How do different firms react to exchange rate changes? Prices, quantities, entry and exit[1]

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Abstract

This paper analyzes the reaction of exporters to exchange rate changes. We show that, in the presence of distribution costs in the export market, high and low productivity firms react differently to a depreciation . Whereas high productivity firms optimally raise their markup rather than the volume they export, low productivity firms choose the opposite strategy. This heterogeneity has interesting consequences for the aggregate impact of exchange rate movements. The presence of fixed costs to export means that exporting requires a high productivity, an attribute which in turn gives an incentive to firms to react to an exchange rate depreciation by increasing their export price rather than their sales. Exporters are, by selection, firms which optimally choose not to increase export volumes following a depreciation. We then test the main predictions of the model on a very rich French firm level data set with destination-specific export values and volumes on the period 1995-2005. We find that high performance firms react to a depreciation by increasing their export price rather than their export volume. The reverse is true for low productivity exporters. We also show that the probability of firms to enter the export market following a depreciation increases. However, the extensive margin response to exchange rate changes is small at the aggregate level because firms that enter, following a depreciation, are less productive and smaller relative to existing firms.

1 Introduction

Movements of nominal and real exchange rates are large. They however seem to have little effect on aggregate variables such as import prices, consumer prices, and the volumes of imports and exports. The sensitivity, or rather lack of, of prices to exchange rate movements has been well documented by Goldberg and Knetter (1997) and Campa and Goldberg (2005 and 2008) who provide estimates of the pass-through of exchange rates into import prices. There is also evidence indicating a decline in exchange rate pass-through to import prices in the U.S.

One possible explanation is that prices are rigid in the currency of the export market. However, Campa and Goldberg, (2005) show that the incomplete pass-through of exchange rate changes into import prices is far from being a short-term phenomenon as it remains after one year. This suggests that price rigidities cannot fully explain this phenomenon. Moreover, Gopinath and Rigobon (2008) have recently shown on good-level data, that even conditioning on a price change, trade weighted exchange rate pass-through into U.S. import prices is low, at 22%. Another explanation is the presence of local distribution costs. These can directly explain why consumer prices do not respond fully to exchange rate movements. Corsetti and Dedola (2007) show that with imperfect competition, distribution costs may also explain why import prices themselves do not respond much to exchange rate movements.

In this paper, we focus on the heterogeneity of the optimal response of exporters to exchange rate movements in a model with distribution costs and imperfect competition. We show theoretically and empirically that high and low performance firms react very differently to a depreciation. We interpret performance in terms of productivity or, in an alternative version of the model, in terms of quality. Whereas, following a depreciation, high performance firms optimally raise their markup rather than the volume they export, low performance firms choose the opposite strategy. This heterogeneity in response is interesting it itself but it is also interesting because of its implications for aggregate effects of exchange rate movements. Given that fixed costs to export allow only the best performers to export, and that a very large share of exports are made by a small portion of high performance firms, it follows that the heterogeneity in reaction can help explain the weak reaction, at the aggregate level, of exports to exchange rate movements. Exporters, and even more so big exporters, are, by selection, firms which optimally choose their export volumes to be less sensitive to exchange rates. We show that our model, with sufficient heterogeneity in productivity, can reproduce both the low level of the elasticity of the intensive and extensive margins of trade to exchange rate movements.

The model produces testable implications on the heterogeneity of the sensitivity of firm level prices and export volumes to exchange rates. We test these predictions on a very rich firm level data set. We collected information on firm-level, destination-specific export values and volumes from the French Customs and other information on firm performance. This is the same source as the one used by Eaton, Kortum, and Kramarz (2008) for the year 1986. We use this data set for a longer and more recent period - 1995-2005 - so that we can exploit variation across years and destinations[1]. To our knowledge, our paper is the first to exploit such detailed data to analyze how different firms react differently to exchange rate movements. We first show that firms with performance (measured by TFP, labor productivity, export size, number of destinations) above the median react to a depreciation of 10% by increasing their (destination specific) export price in euro by around 2% to 3.8%. Those firms below median performance do not change export prices in reaction a change in exchange rate. Hence, only high performance partially price to market and partially absorb exchange rate movements in their mark-ups. On export volumes (again destination specific), the reverse is true: for the best performers export volumes do not react to exchange rate movements but poor performers react by increasing their export volumes by around 3.9% to 6.9%.

To our knowledge, our paper is also the first to document the impact of exchange rate changes on entry and exit at different destinations. The model predicts entry of firms following a depreciation[2]. We find that this is indeed the case for French firms. A 10% depreciation vis a vis a specific destination increases the probability that a firm starts exporting to this destination by 1.7%. However, the new entrants are on average smaller than existing exporters so that the extensive margin of exchange rate movements on exports does not matter too much at the aggregate level.

Consistently with the existing literature, we find that the aggregate elasticity of exports to exchange rate is low, a little bit above unity. We show that our model and its key mechanism, in particular the heterogeneity of response to exchange rate movements, can reproduce this low elasticity.

At the origin of our results is the interaction between two key elements recently emphasized by the international trade and macroeconomy literatures. The first element is productivity heterogeneity across firms which has been theoretically analyzed by Melitz (2003) in the trade context. Several papers have documented the fact that firms that export

[1] Berthou and Fontagne (2008a, and b) use this same data set to analyze the effect of the creation of the euro on exports of French firms.

[2] Bernard, Eaton, Jenson and Kortum (2003), in a model with firm heterogeneity, entry and exit find in their simulation that a 10% depreciation leads 10% of firms to stop exporting.

have higher productivity and perform better than other firms more generally (see for the French case, Eaton, Kortum, and Kramarz (2004 and 2008)). This is due to the existence of fixed costs of exports that allows only high performers to export. Moreover, a very large share of exports is concentrated on a small number of firms, the best performers among the exporters (see Bernard, Jensen, Redding and Schott 2007 and Mayer and Ottaviano, 2007). The second element is local distributions costs that have to be paid by firms to reach consumers. Evidence of the significance of these costs have been found by Golberg and Campa (2008) and previously emphasized by Anderson and Van Wincoop (2001) among others; they are generally found to constitute a 40 to 60% share of consumer prices. We show in this paper that the interaction of firms' heterogeneity and local distribution costs generate heterogenous optimal response to exchange rate changes in terms of prices (heterogenous pricing to market) and quantities.

Our paper is related to the literature on incomplete exchange rate pass-through and pricing to market. A recent paper by Auer and Chaney (2008) shows that the pass-through can be incomplete and heterogeneous across goods of different quality in a model with heterogenous consumers. Our paper is also related to the papers which have shown the impact of distribution costs on the extent of the pass-through. Indeed, in our model, local distribution costs directly lower the pass-through to consumer prices but also generate variable producer mark-ups as in Corsetti and Dedola (2007) that further reduce the pass-through. Higher productivity firms and more generally firms with better export performance have more variable mark-ups and lower pass-through than other firms.

There is an extensive literature on the role of nontradeable distribution costs in accounting for the behavior of international relative prices. Burstein, Neves, and Rebelo (2003) report that distribution costs represent more than 40 percent of the retail price in the US and 60 percent of the retail price in Argentina. They show that because distribution services require local labor, they drive a natural wedge between retail prices in different countries. Burstein, Eichenbaum, and Rebelo (2005) also show that distribution costs are also key to understand the large drop in real exchange rates that occurs after large devaluations. In the theoretical contribution of Atkeson and Burstein (2008), distribution costs also play an important role to explain deviations from relative purchasing power parity in a model with imperfect competition and variable markups. The model they present is related to ours because they show that in the presence of trade costs and imperfect competition large firms have an incentive to price to market due to their market share. Hence, heterogeneity across firms also features prominently in their analysis of pricing to market.

There are few empirical contributions on pricing to market, exchange rate and export flows using firm-level data[3]. Martin and Rodriguez (2004) find that firms do react to a depreciation by raising their mark up. Hellerstein (2008) uses a detailed data set with retail and wholesale prices for beer and finds that markups adjustments by manufacturers and retailers explain roughly half of the incomplete pass-through whereas local costs components account for the other half. However, these studies do not analyze how different firms react differently to an exchange rate movement and in particular how their sales and entry/exit decision are affected. Using British data, Greenaway, Kneller and Zhang (2007) analyze the exporter status choice following exchange rate variations but these authors do not have information on export destination, nor on the pricing strategy of firms. They find a small effect of exchange rate changes on the decision of firms to become an exporter.

The paper is organized as follows. We derive the main theoretical results and predictions in the next section. Section 3 presents the data set, the empirical methodology and the main findings. Section 4 concludes.

2 Theoretical framework

2.1 Preferences and technology

We analyze a simple model with N countries which allows us to develop testable implications on the impact of exchange rate movements on exporters behavior. There is only one sector, a manufacturing sector, which operates under monopolistic competition .

The origin of the movements in the real exchange will be left unexplained but could be made endogenous either by introducing monetary shocks that move the nominal exchange rate under the assumption of rigid nominal wages or aggregate productivity shocks that could take the form of productivity shocks in a non tradable sector. Corsetti and Dedola (2007) develop a model that goes further in the direction of making the origin of real exchange rate movements more explicit in a general equilibrium model. In particular, they show that under complete markets the bilateral exchange rate depends only on the relative monetary stance of the two countries. The real exchange rate will then be equal to the nominal exchange rate in the case of rigid wages. We prefer to remain agnostic on the origin of real exchange rate

[3]Other papers analyze different aspects of firms reactions to exchange rate shocks. Gourinchas (1999), evaluates the impact of exchange rate fluctuations on inter- and intra-sectoral job reallocation. The paper investigates empirically the pattern of job creation and destruction in response to real exchange rate movements in France between 1984 and 1992, using disaggregated firm level data and finds that traded-sector industries are very responsive to real exchange rate movements. Ekholm et al. (2008) study firms' response to the appreciation of the Norwegian Krone in the early 2000s with respect to employment, productivity, and offshoring.

movements in short-medium term horizon (one to three years) on which we will focus in the empirical section. One reason is the failure of the empirical literature to find an important role for fundamentals (monetary or real) to real exchange rate movements on this horizon.

