Real exchange rate and manufacturing industry profitability and employment in Ecuador

Sara A.Wong*

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Abstract[1]

We study profits and employment impacts of real exchange rate (RER) changes in Ecuadorian manufacturing establishment, in particular the RER appreciation observed during the oil export boom of the 2000s. Ecuadorian manufacturing industry sells domestically most of its production and purchase a considerable share of its inputs from foreign sources. We apply panel data techniques and find that such impacts depend on the trade orientation of the industry, much in line with previous empirical studies on the subject. We find a negative and significant effect of the RER on profits: given that most firms sell most of its production to the domestic market and work in an import competitive environment, when the RER falls (appreciation in RER) competition from imports abates and profit increase. RER appreciation should have a negative impact on employment through the revenue channel for export oriented firms, which with a higher share of exports in total sales, should show a stronger fall in employment induced by the appreciation, but a RER appreciation reduces the cost of foreign inputs and the higher the share of foreign inputs the more the increase in employment (provided they are complement) –for establishments in export-oriented industries, the latter effect may lessen the former. Given that the data shows that most industries in Ecuador have higher import intensity, and high import penetration, these results suggest that profits and employment impacts of a RER appreciation may actually be positive in Ecuador. Ecuador is a country that has issued laws to foster export-oriented industries and that needs to expand productive activities that generate US dollar, given that it is a dollarized economy –the country renounced its own currency in January 2000. However, in practice, the current oil export boom may act against the export manufacturing activity, while being in favor of the import competing industry. The favorable impact on profits and employment that it implies seems to generate all the incentives to continue the growth of import competing industries –a short run interest may be acting against a long-run goal of a more export-oriented economy.

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I. Introduction

Since 2000, Ecuador has faced three important economic developments: (i) the country adopted the US dollar as its own currency in January 2000, making it all the more important to have entry of foreign currency through export activities (FDI or remittances, but these sources are not the focus of the present study)[2], (ii) an oil export boom throughout the 2000s, which has been one of the main sources of revenue for the government, and (iii) associated to the export boom, RER appreciation since early-mid 2000s. Also, since mid 2000s, as reflected by government laws and rules, there has been a renewed interest in fostering domestic industries, although not necessarily manufacturing, or export-oriented manufacturing for that matter – despite demonstrated value of manufacturing to generate formal employment and value added in the process of development (see for instance Pages 2010 eds) and the need of Ecuador, as a dollarized economy, to foster productive exports.

Manufacturing development has been in the policy agenda for some time now in Latin American countries, employment generation being one reason of this interest. However, nowadays this region has a larger share of employment in the service sector than expected, given its stage of development, which has been attributed to both the relative specialization of the region in services and the Dutch disease, by which non-tradable sectors thrive induced by the real exchange rate appreciation that is associated to a resource boom or large and persistent terms of trade gains, as it has been the case in Latin America in the 2000s (de la Torre et al., 2012).

The trends apparent for the entire LAC region could be also observed in the case of Ecuador. According to Figure 1a, there has been an oil export boom in Ecuador in the 2000s triggered by the increase in oil prices. In the same period we observe, in Figure 1b, periods of important RER appreciation (but also real devaluation). As Figure 1c shows, periods of appreciation coincide with periods of non-tradable sectors grow, while manufacturing decreases or stagnates (granted not all manufacturing industries are export-oriented, and as the evidence will later point, most manufacturing industries in Ecuador are import-competing and sell most of its production in domestic markets). We consider the case of Ecuador to delve into the nexus between RER developments and manufacturing performance, working with firm-level data, which may allow us to uncover channels of transmissions of RER changes, namely impacts on profits and employment, while controlling for firm and industry characteristics. These issues have not, to the best of our knowledge, been studied so far in the literature for the case of Ecuador. We expect the analysis based on firms to produce guidance for policymakers in the entire region.

Figure 1 offers a couple of notions on this regard for Ecuador. Notably, the potential source of the 'Dutch disease' is the large oil revenues (panel a), which somehow coincided with the decline of the manufacturing sector (panel c and d). Panel b shows the sharp RER appreciation in early 2000s and a small trend of depreciation later on. In fact, if we observed the RER vis-à-vis the countries with which Ecuador trades most (notably some LAC), then depreciation is apparent, but this is likely compensated by the appreciation observed in other countries, like those of the EU (in particular for the late 2000s, not shown in the figure) –that are also important trade partners in particular for industry exports.

Also in the 2000s, the government of Ecuador has issued several laws and rules to foster competitiveness, industry growth and exports. Two examples are the Constitution of Ecuador which sets "…the government obligation of promoting exports … with preference those that generate more employment and value added, in particular, exports from medium and small producers …" (See Constitution of Ecuador 2008, article 306). The other example is the "Código Orgánico de la Producción, Comercio e Inversiones", issued in 2010 that establishes

[2] Of course it also means that the country lost policy instruments such as money supply (although the government still may affect it through the money multiplier and open market operations) and nominal exchange rate, that are typically used by governments to face shocks. It also means that the country should commit to fiscal discipline as well as other institutions to keep dollarization in place. The study of these policy constraints and commitments go beyond the reach of our study.

among its goals to foster and diversify exports, and commands the government to foster export-oriented production. More recently –in particular after the 2008 crisis, the emphasis on the government interest has been on manufacturing to substitute imports.

In fact, the Ecuadorian manufacturing industry sells domestically most of its production. Using data from the 2006 survey of manufacturing industries we find that 75% of the production is sold domestically. Using the same data we also estimate that around 25% of the inputs are bought from foreign sources.[3] Using data on imports and export combined with production from the manufacturing survey, by group of industry (roughly at the 2-digit ISIC revision 3) we also find that, except for two industries (food and beverages, and wood and wood products), manufacturing in Ecuador is import competing –there is a high import penetration (measured customarily as imports over consumption, in turn equals to production plus imports minus exports) or a high import intensity (imports over sales) in the Ecuadorian manufacturing industries. See Table 1.

Given the policy relevance of the manufacturing sector for Ecuador, vis-à-vis its decline in light of the RER changes triggered by oil export developments since the 2000s, the objective of the proposed work is to provide empirical evidence on manufacturing firm performance and disentangle de-industrialization concerns in Ecuador. In particular we ask, how have RER changes during the 2000s oil export boom affected manufacturing industries profitability and employment in Ecuador?

In answering these research questions we provide inputs and guidance for the Ecuadorian Government regarding seemingly contradictory policies: on the one hand, policies that aim to promote manufacturing development, but on the other, policies that do not shield the economy from the negative impacts that the oil export boom –that increases government revenues– may bring in the manufacturing sector.

