right)\right]$$

Note that for plants selling exclusively for the domestic market $\varepsilon > 0$, while that for exporters $\varepsilon < 0$

A.1.4 Triggers for Domestic Entry

In this subsection we derived the expressions used in the main text in each for the triggers for export entry referred in the main text.

Demand Shock

Plants could enter in the export market if the demand for their products or the overall demand in the external markets improve. In terms of our notation, this would be equivalent to higher M^* or δ_i^*. In terms of equation (A.8), this imply that the threshold for export entry increases, making entry profitable for plants that previously were selling for the domestic market only.

What does this mechanism imply for price, revenue, markups and productivity? If this is the dominant mechanism in the data, we would observe higher prices, quantities and TFPR, but no change in TFPQ. Note that the increase in revenue productivity is caused exclusively by changing prices and it does not reflect any change in plant-level efficiency.

Domestic Productivity Shock

A second channel that could induce entry to export markets is that plants experience a domestic productivity shock. In terms of equation (A.8), more efficient plants produce at a lower marginal cost, making more likely to fall below the threshold for export entry.

We analyze the case of a plant that initially does not export –i.e. with a positive export entry wedge (ε)– and that after the domestic productivity shock decide to enter the export market. Assume that the domestic productivity shock is such that the marginal production cost decreases, so that the new marginal cost is $MC_i^{shock} = \frac{MC_i^0}{\varphi_i^{shock}}$, with $\varphi_i^{shock} > 1$. Since the plant initially does not export, the profits derived from selling in the domestic market only are at least as high as the profit it would experience exporting as well. After entry, the opposite is true so profits are higher exporting than selling domestically only. In terms of equation (A.7) this two conditions can be written as

$$\left(M^* + \delta_i^* - 2\sqrt{F_E \gamma \tau}\right) < MC_i^0 \leq \frac{1}{\varphi_i^{shock}} \left(M^* + \delta_i^* - 2\sqrt{F_E \gamma \tau}\right) \tag{A.9}$$

which implies that the shock induce entry if

$$\varphi_i^{shock} \geq (1 + \varepsilon) \tag{A.10}$$

Note that this mechanism implies a reverse causality between exporting and efficiency gains, since the increase in efficiency occurs before entry. Thus, efficiency comparison before-after export entry shows efficiency gains for both exporters and non-exporters

Learning by Exporting

Suppose now that plants learn after entry so that they become more efficient after entry. [++Implicit assumption: Plants are Myope. Plants do not observe potential efficiency gains??++]In particular, after paying the fixed cost $F^E > 0$ for entry, the marginal cost becomes $MC_i^E = \frac{MC_i^0}{\varphi_i^{LBE}}$, $\varphi_i^{LBE} > 1$. As in the case with no learning, plants start exporting if the profits obtained exporting are higher than the profits obtained selling in the domestic market only:

$$\pi_i^{LBE}(E = 1) \geq \pi_i^0(E = 0) \tag{A.11}$$

After manipulating condition (A.11) we get that the entry condition could be expressed as

$$\Leftrightarrow \underbrace{\frac{\left[M^{*}+\delta_{i}^{*}-\tau\frac{MC_{i}^{0}}{\varphi_{i}^{LBE}}\right]^{2}}{\tau}-4\gamma F_{E}}_{\geq \mathbf{0}\ \text{if}\ \varphi_{i}^{LBE}\geq(\mathbf{1}+\varepsilon)} \geq \underbrace{\left[M+\delta_{i}-MC_{i}^{0}\right]^{2}-\left[M+\delta_{i}-\frac{MC_{i}^{0}}{\varphi_{i}^{LBE}}\right]^{2}}_{\leq\mathbf{0}}$$

This condition seems to be less restrictive than the condition derived for the case where plants experience a domestic productivity shock. The LHS of (A.11) is greater than zero as long as $\varphi_i^E > (1+\varepsilon)$, while the RHS is always negative because the domestic profits are higher when plants experience LBE than if they stay selling domestically only. Therefore, plants that are initially further from the export threshold (i.e, higher ε) relative to the previous case will enter to the export market.

