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Relative Real Exchange-Rate Volatility, Multi-Destination Firms and Trade: Micro Evidence and Aggregate Implications

Jérôme Héricourt & Clément Nedoncelle

Highlights

- Using a French firm-level database over the period 1995-2009, we study how firm-level export performance is affected by relative Real Exchange Rate (RER) volatility.
- Firm-level export performance is affected by both bilateral and multilateral real exchange rate volatility, the latter embodying the existence of strong third-market effects.
- Firms tend to reallocate exports away from destinations characterized by higher, relative RER volatility.
- Firms are even more prone to reallocate when the scope of possible reallocations is extended.

Abstract

In this paper, we study how firm-level export performance is affected by Real Exchange Rate (RER) volatility and investigate the way this effect is shaped by firm size and more specifically, the number of destinations. Our empirical analysis relies on a French firm-level database that combines balance-sheet and product-destination-specific export information over the period 1995-2009. More specifically, we show that export performance is affected by both bilateral and multilateral real exchange rate volatility (that is, the weighted volatility of all other destinations served by firms), the latter embodying the existence of third-market effects. Besides, we find that firm size and the number of destinations seem to exacerbate the impacts of both bilateral and multilateral RER volatilities on export performance: firms tend to reallocate exports away from destinations characterized by higher, relative RER volatility, and are even more prone to do so when the scope of possible reallocations is extended. Our results suggest that more destination-diversified firms are better able to handle exchange rate risks, with significant implications for exports at the macro level: a very simple empirical exercise shows that aggregate exports would have been 6.6% larger if all firms had been able to reallocate exports across sufficiently numerous destinations.

Keywords

Exchange rate volatility, multi-destination exporters, hedging, reallocation.

JEL

F14, F31, L25.

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RESEARCH AND EXPERTISE ON THE WORLD ECONOMY

Relative Real Exchange-Rate Volatility, Multi-Destination Firms and Trade: Micro Evidence and Aggregate Implications[1]

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1. Introduction

The increasing volatility of real exchange rates after the fall of Bretton-Woods agreements has been a source of concerns for both policymakers and academics. In a context where firms are risk averse, exchange rate risk increases trade costs and reduces the gains from international trade (Ethier, 1973). Surprisingly, macroeconomic evidence of the effect of real exchange rate (RER) volatility on trade has however been quite mixed, yielding either small or insignificant effect on aggregate outcomes (see Greenaway and Kneller, 2007 and Byrne et al., 2008 for a survey). A common explanation refers to the existence of hedging instruments for exchange rate risks, which are designed precisely to dampen the effect of exchange rate volatility on trade. However, Wei (1999) shows that this explanation is unlikely. Using bilateral trade data for 63 countries over the 1975-1990 period, he finds substantial evidence against the idea that exchange rate volatility is hedged: no effect of exchange rate volatility on trade can be found for country pairs with small potential trade, whereas country pairs with large potential trade exhibit a negative effect of volatility. More recently, a couple of papers provided microfounded evidence than previous macro or sector-level studies were likely flawed by aggregation biases and non-linearities due, for instance, to financial constraints. Cheung and Sengupta (2013) simultaneously study the impact of real effective exchange rate variations and volatility on the share of exports-to-sales ratio for a sample of a few thousand Indian non-financial sector firms, and find support for a negative effect of volatility. Héricourt and Poncet (2015) confirm a trade-deterring effect of real exchange rate volatility on both (extensive and intensive) margins of trade for Chinese exporters, with a magnifying effect of financial constraints.