- *Main findings*

The main findings should be understood in the context of the predominantly import competing setting of the Ecuadorian manufacturing industry, where most of the production is sold domestically and a sizable share of inputs is brought abroad, and shocks faced by the economy in the 2000s. Manufacturing has faced a boom in imports that has been fueled by the increasing oil revenue channeled through increasing wages and wage expenditures. Thus we find that a real appreciation (fall in RER) actually has significant positive effects on profitability which is in line with the imported input setting of manufacture, but more import intensity hurts manufacturing's profitability through increased competition. This latter negative effect is lessened in period of increasing value (depreciation) of RER for more import-intense industries. RER developments also affect employment in a similar fashion. We find a negative and significant effect of the RER on employment, in agreement with the profitability impacts: a real appreciation or fall in RER (that positively affects profits in our previous finding) increases employment. In contrast, the more the ratio of imports over sales and of production over exports the more employment is demanded, the former may reflect larger need of workers when more imported inputs come in, the latter the need of more workers when more production is done locally (as the lion's share of the manufacturing sales are domestic). When the effect of the RER is taken into account along the trade setting, results indicate that a fall in RER (appreciation) reduces the need of employment in import competing industries (again as domestic industries have to compete against more imports), but increases it in export oriented ones.

- *Main sections*

This research is organized as follows. The next section present key theoretical underpinnings and summarizes key previous empirical work. Section III lays out the methodology, while Section IV discusses data sources and variables, and Section 6 presents the results for the hypotheses under analysis. Section VI concludes.

[3] Unfortunately, not all the years of the manufacturing survey has such detailed data on market destiny of production or market source of inputs. We only have year 2006 and 2008 with these information.

II. Theoretical foundation and empirical literature review

How RER developments affect manufacturing industries is an old question that has been empirically addressed in the past mostly by developed countries when bouts of RER appreciation have happened in an economy. For instance, Branson and Love (1988) discusses the impacts of a RER appreciation of the US dollar on productivity and employment in early 1980s using data at the 2-digit manufacturing industry level; these authors find significant negative impacts on employment when the dollar appreciates. Clarida (1997) studies RER changes and US manufacturing profits and find that, during the early 1980s, the appreciation of the dollar reduced profits by at least 25% (conditional on the realized time path of sales, costs, and markup).

A main concern of these and many other studies is the negative impacts that a real appreciating currency may have on employment and profits of manufacturing industry, particularly in countries whose output is directly or indirectly substitutable for foreign production. For this analysis is important to distinguish between exportable, import-competing and non-tradable industries. Although nice models involving these sectors and issues of RER, employment and profits are possible, we just outline interpretations of the developments that would help us layout the econometric model later on. A RER appreciation (due to, for instance, an oil export boom) squeezes output prices relative to input prices in tradable goods industries, which in the short run means that firms produce at lower margins and competitive sectors make negative profits (at least while revenue still cover variable costs) (See Tybout, 2000). And an appreciating currency may also mean increase import penetration, putting even more competitive pressures on domestic production.

The literature (Gourinchas 1999, Campa and Goldberg 2001, Goldberg and Hellerstein 2008, Nucci and Pozzolo 2010) points that these issues should be studied at the firm level because in the aggregate we may not be able to capture changes that help see relationships between the RER and the variables of interest (profits, output, employment).[4] We follow this literature and study manufacturing sector developments when it faces RER changes (appreciation during the export booms, and depreciation, say in case of a reversal of flows due to the post crises), using Ecuadorian manufacturing establishment-level data[5]. In other words, what are the impacts on profits and employment in these firms. The empirical literature on real exchange rate and manufacturing industry, with industry and firm-level data focuses notably on developed countries, but not so much in developing countries (data availability may explain the situation), in this vein our study should be an important contribution to the empirical literature.

However, determinants of exchange rate exposure are complex and may be difficult to pinpoint –lack of adequate data being one reason. For instance, firms may take actions to hedge against exchange rate movements designing a proper financial market strategy –as an increasing number of financial instruments become available (Gao 2000). However, to the extent that financial markets are underdeveloped in Ecuador we expect this aspect (ability to hedge) to be less important for our study. In fact, an important issue should be to control for financial pressure when studying employment in manufacturing, as financial pressures (ratio of interest to cash flow) may affect negatively employment (Nickell and Nicolitsas 1999).

A study that tackles the role of financial constraints for developing countries is Galindo, Izquierdo and Montero (2007). Using annual industry-level data for 9 LAC countries for the 1990s, the authors test employment impacts of RER fluctuations, focusing on whether impacts

[4] Schmalensee (1985) in seminal paper raises the issue of the relative importance of firm, market, and market share differences in the determination of profitability in U.S. manufacturing. Tybout (2000) discusses why Schamalensee's methodology may not work in developing countries due to the poor correspondence between their profit measure (price-cost margins) and economic profits.

[5] Establishments as opposed to firms, as recently stated in Baggs et al (2009), firms may include more than one establishment, which mostly applies to large firms. However, as in Baggs, not to make the terminology too cumbersome, we use the term firm and establishment interchangeably in our study.

vary with liability dollarization. Their results suggest that RER depreciation has a positive impact on employment; but in industries with high liability dollarization, the overall impact can be negative. Their study controls from total indebtedness effect, so that it does not overtake the balance sheet effect. Given that Ecuador is a dollarized economy (this country adopted the US dollar as its currency in year 2000), liability dollarization should not be an issue but still there is the issue of indebtedness (or liquidity effect). This effect should ideally be captured by a leverage ratio (total debt over total assets). However, there is not data on debt in our survey data. But the data may allow us to control for financial pressure (or the increase in cost of external funds), measured as the ratio of interest payments to cash flow (the latter proxied by sales) at the firm level.

One of the few recent empirical studies to tackle the effects of RER changes on manufacturing firms is Dhasmana (2013). Using data for Indian firms for 2000-2012 the author highlights the importance of distinguishing between share of imports and exports along degree of market power to study such effects. The channels of the effects are costs and revenues which have asymmetric behavior in appreciating and depreciating periods: appreciation has a stronger impact through the revenue channel while depreciation has a stronger impact through the cost channel, and concludes that appreciation likely has an overall negative effect on firm's growth performance.

An earlier work, which of Nucci and Pozolo (2010), stresses the cost and revenue channels and market power. With the firm-level data for Italy, these authors' conclusions highlight the need to account for factors such as import penetration, degree of monopoly power, export status, and degree of substitutability between imported and domestic inputs, and that as results of them RER effects should be very heterogeneous at the firm level.