Equation (A.11) can be solved implicitly for φ_i^{LBE} en terms of ε and F^E. Since the LHS is strictly increasing in φ_i^{LBE} while the RHS of (A.11) is decreasing in φ_i^{LBE}, there exists a unique φ_i^{LBE} that makes both sides of (A.11) equals. In particular, it can easily shown that the LHS is strictly decreasing in (ε, F^E) while the RHS is strictly increasing in ε. Therefore, the export entry condition can be written as:

$$\varphi_i^{LBE} \geq f(\underset{(+)}{\varepsilon}, \underset{(+)}{F^E}) \tag{A.12}$$

so that for plants further from the export entry threshold or for higher fixed export cost, the necessary efficiency gain induced by entry need to be higher to induce entry.

Note that if plants experience LBE, entrants should display increasing efficiency trajectories. Moreover, since LBE is a causal story –i.e., there are efficiency gains only if there is entry– we should observe higher efficiency levels only after entry.

Investment in new technology

The last mechanism we study involves complementarity between exporting decision and investment in new technologies. In particular, assume that after paying a fixed cost $F^{inv} > 0$, plants access to new technology such that marginal cost decreases to $MC_i^{inv} = \frac{MC_i^0}{\varphi_i^{inv}}$, with $\varphi_i^{inv} > 1$. As in **?**, we study the case in which a plant can only access the export market if invest in technology –which is the relevant case for triggering entry to export markets.[4] These plants export only if

[4]If entry occurs without investment in new technology, only the most productive plants –with lower marginal cost– enter into export markets (See **?**).

$\pi_i^{inv}(E=1) \geq \pi_i^0(E=0)$. We can manipulate this expression as in the previous subsection

$$\frac{\left[M^* + \delta_i^* - \tau \frac{MC_i^0}{\varphi_i^{inv}}\right]^2}{\tau} - 4\gamma F_E \geq \left[M + \delta_i - MC_i^0\right]^2 - \left[\left[M + \delta_i - \frac{MC_i^0}{\varphi_i^{inv}}\right]^2 - 4\gamma F_I\right] \quad \text{(A.13)}$$

The LHS of equation (A.13) is positive as long as $\varphi_i^{INV} \geq (1+\varepsilon)$. However, the RHS of equation (A.13) could be positive or negative depending on whether for the plant it is relatively more profitable to invest without exporting or not.

As in the previous case, we can solve equation (A.13) implicitly for φ_i^i en terms of ε and (F^E, F^I). The LHS is strictly increasing in φ_i^{Inv}, while the RHS of (A.13) is decreasing in φ_i^{Inv}, so there exists a unique φ_i^{inv} that makes both sides of (A.13) equals. In particular, the LHS is strictly decreasing in (ε, F^E) while the RHS is strictly increasing in (ε, F^I). Therefore, the export entry condition can be written as:

$$\varphi_i^{LBE} \geq f(\underset{(+)}{\varepsilon}, \underset{(+)}{F^E}, \underset{(+)}{F^I}) \quad \text{(A.14)}$$

so that for plants further from the export entry threshold or for higher fixed investment or export cost, the necessary efficiency gain induced by both entry and investment need to be higher to induce entry. Note that the magnitude of the complementarity between investment and exporting depends on both the efficiency gain (φ_i^{Inv}) and the size of the exporting market.

A.2 Estimation of the Production Function

Operationally, we first estimate (1) for each product of the sample of single-product plants and then we use the reported coefficients to calculate the output elasticities of each product for the sample of multiple product plants.