Utility for a representative agent in country i is derived from consumption of a continuum of differentiated varieties in the standard Dixit-Stiglitz framework:

$$U(C_i) = \left[\int_X x(\varphi)^{1-1/\sigma} d\varphi \right]^{\frac{1}{1-1/\sigma}} \tag{1}$$

where $x(\varphi)$ is the consumption of variety φ. φ defines the productivity of the firm as $1/\varphi$ is the number of units of labor necessary in the production of the good. It also affects the fixed cost of production in the country where the firm is located (see below). The set of traded varieties is X. The elasticity of substitution between two varieties is $\sigma > 1$.

We assume that several trade costs impede transactions at the international level: an iceberg trade cost, a fixed cost of exporting and a distribution cost. First, we assume an iceberg trade cost $\tau_{ij} > 1$ specific to the pair of countries i and j. τ_{ij} units of the good are produced and shipped but only one unit arrives at destination. Second, to export in country j, a firm producing in country i must pay a bilateral fixed cost. We assume that workers in both countries are employed to pay this fixed cost which we interpret as research and development, innovation, adaptation to the market and marketing. Importantly, and differently from the rest of the literature, we assume that firms with higher productivity in production are also more productive in those activities necessary to provide the fixed cost. The production function for the fixed cost to export is Cobb Douglass in labor of country i and labor in country j, with shares α and $1-\alpha$ respectively so that the fixed cost to export is: $f_{ij} \left(\frac{w_i}{\varphi} \right)^{\alpha} (\varepsilon_{ij} w_j)^{1-\alpha}$. ε_{ij} is the nominal exchange rate between country i and j expressed as currency i in units of j currency. An increase in ε_{ij} is a depreciation in currency i vis a vis currency j. This specification implies that the productivity parameter that characterizes the firm affects its fixed cost only in the country where production is located. Implicitly, this means that the share of fixed costs paid in the foreign country is outsourced.

Finally, we assume that distribution costs have to be paid in the destination country on the amount that reaches the destination. Distribution takes η_j units of labor in country j per unit consumed in that country. Hence, we follow Tirole (1995), (p. 175) characterization of distribution: "production and retailing are complements". This is the same assumption as in Burstein, Neves and Rebelo (2003) and Corsetti and Dedola (2007). The wage paid in distribution is the same as in the manufacturing sector. We assume that the cost of distribution does not depend on the idiosyncratic productivity of the firm. Again, this means that the distribution costs are outsourced. Those costs are paid to an outside firm that provides distribution services. If a French firm exports to the US, we therefore assume that what it pays in distribution services (to wholesalers and retailers) does not depend on its productivity. Any cost paid in local currency and which does not depend on the productivity of the exporter would have the same impact. Qualitatively, our results would remain if these distribution costs depend on the firm productivity, as long as distribution costs are less dependent on the firm productivity than production costs.

Hence, some costs paid by the firm depend directly on its productivity. They are at the core of what defines a firm and a product: these are the production costs and the share of the fixed cost of exporting that is borne in the country where the firm is located.

In units of currency of country j, the consumer price of a variety φ exported from country i to country j is:

$$p_{ij}^{c}(\varphi) = p_{ij}(\varphi)\tau_{ij} + \eta_j w_j \tag{2}$$

where $p_{ij}(\varphi)$ is the producer price expressed in foreign currency, and w_j the wage rate of country j in the currency of this country. The demand for this variety is:

$$x_{ij}(\varphi) = Y_j P_j^{\sigma-1}\left[p_{ij}(\varphi)\tau_{ij} + \eta_j w_j\right]^{-\sigma} \tag{3}$$

where Y_j is the income of country j and P_j is the price index in country j. The cost (in units of currency of country i) of producing $x_{ij}(\varphi)\tau_{ij}$ units of good (inclusive of transaction costs) and selling them in country j for a firm with productivity φ is:

$$c_{ij}(\varphi) = w_i x_{ij}\tau_{ij}(\varphi)/\varphi + f_{ij}\left(\frac{w_i}{\varphi}\right)^{\alpha}(\varepsilon_{ij}w_j)^{1-\alpha} \tag{4}$$

where w_i is the wage rate in country i. φ will be more generally interpreted as a measure of the performance of the firm that can affect its sales and its presence on markets. Note indeed that the productivity of the firm also affects its fixed costs of exporting. The profits (in units of currency of country i) of exporting this variety are therefore given by:

$$\pi_{ij}(\varphi) = \varepsilon_{ij}p_{ij}(\varphi)x_{ij}(\varphi)\tau_{ij} - w_i x_{ij}\tau_{ij}(\varphi)/\varphi - f_{ij}\left(\frac{w_i}{\varphi}\right)^{\alpha}(\varepsilon_{ij}w_j)^{1-\alpha} \tag{5}$$

2.2 Prices and the intensive margin

With monopolistic competition on the production side, the producer price $\varepsilon_{ij}p_{ij}(\varphi)$ expressed in currency i of firm/variety φ in country i and sold in country j is not the usual mark-up over marginal cost. It is given by:

$$\varepsilon_{ij}p_{ij}(\varphi) = \frac{\sigma}{\sigma-1}\left(1+\frac{\eta_j\varepsilon_{ij}w_j\varphi}{\sigma w_i\tau_{ij}}\right)\frac{w_i}{\varphi} = m(\varphi)\frac{w_i}{\varphi} \tag{6}$$

Note that the mark-up over the marginal cost of production $\frac{w_i}{\varphi}$ is higher than in the usual monopolistic competition model because of the presence of distribution costs. Note also that the mark-up increases with the productivity of the firm. The reason is that for high productivity firms, a large share of the consumer price does not depend on the producer price so that the perceived elasticity of demand by those firms is lower. Finally, the law of one price does not hold: the producer price of the same variety sold in different countries depends on the bilateral exchange rate, trade cost with this country and the wage rate of this country. The impact of a depreciation on the producer price is given by the following elasticity, specific to each firm:

$$e_{p_{ij}}(\varphi) = \frac{d\varepsilon_{ij}p_{ij}(\varphi)}{d\varepsilon_{ij}}\frac{\varepsilon_{ij}}{\varepsilon_{ij}p_{ij}(\varphi)} = \frac{\eta_j\varphi w_j\varepsilon_{ij}}{\sigma w_i\tau_{ij}+\eta_j\varphi w_j\varepsilon_{ij}} \tag{7}$$

Testable Prediction 1. *$\varepsilon_{ij}p_{ij}(\varphi)$ increases with ε_{ij}, the more so the higher φ the productivity of the firm .*

Hence, firms react to a depreciation by increasing their mark-up and their producer price. The mark-up increases with a depreciation because distribution costs involve some endogenous pricing to market as explained by Corsetti and Dedola (2007). Firms partially absorb some of the exchange rate change in the mark-up. High productivity firms have more incentive to do so and to price to the market. This result holds in a version of the model presented in appendix in which firms differ in the quality of the goods they export. In the empirical section we indeed find that French firms react to a depreciation by increasing their producer prices and that firms which have better performance have a higher elasticity of producer prices to exchange rate movements. Note also that the level of the exchange rate affects the optimal response of firms to an exchange rate depreciation: for a given productivity level, the elasticity of the producer price to an exchange rate depreciation increases as the exchange rate depreciates. We will also test for this non linearity.

The import price and the consumer price (in currency j) are:

$$p_{ij}(\varphi)\tau_{ij} = \frac{\sigma}{\sigma-1}\left(\frac{w_i}{\varphi\varepsilon_{ij}}\tau_{ij}+\frac{\eta_j w_j}{\sigma}\right) \quad ; \quad p^c_{ij}(\varphi) = \frac{\sigma}{\sigma-1}\left(\frac{w_i}{\varphi\varepsilon_{ij}}\tau_{ij}+\eta_j w_j\right) \tag{8}$$

so that there is incomplete pass-through of a depreciation at the level of both import and consumer prices. Part of the lack of response of the consumer price to exchange rate comes from the change in the mark-up of the producer as a response to the exchange rate change and part from the presence of local distribution costs[4]. The optimal degree of pass-through on prices at the import and consumer levels are respectively:

$$\frac{dp_{ij}(\varphi)\tau_{ij}}{d\varepsilon_{ij}}\frac{\varepsilon_{ij}}{p_{ij}(\varphi)\tau_{ij}} = -\frac{\sigma w_i\tau_{ij}}{\sigma w_i\tau_{ij}+\eta_j w_j\varepsilon_{ij}\varphi} \quad ; \quad \frac{dp^c_{ij}(\varphi)}{d\varepsilon_{ij}}\frac{\varepsilon_{ij}}{p^c_{ij}(\varphi)} = -\frac{w_i\tau_{ij}}{w_i\tau_{ij}+\eta_j w_j\varepsilon_{ij}\varphi} \tag{9}$$

and decreases with both the importance of the distribution cost and the productivity of the firm. For an active exporter, the volume of exports is:

$$x_{ij}(\varphi) = Y_j P_j^{\sigma-1}\left[\frac{w_i}{\varphi\varepsilon_{ij}}\tau_{ij}+\eta_j w_j\right]^{-\sigma}\left(\frac{\sigma-1}{\sigma}\right)^{\sigma} \tag{10}$$

where P_j is the ideal price index in country j:

$$P_j = \left(\sum_{h=1}^{N} L_h \int_{\varphi^*_{hj}}^{\infty}\left[\frac{\sigma}{\sigma-1}\left(\eta_j w_j + \frac{w_h}{\varphi\varepsilon_{hj}}\tau_{hj}\right)\right]^{1-\sigma} dG(\varphi)\right)^{-1/(\sigma-1)} \tag{11}$$

Note that as in Chaney (2008), we assume that the number of entrepreneurs who get a productivity draw is proportional to the population size L_i in country i. Only firms with productivity above φ^*_{ij} in country i can export in country j. Note that P_j the price index of the manufacturing sector for country j depends on the bilateral exchange rates of country j with all its trade partners. In this perfect price index appears (in a very non linear way) a measure of an effective exchange rate of the country in the second part of the bracket: the weighted sum of bilateral exchange rates of country j with all its trading partners. The weights depend in particular on the number of exporters size of the country, i.e. the number of workers. Hence an effective exchange rate appreciation of country j that decreases P_j leads (for a given bilateral exchange rate) to a fall of the volume of exports from an exporter of country i. We will assume that country i is too small for its bilateral exchange rate to affect the price index of country j.

