The Effects of Exports and Imported Intermediates on Productivity and the Demand for Skilled Labour: A Firm Level Analysis for Uruguay

*Adriana Peluffo**

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Abstract

This work analyses the impact of the use of imported intermediate inputs and exports on productivity, and the demand of skilled workers of the Uruguayan Manufacturing firms for the period 1988-2005. We use conventional Ordinary Least Squares, quantile regressions to take into account firm heterogeneity and treatment effects techniques for analyzing causality. Our results seem to indicate that increased levels of exports and imported intermediates are associated with higher productivity and an increased demand for skill labour. Thus, promoting these activities and training of workers would lead to increases in productivity and better opportunities for skilled workers while other social policies could help to mitigate wage inequality effects.

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Keyword: trade, labour markets, productivity, exports, imported intermediates.

*Institute of Economics, School of Economics, University of the Republic
Address: Dr. Joaquin Requena 1375, CP. 11.000, Montevideo, Uruguay.
Phone: (598) 2403 3289 ext. 112; Fax: (598) 2408 9586
E-mail: apeluffo@iecon.ccee.edu.uy; Adriana.peluffo@gmail.com

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1. Introduction

Nowadays countries are more interdependent than ever. This increasing interdependence, named "globalization", could be measured through the increase in trade flows, foreign direct investment and financial flows and labour movements between nations. An important issue in our increasing globalized economic environment is if these international linkages can enhance productivity and help to raise the income of nations, improving so the standard of living. Nevertheless, another related question arise: which are the effects of these international linkages on employment and wages? Are these effects, if any, evenly distributed among firms and workers? or do they have a higher impact on skilled workers than for unskilled ones?. These latter issues have been a source of concern for both developed and developing nations.

Regarding to productivity endogenous growth theory considers that innovation is the main source of productivity growth (Romer 1990; Lucas 1988) related either to internal or external factors. Endogenous growth models in open economies recognize that trade in goods and factors of production may open new sources of technological inputs (D. T. Coe and Helpman 1995; Keller 2001; Eaton and Kortum 2002). In these models knowledge is not only contained within national boundaries, but it is transmitted through a variety of ways such as trade, foreign direct investment, and personal mobility among others. In particular, some empirical studies have shown that international linkages or technology transfer may be closely related to productivity growth among developed countries (D. T. Coe and Helpman 1995; Eaton and Kortum 2002; Keller 2001) as well as among developed and developing countries (D. Coe, Helpman, and Hoffmaister 1997; Barba Navaretti and Soloaga 2002; Meyer and Tra 2001; Falvey, Foster, and Greenaway 2002; Schiff and Wang 2004). Thus increased integration with the world economy could lead to the transfer of skill-biased technologies from more developed countries helping to raise productivity and to narrow the income gap between developed and developing economies but also increasing the demand for skilled labour in the recipient economy. Nevertheless, according to standard trade models increased international integration could also lead to a greater specialization in line with the comparative advantage of the country. Since developing countries are characterized by relative abundance of unskilled labour increased participation in world markets could increase the demand of unskilled labour. Then it follows that the diffusion of skill-biased technologies and specialization according to the comparative advantage could have opposite effects in the demand of skilled labour.

Recently, the examination of the new microeconomic evidence points out that exporting- and foreign owned firms- firms are more productive than non-exporting ones, and that increased exposure to international markets may increase productivity. This stylized fact gives raise to new models that incorporates firms' heterogeneity.

These new models of trade with firm heterogeneity, predict that trade liberalization could generate significant across and within-industry reallocation effects. In these models opening to trade and consequently increased trade exposure may not only generate the traditional resource reallocation effects

from comparative disadvantage industries to comparative advantage ones, but also from less to more productive firms within industries. Firm heterogeneity in productivity is at the heart of the New-New International Trade Theory, pioneered by Melitz (2003) who develop a theoretical model which introduces firm heterogeneity. This researcher explicitly motivates his theoretical model by referring to empirical findings in the micro-econometric literature, namely that exporting firms are more productive than non-exporters, furthermore they are bigger, pay higher wages and are more capital intensive.[1] The studies by Bernard and Jensen (1999; 1995); Clerides et al. (1998); Aw et al. (2000); Isgut (2001); Alvarez and López (2005) are some studies of this empirical literature. Wage dispersion is related to export participation, with exporters paying higher wages than non exporters. This exporter wage premium is in turn accompanied by differences in workforce composition across firms (Kaplan and Verhoogen 2006; Schank, Schnabel, and Wagner 2007; Munch and Skaksen 2008). Further, wage dispersion within industries is closely related to productivity dispersion (Davis and Haltiwanger 1991; Faggio, Salvanes, and Van Reenen 2010). To the extent that wages vary across firms within sectors the reallocation of resources across firms provides an additional channel for international trade/activities to influence income distribution.

Helpman et al. (2008) have provided a theoretical framework for analyzing wages, unemployment and inequality with heterogeneous firms and workers. In their model observed differences in economic outcomes across firms and workers are the result of the interaction of firm and worker heterogeneity with labour market frictions. In this model, heterogeneity in product and labour markets are closely intertwined, with workers sorting across firms according to worker and firm characteristics. As a result firm size and wage distributions are both influenced by the distribution of firms and worker characteristics, as well as features of labour and product markets. One of the results that emerge from this model is that more productive firms screen to a higher ability threshold, employ workers with a higher average ability, and pay higher equilibrium wages.

Even though most empirical works find support for the hypothesis that exporting firms are more productive than non-exporting ones, results regarding to the learning by exporting hypothesis are not so clear cut. While some works support the self-selection hypothesis, i.e. most efficient firms self-select into export markets (A. B. Bernard and Jensen 1999; Clerides, Lach, and Tybout 1998; Aw, Chung, and Roberts 2000), some recent work for developing countries at the disaggregate level also find evidence of learning by exporting effects (Kraay, Soloaga, and Tybout 2002; Castellani 2002; Girma, Wakelin, and Research 2001; Girma and Görg 2003; Roberto Alvarez and López 2005; Van Biesebroeck 2003; Blalock y Gertler 2004; Baldwin and Gu 2003; Yasar and Morrison Paul 2007; De Loecker 2007; Fernandes and Isgut 2006) (2007). Nevertheless, both effects may be present: firms that participate in international

[1] See Wagner (2005) for a survey on the empirical literature.

markets may be more productive but also improve their productivity through its participation in world markets.

Furthermore, Brambilla et al. (2010) studying the skill premium for sixteen Latin American countries find evidence that higher sectoral exports are positively linked with the skill premium at the industry level, a result that supports recent trade models linking exports with wages and the demand for skills.