A.3 Estimation of Marginal Cost

Note that because we use a translog production function, material elasticities depends on the use of *all* inputs of production:

$$\theta_{ijt}^M = \beta_m^j + 2\beta_{mm}^j m_{ijt} + \beta_{mk}^j k_{ijt} + \beta_{lm}^j l_{ijt} + \beta_{lmk}^j l_{ijt} k_{ijt} \quad \text{(A.15)}$$

The vector of coefficients $\boldsymbol{\beta}^j = (\beta_m^j, \beta_{mm}^j, \beta_{mk}^j, \beta_{lm}^j, \beta_{lmk}^j)$ is obtained from the procedure outlined in subsection 3.2.We estimate markups for each good produced by each plant. This implies a complication for the sub-sample of multi-product plants, where we do not observe the allocation of inputs *per product*. To bypass this issue, we follow Foster, Haltiwanger, and Syverson (2008) assuming that plants allocate their inputs proportionally to the share of each product in total revenues. Although strong, this assumption is somewhat milder than the one in De Loecker (2011), who assume that each output uses the same fraction of each input, independent of the scale of production.[5]

A.4 Propensity Score Matching

In the following, we provide further detail on the implementation of our propensity score matching analysis (see section 5.2). We estimate the equation

$$Pr(\text{Exp}_{ijt} = 1|\text{Exp}_{ij,t-s} = 0 \;\forall\; s > 0) = \Phi\{f(\Delta mc_{ijt}, mc_{ij,t-1}, TFPR_{i,t-1}, k_{i,t-1}, Z_{ij,t-1})\} \tag{A.16}$$

where $\Phi(\cdot)$ is the normal cumulative distribution function. As Wooldridge (2002) suggests, including a polynomial in the elements of $f(\cdot)$ could improve the resulting matching as consequence of the more flexible functional form. Importantly, in our specification we include the lagged and differential marginal cost ($\Delta mc_t, mc_{t-1}$) to control for the pre-trend reported in the previous subsection. We also include lagged capital stock and productivity, both states of the plant in the subjacent model. Finally, we include other product and plant variables in the vector $Z_{ij,t-1}$ to control for differences unaccounted by the states and the pre-trend of the marginal cost. Within the set of variables of variables in $Z_{ij,t-1}$, we consider the number of employees and product sales to control for the size and scale of production, the share of white collar workers to control for differences in human capital, and the import-status of the plant to control for potential differences in efficiency arising from the use of more advanced technology embodied in the use of foreign goods.

We use the technique of the nearest neighbors to find the control units for the group of new exported products. According to this, the group of matched non-exported observations are the plants/products with a propensity score that is closest to that of the new exported product. In our benchmark analysis we use the five nearest-neighbors and we match them to the export entrants only if the maximum distance –the caliper– between export entrants and controls is equal or smaller than 0.01.[6] We perform this matching procedure within products measured in the same units. Thus,

[5]Our rule for input allocation is somewhat stronger than the one made in De Loecker, Goldberg, Khandelwal, and Pavcnik (2012) where the average input share is obtained from a system of equations that reflects the implied differences on the allocations of inputs across outputs. Although more flexible than ours, this methodology could yield corner solutions, i.e. outputs with input shares equal to 0 or 1. In the sample of De Loecker et al. (2012) this issue seems to be non-important. However in our sample we find corner solutions in a substantial number of cases –in about 50% of the multi-product plants.

[6]As we show later, our main results stay relatively unchanged if 1, 3 or the 10 nearest neighbors are matched to each new exported product, and if the caliper is tightened to 0.005 or widened to 0.02.

each new exported product is compared to products in the same product category measured in the same units.

B Data Appendix

B.1 Details on Sample Selection and Data Consistency

In some cases, the unit of measurement changes at the plant-product level. For example, wine production changes from "bottles" to "liters." We correct the derived unit values (prices) as follows: Suppose that the unit of measurement changed in year t. We assume that total quantity (measured in the 'old' unit) grew at the same rate as total revenue between $t-1$ and t. This allows us to derive quantity measured in the 'old' unit for period t, Q_t^{old}. Consequently, we can derive the price in terms of the old and the new unit: $P_t^{old} = R_t/Q_t^{old}$; $P_t^{new} = R_t/Q_t^{new}$, where R denotes revenue. This implies the conversion rate $X = P_t^{old}/P_t^{new}$ that we use for all periods from t onwards – which allows us to measure the good in the old unit throughout the sample period.