We can now analyze the impact of a change in bilateral exchange rates (for given nominal wages) on the *volume* of exports, characterized by the following elasticity, specific to each firm:

$$e_{x_{ij}}(\varphi) = \frac{dx_{ij}(\varphi)}{d\varepsilon_{ij}}\frac{\varepsilon_{ij}}{x_{ij}(\varphi)} = \sigma\frac{w_i\tau_{ij}}{w_i\tau_{ij}+\eta_j w_j\varepsilon_{ij}\varphi} \tag{12}$$

[4]Hellerstein (2008) work on the beer market estimates that half of the lack of complete pass-through in this market is due to changes in mark-up and half to local distribution costs.

Testable Prediction 2. *The elasticity of the firm exports,$x_{ij}(\varphi)$ to exchange rate movements ε_{ij}*

i) decreases with the productivity of the firm, the size of its exports and more generally its performance on exports markets.

ii) decreases with the importance of local distribution costs

iii) decreases with the amount of the depreciation

iv) increases with variable trade costs.

The intuition of the first testable prediction (i) is that for high productivity/low price firms, a large part of the price for the consumer (the distribution cost) is unaffected by exchange rate movements. Hence, for high productivity firms the elasticity of demand to marginal costs (and exchange rate changes affect relative marginal costs) will be lower. The same mechanism explains that high productivity firms have lower a price elasticity, higher markup, lower elasticity to exchange rate movements. Again, these results holds in a version of the model presented in appendix in which firms differ in the quality of the goods they export.

The reason for prediction (iii) is that the share of the price affected by the exchange rate decreases with the size of the depreciation, thus limiting the effect on exchange rate on export volumes. In fact, a larger exchange rate depreciation acts as a productivity gain for all firms that increases the share of the distribution costs in consumer prices.

Finally, the reason of the last prediction (iv) is that as distance increases (and distance related costs increase), the share of the distribution cost in the consumer price falls and the elasticity to the exchange rate itself increases. This result is however ambiguous, since part of the trade costs may be paid in the currency of the importer - like distribution costs. In this case, higher distance implies both higher trade costs and distribution costs. - increases with bilateral distance between the exporter country and the importer country.

Note that in a model where countries are symmetric (so that wages are identical across countries) and the elasticity is estimated for small exchange rate changes (so that the elasticity is estimated at $\varepsilon_{ij} = 1$ in equation (12)), the elasticity of the intensive margin of exports to the exchange rate for the average firm can be small if the share of the distribution costs in the consumer price (which depends on the inverse of the productivity in the distribution sector) is high as well as the average productivity of exporters.

The elasticity of the value of exports (in currency i) to exchange rate change of a firm with productivity φ is the sum of the elasticities given in (7) and (12). It can be checked that the elasticity of the value of exports to ε_{ij} decreases with the productivity of the firm as long as $\sigma > 1$.

2.3 Profits and the extensive margin

The profits for an active exporter of country i to country j are:

$$\pi_{ij}(\varphi) = \frac{Y_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{\tau_{ij}}{P_j}\right)^{1-\sigma}\left[\frac{w_i}{\varphi}+\frac{\eta_j w_j \varepsilon_{ij}}{\tau_{ij}}\right]^{1-\sigma}\varepsilon_{ij}^{\sigma} - f_{ij}\left(\frac{w_i}{\varphi}\right)^{\alpha}(\varepsilon_{ij}w_j)^{1-\alpha} \tag{13}$$

On can show that they increase with a depreciation. Partly this is because sales increase in country j and partly this is because the mark-up of exporting in country j increases with the depreciation.

The threshold such that profits of a firm φ_{ij}^{*} exporting in j are zero is defined by the following cutoff condition:

$$\frac{Y_j}{\sigma}\left(\frac{\sigma}{\sigma-1}\frac{\tau_{ij}}{P_j}\right)^{1-\sigma}\left[\frac{w_i}{\varphi_{ij}^{*}}+\frac{\eta_j w_j \varepsilon_{ij}}{\tau_{ij}}\right]^{1-\sigma}\varepsilon_{ij}^{\sigma} = f_{ij}\left(\frac{w_i}{\varphi_{ij}^{*}}\right)^{\alpha}(\varepsilon_{ij}w_j)^{1-\alpha} \tag{14}$$

Below the threshold productivity φ_{ij}^{*}, firms will not be able to export on market j. Given what we showed in the previous section on the relation between productivity and the sensitivity of export volumes to exchange movements, this implies that exporters are firms which, by selection, are less insensitive to exchange rate movements than other firms.

The elasticity of the threshold productivity to exchange rate movements can be shown to be:

$$e_{\varphi_{ij}^{*}} = \frac{d\varphi_{ij}^{*}}{d\varepsilon_{ij}}\frac{\varepsilon_{ij}}{\varphi_{ij}^{*}} = -\frac{\sigma-1+\alpha+\eta_j\alpha\frac{\varepsilon_{ij}w_j\varphi_{ij}^{*}}{w_i\tau_{ij}}}{\sigma-1+\alpha+\eta_j\frac{\varepsilon_{ij}w_j\varphi_{ij}^{*}}{w_i\tau_{ij}}} < 0 \tag{15}$$

Note that without distribution costs, the elasticity is -1. The threshold decreases with a depreciation. Note that the presence of distribution costs decreases the response of the threshold to a depreciation (as long as $\alpha < 1$). In absolute value, the elasticity of the threshold to an exchange rate movement is less than unity. At the limit when all the fixed cost is paid in local currency ($\alpha = 1$), the elasticity is simply -1.

If the distribution costs are sufficiently large, the change in the threshold may be very small. Given that a depreciation reduces the productivity threshold, we should also observe that a depreciation reduces the average productivity of firms exporting to this destination as well as the average export volume.

The elasticity (in absolute term) increases with transaction costs and decreases with the depreciation. This last prediction is at odds with the one that comes out of Baldwin and

Krugman (1989). According to this influential work, the elasticity of trade to exchange rate variations increases with the magnitude of the exchange rate change. The reason is that in presence of sunk costs of exports, only large exchange rate swings will generate sufficient entry-exit incentives, thus affecting the extensive margin of trade. In our framework, the effect observed on both the intensive margin (see above) and the extensive margin is the exact opposite.

2.4 Aggregate exports

We denote $G(\varphi)$ the cumulative distribution function of productivity (symmetric in all countries). Hence, aggregate exports from i to j are given by the sum of all individual exports of firms with productivity above the threshold φ_{ij}^* :

$$X_{ij} = \int_{\varphi_{ij}^*}^{\infty} L_i Y_j \left(\frac{\sigma}{\sigma-1}\frac{1}{P_j}\right)^{1-\sigma}\left[\frac{w_i}{\varphi\varepsilon_{ij}}\tau_{ij} + \eta_j w_j\right]^{-\sigma} dG(\varphi) \tag{16}$$

The elasticity of aggregate exports to exchange rate shocks can be decomposed into the intensive and extensive elasticities as follows:

$$\frac{\partial X_{ij}}{\partial \varepsilon_{ij}}\frac{\varepsilon_{ij}}{X_{ij}} = \underbrace{\frac{\varepsilon_{ij}}{X_{ij}} L_i \int_{\varphi_{ij}^*}^{\infty} \frac{\partial x_{ij}(\varphi)}{\partial \varepsilon_{ij}} dG(\varphi)}_{intensive} - \underbrace{\frac{\varepsilon_{ij}}{X_{ij}} L_i x_{ij}(\varphi_{ij}^*) G'(\varphi_{ij}^*) \times \frac{\partial \varphi_{ij}^*}{\partial \varepsilon_{ij}}}_{extensive} \tag{17}$$

The first term represents the increase in exports that comes from existing exporters. The second term is the increase in exports due to entry of new exporters and is also positive (as $\frac{\partial \varphi_{ij}^*}{\partial \varepsilon_{ij}} < 0$).

We now want to check whether our model can broadly reproduce the low elasticity of aggregate export to exchange rate movements. To do this we need to calculate the two terms of (17). We assume a Pareto distribution for productivity of the form $G(\varphi) = 1 - \varphi^{-k}$, $dG(\varphi) = k\varphi^{-k-1}$ where k is an inverse measure of productivity heterogeneity. We calibrate the model around a symmetrical equilibrium where $w_i = w_j$, $L_i = L_j, \varepsilon_{ij} = 1$.