As we mention above, aside exports, other international linkages – which are also considered channels of international knowledge transfer- widely cited in the literature, are knowledge transfer by imports and foreign direct investment. Regarding to imports, the role of technology embodied in intermediate inputs and capital has been recognised –imports of intermediate inputs, capital or knowledge embodied in imports of goods that may spill over the domestic economy- some studies have shown that technology transfer from abroad may be closely related to productivity growth (Grossman and Helpman 1991; D. T. Coe and Helpman 1995; Xu and Wang 2000; Eaton and Kortum 2002; Lumenga-Neso, Olarreaga, and Schiff 2005; Kraay, Soloaga, and Tybout 2002; D. Coe, Helpman, and Hoffmaister 1997; Barba Navaretti and Soloaga 2002; Meyer and Tra 2001; Falvey, Foster, and Greenaway 2002; Schiff and Wang 2004). Though, most of these studies have shown a positive association between imports and productivity gains, the evidence on labour market outcomes is not clear cut. Even more, usually most of the literature analyses the impact of imports of final goods, and the impact of imported intermediates has been less explored. Among the few exceptions are the works by Muuls and Pisu (2008) and Fajnzylber and Fernandes (2004). Muuls and Pisu analyse the effects of imported inputs and exports finding that both increases firms' productivity. Fajnzylber and Fernandes (2004) analyse the effects of international world integration on the demand for skilled workers for Brazil and China. These authors find that while in Brazil greater integration is associated with an increased the demand for skilled labour the opposite is true for China. These findings support the importance of country specific studies.

Moreover, these international channels may be associated with internal factors specific to countries, industries and firms. One of the internal factors is absorptive capacity which can be proxied by R&D efforts and skilled labour force. For instance, Blömstrom and Kokko (1998), show that FDI may enhance host country firms' productivity through knowledge flows from cumulative R&D efforts in the foreign country, and of skilled employees and management techniques in the recipient country.

In this work we analyze the effects of exports and imported intermediates-which may act as international technology transfer channels- at the firm level for a developing country analyzing the impact on productivity, the employment and wages of skilled labour force for the period 1988-2005. To this aim we use various methodologies to test the results. Firstly, we assess performance premia associated with these international channels. Then, we estimate quantile regressions and finally we apply treatment effect

techniques to examine the causal effect of imported intermediates and exporting directly on productivity, employment and wages of skilled workers.[2]

The remainder of this work structures as follows: after this introduction in section 2 we describe the empirical strategy followed, while section 3 presents the results and in the fourth the main conclusions.

2. Empirical Strategy

2.1. Performance Premia

Firstly, we analyze the relationships between imports, exports and measures of productivity, employment and wages of skilled workers. In particular we estimate the proportional differences in performance characteristics (P_{it}) of exporting firms (EXP) and firms that use imported intermediates (IMPI) and their combinations, and those that do not. To this aim we estimate the following equation:

$$\ln P_{it} = \beta_0 + \beta_1 X_{it} + \beta_2 Size_{it} + \delta_j + \lambda_t + \varepsilon_{it} \quad (1)$$

The performance measures P_{it} include measures of productivity, employment and wages paid to skilled employees and capital-labour ratios, expressed in natural logarithms.

The measures of productivity considered are Total Factor Productivity (TFP) estimated assuming a Cobb-Douglas functional form and using the Levinshon and Petrin (2003) methodology. Also we include a measure of labour productivity defined as value added over total number of workers.

We define as skilled labour those workers in non-production activities – usually referred as white collars- and professionals and technicians. Professionals and technicians could be considered to be more skilled than other white collars.

Thus, the measures of employment include the number of skilled workers –i.e. non-production workers and professional and technicians and the share of skilled workers in total employment.

As measures of wages we considered wages of skilled workers per firm, the share of skilled wages in variable costs of the firm and the share of wages of skilled workers in total wages per the firm.

The international linkages variables included in $\mathbf{X}_{it}$ are the dummy variables EXP, IMPI and their combinations.[3] We control for firm size using two different definitions: as the natural logarithm of total employment and a dummy variable equal to one for those firms with more than 100 workers. This variable captures differences in production technologies of firms with different size. This is omitted when the performance measure ($\ln P_{it}$) measure is based on overall employment or is on a per employee basis.

[2] Further, we estimate continuous treatment effects for the export propensity and the share of imported intermediates in other related work.

[3] Foreign ownership is analysed in other related work.

Time dummies (λ_t) capture macroeconomic shocks and changes in the institutional environment. Finally, industry dummies (δ_t) control for sectoral differences that remain invariant during the period. The parameter β_1 indicates the average differences in performance ($\ln P_{it}$), i.e. the percentage premia in terms of performance characteristics between firms for the various channels of knowledge transfer and firms that do not have these channels, conditional on industry, year and size.

2.2. Quantile regressions

Quantile regressions allow examining the performance effect of international linkages at different points of the conditional distribution of the dependent variables (productivity, skilled labour and wages paid to skilled workers, share of skilled employment and of skilled wages per firm).

When Ordinary Least Squares (OLS) is used to estimate (1) and there is unobserved heterogeneity, then the estimated coefficients are not representative of the entire conditional distribution (Dimelis and Louri 2002).

To account for some of the heterogeneity in the sample, observed firm level characteristics (such as firm size and industry) are explicitly included in the regression equation. Nevertheless, in the case of firm level data, usually there is heterogeneity which is quite difficult to observe, such as managerial capability.

Unobserved heterogeneity may cause that the dependent variables in (1) and the error term to be independently but not identically distributed across firms. If observations are not identically distributed then OLS will be inefficient. Moreover, if there are long tails, extreme observations will have significant influence on the estimated coefficient. In this regard quantile regression estimates place less weight on outliers and are robust to departures from normality.

In contrast to the OLS estimator, which provides information only about the effect of regressors at the conditional mean of the dependent variable, the results of quantile regressions give parameter estimates at different quantiles. Thus, this technique provides information regarding to the variation in the effect of the regressors on the dependent variable at different quantiles.

2.3. Treatment Effects Analysis

We use a matching and difference-in-differences methodology which allows studying the causal effect of international linkages (the treatment) on firms which engage in international linkages (the treated) relative to firms that did not have international linkages (the control group). Thus, our aim is to evaluate the causal effect of exporting and using imported intermediates on **Y**, where **Y** represents productivity, number and shares of skilled workers and the level and shares of wages paid to skilled workers. Y is referred to as the "outcome" in the evaluation literature. [4]

[4] Blundell and Costa Dias (2000) present a review of the microeconomic evaluation literature.

The effect of international activities is the estimated difference-in-difference of the outcome variable (productivity, share of skilled employment and wages) between the treated and the control groups.
Let Y_{it} be the outcome for plant *i* in industry *j* at time *t*.