Another correction is needed because the product identifier in our sample changes in the year 2001. The Chilean Statistical Institute provides a correspondence for the new product categories in terms of the former product category. However, this crosswalk does not allow to establish a one-to-one match for all the observations. This generates two problems. First, for a subset of the sample no correspondence is provided, and only the new product category is available. We drop all plant-product pairs for which no correspondence is available.[7]

Finally, plants in our sample reclassify products with the same description in different categories from year to year.[8] Since we are interested in studying the trajectories of prices and marginal costs of each product after their entry to export markets, we chain consecutive products – i.e., cases where the last year of one product precedes the first year in the sample of a different product – to maximize the number of consecutive observations when there is reasonable evidence that the observations correspond to the same product. In particular, we assign a common product category for (i) single-product plants producing products in the same broad product category (1,296 changes), (ii) multiple-product plants with no adding or dropping of products and with exactly one product

[7] In a few cases, the correspondence rule between new and old product classifications is such that within plants, more than one new category is assigned to an old product category. In these cases, we combine for each plant-year pair the observations reported in the same units of measurement under a same product category if the value of sales, production cost and quantities produced and sold are positive.

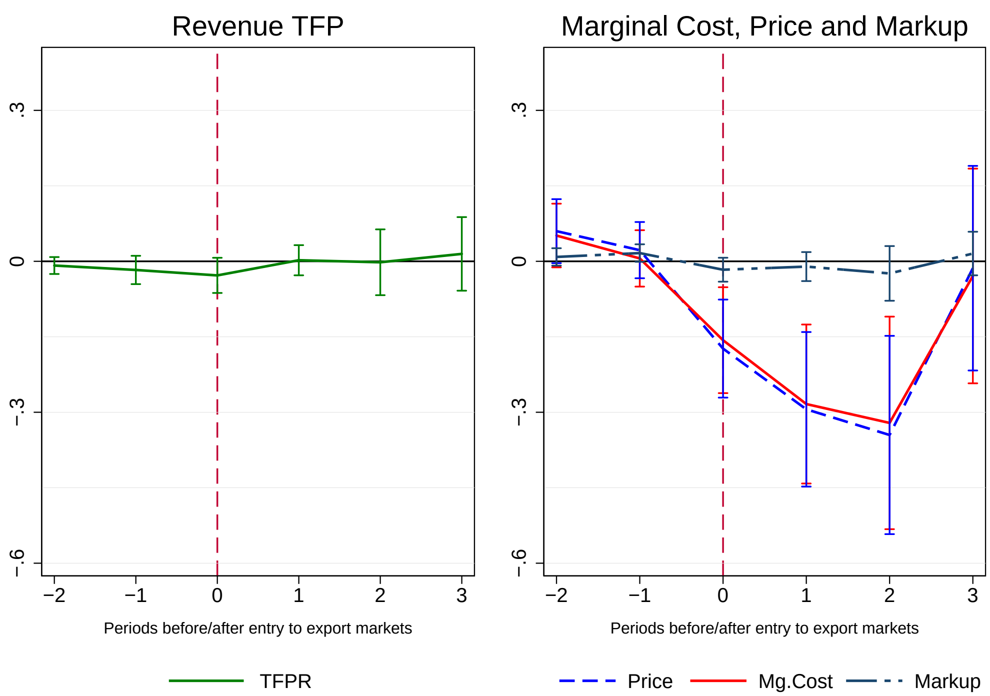
[8] Plants are required to manually report the description of products. We compared the product description with the product ID for a sub-sample of plants and we detected that for a number of cases [++provide number here++] plants changed the category in which they report their products even when the description of the product was practically identical.

changing classification per year (538 changes), (iii) multiple-product plants with exactly at most one product being exported, and with the exported product in two consecutive years changing of product category (167 changes). For (i)-(iii), we require potential candidates to stay within the same broad product category before and after the change in CUP.[9] In addition, whenever the chained products are recorded in different units we apply the procedure outlined in the previous paragraph to homogenize the unit of measurement. This methodology expands the sample by 2,001 plant-product observations – less than 2% of the overall sample size.