We take a value of 1.2 for τ_{ij} so that trade costs are 20%. Distribution costs are assumed to be a constant share a of the average manufacturing price in country j. We take a value $a = 0.5$, in line with existing estimations (see Campa and Golberg, 2005). We also choose $\alpha = 0.5$ so that half of the fixed export cost is paid in the destination country. This parameter only affects the extensive margin of trade.

The elasticity is evaluated around an equilibrium where φ_{ij}^* is such that $P(\varphi < \varphi_{ij}^*) = G(\varphi_{ij}^*) = 0.8$ so that 20% of firms in country i export to country j. Finally, we assume that home country exporters have a negligible impact on the foreign country's price index[5].

k has been estimated on French firms by Mayer and Ottaviano (2007) using the methodology proposed by Norman, Kotz and Balakrishnan (1994), and the results always range between 1.5 and 3. We thus take a value of 2 for k as a benchmark and see what happens when we take a lower value $k = 1$ and higher value $k = 3$. For the elasticity of substitution we take as our benchmark a value of 4[6].

What are we attempting to replicate? In the literature on the effect of exchange rate on aggregate exports, a typical elasticity is around unity or a bit above unity. On our French data, as explained in the empirical section of the model, we find something similar, more precisely 1.11 (see table 7). Given that we can disentangle between the increase of exports that comes from existing exporters and from new exporters, we can compute the intensive margin and the extensive margin elasticities. In table 8, we find the intensive elasticity to be 0.88 which implies that the extensive elasticity is around 0.23. These are the three elasticities that we attempt to replicate in our model.

In table 1, we report the results of our calibration. In our benchmark calibration ($\sigma = 4$; $k = 2; \alpha = 0.5$), we find that both the intensive margin and the extensive margins are low even though a bit higher than in the data. The aggregate elasticity is 1.85. Remember that in many macro models (such as the Krugman model) without heterogeneity and entry/exit, this elasticity would be equal to the elasticity of substitution between domestic and foreign goods, in this specific case 4. Increasing heterogeneity (with a lower k) means that both the intensive and extensive margins fall. A Pareto parameter around 1.5 would generate results very close to the data. The reason for the fall in the intensive margin is that with more heterogeneity, a larger share of exports is made by a few very productive and very large firms which we have seen prefer to increase their markup rather than their export volumes following a depreciation. The extensive margin also falls because firms that enter the export market following the depreciation are much less productive and smaller than those already on the market so that their impact in the aggregate is small. Vice versa we have checked that with a low level of heterogeneity (high value of k), the aggregate elasticity becomes very large and very different from the data: heterogeneity of firms performance is a key ingredient to explain the low aggregate elasticity of export volumes to exchange rate changes.

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[5] Note that this assumption means that we overestimate the simulated elasticity.

[6] Note that this means that contrary to Chaney (2008), whose model restricts parameters such that $k > \sigma - 1$, we can have low values of k (high degrees of firm heterogeneity). The reason that the size distribution of exports has finite mean even with low values of k relative to σ is the presence of local distribution costs which do not depend on the productivity of the firm.

The impact of the extensive margin also decreases with the share of the fixed cost paid in the export market (α decreases). Note that when all the export fixed cost is paid in the exporter country ($\alpha = 1$), the total elasticity is equal to k as in Chaney (2008) on the elasticity of trade to trade costs. However, the decomposition is different from Chaney (2008) where the intensive elasticity is σ and the extensive elasticity is $k - \sigma$.

In Romalis (2007) as well as in Imbs and Mejean (2008), elasticities of substitution between domestic and foreign varieties are estimated to be higher than 4, in fact between 4 and 13 in the case of Romalis. Hence, we also calibrate the model for a higher value of $\sigma = 7$. In this case, the intensive margin increases a bit but the extensive falls quite a bit so that the net effect is small on the total elasticity, a result in the spirit of Chaney (2008).

Table 1: Calibration of export elasticities to exchange rate

	$\alpha = 0.5$			$\alpha = 0$			$\alpha = 1$		
k	2	1	3	2	1	3	2	1	3
σ	4	4	4	4	4	4	4	4	4
Intensive	1.02	0.51	1.31	1.02	0.51	1.31	1.02	0.51	1.31
Extensive	0.83	0.39	1.46	0.65	0.26	1.18	0.97	0.49	1.69
Total	1.85	0.90	2.77	1.67	0.77	2.49	2	1	3

	$\sigma = 7$			10% firms export		
k	2	1	3	2	1	3
σ	7	7	7	4	4	4
Intensive	1.51	0.74	2.06	0.82	0.31	1.14
Extensive	0.44	0.22	0.86	0.95	0.48	1.56
Total	1.95	0.96	2.92	1.77	0.79	2.70

Hence, overall these numerical results are consistent with our main story. If exporters are selected among the most productive firms because of the presence of a fixed cost to export and there is sufficient heterogeneity among firms, then exporters are firms which prefer to react to a depreciation by an increase of their markups rather than an increase of the volumes they export. This explains that at the aggregate level, the intensive elasticity of exports to exchange rate is small. Furthermore, with sufficient heterogeneity, firms that enter following a depreciation are small so that their effect in the aggregate is also small. Our model is therefore able to explain the weak reaction of aggregate exports to exchange rate movements we observe in the data. A key ingredient for this result to hold is the heterogeneity of firms in their performance and the heterogeneity of firms in their reaction to exchange rate movements. We test the empirical validity of this mechanism in the next section.

3 Empirics

We test the predictions of the model of the prediction using a large database on French firms. The data comes from two different sources: 1) the French customs for firm-level trade data, which reports exports for each firm, by destination and year. This database reports the volume and value of exports by 8-digit product (combined nomenclature) and destination, for each firm located on French metropolitan territory. For each flow, the customs record values and quantities. The database does not report all export shipments. Inside the EU, shipments are reported only if their annual trade value exceeds the threshold of 250,000 euro. For exports outside the EU all flows are recorded, unless their value is smaller than 1000 euros or one ton. Nevertheless, the database is almost comprehensive. 2) the BRN which contains other firm-level information, including firms sales, size, sector, and other balance-sheet variables. The period for which we have the data is from 1995 to 2005. The BRN database is constructed from mandatory reports of French firms to the fiscal administration, which are in turn transmitted to the INSEE (the French Statistical Institute). The customs database is virtually exhaustive, while the BRN contains between 650,000 and 750,000 firms per year over the period - around 60% of total the number of French firms. A more detailed description of the database is provided by Biscourp and Kramarz (2002) and Eaton, Kortum and Kramarz (2004). After merging the two sources, more than 90% of French exporters are still present in the database. Finally, macroeconomic variables come from the Penn World tables and the IMF's International Financial Statistics.

We restrict the sample in several ways. First, our data contains information on firm-level, destination-specific export volumes; this information is given in quantity (number of units). Variations in these quantities can be empirically used for our purpose only if the firm is not multi-product: a change in the mix of products for multi-product exporters can modify the number of exported units, so that variations in the export volumes for those firms are difficult to interpret. We therefore choose to restrict our analysis to single-product exporters. Alternatively, we run robustness checks using the export values and product-specific export information, as our database contains trade flows at the product-level (10,000 products). Second, the results presented here contain only non Eurozone destinations, to focus on destinations characterized by a sufficient level of variance of the exchange rate. Robustness checks have been made on the entire sample.

Table 2 contains some descriptive statistics. The total number of firms is equal to 175,496, which corresponds to a number of exporters per year comprised between 90 and 100,000.This lowest number demonstrates the important turnover in the export market already emphasized, among other, by Das, Robert and Tybout (2007). Restricting the sample to single product observations reduces the number of observations but an important number of exporters remain in the database - between 50 and 60,000 - since most of the firms are single-product toward at least one destination/year.

Table 2: Descriptive Statistics

	Nb. Obs.	Nb firms	Mean	Median	1st quartile	3rd quartile
ALL OBSERVATIONS						
Nb Employees	9401098	165992	260	36	11	120
VA / L	9150224	162153	81.65	51.99	37.87	111.05
Number of destinations	12149676	175496	14.8	12	5	22
Number of products by dest.	12149676	175496	4.03	2	1	4
Export status	12149676	175496	0.34	0	0	1
SINGLE-PRODUCT OBS.						
Nb Employees	7243490	154215	164	27	9	78
VA / L	7031301	150548	73.45	50.15	36.6	72.04
Number of destinations	9887117	164479	6.5	5	2	9
Export status	9887117	164479	0.20	0	0	1

3.1 Firm-level Methodology

Our first testable prediction is that firms react to a currency depreciation by increasing their market, and the more so the higher the performance of the firm. Recall the expression of producer prices in euro (6) :

$$\varepsilon_{ij} p_{ij}(\varphi) = \frac{\sigma}{\sigma-1}\left(1+\frac{\eta_j \varepsilon_{ij} w_j \varphi}{\sigma w_i \tau_{ij}}\right)\frac{w_i}{\varphi}$$

This expression depends on the elasticity of substitution σ, distribution costs η_j in the destination country, real exchange rate $\frac{\varepsilon_{ij} w_j}{w_i}$, the performance of the firm φ, the wage rate in the domestic country w_i, and bilateral variable trade costs τ_{ij}. We proxy producer prices by the export unit values. The inclusion of firm-destination fixed effects controls for σ, η_j and τ_{ij}, while year dummies capture w_i.[7] We are left with the following reduced-form equation:

$$Log(Unit_{hjt}) = \alpha_0 Log(\varphi_{ht-1}) + \alpha_1 Log(RER_{jt}) + \psi_t + \mu_{hj} + \epsilon_{ijt} \quad (18)$$

[7] As all firms in our sample are French, year dummies capture in particular the variations in the French wage rate.

where h represents the firm, j the destination and t the year. φ_{ht-1} is firm h's productivity in year $t-1$, $RER_{jt}$is the average real exchange rate between France and country j during year t. Firm-destination fixed effects are labeled μ_{hj} and year dummies ψ_t. Robustness checks have been made, controlling for country-specific variables such as GDP and GDP per capita as well as past values of the real exchange rate. The results are not affected.