Let the international linkages (IL) where $IL_{it} \in \{0,1\}$ denotes an indicator (dummy variable) of whether firm *i* has started to have an international linkage -exports (EXP) or using imported intermediates (IMPI)- and $Y_{i,t+s}^{1}$ is the outcome at t+s, after starting this activity. Also denote by $Y_{i,t+s}^{0}$ the outcome of firm *i* had it not has this international linkage. The causal effect of the IL for firm *i* at period (t+s) is defined as: $Y_{i,t+s}^{1} - Y_{i,t+s}^{0}$

The fundamental problem of causal inference is that the quantity $Y_{i,t+s}^{0}$, referred as the counterfactual, is unobservable. Causal inference relies on the construction of the counterfactual, which is the outcome the firms would have experienced on average had they not been exposed to the IL. The counterfactual is estimated by the corresponding average value of firms that do not have this IL. An important issue in the construction of the counterfactual is the selection of a valid control group and to this end me make use of matching techniques.

The basic idea of matching is to select from the group of firms belonging to the control group those firms in which the distribution of the variables $\mathbf{X}_{it}$ affecting the outcome is as similar as possible to the distribution to the firms belonging to the treated group. The matching procedure consists on linking each treated individual with the same values of the $\mathbf{X}_{it}$**.** We adopt the "propensity score matching" method. To this end, we first identify the probability of being a firm engaged in IL (the "propensity score") for all firms, irrespective if they belong to treated or control group by means of a logit model. A firm *k* belonging to the control industries, which is "closest" in terms of its "propensity score" to a firm belonging to the tradable industries, is then selected as a match for the former. There are several matching techniques, and in this work we use the "kernel" matching method that penalises distant observations, and bootstrapped standard errors.

A matching procedure is preferable to randomly or arbitrarily choosing the comparison group because it is less likely to suffer from selection bias by picking firms with markedly different characteristics. As Blundell et al (2004) point out, a combination of matching and difference-in-difference is likely to improve the quality of non-experimental evaluation studies. The difference-in-difference approach is a two step procedure. Firstly, the difference between the average output variable before and after engaging in the international activity is estimated for firms belonging to the treated group, conditional on a set of covariates ($\mathbf{X}_{it}$). However, this difference can not be attributed only to the IL since after the firm started to undertake this activity the output variables might be affected by other macroeconomic factors, such as policies aimed to stabilization of the economy. To deal with this the difference obtained at the first stage is further differenced with respect to the before and after difference

for the control group of non-tradable plants. The difference-in-difference estimator therefore removes effects of common shocks and provides a more accurate description of the impact of the international linkages.[5]

2.4. Data sources

The data sources for the panel of firms are from the Industrial Census for 1997 and the Annual Surveys from 1988 until 2005, carried out by the "Instituto Nacional de Estadísticas del Uruguay" (INE). The harmonised data for the period 1988-2005 was provided by the Department of Economics of the School of Social Sciences.

In 1988 an Economic Census was conducted, and in the period 1989-1996 Annual Surveys were undertaken. In 1997 an Economic Census was carried out and changes in the sample as well as in the methodology with respect to previous years were introduced in the following Annual Surveys.

Before 1997 the INE discriminated firms according to units of activities (Unidades de clase de Actividad also named UCAs) since the same firm can undertake activities in several different sectors. Thus, a firm could have several records in the Survey according to its different activities. Moreover, the Industrial Surveys gathered the data exclusively for manufacturing activities. This methodology changed since the 1997 Economic Census while the INE instead of recording data by activities started to register data globally at the firm level in the so called Surveys of Economic Activities. Hence, since 1997 if a firm has activities in several sectors (which can be manufacturing as well as commerce and services) the data will be at the firm level in just one record and it is not possible to discriminate the different activities. The firms are classified by the INE according to its main activity.
For this reason the data will take into account the whole activity of the firm and do not allow isolating the manufacturing activity from commerce and services, neither the different manufacturing sectors. Thus, the data on the firm give us an approximation to the value of production and the resources used but in some cases could be overestimated.[6]

The data provided by the INE includes gross output, value added, sales, exports, intermediate consumption discriminated in various items, number of workers, capital, imported and domestic intermediates and expenditures in R&D.

[5] In future work we will address the continuous treatment effect since it is likely to have a different response at different export-sales ratio and rate of imported intermediates in total imports. For FDI we have some data limitation since in most years is a binary variable, and for some years we have 4 categories.

[6] According to the INE the percentage of firms that has activities in several sectors (manufacturing and/or commerce and/or services) accounts for the 25 % of the whole firms surveyed in the period 1997-2005.

One important variable is capital which is defined as the value of lands, buildings and constructions, machinery and equipment, intangible assets and other capital goods used by the firm.
In order to approximate the flow services of capital we use the stock under the assumption that flow services are proportional to the stock of capital. Nevertheless we should keep in mind that the stock of capital does not adjust quickly to changes in business cycles. Hence, total factor productivity estimated using data on capital stock will fluctuate pro-cyclically in relation to the rate of capital utilization. Nevertheless, since there is no data available to estimate flow services of capital and most of the empirical works use the stock of capital, in this study we use stock the capital in the estimation of the production functions and total factor productivity. Gross output, value added, intermediates, capital and wages were deflated by specific industry price deflators that were constructed at the 4 ISIC digit level, with base year 1997.

We have to keep in mind that the Uruguayan economy was also affected by the Brazilian devaluation in the 1998 and since this year entered in a phase of recession that end up with the economic crisis in 2002 and the beginning of the recovery in 2004.

2.5. Variable definition

As measures of productivity we estimate Total Factor Productivity (TFP) and Labour Productivity (LP).
Total Factor Productivity was estimated assuming a Cobb-Douglas functional form and using the Levinshon and Petrin methodology which allows correcting for endogeneity in inputs (Ln TFP) while the attrition bias was tackled using an unbalanced panel of firms.
Labour Productivity was defined as value added over total employment (Ln LP).

As measures of skilled employment we considered the number of skilled labour per firm-defined as workers in non-production activities and professionals and technicians- and the share of employees and professionals and technicians in total workforce (Ln SL_S0).[7]

As measures of skilled wages we analysed the wages of skilled workers at the firm level (Ln Wages_SL), the share of wages of skilled workers in variable costs (Ln Wages_C0),[8]and the share of wages of skilled workers in total wages of the firm (Ln Wages SL_S0).

As explanatory variable we analyse the export status of the firm defined as a dummy variable that takes the value of one when the firm undertakes exports and zero otherwise (EXP) and imported intermediates

[7] Further we discriminate skilled workers in professionals and technicians and other white collar workers. Results are available upon request.

[8] Fajnzylber and Fernandes (2004) analysing the demand for skilled labour for Brazil and China use a similar definition of skilled wages over variable costs and skilled labour over total labour.

defined as a dummy that takes the value of one if the firm uses imported intermediates and zero otherwise (IMPI).

3. Results

3.1. Descriptive statistics

In Table 1 we present some descriptive statistics indicating the percentage of firms falling into each category for the dummy variables that capture international linkages (EXP and IMPI), and the average value for the shares of exports in total sales and imported intermediates in relation to total intermediates.