[9]The broad categories we use – which we define in terms of the CUP – are comparable to 4-digit ISIC categories.

C Additional Figures

Figure A.1: Price, Marginal Cost, Markup and TFPR Trajectories for New Exported Products. Alternative Definition for Entry into Export Markets: Two Periods Before Entry



Source: Author's construction. Period zero is defined as the period of entry to export markets. We label as entrant into export markets new exported products that have been produced for two consecutive periods before being exported.

D Additional Tables

Table A.1: Within Plant Trajectories for New Exported Products. Alternative Definition for Entry into Export Markets: Two Periods Before Entry

	(1)	(2)	(3)	(3)
Dependent Variable	ln(TFPR)	ln(Price)	ln(Mg. Cost)	ln(Markup)
Period ($t-2$)	-.00839	.0600	.0513	.00871
	(.0193)	(.0636)	(.0633)	(.0173)
Period ($t-1$)	-.0172	.0222	.00579	.0164
	(.0278)	(.0559)	(.0560)	(.0174)
Entry Period (t)	-.0280	-.173*	-.157	-.0167
	(.0347)	(.0974)	(.105)	(.0238)
Period ($t+1$)	.00216	-.294*	-.284*	-.0105
	(.0361)	(.154)	(.158)	(.0288)
Period ($t+2$)	-.00190	-.345*	-.321	-.0240
	(.0894)	(.197)	(.211)	(.0543)
Period ($t+3$)	.0148	-.0137	-.0291	.0155
	(.0490)	(.203)	(.213)	(.0433)
Period ($t+4$)	-.0546	.0651	.157	-.0923**
	(.0943)	(.268)	(.283)	(.0441)
Period ($t+5$)	-.0239	-.469**	-.333	-.136**
	(.0689)	(.236)	(.249)	(.0556)
Sector-Year FE	✓	—	—	—
Plant FE	✓	—	—	—
Product-Unit-Year FE	—	✓	✓	✓
Plant-Product-Unit FE	—	✓	✓	✓
Observations	1,368	1,337	1,337	1,337
R^2	.57	.68	.67	.50

Notes: Regression output corresponds to the estimation of equation 2. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: *** significant at 1%; ** 5%; * 10%.

Table A.2: Matching Quality: Mean Comparison Test Between Treated and Controls

Periods After Entry	0	1	2	3
Panel A: Product Variables				
log(Price)(t-1)	0.00	-0.36	-0.51	-0.14
log(Marginal Cost)(t-1)	-0.21	-0.66	-0.62	-0.03
Δ log(Marginal Cost)(t)	0.18	0.27	0.58	-0.20
log(Average Cost)(t-1)	-0.30	-0.55	-0.58	0.24
log(Markup)(t-1)	1.57	2.18**	0.72	-0.76
log(Product Sales)(t-1)	0.86	0.78	0.47	0.47
Panel B: Plant Variables				
log(TFPR)(t-1)	0.09	0.24	0.38	0.37
log(Workers)(t-1)	0.16	1.02	0.66	0.29
log(Capital)(t-1)	0.25	0.82	1.2	0.17
log(Blue Collar/White Collar)(t-1)	-0.37	-0.57	-0.5	0.46
log(Plant Sales)(t-1)	0.69	1.24	1.17	0.31

Notes: Coefficient corresponds to the t-tests for the difference in means between matched treated and controls. Period 0 corresponds to the entry year. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: ** significant at 1%; ** 5%; * 10%.