Firm export volumes are given by equation (10):

$$x_{ij}(\varphi) = Y_j P_j^{\sigma-1} \left[\frac{w_i}{\varphi \varepsilon_{ij}} \tau_{ij} + \eta_j w_j \right]^{-\sigma} \left(\frac{\sigma - 1}{\sigma} \right)^{\sigma}$$

In addition to the regressors present for the unit values equation, export volumes depend on Y_j, w_j and P_j, i.e. on country j's GDP, wage and its price index. The second is proxied by GDP per capita, and the third by the country j's effective real exchange rate[8]. Our estimated equation takes the form:

$$Log(x_{hjt}) = \beta_0 Log(\varphi_{ht-1}) + \beta_1 Log(RER_{jt}) + \gamma Z_{jt} + \psi_t + \mu_{ij} + \upsilon_{ijt} \tag{19}$$

where Z_{jt} is a set of destination-year specific variables containing the above-mentioned variables: GDP, GDP per capita and effective exchange rate. As for the price equation, we include firm-destination fixed effects and year dummies.

Our model predicts that in presence of distribution costs, the effect of exchange rate changes on producer prices is positive, the more so the better the firm's performance. We thus expect the effect of exchange rate on unit values, i.e. the estimated α_1, to be larger when the firm is characterized by a high φ. Moreover, we have shown that export volumes react less to exchange rate changes when the firm is a better performer. Hence, β_1 should be lower for better performers.

To assess the relevance of these predictions, we estimate equations (18), and (19), on different subsamples, defined according to the level of performance of the firm. More precisely, we run separate estimations for firms above (respectively below) the median of φ_{it}, computed for each destination. Firms' performance φ_{it} is proxied in different ways: in addition to its contemporaneous TFP[9] and labor productivity we use its TFP in period $t-2$, the number of destinations it exports to, and its total export volume. Each indicator is a proxy for the performance of the firms as an exporter. In the model, it is easy to check that

[8]The effective exchange rate is computed from CEPII and IFS data as an average of the real exchange rates of destination countries toward all its trade partners - including itself - weighted by the share of each trade partner in the country's total imports.

[9]We compute Total Factor Productivity with the Olley-Pakes (1996) methodology.

a firm with a higher φ will export to more destinations and will have a larger volume of exports to each of these destinations.

Our theoretical framework also predicts that the exporting probability - $P(\varphi > \varphi_{ij}^*)$ - increases with an exchange rate depreciation. We thus estimate the exporting probability by replacing the dependent variable of equation (19) a dependent variable which equals 1 when the firm h exports to country j during year t. We further estimate this equation under the conditions $x_{hj,t-1} = 0$ and $x_{hj,t-1} = 1$ to assess separately the effect of exchange rate on entry decisions and on the decision to stay on the export market.

3.2 Firm-Level Results

3.2.1 Intensive Margin.

Tables 3 and 4 report the results on the impact of exchange rate on unit values and export volumes. In each table, we present in the first two columns the results on the whole sample, using alternatively labor productivity and total factor productivity as a measure of φ, before spliting the sample according to the firm's performance in the other estimations. The results are clear-cut. Regarding unit values (Table 3), exchange rate has a positive effect on the whole sample, as the model predicts (columns (1) and (2)). Firms do react to an exchange rate depreciation (apreciation) by increasing (decreasing) their producer prices. However, the sub-sample analysis shows that only high performers absorb part of the exchange rate depreciation by increasing their producer prices. Firms which are above the median in terms of performance react to a 1% depreciation by increasing their producer price between 0.16% and 0.30% depending on the performance indicator. Low performers' unit values are unaffected by exchange rate variations whatever the definition of performance.

The implications of this result on export volumes (Table 4) are also in line with our theoretical predictions. On the whole sample (columns (1) and (2)), exchange rate has a positive and significant impact on individual export volumes. The effect however varies importantly across firms: exchange rate has a significant positive impact on export volumes of low performers, whereas the impact is not significantly positive among high performance firms. Note that even among low performers, the elasticity of export volumes to exchange movements is rather small, between 0.38 and 0.69. High and low productivity exporters clearly have a different strategy when faced with an exchange rate change. As mentioned before, this effect has interesting aggregate implications, since exports are very concentrated toward high performers. In the next section we will indeed show that the distribution of performance among exporters importantly modifies the response of aggregate export volumes to exchange rate movements.

TABLE 3 : EXCHANGE RATE AND UNIT VALUES

Dep. Var. : Unit Value	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Performance Indicator			TFP		TFP(t-2)		Labor Productivity		Nb Destinations		Export Volume	
Sub-sample	All	All	High	Low	High	Low	High	Low	High	Low	High	Low
TFP(t-1)	0.005		-0.024*	0.023*					0.006	0.009	0.014	-0.01
	(0.008)		(0.013)	(0.013)					(0.011)	(0.013)	(0.009)	(0.016)
Labor Productivity(t-1)		0.014*					0.005	0.024**				
		(0.007)					(0.012)	(0.011)				
TFP(t-2)					0.012	0.023						
					-0.02	-0.017						
RER	0.166***	0.176***	0.224**	-0.008	0.298***	0.14	0.211***	0.054	0.222***	-0.093	0.165***	0.124
	(0.055)	(0.051)	(0.089)	(0.084)	(0.107)	(0.095)	(0.081)	(0.079)	(0.064)	(0.129)	(0.063)	(0.104)
Observations	161176	227530	82516	78660	54980	57467	114592	112938	104726	56450	86475	74701
R-squared	0.96	0.95	0.96	0.96	0.97	0.96	0.96	0.96	0.95	0.96	0.96	0.94

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies.
Subsamples computed by destination-year. * significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 4 : EXCHANGE RATE AND EXPORT VOLUMES

Dep. Var. : Unit Value	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Performance Indicator			TFP		TFP(t-2)		Labor Productivity		Nb Destinations		Export Volume	
Sub-sample	All	All	High	Low	High	Low	High	Low	High	Low	High	Low
TFP(t-1)	0.073***		0.083***	0.024					0.087***	0.037	0.070**	0.055*
	(0.020)		(0.032)	(0.033)					(0.027)	(0.032)	(0.028)	(0.032)
Labor Productivity(t-1)		0.061***					0.033	0.051*				
		(0.016)					(0.025)	(0.027)				
TFP(t-2)					0.012	-0.025						
					(0.050)	(0.043)						
RER	0.332**	0.329***	0.121	0.689***	-0.124	0.489**	0.300*	0.481**	-0.366	0.395***	0.268	0.389*
	(0.129)	(0.116)	(0.213)	(0.205)	(0.271)	(0.219)	(0.181)	(0.191)	(0.288)	(0.149)	(0.185)	(0.211)
Effective RER	-0.236***	-0.220***	-0.203*	-0.262*	-0.293*	-0.396***	-0.152	-0.339***	-0.190*	-0.126	-0.026	-0.379***
	(0.081)	(0.072)	(0.122)	(0.143)	(0.155)	(0.149)	(0.109)	(0.121)	(0.098)	(0.171)	(0.111)	(0.135)
GDP	0.742*	0.516	0.497	0.636	0.958	2.140**	0.101	0.922	0.452	1.969	0.86	0.86
	(0.441)	(0.399)	(0.699)	(0.744)	(0.959)	(0.888)	(0.610)	(0.672)	(0.509)	(1.204)	(0.593)	(0.769)
GDP per capita	0.231	0.337	0.573	0.434	0.118	-1.534*	0.8	0.078	0.683	-2.013	0.138	-0.026
	(0.449)	(0.409)	(0.715)	(0.753)	(1.038)	(0.929)	(0.627)	(0.687)	(0.505)	(1.320)	(0.609)	(0.781)
Observations	136328	191981	67978	68350	43393	49323	95765	96216	88372	47956	73139	63189
R-squared	0.93	0.93	0.94	0.94	0.95	0.94	0.95	0.94	0.93	0.94	0.92	0.86

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies.
Subsamples computed by destination-year. * significant at 10%; ** significant at 5%; *** significant at 1%

Different robustness checks are made. First, we have so far only considered single-product firms, since the analysis of export volumes and unit values for multi-product firms is more difficult to interpret. To control the robustness of our results to the use of the entire sample of firms, we have estimated (18) and (19) at the product level. Results are presented in Table 10 and 11 (in appendix).The results on unit values are unchanged (Table 10) and the results on export volumes are broadly consistent with our theoretical predictions on the difference of reaction of high and low performance firms to exchange rate movements. However, the difference between the *high* and *low* subsamples is less important than in previous specifications on export volumes. This may be due to the fact that our performance indicators - and therefore the subsample separation - are not at the product-level. It may also be due to the fact that both low and high performance firms react to an exchange rate depreciation by increasing the number of products they export to a destination.

We have also estimated (19) using individual export values instead of export volumes as a dependent variable. As mentioned in the theoretical section, the elasticity of individual export values to exchange rate is the sum of the elasticities on unit values and export volumes, which approaximatly holds in the data. Moreover, the first elasticity increases with productivity, while the second decreases with productivity. The total effect is thus less clear than on export volumes, but the model predicts that the total elasticity should decrease with productivity as long as the elasticity of substitution between goods is larger than unity. This is what Table 12 (in appendix) confirms: the elasticity of the value of exports to exchange rates is always lower for high than for low performers. As expected, the difference is less striking than in Table 4.