Thus the main goal in this part of the study will be to provide empirical evidence on the sensitivity of the profitability and employment of manufacturing establishments in Ecuador to changes in the RER.[6] We expect to point out main channels through which the RER influences profitability in tradables manufacturing establishments (more import competing or more export oriented). To the extent that RER appreciations (expected during the oil export boom) reflect the increase in the price of nontradables, such as wages, the cost of factor inputs increase (assuming most of the inputs costs are domestic) which may impact employment negatively. Also, a domestic currency appreciation reduces de relative cost of foreign firms in terms of the domestic currency, leading to increasing competition faced by domestic firms in both domestic and foreign markets, so domestic firms should reduce their mark-ups to remain competitive. However, as pointed by previous studies, results may differ depending on the type of market a firm faces, that is, export-oriented or with higher import penetration.

Despite the relevance of studying manufacturing industry firm performance and RER changes, in particular given latest developments in RER and the importance of manufacturing and exports in Ecuador, no previous study on the issue is recalled. The present study fills in this empirical gap.

III. Methodology

To test the hypotheses that changes in the RER, observed in the latest episode oil exports boom in Ecuador (years 2000s), may have affected manufacturing industries profitability and employment negatively we use manufacturing establishment data from Ecuador. In particular, we test the following hypotheses:

[6] As noted above, Ecuador adopted the US dollar as its own currency in 2000, thus the RER is affected by world developments in the value of the US dollar. Data on bilateral RER shows a clear appreciation vis-à-vis European partners, but the trend to appreciation is not so clear in bilateral RER with Latin American trade partners. The Effective RER follows a combined path of those in the bilateral RERs. The EU, US, China and a few Latin American countries are the main trade partners of Ecuador.

(i) RER appreciation, linked to the periods of the oil export boom in the 2000s, potentially affects the mark-up of manufacturing firms, diminishing their profits, and

(ii) RER changes affect labor demand through changes induced in the value of the marginal productivity of labor, via both: (i) import competition, and (ii) financial pressures.

To test the first hypothesis we follow Baggs and Brander (2006) and include variables that control for the degree of import and export intensity in manufacturing. Thus for the *first hypothesis* we estimate the equation:

$$\ln profits_{ft} = \beta_0 + \beta_1 \ln RER_t + \beta_2 \ln Mint_{it} + \beta_3 \ln Mint_{it} * \ln RER_t + \beta_4 \ln Xint_{it} + \beta_5 \ln Xint_{it} * \ln RER_t + \gamma x_{ft} + \mu_i + t + \varepsilon_{ft} \quad (1)$$

where *ln profit* is the logarithm of profits in firm *f* (manufacturing establishment) in period *t*. *ln RER* is the logarithm of the effective real exchange rate at time *t*. *lnMint* and *lnXint* are logarithm of import and export intensity, respectively, that vary by industry group and *t*. Import intensity is imports over sales and export intensity is production over exports. We also include interactions between these trade intensity terms and the *lnRER*. These two pairs of terms aim to capture the importance of the industry environment regarding domestic and foreign competition. Given that the Ecuadorian industry is characterized by import competing industries We expect that *lnMint* has a negative sign (a higher import intensity means a lower profit as, the more a establishment has to compete against imports, the lower their profits), but the interaction with the RER should have a positive sign and it lessens the effect of import intensity alone, because with a more devaluated the currency (increase in lnRER) the higher the profits for establishments (that sell domestically) in more import competing industries. The expected sign of the export intensity term is also negative: if export intensity increases (that is, production gets relatively higher to exports –and manufacturing production in Ecuador as we have seen in the data is mostly sold in domestic markets) local competitions increases and this squeezes profits out. While the interaction term between exports intensity and the RER may also be positive: an increase in the RER may help increase profits in the more export intense market through a reduction in foreign input costs (which represent around a fourth of the total inputs).

x_{ft} is a vector of firm characteristics that include number of workers and employees, and assets[7], and t is a time trend. y_{it} is a vector of industry level control variables including a market concentration index, and industry dummies.[8] As in Baggs, the time trend is used to control for changes in the macro environment, and industry dummies control for own industry shocks. The error term is assumed well behaved.

Whether we need or not to correct the dependent variable, profits, truncating it, is a matter of discussion. The variable profits presents just a few observations (354 observations out of over 11,000) with negative profits –most of which correspond to establishments that report zero production of goods (thus likely it is a case of not reporting). There are two alternatives. (i) The zeroes are a problem of not reporting, thus profits may not be indeed zero. If we believe that there is no actual negative profits we may just drop the observation with zeros and continue the analysis accordingly: we apply first OLS, and then add fixed effects. (ii) Alternatively, if we believe that some firms have indeed negative or zero profits we need to truncate the profit variable because taking natural logarithm of profits is not feasible for negative or zero profits (so that negative or zero profits are replaced with 1 before taking logs). The latter alternative preclude us from applying OLS, instead we shall use a Tobit.

We also explore the employment impacts of changes in RER. After a RER appreciation, the more the establishment depend on exports the lower the increase in its sales (in marginal

[7] The inclusion of these variables aims to control for size.

[8] Some studies add capital output ratios, but when capital output ratio is included the industry dummies may not add any explanatory power and may not be significant (Wong 2009).

profitability, and thus in the use of labor), but the more the establishment relies on imported inputs the lower the increase in its costs, the marginal profitability, and the expected fall in employment. These two forces should help determine the final result on employment. However we consider that employment adjustment is costly and we need to account for that. As pointed in the literature of employment demand estimation, when hiring and firing of workers is costly (as it is in Ecuador), employment is expected to adjust with delay to changes in factors such as capital stock, wages, and demand for firms' output. The lag in adjustment is reflected in lags for those factors as regressors, and on the difference between the current and past employment, all of which leads to a dynamic model.

We follow thus the strategy for estimation used in Arellano and Bond (1991) to illustrate panel data tests using a dynamic employment equation with firm-level data, and apply the following regression form for the *second hypothesis*:

$$\ln L_{ft} = \beta_1 \ln L_{f(t-1)} + \beta_2 \ln RER_t + \beta_3 finpre_{ft} + \beta_4 finpre_{ft} * \ln RER_t + \beta_5 M_{it} + \beta_6 M_{it} * \ln RER_t + \beta_7 X_{it} + \beta_8 X_{it} * \ln RER_t + \gamma x_{ft} + \mu_i * \tau_t + \varepsilon_{ft} \quad (2)$$

Where, and as in previous sections, *f*, *i* and *t* are sub-indices for firm or establishment, industry, and time, respectively. *L* is the level of employment (number of workers), *RER* is the real effective exchange rate, $finpre_{ft}$ is financial pressure (measured as interest paid over sales, the latter as a proxy for cash flow), *finpre*lnRER* is the interaction between financial pressure and the RER. M and X represent measures of import and export competition, respectively. We use two alternative measures. First, we use import and export intensities, as in equation (1), with its corresponding interaction terms with the lnRER. Second, we use import penetration (imports over consumption, where consumption is measured as production minus exports plus imports) and export share (exports over production, that is, the opposite of export intensity), both terms with its respective interaction terms with the lnRER. We account for import penetration as firms more exposed to foreign competition may experience stronger employment impacts.