Table A.3: Matching Robustness: Different Number of Neighbors

Periods After Entry	0	1	2	3
Panel A: 1 Neighbor				
A. Revenue TFP	-.0253	.0477	.0525	.136*
	(.0224)	(.0395)	(.0502)	(.0771)
B. Price	-.0187	-.199**	-.110	-.486**
	(.0444)	(.0791)	(.106)	(.192)
C. Marginal Cost	-.0295	-.172*	-.176	-.785***
	(.0546)	(.0966)	(.109)	(.219)
D. Average Cost	-.0681	-.267***	-.116	-.792***
	(.0518)	(.0963)	(.128)	(.220)
Panel B: 3 Neighbors				
A. Revenue TFP	-.0108	.0271	.0324	.100
	(.0211)	(.0365)	(.0441)	(.0622)
B. Price	.00315	-.154**	-.141	-.551**
	(.0340)	(.0657)	(.100)	(.200)
C. Marginal Cost	-.0108	-.117	-.150	-.634***
	(.0477)	(.0742)	(.117)	(.187)
D. Average Cost	-.0357	-.177**	-.136	-.587***
	(.0386)	(.0773)	(.123)	(.187)
Panel C: 10 Neighbors				
A. Revenue TFP	-.0112	.0413	.0517	.0835
	(.0186)	(.0328)	(.0410)	(.0626)
B. Price	-.0142	-.108**	-.196**	-.384**
	(.0282)	(.0463)	(.0909)	(.146)
C. Marginal Cost	-.0236	-.136**	-.208**	-.553***
	(.0370)	(.0625)	(.101)	(.165)
D. Average Cost	-.0505	-.153**	-.248**	-.625***
	(.0342)	(.0580)	(.0966)	(.190)

Notes: Coefficient corresponds to the differential growth of the variable with respect to the pre-entry year ($t-1$) between entrants and controls. Period t corresponds to the entry year. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: ** significant at 1%; ** 5%; * 10%.

Table A.4: Matching Robustness: Different Calipers

Periods After Entry	0	1	2	3
Panel A: Caliper: 0.005				
A. Revenue TFP	-0.0185	0.0498	0.0432	0.0874
	(0.0201)	(0.0325)	(0.0427)	(0.0787)
B. Price	0.00892	-0.111**	-0.171**	-0.573***
	(0.0314)	(0.0541)	(0.0810)	(0.202)
C. Marginal Cost	-0.0279	-0.110	-0.202*	-0.918***
	(0.0422)	(0.0716)	(0.102)	(0.219)
D. Average Cost	-0.0768*	-0.123**	-0.212**	-0.687***
	(0.0410)	(0.0610)	(0.0915)	(0.186)
Panel A: Caliper: 0.02				
A. Revenue TFP	-0.0200	0.0477	0.0367	0.110
	(0.0183)	(0.0321)	(0.0394)	(0.0662)
B. Price	0.0195	-0.114**	-0.242**	-0.357**
	(0.0289)	(0.0506)	(0.0967)	(0.159)
C. Marginal Cost	-0.00714	-0.132**	-0.228**	-0.574***
	(0.0373)	(0.0623)	(0.109)	(0.191)
D. Average Cost	-0.0436	-0.169***	-0.287***	-0.447***
	(0.0345)	(0.0603)	(0.0989)	(0.153)
Panel C: Caliper: 0.05				
A. Revenue TFP	-0.0112	0.0260	0.00841	0.0950
	(0.0189)	(0.0304)	(0.0374)	(0.0651)
B. Price	0.0103	-0.101*	-0.219***	-0.367**
	(0.0295)	(0.0531)	(0.0785)	(0.153)
C. Marginal Cost	-0.0186	-0.0877	-0.193**	-0.564***
	(0.0377)	(0.0597)	(0.0876)	(0.184)
D. Average Cost	-0.0472	-0.140**	-0.237***	-0.435***
	(0.0385)	(0.0626)	(0.0867)	(0.148)

Notes: Coefficient corresponds to the differential growth of the variable with respect to the pre-entry year ($t-1$) between entrants and controls. Period t corresponds to the entry year. The criteria for defining a plant as entrant can be found in section 4. Clustered standard errors (at product level) in parentheses. Key: ** significant at 1%; ** 5%; * 10%.

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