Finally, those results are not modified when considering a different decomposition of firms' performance, based on the first and last deciles Tables 13 and 14 (appendix) show on the contrary that, as predicted by theory, the use of deciles instead of median reinforces the difference of behavior between high and low performers. We also checked that introducing lags of the exchange rate in the regressions does not alter the firm-level results. In most regressions the lagged exchange rate is not significant which suggests that the effects we document are mostly contemporaneous. This is not true when we aggregate the results at the sector level (see Table 15 in appendix). Lagged exchange rates are in some regressions significant. These regressions at the ector level also serve as a robustness check. When we split the sample between high and low performance sectors (rather than high and low performance firms), we find again that only the low perfoamance sectors react to an exchange rate depreciation by increasing their export volumes.

Another prediction of our theory is that the effect of exchange rate changes varies with the level of the exchange rate itself: a more depreciated exchange rate level (a higher value of ε_{ij} in the model) is associated with a larger elasticity of prices and in turn a lower elasticity of export volumes to exchange rate movements. In fact, a more depreciated exchange rate level acts as an aggregate positive productivity shock which negatively affects the elasticity of the intensive margin to the exchange rate. To test this result from the theory, we further split the sample according to the level of exchange rate (above and below the median level, computed for each destination on the period). Our results are presented in Table 5. They are in exactly line with our predictions: a more depreciated level of the exchange rate increases the elasticity of producer prices to an exchange rate change, thus reducing the elasticity of export volumes.

TABLE 5 : NON LINEARITY, EXCHANGE RATE

	(1)	(2)	(3)	(4)
Dep. Var.	Unit Value		Export volume	
Indicator	RER		RER	
Sub-sample	High	Low	High	Low
TFP(t-1)	0.002	0.027*	0.075***	0.097***
	(0.011)	(0.014)	(0.024)	(0.034)
RER	0.374***	0.023	-0.342	0.958***
	(0.116)	(0.116)	(0.246)	(0.320)
…				
Observations	142022	114392	125948	91998
R-squared	0.97	0.97	0.95	0.96

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies. Subsamples computed by destination. * significant at 10%; ** significant at 5%; *** significant at 1%

3.2.2 Extensive Margin.

Table 6 reports the results on firms' exporting probability. The first panel (column 1 to 3) reports probit estimations whereas the second panel (columns 4 to 6) report OLS estimations. As predicted by the theory, productivity and exchange rate both have a positive impact. An increase of exchange rate of 1% increases the exporting probability by 0.21%; the effect comes from the entry probability, which increases by 0.17%, and the probability of remaining an exporter (not exiting) which increases by 0.23%. These results contrast with those of Greenaway et al. (2007) who find that exchange rate changes have little impact on entry decisions. This suggests that using destination-specific information (which they do not) enables us to estimate more precisely the effect of exchange rates on the extensive margin. Interestingly also, we have checked that the effect of exchange rate changes on entry is contemporaneous. No delayed effect can be detected.

TABLE 6 : EXCHANGE RATE AND EXPORTING DECISIONS

	(1)	(2)	(3)	(4)	(5)	(6)
Dep. Var.	P(X>0)	P(X>0)	P(X>0)	P(X>0)	P(X>0)	P(X>0)
Condition	All	X(T-1)=0	X(T-1)=1	All	X(T-1)=0	X(T-1)=1
Labor Productivity(t-1)	0.228***	0.076***	0.324***	0.053***	0.012***	0.062***
	(0.002)	(0.003)	(0.004)	(0.001)	(0.003)	(0.001)
RER	0.898***	1.258***	1.154***	0.199***	0.180***	0.244***
	(0.033)	(0.052)	(0.060)	(0.007)	(0.007)	(0.011)
GDP	-0.489***	-0.073	1.224***	-0.123***	-0.015	0.240***
	(0.113)	(0.178)	(0.197)	(0.026)	(0.026)	(0.040)
GDP per capita	1.648***	1.234***	-0.450**	0.382***	0.188***	0.070*
	(0.112)	(0.175)	(0.194)	(0.025)	(0.026)	(0.040)
Effective RER	0.012	-0.110***	0.045	0.004	0.016	0.029
	(0.021)	(0.034)	(0.178)	(0.005)	(0.030)	(0.035)
Marginal effects						
Labor productivity(t-1)	0.054***	0.012***	0.065***			
RER	0.214***	0.193***	0.231***			
Observations	2430544	1482033	948511	2430544	1482033	948511
Pseudo R-squared	0.02	0.01	0.01	0.02	0.01	0.01
Estimation		Probit			OLS	

Robust standard errors in parentheses.All estimations include destination fixed effects and year dummies. Marginal effects computed at means. * significant at 10%; ** significant at 5%; *** significant at 1%

3.3 Aggregate results

Our model predicts that the heterogeneity of response to exchange rate movements and the distribution of productivity (or more generally performance) among exporters is crucial to understand the aggregate effect of those exchange rate movements. If the mechanism at work in our theoretical framework is valid, then sectors for which exports are concentrated on a few high performers should be those also for which total sector export volumes are least sensitive to exchange rate movements. There are two reasons for this in our theoretical model. First, as in Chaney (2008), the extensive margin is reduced in more heterogenous sectors. The reason is that in sectors with high performance heterogeneity, firms that enter following a depreciation are much less productive and smaller than existing ones. Second, in our framework, performance heterogeneity also reduces the intensive margin. The reason is that in sectors with high performance heterogeneity, exports are concentrated on a few very productive firms. We have shown (theoretically and empirically) that the exports of those firms are more insensitive to exchange rate movements.

By analyzing how different sectors react differently to an exchange rate depreciation we can therefore better understand the aggregate implications of the mechanisms we study.

To do this, we aggregate the volume of exports by sector / destination and estimate its reaction to exchange rate variations. Our estimated equation takes the form:

$$Log(X_{kjt}) = \gamma_1 Log(RER_{jt}) + \gamma_2 Log(RER_{j,t-1}) + \gamma_3 Z_{j,t} + \psi_t + \mu_{kj} + \epsilon_{kjt} \tag{20}$$

where k is the sector and j the destination. $Z_{j,t}$ is the same vector of country-specific controls than in equation (19): GDP, GDP per capita and effective exchange rate. We introduce a lagged term of the exchange rate to capture the whole effect of exchange rate on exports, since, contrary to the firm level estimations, this lag is often significant here.

TABLE 7 : EXCHANGE RATE AND EXPORT VOLUMES, AGGREGATED

Dep. Var. : Sectoral Export Volume Sectoral Indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		κ (Pareto Shape)		10% bigger		10% more productive	
Sub-sample	Whole Sample	High	Low	High	Low	High	Low
RER	0.903***	0.753***	1.133**	0.501**	1.319***	0,044	1.115***
	(0,218)	(0,183)	(0,446)	(0,215)	(0,309)	(0,535)	(0,240)
RER(t-1)	0,206	0.490**	-0,24	0,349	-0,037	0,005	0.523**
	(0,215)	(0,211)	(0,388)	(0,261)	(0,293)	(0,355)	(0,233)
GDP	1.469***	1.505***	1.345**	1.189***	1.187***	1.622***	1.353***
	(0,329)	(0,325)	(0,630)	(0,383)	(0,452)	(0,558)	(0,462)
…							
Total effect of RER	1.111***	1.244***	0.895*	0.850***	1.282***	0,050	1.640***
	(0,290)	(0,287)	(0,537)	(0,292)	(0,390)	(0,541)	(0,376)
Observations	8041	4789	3550	4152	3889	3670	4371
R-squared	0,96	0,97	0,96	0,96	0,97	0,96	0,97

Robust standard errors in parentheses.All estimations include sector-destination fixed effects and year dummies.
* significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 8 : EXCHANGE RATE AND EXPORT VOLUME OF EXISTING EXPORTERS, AGGREGATED

Dep. Var. : Sectoral Volume of export, existing exporters Sectoral Indicator	(1)	(2)	(3)	(4)	(5)	(6)	(7)
		κ (Pareto Shape)		10% bigger		10% more productive	
Sub-sample	Whole Sample	High	Low	High	Low	High	Low
RER	0.678***	0.600***	0,808	0,247	1.130***	0,205	0.711**
	(0,247)	(0,193)	(0,525)	(0,254)	(0,328)	(0,544)	(0,286)
RER(t-1)	0,202	0,254	0,126	0,326	-0,168	-0,348	0.544**
	(0,228)	(0,216)	(0,439)	(0,267)	(0,278)	(0,341)	(0,254)
GDP	1.691***	1.590***	1.789**	1.325***	1.691***	2.078***	1.249***
	(0,377)	(0,314)	(0,784)	(0,451)	(0,576)	(0,712)	(0,481)
…							
Total effect of RER	0.880***	0.853***	0,934	0.573*	0.962***	-0,143	1.255***
	0,325	(0,305)	(0,629)	(0,311)	(0,443)	(0,576)	(0,391)
Observations	8040	4789	3549	4151	3889	3670	4370
R-squared	0,96	0,97	0,96	0,96	0,96	0,95	0,97

Robust standard errors in parentheses.All estimations include sector-destination fixed effects and year dummies.
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 7 reports the results. Around 800 destination-sector pairs of are included in the estimations. The total effect of real exchange rate on the whole sample is found to be a bit above unity. There are however large disparities across sectors. In columns (2) to (7) we split the sample according to the relative position of the sector exporters for each destination and year. More precisely, for each sector we compute the estimated Pareto shape, and the share of the 10% largest and most productive exporters. For the Pareto shape, we estimate a Pareto distribution based on the methodology provided by Norman, Kotz and Balakrishnan (1994) (see also Mayer and Ottaviano, 2008). High and Low represent, as in tables 3 and 4, above and below the median of these indicators. Here again, the results confirm the theoretical predictions: more heterogenous sectors have a lower elasticity of export volumes to exchange rate movements. This is true whether a high degree of heterogeneity is proxied by a low Pareto shape k (columns 2 and 3), a high share of the 10% largest firms (columns 4 and 5) or most productive (columns 6 and 7).