The expressions $\beta_2 lnRER_t$ and the interactions terms between *lnRER* and the trade measures aim to capture the impact of changes in the RER on employment through the channels mentioned above: the cost and revenue channels (that should vary over time and across firms).[9] A RER appreciation[10] should have a negative impact on employment through the revenue channel for export oriented firms, which with a higher share of exports in total sales ($\mathcal{X}$), should show a stronger fall in employment induced by the appreciation. On the contrary, a RER appreciation reduces the cost of foreign inputs and the higher the share of foreign inputs the more the increase in employment.[11]

We also include control variables at the firm level such as wages and salaries, and capital (we proxy it with assets at the end of the year). We include the logarithm of industry output (as an instrument) to capture industry demand shocks. Aggregate demand shocks are also included through an interaction effects between industry and time dummies. A key aspect of including

[9] The original proposal tried to capture the cost and revenue channels through information on sales by destiny (domestic or foreign markets) and use of inputs by origin (domestic or imported). However the data available up to now preclude us from following such approach (the available data is for only two years, 2006 and 2008, but could not use data for 2008). Thus we use data on total imports and exports, by group of industry, and combine that we data on production and consumption to construction the trade shares above mentioned. These trade measures (that somehow try to account for cost and revenue channels are far from perfect but should give us sensible and enough variation by firm to capture cost and revenue channels of the employment impacts of RER changes.

[10] Several authors (Nucci and Pozzolo 2010, Campa and Goldberg 2001) highlight the idea of using only the permanent component of the changes in the exchange rate.

[11] However, it is interesting to see that, according to trade data from the Central Bank of Ecuador, imports of raw material (as a share of GDP) actually fell during the RER appreciation period (2000-2003), but the share of imports of capital and consumption goods increased. All three types of imports (again as a share of GDP) increased in the subsequent period of RER devaluation (2004-2007). At the same time we observe an increase in the share of wage expenditure in total government expenditures during the RER appreciation period. See Figure 2.

time dummies is that the test of autocorrelation and robust estimates of the standard errors assume no correlation across individuals in the idiosyncratic disturbances, and the inclusion of time dummies help make this assumption to hold (Roodman 2009). We expect again that the error term be well behaved. All variables are in natural logarithms. This short-run dynamic set up tries to account for adjustment costs, expectation formations and decision processes (Arellano and Bond 1991),

We estimate the regressions in (2) above through the *system* GMM (generalized method of moments), dynamic panel data estimator, developed by Arellano and Bond (1991) and the subsequent improvements[12]. This methodology accounts for any specification error stemming from correlations between the regressors and the individual effects. If OLS were applied to the dynamic setting above, because of the lagged dependent variable is included as a regressor, this term is correlated with the fixed effects in the error term, which leads to a "dynamic panel bias" (Nickell 1981, as cited in Roodman 2009). Such correlation would make OLS estimates inconsistent, which in panel data with large T (periods) should not be a problem, but in panels with small T (such as the one we work with) it is a problem.[13] GMM strategy is to transform the data to remove fixed effects, and in particular, for system GMM the strategy is to instrument the lagged dependent variable used as regressor and any other endogenous variables with variables thought to be uncorrelated with the fixed effects. And it draws such instruments from within the regression. Thus to avoid dynamic panel bias, instead of transforming the regressors to 'clean' them of fixed effects (the difference GMM approach, that instruments differences with levels), system GMM transforms the instruments (differences them) to make them exogenous to the fixed effects (that is, system GMM instruments levels with differences). This approach is valid assuming that changes in any instrumenting variable are uncorrelated with the fixed effects. For more details on how system GMM works see Roodman (2009).

In the estimation of employment we apply a one-step system GMM, with robust errors estimation. We treat wages and capital as potentially endogenous including them in the list to generate GMM-style instruments for them[14]. We include industry output in that list too. We treat the industry-time dummies as IV-style (strictly exogenous) instruments. We limit to two the maximum lag distance to check for autocorrelation.

In summary, we choose to estimate the dynamic regression for employment with the system GMM, given that this estimation methodology tackles panel data issues that are a concern in our sample data, such as the one summarized in Roodman (2009):

-The process is dynamic, with current realizations of the dependent variable affected by past ones.

-We expect fixed individual effects, in particular in our setting this may refer to each firm's managerial decisions. The panel setup, with variation over time, should help us to identify parameters.

-There are regressors that are considered endogenous.

-The idiosyncratic disturbances (others than the fixed effects) may have individual-specific patterns of heteroskedasticity and serial correlation.

-The idiosyncratic disturbances are uncorrelated across individuals.

[12] In particular we use the xtabond2 command developed by Roodman. See Roodman (2009).

[13] Another estimation method applied in some studies of employment demand with panel data is the OLS with within groups estimator, however, this estimator may be a problem for several reasons: standard errors are biased as they do not account for the loss of N degrees of freedom in the pretransformation, and the within transformation does not eliminate the dynamic panel bias, and the endogeneity (of the lagged dependent variable used as regressor) cannot be addressed because they are embedded in the transformed error (See Roodman 2009, p. 103).

[14] GMM-sytle, by default, generates the instruments appropriate for predetermined variables: lag 0 of the instrumenting variable in differences for the levels equation. Whereas IV-style excluded instruments are strictly exogenous regressors, which ordinarily instrument themselves.

-The number of available time periods is small (8 years), whereas the number of individuals (firms or establishments) is large (around 1,500 establishments per year).

IV. Data sources and variables

For manufacturing data, we use annual data from the Mining and Manufacturing establishment survey data of the National Institute of Statistics and Census (INEC) of Ecuador, from years 2000 to 2010. We focus only on manufacturing establishments, excluding the industry of refinery of petroleum products.

Other domestic data such as prices (RER, GDP deflators, oil prices, etc.) and other domestic series are collected from the Central Bank of Ecuador. Trade is collected from COMTRADE. A note of caution is that export data from COMTRADE may contain re-exports.

These data sets are publicly available at no cost over the Internet.

The definition of each of the variables used in the regression is included in Annex 1.

The data on manufacturing industries proposed to be used goes from 2000 to 2007.[15] The panel data is unbalanced, with some firms appearing for the full 8-year period and others for less than 8 years. Tables 2 and 3 provide summary statistics for the variables under analysis, profits and employment, and key control variables, respectively.