We find that in the period analyzed 8 % are foreign firms, 34 % undertake exporting activities and 42 % use imported intermediates. On the other hand 19 % of the firms sampled do not undertake any of the three activities analyzed. Regarding to technological capabilities, 8.5 % of the firms carry out R&D activities. The average export propensity is of 14 % while the share of imported intermediates used by the firms is of 21 %.

The average number of total workers per firms in the period is of 56 workers, while the 75 % of the firms has less than 50 workers and 14 % more than 100 workers. As we mention before, we discriminate between skilled workers and unskilled ones using a rough proxy: we considered skilled workers employees and professional and technicians. The latter are assumed to be even more skilled than employees (usually administrative workers). The average number of skilled workers is of 15.49, for employees the figure is of 15 and for professional and technicians of 3. On the other hand the average number of blue collar per firm is of 49 workers (see Table 1.2.).

With respect to wages, the average wage premia of professionals and technicians in relation to blue collars is of 15 %[9] and a maximum of 240 % while the wages of employees to blue collars reaches maximum gap of 98 %.

In what follows we present our results.

3.2. Premia

In Table 2 we present the estimated performance premia associated to the two international transfer channels and their combination.

We find that the coefficients for labour productivity, TFP and employment are positive and significant indicating that those firms that undertake exports and use imported intermediates perform better in terms of labour productivity, total factor productivity and employment. Our results support the findings of Bernard et al. (2003) that exporting firms perform better and are larger than non-exporting firms. These results are consistent with those obtained in most of the empirical evidence reviewed. Further, firms that

[9] This figure is affected by the large number of firms that do not report professionals and technicians.

use imported intermediates also have a superior performance than the base group as found by Muuls and Pisu (2008).

Regarding to skilled labour, we find a positive association with the two channels of international technology transfer considered in this work. On the other hand, the share of skilled workers in total employment shows a negative and significant association with exporting, and a positive association with imported intermediates. One possible explanation for the negative impact of exports may be the export specialization of the country based on low value added products, mainly agro-industrial goods according to the comparative advantage of the country.[10] Thus, even though exporting firms hire a large number of skilled workers compared to non-exporting firms, the relation is not linear, and the share of unskilled workers is even higher compared to non exporting firms. This could be explained due to the fact that exporting requires both the production of physical units of the good and the provision of export services. These include labelling, marketing, technical support, consumer support (webpage, email, warranty. Then, it follows that to export –even low technology intensive products- will require more skills than to sell in the domestic market (Brambilla et al. 2010) which could explain the positive association between exports and the number of skilled workers. In other words, the negative association between exports and the share of skilled labour in total labour could be explained by a higher increase in unskilled labour in total labour in line with comparative advantages of the country in low technological intensive products. Summing up, exporting firms and firms that use imported intermediates have a higher number of skilled labour force but when we considered the share of skilled workers in relation to total workers there is a negative association with the export status of the firm and a positive relationship with imported intermediates.

The wages of skilled workers per firm show a positive association with international linkages. On the other hand the wage bill share of skilled workers in variable costs also shows a positive association with exports and imported intermediates. Finally, the share of wages of skilled workers in total wages per firm shows a negative association with exports and a positive one with intermediate imports, mimicking the behaviour of the number of skilled workers in total workers analysed previously.

Thus, wages of skilled workers seem to be higher for exporting firms and when we take these variables in level and as share of variable costs, but show a negative association when we consider them as shares of total wage bill per firm. As commented above, these results may be driven by the high presence of firms belonging to the agro-industrial sector, in which the country enjoys comparative advantage and specialize in exporting low value added products, so even though the wage bill of skilled workers per firm is higher in absolute terms when we take this variable in terms of total wage bill there is a negative association, in line with the previous finding on the shares of skilled employment in total employment.

[10] This is so even controlling for sectoral dummies at the two digit ISIC level.

Thus, we find a positive association of exporting and imported intermediates with productivity, number and wages of skilled workers per firm. When we consider the share of skilled workers in total employment we find a positive association with imported intermediates but a negative association with exports which could be explained by a higher increase in unskilled labour in total labour in line with the comparative advantage of the country. Nevertheless, the wage bill share of skilled workers in total wages shows a negative association with the export status and a positive significant association with imported intermediates. Finally, it is worth noting that the coefficient for wages are higher than for employment which would indicate that the demand operates more through the price of skilled labour than through the number of skilled workers.

3.3. Quantile regressions

The tests of the normality[11] of the dependent variable indicate that the dependent variables depart from normality which justifies the use of quantile regressions.

In Table 3 we present the results for OLS and of the quantile regressions at 0.10, 0.25, 0.50, 0.75 and 0.90 quantiles of the distribution of each dependent variable. The coefficients can be interpreted as the partial derivative of the conditional quantile of **Y** with particular regressors, i.e. the marginal change in **Y** at the conditional quantile due to the marginal change in a particular regressor- in our case EXP and IMPI-.

For productivity, the coefficients associated with EXP vary significantly as we move from the lowest to the highest quantile. This provides evidence that there is a positive effect of exports on productivity across the entire conditional output distribution.[12] Thus, firms with higher productivity levels are more responsive to the export status. On the other hand the use of imported intermediate (IMPI) shows a relatively stable and positive coefficient across quantiles. In Chart 1 we depict the estimated coefficients for the different quantiles.

Regarding to the number of skilled workers per firm the coefficients are relatively stable from the 0.1 quantile up to the 0.5 and then decrease at the highest quantiles. Thus, the number of skilled workers shows a slightly decreasing trend from the lowest to the highest quantile for the two international channels (Chart 2). On the other hand, the share of skilled workers in total employment shows a negative association with exporting, with and increasing negative effect as we move towards higher quantiles (Chart 3).

[11] We perform the sktest in Stata 11, which throws the skewness and kurtosis tests of normality. In all cases we reject normality. The Kolmogorov-Smirnov tests (ksmirnor in Stata) also confirm non-normality.

[12] The positive shift of all quantiles means that foreign ownership and exporter productivity distribution first order stochastic dominates the non-foreign and non-exporter productivity distribution.

Finally, the use of imported intermediates has a positive association with the share of skilled workers at the lower quantiles, decreases at the median and becomes negatively significant at the highest quantiles.[13] While association of the share of skilled workers with exporting is not significant at the 10th and 25th quantile and becomes negative from the 50th onwards, indicating that a higher export share is associated to relatively more unskilled employment in line with the comparative advantages of the country.

Regarding to wages of skilled workers per firm we find a positive and significant effect with a higher effect at the lower quantiles and it decreases as we move toward the upper tail, for both, exports and imported intermediates (Chart 4), so the conditional effect is highest at the lower tail of the distribution.

The wages of skilled workers over variable costs shows a positive and significant increasing effect from the 50th quantile onwards and for imported intermediates a positive and increasing effect across the entire distribution for exports (Chart 5). On the other hand, the wages bill share of skilled workers shows a negative association with the export status of the firm. Finally, imported intermediates show a higher coefficient at the lowest tail of the distribution (Chart 6).