The low reaction of exports found at the aggregate level may both come from the low elasticity of the intensive margin (existing exporters) or the low response of the extensive margin (entrants). The mechanism stressed in this paper mainly relies on the effect of heterogeneity on the intensive margin: when existing exporters are high performance firms, their export sales react less to exchange rates. This is especially true in those sectors where firms selection is stronger, i.e. where firms are very good performers and sectors with more heterogeneity. The difference of elasticity between high and low performance heterogeneity sectors shown in table 7 may also be due to the effect of heterogeneity on the extensive margin as shown by Chaney (2008). In table 8 we estimate the effect of exchange rate on the intensive margin, i.e. the volume of exports of firms that exported in $t-1$. Results found in table 8 supports the hypothesis that heterogeneity matters for the intensive margin: the elasticity of the intensive margin to real exchange rate changes is found to be significant only in sectors where productivity is sufficiently homogenous. Even in these sectors, the elasticity we find is quite low. This is consistent with our main story: the aggregate effect of exchange rate movements is low because exporting requires a high productivity, an attribute which in turn gives an incentive to firms to react to an exchange rate depreciation by increasing the export price rather than their sales.

TABLE 9: EXCHANGE RATE, NUMBER OF EXPORTERS AND MEAN VOLUME OF SHIPMENT

	(1)	(2)	(3)
Dep. Var	Total export volume	Number of Exporters	Mean Vol. of Shipment
RER	0.903***	0.544***	0.359*
	(0,218)	(0,057)	(0,213)
RER(t-1)	0,206	0.147***	0,059
	(0,215)	(0,043)	(0,204)
GDP	1.469***	0.738***	0.731**
	(0,329)	(0,068)	(0,322)
…			
Total effect of RER	1.111***	0.691***	0,420
	(0,290)	(0,059)	(0,285)
Observations	8041	8041	8041
R-squared	0,96	0,99	0,93

Robust standard errors in parentheses.All estimations include sector-destination fixed effects and year dummies.
* significant at 10%; ** significant at 5%; *** significant at 1%

In Table 9 we decompose the total volume of exports into an extensive and an intensive margin using a more traditional definition, i.e. the number of exporters and the mean volume of shipment. Whereas the number of exporters is expected to increase with the exchange rate, this is less clear for the mean volume of shipment, since entrants following a depreciation should be less productive and smaller than existing exporters. This is indeed what our results, presented in Table 9, suggest: only the number of firms is significantly affected by the exchange rate. The mean volume of shipments remains unaffected by a change in the exchange rate.

4 Conclusion

We have shown that exporters react differently to exchange movements. High performance firms, the largest exporters, react to a depreciation by increasing their producer price. They therefore partially absorb exchange rate movements in their mark-up. This also means they price to market. They choose this strategy rather letting the import price fall and increase their export sales. Low performance firms choose not to increase their mark-up, let the import price fall and increase their sales. A simple model that features this heterogeneity in reaction is presented where the main feature is the presence of distribution costs in the destination country that are not affected by the productivity of the exporter. These distribution costs reduce the demand elasticity to a larger extent for high performers than for low performers.

We show that the difference in reaction to exchange rate movements is very robust for French exporters. To our knowledge, our paper is the first to document this fact and more generally it the first to use a very rich firm level data set to analyze how firms react to exchange rate movements in their choice of prices, of quantities, of exit and entry.

This heterogeneity is interesting in itself but it also has interesting implications for the impact of exchange rates on exports at the aggregate level. The mechanism that we document can explain the low aggregate elasticity of export volumes to exchange rate movements: the bulk of exports is made by high performance firms which we show optimally prefer to absorb exchange rate movements in their mark-up. Heterogeneity matters for the intensive margin. It also matters for the extensive margin because firms that enter the export market following the exchange rate movement are less productive and smaller than existing ones.

Our mechanism is based on the presence of three features: the heterogeneity of firms, the presence of fixed costs to export and of local distribution costs. It is not based on any assumption of price rigidity. We believe therefore that it is quite general. We however have not explored how this mechanism would work in a general equilibrium framework in particular one in which exchange rate movements are endogenous as in Corsetti and Dedola (2005).

Our results have implications for the import pass-through literature which we have not fully explored because we have focused on the export side of the story. Our results suggest that the low level of pass-through of exchange rate movements into import and consumer prices and may be the its fall over time can be explained by the mechanism at work in our model (for an explanation of the fall of pass-through over time see, Bergin and Feenstra (2007)). Exporters, because of the presence of fixed costs to export, are high performance firms which optimally choose a low degree of pass-through. If high performance firms are over-represented in the imports of a country and therefore in its import price index, then the mechanism we have analyzed should also explain the low degree of pass-through we observe.

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5 Appendix

5.1 Heterogenous quality

We present a version of the model where firms differ in terms of quality. This generates similar empirical predictions as long as quality increases quickly enough with the cost of production so that the higher quality firms have higher operating profits. As shown by Baldwin and Harrigan (2007), this is the empirically relevant case The quality part of this version of the model is similar to Baldwin and Harrigan (2007). Utility is:

$$U(c_i) = \left[\int_X \left[s(\varphi) q_i(\varphi) \right]^{1-1/\sigma} d\varphi \right]^{\frac{1}{1-1/\sigma}} \tag{21}$$

where $q_i(\varphi)$ is the consumption of variety φ. and $s(\varphi)$ is the level of quality. Higher quality goods have higher marginal costs: $s(\varphi) = \left(\frac{w_i}{\varphi}\right)^{\lambda}$ so that they are associated with low φ. The relevant case where quality increases profits is $\lambda > 1$ We also assume that higher quality goods have higher distribution costs: $\eta w_j s(\varphi)$. The demand for variety φ is:

$$x_{ij}(\varphi) = Y_j P_j^{\sigma-1} \left[\frac{p_{ij}(\varphi)\tau_{ij}}{s(\varphi)} + \eta w_j \right]^{-\sigma} \tag{22}$$

The optimal producer price $\varepsilon_{ij} p_{ij}$ expressed in currency i of firm/variety φ in country i and sold in country j is:

$$\varepsilon_{ij} p_{ij}(\varphi) = \frac{\sigma}{\sigma - 1} \left(1 + \frac{\eta \varepsilon_{ij} w_j \varphi s(\varphi)}{\sigma w_i \tau_{ij}} \right) \frac{w_i}{\varphi} \tag{23}$$

For an active exporter, the volume of exports is:

$$x(\varphi) = Y_j P_j^{\sigma-1} \left[\frac{w_i}{\varphi s(\varphi)\varepsilon_{ij}} \tau_{ij} + \eta w_j \right]^{-\sigma} \left(\frac{\sigma - 1}{\sigma} \right)^{\sigma} \tag{24}$$

We can now analyze the impact of a change in bilateral exchange rates (for given nominal wages) on the producer price:

$$\frac{d\varepsilon_{ij} p_{ij}(\varphi)}{d\varepsilon_{ij}} \frac{\varepsilon_{ij}}{\varepsilon_{ij} p_{ij}(\varphi)} = \frac{\eta \varphi s(\varphi) w_j \varepsilon_{ij}}{\sigma w_i \tau_{ij} + \eta \varphi s(\varphi) w_j \varepsilon_{ij}} \tag{25}$$

and on the *volume* of exports:

$$\frac{dx(\varphi)}{d\varepsilon_{ij}} \frac{\varepsilon_{ij}}{x(\varphi)} = \sigma \frac{w_i \tau_{ij}}{w_i \tau_{ij} + \eta \varphi s(\varphi) w_j \varepsilon_{ij}} \tag{26}$$

The elasticity of the producer price to an exchange rate change increases with the quality of the good it produces (and its value added per worker) as long as $\lambda > 1$, the relevant case. The same condition applies for the elasticity of the volume of exports to an exchange rate change to decrease with the quality of the good it produces and its value added per worker.