V. Results

Results for hypothesis 1: effects on profits

We start by assuming that the zero profits are not reporting errors (which we believe it is more likely the case that they are omissions) and we apply a Tobit estimator. The problem with applying this estimator is that we cannot apply fixed effects.[16] We believe that we should account for such fixed effects in a regression of profits with firm-level data.[17] However, we run the Tobit regressions for the sake of comparison with the following set of regressions that drops zero profit observations and apply OLS (with fixed effects) and IV (with random effects). We present these results in Table 4.

In the baseline model, that includes the RER and controls for firm size characteristics (employment and assets), time trend, and includes industry fixed effects,[18] we find a negative and significant effect of the RER on profits. Given that most firms sell most of its production to the domestic market and work in an import competitive environment, when the RER falls (appreciation in RER) competition from imports abates and profit increase. The next specification applying Tobit adds the trade variables, but although with the expected sign (see discussion above in section III), the trade variables result not significant.

If we believe that the zero profits are reporting errors and delete such observations from the sample data we run OLS, with FE. For the basic model again we find a negative and significant effect of the RER on profits. Adding the trade variables we only find that import intensity has a negative and significant effect on profits (although at the 10 percent); its interaction term with the RER and the export terms again with the expected signs but no significant. We finally run an additional regression, instrumenting employment with its own lag, with specification similar to

[15] Originally we proposed to analyze the period 2000-2010, to include the crisis years, however, data from 2008-2010 does not have a proper identification variable to continue the panel data analysis. Despite continuous requests to INEC, our petition of revision of such variable has not received a proper answer.
[16] Honoré reports a program that estimates Tobit with fixed effects but its implementation in Stata is quite difficult. See Honoré (1992) and http://www.princeton.edu/~honore/stata/index.html .
[17] In fact, the default setting for Tobit is random effects.
[18] Throughout this study industry fixed effects are at the 2-digit ISIC classification, revision 3, except for a few cases that were lumped together. See Table 1 for the group industry classification.

Baggs et al (2006). [19] In this case the trade variables are all with the expected signs and significant. Interestingly, the sizes of the coefficients of the variables of interest in the IV estimation are similar to the sizes of the respective coefficients in the OLS regression with fixed effects.

Results for hypothesis 2: effects on employment

As mentioned before, for the effect on employment all the regressions are estimated with system GMM. We have three different specifications, based on the independent (exogenous) trade variables of interest included. See Table 5.

The first specification studies the effects of RER on employment including the financial pressure and the export share variable with their respective interactions. Export share again is defined as exports over production, by industry group. We find a negative and significant impact on employment of the RER, hinting that a fall in the RER (appreciation) increases employment. However, as discussed above, a RER appreciation should have a negative impact on employment through the revenue channel for export oriented firms, which with a higher share of exports in total sales, should show a stronger fall in employment induced by the appreciation. Our term for export share shows such effect, as its coefficient is negative and significant. However, the interaction term of the export share with the RER is positive. This is possible as a RER appreciation reduces the cost of foreign inputs and the higher the share of foreign inputs the more the increase in employment (provided they are complement). The terms for financial pressure result not significant.

The second specification adds the import penetration (imports over consumption) term and its interaction with the RER. The RER term is again negative and significant but lower in value. Again the export share has a negative and significant coefficient while the coefficient of its interaction with the RER is positive and significant, but the value of their coefficients gets bigger. The coefficient of the import penetration variable is positive and significant, while its interaction term with the RER is negative (just the opposite as the export share variables), for a net result of a positive impact on employment, first through the revenue channel (in industries with more import penetration –i.e. a higher share of imports over consumption– a RER appreciation induces more imports and the need for more labor) and second, through the cost channel as appreciation reduces the cost of foreign inputs and the higher the share of foreign inputs the more the increase in employment (again, provided they are complement). We also find significant effects of financial pressure. An appreciating RER (fall in RER) may easy access to debt and with that we may observe more labor demanded by firms.

The last specification uses import and export intensity variables instead of the import penetration and export share variables. The sign and significance of the variables is maintained, although the magnitude of the coefficients changes for the RER and trade effects. The effect of the RER on employment is still negative but higher in magnitude. Financial pressure variables are still with the same sign, significance and magnitude. Import intensity (recall that it is measured as imports over production) has a positive and significant effect on employment while the coefficient of its interaction term with the RER is negative and significant –similar to the results in the previous specification. The coefficient for export intensity, which is defined as production over exports (just the opposite definition of export share) is positive and significant: the more the production over exports the more a labor is demanded, but when the RER is appreciated demand for labor falls more in industries that have more production over exports.

In Table 5 we also report the Sargan/Hansen tests (all with very low P-values) of overidentified restrictions and of exogeneity of the instruments. We report as well the Arellano-Bond autocorrelation tests. We also report the number of instruments used. Sample size is not such a well-defined concept in system GMM, which actually runs in two sets of samples simultaneously. Xtabond2 reports the untransformed sample in system GMM. We correct for heteroskedasticity by applying the robust command.

[19] We use the xthtaylor command in Stata to implement the IV regression.

VI. Conclusions

We study the manufacturing profits and employment impacts of RER changes that occurred in the 2000s in Ecuador. We apply panel data techniques and find that such impacts depend on the trade orientation of the industry, much in line with previous empirical studies on the subject. A fall in the RER (appreciation) may result in an increase in profits, given the import intensity nature of the manufacturing industry in Ecuador. Similarly, a more import intensity in an industry implies a positive impact on employment, in particular when the RER falls (appreciation). Given that the data shows that most industries in Ecuador have higher import intensity, and high import penetration, these results suggest that profits and employment impacts of a RER appreciation may actually be positive in Ecuador. However, these results also highlight that export oriented industries are just a few in Ecuador, and that still is the case that appreciation may hurt them. Ecuador is a country that has issued laws to foster export-oriented industries and that needs to expand productive activities that generate US dollar, given that it is a dollarized economy –the country renounced its own currency in January 2000. However, in practice, the current oil export boom may act against the export manufacturing activity, while being in favor of the import competing industry. And the favorable impact on profits and employment that it implies seems to generate all the incentives to continue the growth of import competing industries –a short run interest may be acting against a long-run goal of a more export-oriented economy.

References

Arellano, M, and S. Bond (1991), "Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations," *Review of Economic Studies* Vol. 58, pp. 277-297.

Baggs, J., E. Beaulieu, and L. Fung (2009), "Firm Survival, Performance, and the Exchange Rate," *The Canadian Journal of Economics*, Vol.42, No.2, pp. 393-421.

Baggs, J., E. Beaulieu, and L. Fung (2008), "Are Service Firms Affected by Exchange Rate Movements?," mimeo, September 2008.

Baggs, J., and J. Brander (2006), "Trade Liberalization, Profitability, and Financial Leverage," *Journal of International Business Studies*, Vol. 37, No. 2, Mar. 2006, pp. 196-211.