Thus, these results confirms that the effect of the different variables of international linkages have a different effect over the distribution of the dependent variable.

To sum up, productivity is more responsive to exports as we move from the low to the upper tail of the distribution, so firms with higher productivity levels are more responsive to the export status, while for imported intermediates the estimated coefficients are relatively stable and positive across the distribution of productivity. The number of skilled workers shows a positive and decreasing response at the highest tail of the distribution for the two international channels analysed. For the share of skilled workers we find a negative association with exports with and increasing negative effect as we move towards higher quantiles but a positive and decreasing response for imported intermediates. While for wages of skilled workers we find a declining trend over quantiles for the two international channels considered, so the average effect is highest at lower tail of the distribution. While the share of wages in variable costs show different behaviour according to the explanatory variable analysed at the various points of the distribution. To sum up, the response to the variables differ over the conditional distribution of each variable, confirming that the response or premia is not homogeneous. Since firms are heterogeneous, the premium in terms of productivities, skilled labour and wages for the three international linkages vary along the distribution of the various dependent variables considered to analyse

[13] Discriminating in professionals and technicians and other skilled workers we find a different response to exports and imported intermediates.

productivity and the demand of skilled labour. Thus, firm heterogeneity translates into different responses that are better captured using quantile regressions than with the standard OLS regressions.

3.4. Treatment Effect Analysis

We use treatment effect techniques which allows analysing the causal effects of international linkages (the treatment) on firms that engage in international activities (the treated) relative to firms that do not (the control group). Our treatment variables are exports (EXP) and imported intermediates (IMPI). We performed regressions in double differences without matching, matching and double differences (MDID) without bootstrapped standard errors and matching and double differences with bootstrapped standard errors. Due to space constraints[14] we will comment the results for MDID with kernel matching techniques[15] and bootstrapped standard errors which are reported in Table 4.1. The advantage of bootstrapping is that it is not assumed a specific distribution of the variable under analysis. Additionally, in Table 4.2 we report the results of MDID without bootstrapping and in Table 4.3 we present the results of the regressions in double differences without matching.

As covariates we included size defined as a dummy that takes the value of one for firms with more than 100 workers and zero otherwise, a dummy that takes the value of one for firms with value added higher than the median for the whole sample and zero otherwise, and a dummy equal one for those firms with gross output higher than the median and zero otherwise, as well as time and industry dummies. In all the cases we check that the balancing test is satisfied.[16]

For productivity and the number of skilled workers we find a positive impact of exports and imported intermediates.

On the contrary, for the share of skilled workers in total employment exports has a negative and significant impact, consistent with our previous findings, while imported intermediates have a positive and significant impact.

Regarding to wages of skilled workers we observe a positive and significant effect of both exporting and using imported intermediates, while the wage bill share of skilled workers in variable costs also shows a positive and significant effect of both channels, with a slightly higher impact of exports.

[14] An analysis of the results from the different methods used will be performed in a future version of this work.

[15] The kernel technique penalises distant observations.

[16] We use three different commands to estimate results in Stata 11: pscore followed by the attk command with the bootstrap option; the bs: psmatch2 command for MDID and bootstrapping and psmatch2 without the bootstrap option.

Nevertheless, the wage bill share of employees in variable costs shows a positive impact of imported intermediates and exports, while the wage share of professionals and technicians in total costs shows a positive impact of exports and imported intermediates, but no effects of foreign ownership.
In Table 5 we present a summary of the results for the treatment effect analysis.

4. Concluding Remarks

Regarding to the OLS estimations, we find that the coefficients for labour productivity, TFP and employment are positive and significant indicating that firms with external linkages and endogenous R&D perform better in terms of labour productivity, total factor productivity and employment, capital intensity and wages per worker paid. In particular for total factor productivity, firms with foreign ownership and its combinations are far more productive than the base group. Results are not so clear cut when we take skilled labour and wages as shares, particularly when we take skilled employment as the share of total employment and wages of skilled workers as share of total wages. Nevertheless, when we take skilled labour and wages as shares of total variable costs, there is a positive effect of international linkages.

The quantile estimations reveal that the response to the variables differ over the conditional distribution of each variable, confirming that the response or premia is not homogeneous. Since firms are heterogeneous, the premium in terms of productivities, skilled labour and wages for the three international linkages vary along the distribution of the various dependent variables considered to analyse productivity and the demand for skilled labour. Thus, firm heterogeneity is better capture using quantile regressions than with the standard OLS regressions.

The treatment effect analysis reveals a positive causal effect of exports, foreign ownership and imported intermediates on productivity, skilled labour and wages. Nevertheless, the share of skilled workers in total employment show a negative effect of exports but positive for imported intermediates, as we discussed above. Finally, when we take skilled labour wages as share of variable costs, exporting and using imported intermediates show a positive effect. In short, it seems to be a causal association of international linkages with the absolute number and wages of skilled workers but negative in relative terms when the numerator is total employment.

The whole picture that emerges is that knowledge from abroad helps to increase productivity, in line with the predictions of endogenous growth models in open economies. Furthermore, there is evidence that these linkages tend to increase the demand of skilled labour, which would in turn increase income inequality. Nevertheless there is also some evidence that exporting also increases the employment of unskilled workers and that this effect is more important for those firms with a high export propensity and probably producing goods in which the country enjoys comparative advantages, but a positive effect for the remaining exporting firms. Thus, the policy recommendation should be to promote international

linkages as well as to implement complementary domestic policies such as training of workers in order to take advantage of the globalised environment and other social policies to mitigate wage inequality.

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Table 1: Descriptive statistics

Variable	No. Obs.	Mean	Std. Dev.	Min	Max
Foreign Ownership	9,609	0.08	0.27	0	1
Exporter	16,033	0.34	0.47	0	1
Intermediate Imported Intermediates	16,023	0.42	0.49	0	1
R&D expenditures	10,697	0.08	0.28	0	1
Export Propensity	16,033	0.14	0.29	0	1
Share of Imported Imported Intermediates	16,023	0.21	0.33	0	1
Employment (number of workers)	24,313	56.04	148.07	0	4,494
Big	24,330	0.14	0.35	0	1

1.2: Number of Workers per Firm

Variable	No. Obs.	Mean	Std. Dev.	Min	Max
No. of Employees and Prof&Tec	10,182	15.13	36.96	0	954
No. Employees	18,891	15.45	45.17	0	1,419
No. P&T	10,182	3.05	8.68	0	236
No. Blue Collars	18,891	48.59	120.33	0	3,148
Total No. Workers	24,313	56.04	148.07	0	4,494