5.2 Robustness checks

TABLE 10: EXCHANGE RATE AND UNIT VALUES, PRODUCT LEVEL

Dep. Var. : Unit Value	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Performance Indicator		TFP		TFP(t-2)		Labor Productivity		Nb Destinations		Export Volume	
Sub-sample	All	High	Low	High	Low	High	Low	High	Low	High	Low
TFP(t-1)	0.016***	0.022***	0,003					0.020***	0.016***	0.010***	0.025***
	(0,003)	(0,005)	(0,005)					(0,004)	(0,004)	(0,004)	(0,004)
TFP(t-2)				-0,004	0.019***						
				(0,007)	(0,005)						
Labor Productivity(t-1)						0.034***	0.014***				
						(0,005)	(0,005)				
RER	0.110***	0.217***	0,04	0.209***	-0,01	0.164***	0,038	0.124***	0.065**	0.182***	0,015
	(0,021)	(0,030)	(0,034)	(0,030)	(0,034)	(0,031)	(0,031)	(0,030)	(0,030)	(0,023)	(0,033)
Observations	1576027	879348	696679	880687	695340	883672	692355	920662	655365	836071	739956
R-squared	0,77	0,78	0,77	0,79	0,76	0,76	0,8	0,71	0,86	0,8	0,7

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies.
Subsamples computed by destination-year. * significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 11: EXCHANGE RATE AND EXPORT VOLUME, PRODUCT LEVEL

Dep. Var. : Export Volume	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Performance Indicator		TFP		TFP(t-2)		Labor Productivity		Nb Destinations		Export Volume	
Subsample	All	High	Low	High	Low	High	Low	High	Low	High	Low
TFP(t-1)	0.089***	0.040***	0.131***					0.078***	0.075***	0.060***	0.053***
	(0,006)	(0,009)	(0,010)					(0,010)	(0,008)	(0,006)	(0,009)
TFP(t-2)				0.081***	0.065***						
				(0,012)	(0,011)						
Labor Productivity(t-1)						0.034***	0.126***				
						(0,010)	(0,010)				
RER	0.328***	0.268***	0.435***	0.242***	0.468***	0.383***	0.326***	0.265***	0.389***	0.263***	0.351***
	(0,039)	(0,058)	(0,065)	(0,058)	(0,064)	(0,055)	(0,068)	(0,068)	(0,051)	(0,061)	(0,040)
Effective RER	0.052**	0.098***	0,017	0,053	-0,015	0.109***	0,008	0,057	0.059*	-0,003	0.078**
	(0,024)	(0,035)	(0,042)	(0,035)	(0,041)	(0,034)	(0,041)	(0,042)	(0,031)	(0,024)	(0,037)
GDP	1.216***	1.256***	1.219***	1.122***	1.016***	1.522***	0.917***	1.494***	1.132***	0.861***	1.540***
	(0,136)	(0,199)	(0,233)	(0,201)	(0,227)	(0,193)	(0,236)	(0,239)	(0,175)	(0,138)	(0,207)
GDP per capita	-0,027	-0,007	-0,112	0,102	0,086	-0,235	0,192	-0,326	0,051	0,165	-0.966***
	(0,137)	(0,202)	(0,236)	(0,204)	(0,229)	(0,196)	(0,238)	(0,243)	(0,178)	(0,139)	(0,210)
Observations	1344133	747389	596744	745147	598986	755211	588922	559398	784735	713832	630301
R-squared	0,7	0,69	0,71	0,7	0,7	0,68	0,72	0,64	0,76	0,72	0,68

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies.
Subsamples computed by destination-year. * significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 12 : EXCHANGE RATE AND EXPORT VALUES

Dep. Var. : Export value	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
Performance Indicator			TFP		TFP(t-2)		Labor Productivity		Nb Destinations		Export Volume	
Sub-sample	All	All	High	Low	High	Low	High	Low	High	Low	High	Low
TFP(t-1)	0.083***		0.061**	0.053*					0.050*	0.096***	0.090***	0,046
	(0,018)		(0,028)	(0,029)					(0,029)	(0,024)	(0,026)	(0,028)
Labor Productivity(t-1)		0.075***					0.044**	0.072***				
		(0,014)					(0,022)	(0,023)				
TFP(t-2)					0,039	0,003						
					(0,045)	(0,039)						
RER	0.460***	0.466***	0.350*	0.604***	0,191	0.576***	0.492***	0.469***	-0.480*	0.611***	0.397**	0.469**
	(0,112)	(0,101)	(0,183)	(0,178)	(0,228)	(0,196)	(0,156)	(0,164)	(0,247)	(0,129)	(0,164)	(0,183)
Effective RER	-0,069	-0,027	-0,001	-0,066	-0,078	-0.248**	0,035	-0,127	0,07	-0,088	0,039	-0,131
	(0,069)	(0,061)	(0,102)	(0,123)	(0,129)	(0,126)	(0,093)	(0,102)	(0,144)	(0,082)	(0,097)	(0,113)
GDP	0,559	0,49	0,709	0,371	0,508	1.734**	0,408	0,307	2.224**	0,293	0,546	0,748
	(0,386)	(0,348)	(0,613)	(0,651)	(0,828)	(0,803)	(0,539)	(0,583)	(0,989)	(0,448)	(0,526)	(0,662)
GDP per capita	0,439	0,455	0,365	0,674	0,476	-0,979	0,653	0,72	-1.889*	0.819*	0,567	-0,189
	(0,393)	(0,356)	(0,627)	(0,657)	(0,888)	(0,841)	(0,551)	(0,597)	(1,084)	(0,445)	(0,538)	(0,673)
Observations	136328	191981	67978	68350	43393	49323	95765	96216	88372	47956	73139	63189
R-squared	0,88	0,88	0,9	0,89	0,91	0,9	0,91	0,89	0,88	0,9	0,89	0,85

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies.
Subsamples computed by destination-year. * significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 13: EXCHANGE RATE AND UNIT VALUES, TOP 10% VS BOTTOM 10%

Dep. Var. : Unit Value	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Performance Indicator	TFP		TFP(t-2)		Labor Productivity		Nb Destinations		Export Volume	
Sub-sample	10% High	10% Low	10% High	10% Low	10% High	10% Low	10% High	10% Low	10% High	10% Low
TFP(t-1)	0.009	0.025					0.017	-0.007	0.026**	0.102
	(0.017)	(0.021)					(0.022)	(0.025)	(0.013)	(0.065)
TFP(t-2)			-0.017	0.013						
			(0.037)	(0.029)						
Labor Productivity(t-1)					-0.006	-0.004				
					(0.015)	(0.018)				
RER	0.359**	-0.192	0.329*	-0.048	0.456***	0.024	0.524***	-0.266	0.339***	0.519
	(0.146)	(0.217)	(0.194)	(0.217)	(0.150)	(0.224)	(0.136)	(0.325)	(0.098)	(0.449)
Observations	15472	9486	7622	7032	20057	13226	16648	8835	13155	8426
R-squared	0.95	0.94	0.96	0.95	0.95	0.94	0.93	0.95	0.81	0.91

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies.
Subsamples computed by destination-year. * significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 14: EXCHANGE RATE AND EXPORT VOLUME, TOP 10% VS BOTTOM 10%

Dep. Var. : Export Volume	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Performance Indicator	TFP		TFP(t-2)		Labor Productivity		Nb Destinations		Export Volume	
Subsample	10% High	10% Low	10% High	10% Low	10% High	10% Low	10% High	10% Low	10% High	10% Low
TFP(t-1)	-0.028	-0.059					0.069	0.075	0.037	-0.002
	(0.043)	(0.051)					(0.050)	(0.056)	(0.039)	(0.122)
TFP(t-2)			0.073	0.034						
			(0.077)	(0.059)						
Labor Productivity(t-1)					-0.025	-0.022				
					(0.035)	(0.043)				
RER	-0.635*	0.933*	0.188	1.246***	-0.675**	1.219**	-0.093	1.553**	-0.019	0.586
	(0.363)	(0.518)	(0.403)	(0.432)	(0.343)	(0.517)	(0.310)	(0.746)	(0.296)	(0.792)
Effective RER	-0.277	-0.694*	-0.245	-0.541*	-0.385*	-0.954***	-0.183	-0.705*	-0.161	-0.166
	(0.215)	(0.414)	(0.236)	(0.293)	(0.204)	(0.337)	(0.188)	(0.380)	(0.188)	(0.525)
GDP	2.029*	1.037	3.403**	2.879*	0.135	-0.058	-0.748	8.504***	0.616	3.629
	(1.187)	(2.095)	(1.484)	(1.685)	(1.211)	(1.773)	(1.003)	(2.298)	(0.976)	(3.128)
GDP per capita	-0.400	-0.940	-2.258	-3.841**	1.219	0.160	1.451	-10.382***	0.128	-4.852
	(1.230)	(2.148)	(1.580)	(1.759)	(1.259)	(1.825)	(1.033)	(2.658)	(0.989)	(3.329)
Observations	12937	8389	9841	12311	16923	11362	14127	7513	11277	7175
R-squared	0.88	0.90	0.86	0.91	0.87	0.89	0.90	0.87	0.87	0.56

Robust standard errors in parentheses. Panel, within estimations (firm-destination fixed effects) with year dummies.
Subsamples computed by destination-year. * significant at 10%; ** significant at 5%; *** significant at 1%

TABLE 15: EXCHANGE RATE, PRODUCTIVITY AND EXPORT VOLUMES, AGGREGATED

Dep. Var. :	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Sectoral Export Volume	All firms		All firms		Existing Exporters		Existing Exporters	
Sectoral Indicator	Mean Productivity		Median Productivity		Mean Productivity		Median Productivity	
Sub-sample	High	Low	High	Low	High	Low	High	Low
RER	1.147***	0.709**	1.056***	0.711***	0.969**	0.480*	0.850*	0.484*
	(0,365)	(0,277)	(0,361)	(0,269)	(0,431)	(0,289)	(0,441)	(0,281)
RER(t-1)	-0,511	0.812***	-0,345	0.728***	-0,304	0.541*	0,000	0.445*
	(0,342)	(0,268)	(0,353)	(0,262)	(0,363)	(0,277)	(0,394)	(0,269)
GDP	1.173**	1.467***	1.318**	1.491***	1.701***	1.370***	1.825***	1.445***
	(0,514)	(0,416)	(0,521)	(0,428)	(0,579)	(0,454)	(0,587)	(0,477)
…								
Total effect of RER	0,636	1.521***	0,711	1.440***	0,665	1.021***	0,850	0.930***
	(0,451)	(0,365)	(0,460)	(0,380)	(0,491)	(0,381)	(0,544)	(0,395)
Observations	4002	4074	4005	4073	4001	4074	4004	4073
R-squared	0,97	0,96	0,96	0,96	0,95	0,97	0,96	0,97

Robust standard errors in parentheses.All estimations include sector-destination fixed effects and year dummies.
* significant at 10%; ** significant at 5%; *** significant at 1%