Branson, W. H., and J. P. Love (1988), "U.S. Manufacturing and the Real Exchange Rate", in Misalignment of Exchange Rates, Richard C. Marston, ed. University of Chicago Press.

Campa, J., and L. Goldberg (2001), "Employment versus wage adjustment and the U.S. dollar," *The Review of Economics and Statistics* 83, pp. 477-489.

Clarida, R. H. (1997), "The Real Exchange Rate and US Manufacturing Profits: A Theoretical Framework with some Empirical Support", *International Journal of Financial Economics*, Vol. 2, pp. 177-187.

de la Torre, A., J.Messina. S. Pienknagura (2012), "The Labor Market Story Behind Latin America's Transformation". Washington, DC: World Bank.

Dhasmana, A. (2013), "Real Effective Exchange Rate and Manufacturing Sector Performance: Evidence from Indian firms." Indian Institute of Management Bangalore, Working Paper No. 412. May 2013.

Galindo, A., A. Izquierdo, and J.M. Montero (2007), "Real Exchange rates, dollarization and industrial employment in Latin America." *Emerging Markets Review*, Vol. 8, No.4, December 2007, pp. 284-298.

Gao, T. (2000), "Exchange rate movements and the profitability of U.S. multinationals," *Journal of International Money and Finance*, Vol. 19, pp. 117-134.

Goldberg, P., and R. Hellerstein (2008), "A Structural Approach to Explaining Incomplete Exchange-Rate Pass-Through and Pricing-to-Market," *The American Economic Review*, Vol. 98, No. 2, Papers and Proceedings, pp. 423-429.

Gourinchas, P. (1999), "Exchange rates do matter: French job reallocation and exchange rate turbulence, 1984-1992," *European Economic Review* 43, pp. 1279-1316.

Honoré, Bo E. (1992), "Trimmed Lad and Least Squares Estimation of Truncated and Censored Regression Models with Fixed Effects," *Econometrica*, Vol. 60, No. 3, Pages 533-565.

Ismail, K. (2010), "The Structural Manifestation of the 'Dutch Disease': The Case of Oil Exporting Countries." IMF Working Paper WP/10/103, April 2010.

Nickell, S., and D. Nicolitsas (1999), "How does financial pressure affect firms?". *European Economic Review*, Vol. 43, pp.1435-1456.

Nucci, F., and A. Pozzolo (2010), "The exchange rate, employment and hours: What firm-level data say," *Journal of International Economics*, Vol. 82, pp. 112-123.

Pages, C. (2010) ed., "La era de la productividad: Como transformar las economías desde sus cimientos." Inter American Development Bank.

Rajan, R. and A. Subramanian (2011), "Aid, Dutch disease, and manufacturing growth,". *Journal of Development Economics*, 94, pp. 106-118.

Roodman, D. (2009), "How to do xtabond2: An introduction to difference and system GMM in Stata", *The Stata Journal*, Vol. 9, No. 1, pp. 86-136.

Schmalensee, R. (1985), "Do Markets Differ Much?" *The American Economic Review*, Vol. 75, No. 3, Jun. 1985, pp. 341-351.

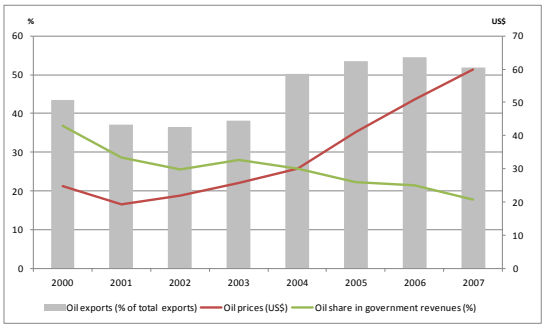
Wong, S. (2009), "Productivity and trade openness in Ecuador's manufacturing industries." *Journal of Business Research*, Vol. 62, No. 9, pp. 868-875, September 2009.

Annex 1 – Variables definitions and sources

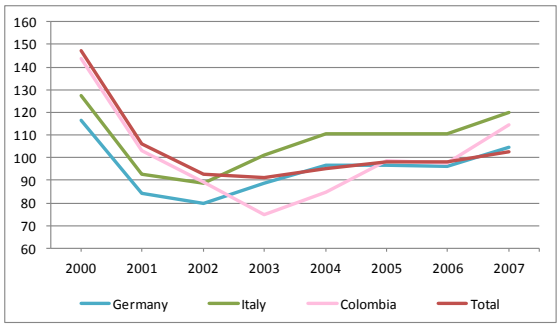
Variable	Description	Source
RER	Effective real exchange rate, 1994=100	Central Bank of Ecuador
Profits	Income – total remuneration - inputs	Own construction using data from manufacturing survey
Employment	Total number of workers and employees	Manufacturing survey
Total remuneration	Wages and salaries paid, including social benefits payments and contributions	Own construction using data from manufacturing survey
Assets	Total assets at the end of each year	Manufacturing survey
Import intensity	Imports / Sales	Own construction using import data from COMTRADE and sales from the manufacturing survey. We apply several correspondences between HSs lines (which are the product classifications used in COMTRADE data) and ISIC rev. 3(which is the industry classification used by the manufacturing survey) to obtain import data by industry.
Export intensity	Production / Exports	Own construction using export data from COMTRADE and production data from the manufacturing survey. We apply several correspondences between HSs lines (which are the product classifications used in COMTRADE data) and ISIC rev. 3(which is the industry classification used by the manufacturing survey) to obtain export data by industry.
Import penetration	Import / Consumption (and consumption is equal to production – exports + imports)	Own construction using trade data from COMTRADE and production from the manufacturing survey. We apply several correspondences between HSs lines (which are the product classifications used in COMTRADE data) and ISIC rev. 3(which is the industry classification used by the manufacturing survey) to obtain import data by industry.
Export shares	Exports / Production	Own construction using export data from COMTRADE and production data from the manufacturing survey. We apply several correspondences between HSs lines (which are the product classifications used in COMTRADE data) and ISIC rev. 3(which is the industry classification used by the manufacturing survey) to obtain export data by industry.
Financial pressure	Interest / sales (as a proxy for cash flow)	Own construction using data from manufacturing survey
Production	Production of goods for sale + Production of goods on behave of others + Production of goods made by others + stock of products in process	Own construction using data from manufacturing survey
Value added	Production – inputs	Own construction using data from manufacturing survey

Figure 1.- Oil export boom, RER, and manufacturing developments in Ecuador, 2000-2007 [1]