No. P&T: number of professionals and technicians

Table 2: Performance Premia

	Ln LP(a)	Ln TFP	Ln EMP(b)	Ln SL (a)	Ln SL_S0	Ln Wages SL	Ln Wages_C0	Ln Wages SL_S0
FDI	0.884	0.700	0.904	0.616	0.290	1.413	0.214	0.391
	(0.045)***	(0.044)***	(0.053)***	(0.051)***	(0.018)***	(0.063)***	(0.154)	(0.032)***
EXP	0.400	0.378	1.329	0.550	-0.147	1.072	0.781	-0.091
	(0.022)***	(0.030)***	(0.020)***	(0.026)***	(0.019)***	(0.046)***	(0.014)***	(0.025)***
IMPI	0.620	0.459	1.136	0.739	0.083	1.327	0.960	0.111
	(0.019)***	(0.027)***	(0.020)***	(0.739)***	(0.018)***	(0.043)***	(0.108)***	(0.024)***
IMPI*EXP	0.442	0.368	1.338	0.616	-0.038	1.092	0.913	0.039
	(0.024)***	(0.033)***	(0.022)***	(0.028)***	(0.020)	(0.050)***	(0.130)***	(0.026)

Ln LP: labour productivity ; lnTFP: Total factor Productivity; Ln EMP: total number of workers; Ln SL: number of skilled workers; Ln SL_S0: number of skilled workers over total workers; Ln Wages SL: wages of skilled workers; Ln WAGES_C0: wages of skilled workers over variable costs; Ln WAGES SL_S0: wages of skilled workers over total wages.

Ln stands for natural logarithms. (a) with a dummy that takes the value of 1 for firms with more than 100 workers and zero otherwise; (b) without control for size. When no specified the control for size is the natural logarithm of the total number of workers.

EXP: dummy equal one if the firm export and zero otherwise; FDI: dummy equal one if the firm has more than 10 % of foreign capital; IMPI: dummy equal one if the firm uses imported intermediates.

Standard errors between brackets. *significant at 10 %; ** significant at 5 %; *** significant at the 1 % of confidence.

Table 3: Quantile regressions

			Quantile Regressions				
Independent	Dependent	OLS	0.1	0.25	0.5	0.75	0.9
	EXP	0.400	0.091	0.161	0.265	0.361	0.450
Ln LP		(0.022)***	(0.037)**	(0.025)***	(0.023)***	(0.025)***	(0.041)***
	IMPI	0.620	0.538	0.437	0.480	0.578	0.686
		(0.019)***	(0.035)***	(0.021)***	(0.020)***	(0.023)***	(0.034)***
	EXP	0.378	0.163	0.201	0.319	0.381	0.512
Ln TFP		(0.030)***	(0.038)***	(0.029)***	(0.022)***	(0.028)***	(0.045)***
	IMPI	0.459	0.475	0.370	0.390	0.435	0.500
		(0.027)***	(0.037)***	(0.026)***	(0.021)***	(0.030)***	(0.042)***
	EXP	0.550	0.693	0.649	0.621	0.472	0.303
Ln LS		(0.026)***	(1.09e-18)***	(8.07e-09)***	(0.015)***	(0.023)***	(0.039)***
	IMPI	0.739	0.860	0.750	0.760	0.688	0.590
		(0.739)***	(1.63e-08)***	(0.020)***	(0.030)***	(0.016)***	(0.037)***
	EXP	-0.147	0.038	-0.042	-0.165	-0.229	-0.305
Ln SL_S0		(0.019)***	(0.040)	(0.028)	(0.022)***	(0.028)***	(0.019)***
	IMPI	0.067	0.219	0.223	0.095	-0.005	-0.075
		(0.019)***	(0.034)***	(0.026)***	(0.023)***	(0.020)	(0.020)***
	EXP	1.072	1.271	1.210	1.165	0.956	0.830
Ln Wages SL		(0.046)***	(0.079)***	(0.062)***	(0.070)***	(0.064)***	(0.073)***
	IMPI	1.327	1.627	1.460	1.319	1.174	1.120
		(0.043)***	(0.071)***	(0.052)***	(0.060)***	(0.063)***	(0.066)***
	EXP	0.781	0.209	0.476	0.873	0.912	1.084
Ln Wages_C0		(0.014)***	(0.168)	(0.129)***	(0.136)***	(0.180)***	(0.255)***
	IMPI	0.960	0.744	0.836	0.933	1.203	1.210
		(0.108)***	(0.189)***	(0.125)***	(0.148)***	(0.159)***	(0.251)***
	EXP	-0.091	0.048	-0.007	-0.117	-0.195	-0.162
Ln Wages SL_S0		(0.025)***	(0.060)	(0.040)	(0.028)***	(0.028)***	(5.70e-09)***
	IMPI	0.111	0.247	0.244	0.137	-0.025	-0.088
		(0.024)***	(0.062)***	(0.038)***	(0.029)***	(0.035)	(2.09e-08)

Ln LP: labour productivity; lnTFP: Total factor Productivity; Ln LS: number of skilled workers; Ln SL_S0: number of skilled workers over total workers; Ln WAGES SL: wages of skilled workers; Ln Wages_C0: wages of employees and professionals and technicians over variable costs; Ln Wages SL_S0: wages of skilled workers over total wages.

Ln stands for natural logarithms. EXP: dummy equal one if the firm export and zero otherwise; IMPI: dummy equal one if the firm uses imported intermediates. Standard errors between brackets. *significant at 10 %; ** significant at 5 %; *** significant at the 1 % of confidence.

Chart 1: Quantile coefficients, dependant variable: Ln TFP

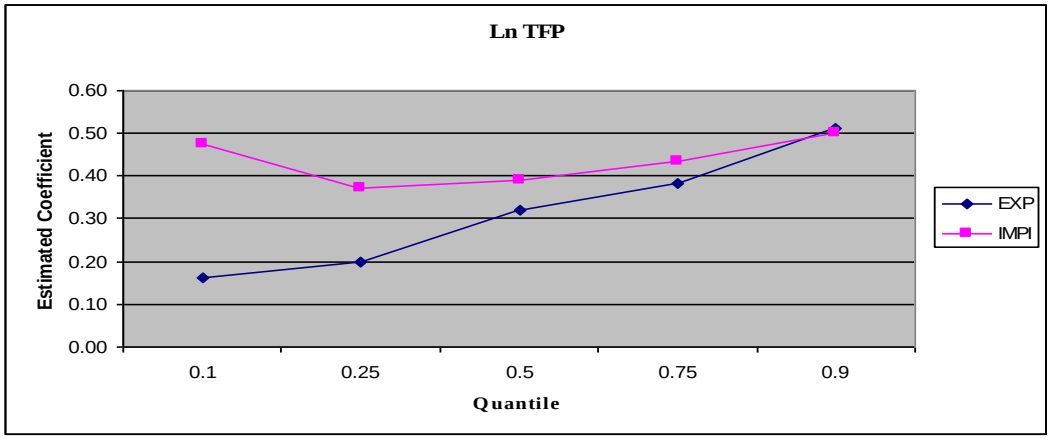

Chart 2: Quantile coefficients, dependent variable: Ln Number of Skilled Worker per firm