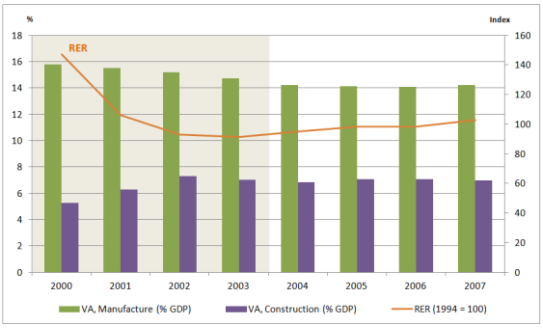
1a.- Oil prices and exports and revenues



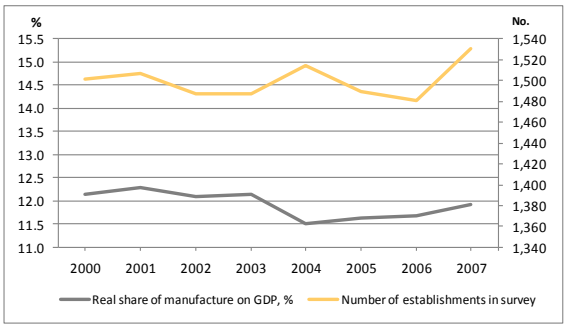
1b.- Real Exchange Rate (decrease = appreciation) [2,3]



1c.- RER and VA in manufacturing and non-tradable sectors [4,5]

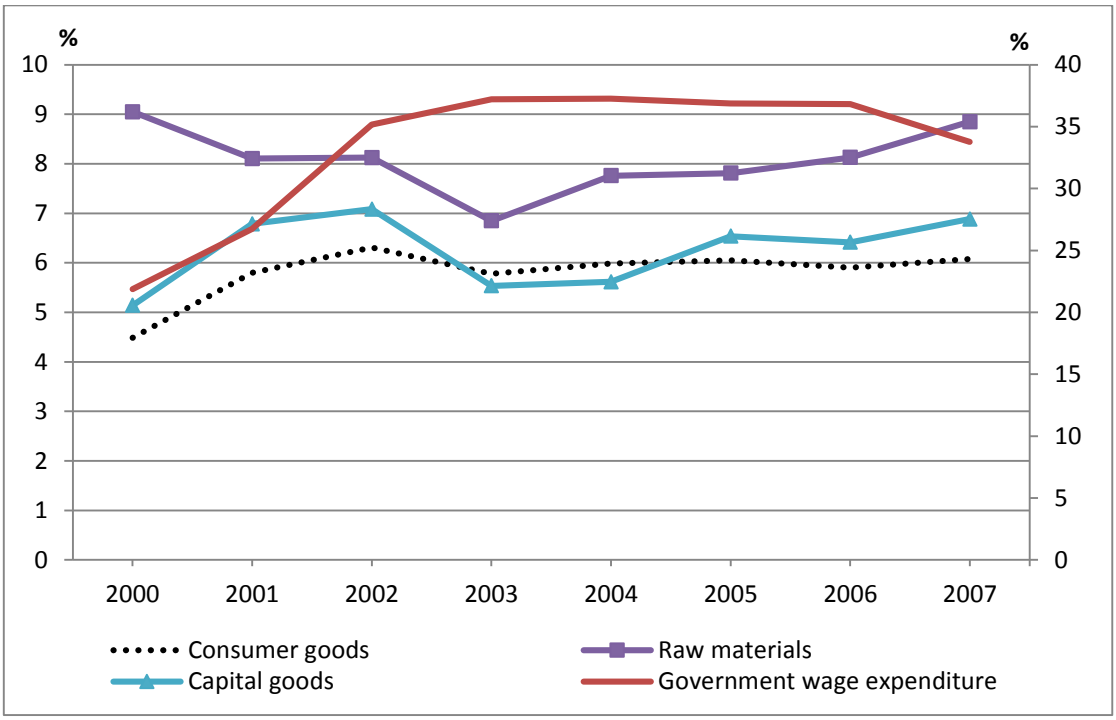


1d.- Manufacturing industries: Share of real manufacturing on GDP and number of establishments [6]



Sources: Own construction with data from the Central Bank of Ecuador, the National Institute of Statistics and Census (INEC), and Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT.
Notes: 1.- Oil exports, and Value added of Manufacture and Construction taken from Economic Commission for Latin America and the Caribbean (ECLAC), CEPALSTAT; Oil prices and Real exchange rate taken from the Central Bank of Ecuador; Real share of manufacture on GDP constructed with data from the Central Bank of Ecuador (Statistics Report of 2014); and Number of establishments data taken from Survey of Manufacturing and Mining of National Institute of Statistics and Census (INEC). **2.-** RER refers to the Real Effective Exchange Rate, which is defined as the rate of nominal exchange rate deflated by the domestic price index and adjusted for variations of relative prices and exchange rates of the countries with which Ecuador trades. An increase in the index means real depreciation, while a decrease shows a real appreciation (1994 = 100). **3.-** The indices for Germany, Italy and Colombia refer to Real Bilateral Exchange Rate, defined broadly as the ratio of the nominal exchange rate of Ecuador and the country with which Ecuador trades, deflated by the domestic price index and adjusted by the price index of the foreign trading partner. An increase in the index means real depreciation, while a decrease shows a real appreciation. **4.-** VA=Value Added. **5.-** Value added is from CEPAL own estimations based in official sources. **6.-** Real share of manufacture on GDP is base 2007. Data from 2000 to 2006 belong to the information obtained in backward projection of the series; from 2007 is the result of the annual national accounts.

Figure 2.- Imports by use (% GDP) & Government wage expenditure (% total expenditures), 2000-2007 [1]



Sources: Own calculation using data from the Central Bank of Ecuador.
Note: 1.- "Others" components of imports are not included. Neither is imports of fuels and lubricants.

Table 1.- Trade orientation and trade intensity by industry group, 2000-2007

Industry group (ISIC r.3)	Description	Import Intensity[1]	Export Intensity[2]	Import Penetration[3]	Export Share[4]	Trade Orientation[5]
15	Food and beverages	0.10	3.66	0.13	0.29	X
16	Tobacco	0.02	1,415.16	0.02	0.02	NT
17	Textiles	0.58	5.59	0.41	0.18	M
18	Apparel	0.71	7.59	0.44	0.16	M
19	Leather and footwear	1.07	4.14	0.57	0.25	M
20	Wood and wood prods	0.09	1.76	0.18	0.57	X
21	Paper and paper prods	0.29	28.33	0.25	0.04	M
22	Publishing and printing	0.49	27.26	0.32	0.04	M
24	Chemicals	2.42	3.30	0.80	0.31	M
25	Rubber and plastics	0.50	7.82	0.37	0.13	M
26	Non metalic min prods	0.22	15.51	0.19	0.07	M
27-28	Basic metals and met prods	1.12	8.99	0.56	0.12	M
29-33	Machine and equipment, and others	6.27	2.90	0.92	0.38	M
34-35	Vehicles and transport eq., and others	1.91	4.60	0.72	0.26	M
36	Furniture	0.77	6.01	0.49	0.17	M

Source: Own construction using the Survey of Manufacturing and Mining from the National Institute of Statistics and Census (INEC).

Notes: 1.- Imports/Sales ratio. **2.-** Production/Exports ratio. **3.-** Imports/Consumption ratio. **4.-** Exports/Production ratio. **5.-** X = exportable, M = importable, and NT = Non tradable.

Table 2.- Descriptive statistics of profits, and employment, 2000-2007[1]

		Profits	Total Workers and Employees
		US$	Number
Mean		3,442,131	99
Standard deviation	Overall	34,900,000	250
	Between	15,100,000	205
	Within	30,400,000	77

Source: Own construction using the Survey of Manufacturing and Mining from the National Institute of Statistics and Census (INEC).
Note: 1.- Profits are real, deflated by the GDP deflator of manufacturing industries. The GDP is from the Central Bank of Ecuador (2007=100).

Table 3.- Descriptive statistics and tabulations of some control variables, 2000-2007

		Assets[1]	Production[2]	Total Remuneration[3]	Import Penetration[4]	Export Share[5]	Import Intensity[6]	Export Intensity[7]
		US$	US$	US$	Ratio	Ratio	Ratio	Ratio
Mean		2,959,681	5,994,504	310,119	0.38	0.22	0.88	9.40
Standard deviation	Overall	11,600,000	33,100,000	1,133,449	0.24	0.13	1.34	126.27
	Between	9,543,862	18,800,000	860,137	0.24	0.12	1.31	45.65
	Within	2,704,109	24,900,000	515,659	0.05	0.05	0.28	114.25

Source: Own construction using the Survey of Manufacturing and Mining from the National Institute of Statistics and Census (INEC).

Note: 1.- Measured at the end of each year. Assets is used as a proxy for capital stock. **2.-** Includes production of goods, production made on behave of third parties, production made for the firm by third parties, and inventory products in process.

3.- Includes not only wages and salaries but also social security benefits and payments, and other income from the firm such as share in firm's profits. **4.-** Imports/Consumption ratio. **5.**- Exports/Production ratio. **6.-** Imports/Sales ratio. **7.-** Production/Exports ratio.

Table 4.- Profits effects of RER changes [1,2]

Dependent Variable: ln real profits

Regressors	Tobit (1)			Tobit (2)			OLS with FE (3)			OLS with FE (4)			IV (5)		
Intercept	8.76	***	(0.8)	10.61	***	(2.22)	9.71	***	(0.46)	9.99	***	(0.9)	8.98		(0.66)
ln RER	-0.70	***	(0.16)	-1.24	**	(0.51)	-0.32	***	(0.06)	-0.45	**	(0.19)	-0.42	***	(0.15)
ln(employment)	0.83	***	(0.04)	0.83	***	(0.04)	0.43	***	(0.03)	0.43	***	(0.03)	0.54		(0.02)
ln(assets)	0.30	***	(0.02)	0.30	***	(0.02)	0.19	***	(0.02)	0.19	***	(0.02)	0.28		(0.01)
Time trend	0.02	**	(0.01)	0.03	***	(0.011)	0.03	***	(0.004)	0.03	***	(0.004)	0.02	**	(0.003)
ln Import intensity				-0.38		(0.63)				-0.44	*	(0.24)	-0.42	***	(0.18)
ln Export intensity				-0.88		(1.14)				-0.25		(0.39)	-0.25	***	(0.33)
ln Import intensity * ln RER				0.05		(0.12)				0.07		(0.05)	0.07	***	(0.03)
ln Export intensity * ln RER				0.23		(0.25)				0.07		(0.08)	0.07	***	(0.07)
Group industry fixed effects	Yes			Yes			Yes			Yes			Yes		
Number of observations	11,829			11,829			11,478			11,478			11,478		
Log likelihood	-26516			-26512			R^2= 0.5042			R^2= 0.5011			Instrument: lag(1) ln(employment)		

Source: Own estimations using panel data from the Survey of Manufacturing and Mining collected by the National Institute of Statistics and Census (INEC).
Notes: 1.- Standard errors are in parentheses. ***, **,*=significant at 1%, 5%, and 10%, respectively. **2.-** Profits are defined as income minus total remunerations and minus total inputs. For definitions of other variables see Annex 1.

Table 5.- Employment effects of RER changes [1]

Dependent Variable: ln Employment

Regressors	Estimation method: System GMM estimator, one-step								
	(1)			(2)			(3)		
lnRER	-5.2	**	(2.3)	-2.82		(2.32)	-20.85	***	(6.17)
lnEmployment(t-1)	0.63	***	(0.03)	0.62	***	(0.03)	0.62	***	(0.03)
lnassets	0.25	***	(0.07)	0.18	**	(0.07)	0.17	**	(0.07)
lnassets(t-1)	-0.1	***	(0.05)	-0.06		(0.06)	-0.05		(0.06)
lnwages	0.25	***	(0.06)	0.25	***	(0.06)	0.24	***	(0.06)
lnwages(t-1)	-0.1	**	(0.04)	-0.08	**	(0.04)	-0.07	**	(0.03)
Financial pressure	21.7		(23.11)	44.19	*	(25.03)	42.49	*	(25.06)
Financial pressure*lnRER	-4.6		(4.99)	-9.82	*	(5.45)	-9.47	*	(5.46)
Import penetration				687.78	***	(151.83)			
Export share	-77	**	(34.72)	-363.9	***	(80.38)			
Import penetration*lnRER				-148.5	***	(32.68)			
Export share*lnRER	16.8	**	(7.58)	78.99	***	(17.41)			
Import intensity							76.28	***	(17.35)
Export intensity							62.59	***	(15.65)
Import intensity*lnRER							-16.53	***	(3.75)
Export intensity*lnRER							-13.64	***	(3.41)
P-value AR(1)	0.000			0.000			0.000		
P-value AR(2)	0.923			0.928			0.975		
P-value of Hansen test of overid. Restrictions	0.000			0.000			0.000		
P-value of Hansen test of exogeneity	0.000			0.000			0.000		
Industry-year dummies	Yes			Yes			Yes		
Number of observations	9,419			9,419			9,419		
Number of instruments	207			207			207		

Source: Own estimations using panel data from the Survey of Manufacturing and Mining collected by the National Institute from the Statistics and Census (INEC).

Note: 1.- Standard errors are in parentheses. ***, **,*=significant at 1%, 5%, and 10%, respectively.