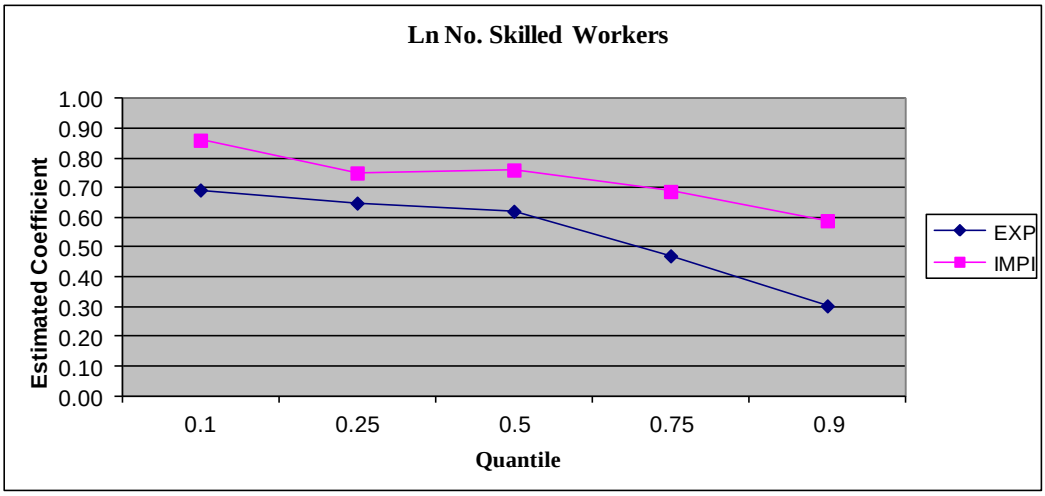

Chart 3: Quantile coefficients, dependent variable: Ln Number of Skilled Workers over total Workers

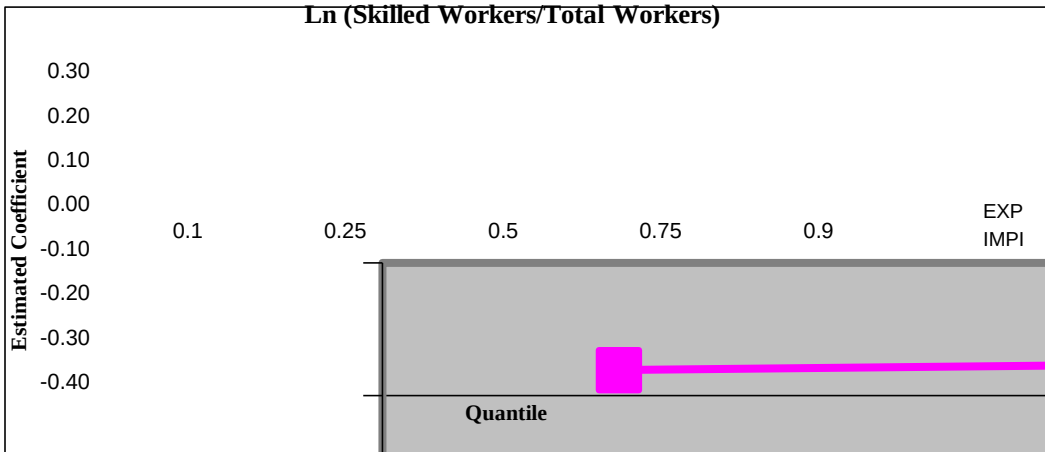

Chart 4: Quantile coefficients, dependent variable: Ln Wages of Skilled Workers

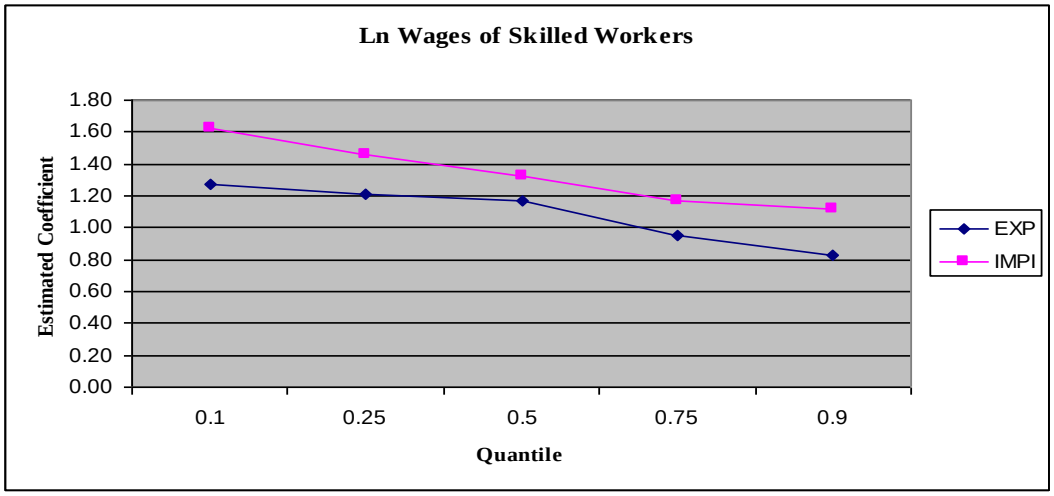

Chart 5: Quantile coefficients, dependent variable: Ln Wages of Skilled Workers over Variable Costs

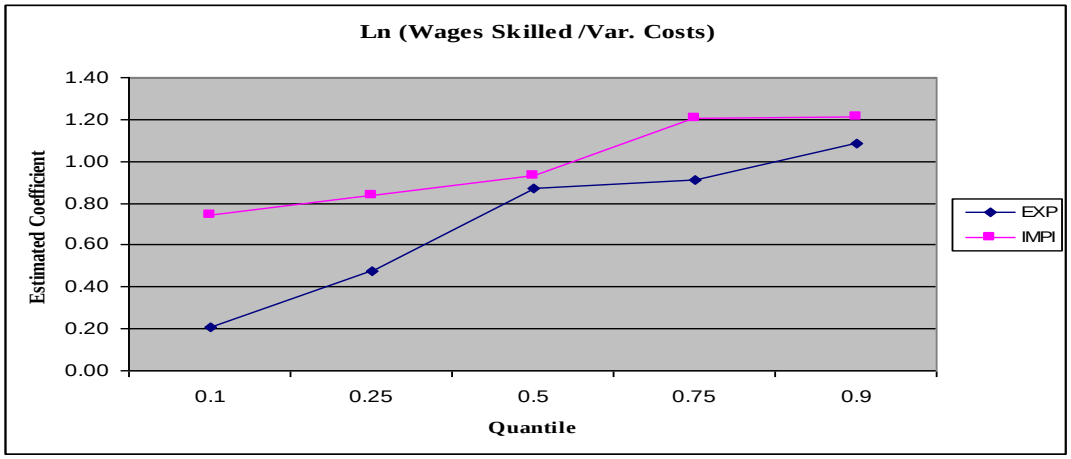

Chart 6: Quantile coefficients, dependent variable: Ln Wages of Skilled Workers/Total Wages

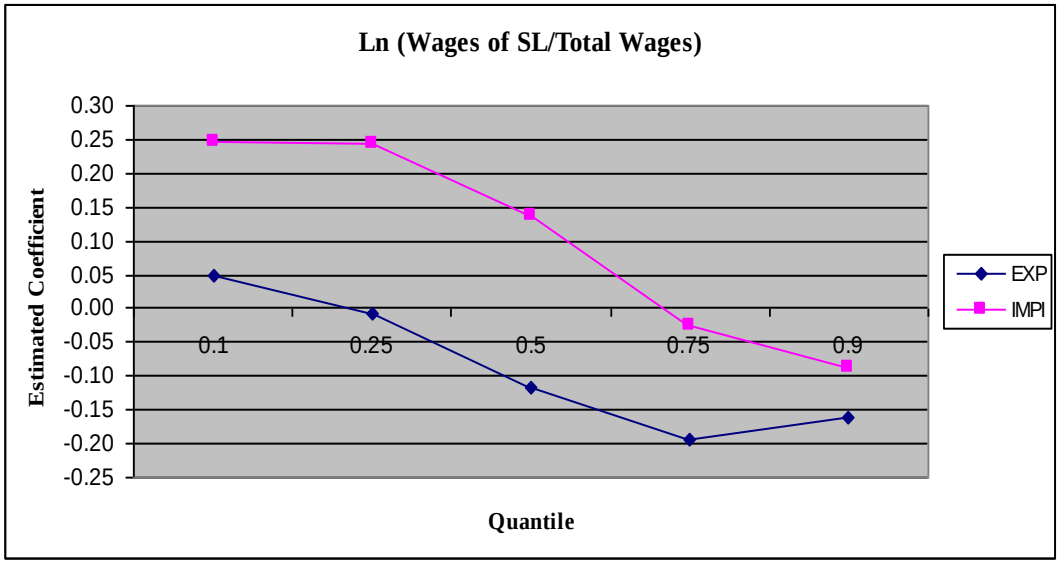

Table 4.1. Matching and Double Difference with bootstrapped standard errors

Output Variable	Ln LP	Ln TFP	Ln SL	Ln SL_S0	Ln Wages_SL	Ln Wages_C0	Ln Wages_S0
EXP	0.171	0.130	0.254	-0.128	0.464	0.308	-0.035
	(0.020)***	(0.067)***	(0.030)***	(0.038)***	(0.052)***	(0.151)***	(0.032)
IMPI	0.284	0.212	0.500	0.107	0.680	0.354	0.101
	(0.018)***	(0.023)***	(0.031)***	(0.029)***	(0.058)***	(0.119)***	(0.031)***

Ln LP: labour productivity; Ln TFP: Total factor Productivity Ln LS: number of skilled workers; Ln SL_S0: number of skilled workers over total workers; Ln WAGES SL: wages of skilled workers; Ln Wages_C0: wages of employees and professionals and technicians over variable costs; Ln Wages SL_S0: wages of skilled workers over total wages. Ln stands for natural logarithms. Standard errors between brackets.
EXP: dummy equal one if the firm export and zero otherwise; IMPI: dummy equal one if the firm uses imported intermediates.
*significant at 10 %; ** significant at 5 %; *** significant at the 1 % of confidence.

Table 4.2: Matching and Double Difference without bootstrapped standard errors

Output Variable	Ln LP	Ln TFP	Ln SL	Ln SL_S0	Ln Wages_SL	Ln Wages_C0	Ln Wages SL_S0
EXP	0.171	0.237	0.254	-0.124	0.464	0.409	-0.035
	(0.026)***	(0.033)***	(0.041)***	(0.026)***	(0.072)***	(0.172)**	(0.34)
IMPI	0.284	0.212	0.500	0.084	0.680	0.395	0.101
	(0.024)***	(0.030)***	(0.039)***	(0.025)***	(0.070)***	(0.209)**	(0.033)***

Ln LP: labour productivity; Ln TFP: Total factor Productivity Ln LS: number of skilled workers; Ln SL_S0: number of skilled workers over total workers; Ln WAGES SL: wages of skilled workers; Ln Wages_C0: wages of employees and professionals and technicians over variable costs; Ln Wages SL_S0: wages of skilled workers over total wages. Ln stands for natural logarithms. Standard errors between brackets.
EXP: dummy equal one if the firm export and zero otherwise; IMPI: dummy equal one if the firm uses imported intermediates.
*significant at 10 %; ** significant at 5 %; *** significant at the 1 % of confidence.

Table 4.3: Double Difference without Matching

Output Variable	Ln LP	Ln TFP	Ln SL	Ln SL_S0	Ln Wages_SL	Ln Wages_C0	Ln Wages SL_S0
EXP	0.154	0.208	0.290	-0.105	0.471	0.509	-0.056
	(0.019)***	(0.022)***	(0.025)***	(0.020)***	(0.041)***	(0.147)***	(0.026)
IMPI	0.264	0.215	0.481	0.136	0.690	0.686	0.176
	(0.017)***	(0.021)***	(0.024)***	(0.019)***	(0.140)***	(0.140)***	(0.026)***

Ln LP: labour productivity; Ln TFP: Total factor Productivity Ln LS: number of skilled workers; Ln SL_S0: number of skilled workers over total workers; Ln WAGES SL: wages of skilled workers; Ln Wages_C0: wages of employees and professionals and technicians over variable costs; Ln Wages SL_S0: wages of skilled workers over total wages. Ln stands for natural logarithms. Standard errors between brackets.
EXP: dummy equal one if the firm export and zero otherwise; IMPI: dummy equal one if the firm uses imported intermediates.
*significant at 10 %; ** significant at 5 %; *** significant at the 1 % of confidence.

Table 5: Summary results of the Matching and Double-Difference Estimations

	Exports		Imported Intermediates	
Output Variable	MDID	DID	MDID	DID
Ln LP	+	+	+	+
Ln TFP	+	+	+	+
Ln SL	+	+	+	+
Ln SL_S0	-	-	+	+
Ln Wages_SL	+	+	+	+
Ln Wages_C0	+	+	+	+
Ln Wages SL_S0	ns	ns	+	+

Ln Lp: Labour Productivity; Ln TFP: Total factor Productivity; Ln LS: number of skilled workers; Ln SL_S0: number of skilled workers over total workers; Ln WAGES SL: wages of skilled workers; Ln Wages_C0: wages of employees and professionals and technicians over variable costs; Ln Wages SL_S0: wages of skilled workers over total wages.
MDID: matching and diff-in-diff; DID: double differences without matching
Ln stands for natural logarithms.