Now that the negative impact of exchange rate volatility on exports appears more firmly established on microeconomic grounds, this paper wants to take several steps further by examining how the volatility of exchange rates may induce firms to reallocate exports *across* destinations. Firms exporting to many destinations may indeed want to minimize the overall impact of exchange rate volatility on their profit by reallocating exports to destinations characterized by relatively less volatility. However, it is also well-known that multi-destinations exporting firms are also the most productive and the biggest ones (Bernard et al., 2012), with a better ability to hedge their exports against exchange rate fluctuations, so that the overall impact of exchange rate volatility on firms' allocation behavior between markets is not clear. The questions seems even more intriguing in the light of other recent works showing the heterogenous response of exporters to the *level* of RER, according to their size/productivity. Berman et al. (2012) provide evidence on French firm-level data of an heterogeneous response of firms to a given change in exchange rate. Chatterjee et al. (2013) conducted the same analysis on Brazilian firm-level data and find that following a real exchange rate depreciation, firms increase markups for all products, but this rise in markup declines with firm-product-specific marginal costs of production. Using Chinese firm-level data, Tang and Zhang (2012) provide evidence of a fast response of firm exporting behavior after real exchange rate movements. Those papers focus on the impact of the exchange rate level on exporting firms rather than its volatility.

The present paper wants to address the question of the effect of RER volatility on firm exporting performance, focusing on the reallocation behavior of exporting firms *across* destinations and the way firm size may affect this behavior, taking into account third-market effects.[2] In

[2]This question of the consequences of diversification of destination markets on firm-level behavior is triggering

a standard firm-level gravity-style model known to be compatible with most of the existing theoretical frameworks, we discriminate between bilateral RER volatility and multilateral RER volatility. The former is the standard RER volatility between the firm's country and the destination country, while the latter is the multilateral RER volatility of all destinations the firm serves but the considered destination. This framework allows us to analyze the reallocation behavior of exporting firms between destinations and how this behavior is affected by relative RER volatility, i.e. by bilateral volatility (i.e. with respect to the considered destination) *and* multilateral volatility (i.e. with respect to all other destinations). Related to our work is the paper by Héricourt and Poncet (2015), with one particular result is that firms with a high number of destinations or products are relatively more sensitive to real exchange rate volatility. Among other things, this paper wants to provide a rationale for this result.

Our empirical analysis relies on a very rich yearly, French firm-level dataset containing both trade data from the French Customs and balance-sheet information over the period 1995-2009. We assess the impact of our two indicators of RER volatility on various definitions of export performance at the firm level, for both intensive and extensive margin. Therefore, the contribution of this paper is threefold. First, we provide new quantitative evidence of the impact of RER volatility on exports at the firm-level behavior. We find that a 10% increase in bilateral volatility reduces the value exported by 0.3%, and entry to a given export market by 0.15%. Symmetrically, we provide evidence for third-market effects, i.e., the pro-trade effect of multilateral (weighted) RER volatility: bilateral exports and entry all increase with the RER volatility of other destinations - respectively, by $+1.5\%$ and 0.3% following a 10% increase in multilateral RER volatility. Second, we find that firm size and the number of destinations seem to exacerbate those effects. Ranking firms according to the number of destinations they serve, we find that a 10% increase in bilateral volatility decreases bilateral exports by 0.7% and entry by 0.2% for firms located at the 90$^{\text{th}}$ percentile of the distribution. Similarly, the trade-promoting effect of multilateral volatility appears also magnified by the number of markets served: a 10% rise in multilateral volatility increases bilateral exports by 2.7% and entry by 0.5% at the 90$^{\text{th}}$ percentile.

Those effects are robust to various specifications and robustness checks. In particular, estimations performed on a subsample of firms exporting exclusively outside the Euro Area shows a similar pattern, with slightly smaller effects. Estimates at the firm-destination-product level provide evidence of significant adjustments going through both the average value exported at the destination-product level and the number of products exported. Third, we use the results obtained from the previous estimates to run some simple quantitative exercises and investigate how much exporting to many destinations distorts the response of aggregate trade flows to RER volatility. We find that French aggregate exports would increase by 6.6% if all firms had the same level of destinations diversification than the upper half of the distribution.

Those results provide useful additional insights to the existing literature. From a general

a growing interest of academic literature. Addressing an issue in a sense symmetrical to ours, Vannoorenberghe et al. (2014) provided evidence, using Chinese data, against the common belief that diversification of exports across countries may decrease the volatility of exports. They show that small firms behave in a different way than the standard portfolio theory should drive them to, because of their temporary entry on markets they are able to reach. Having a diversified portfolio of destinations may not only allow firms to hedge, but also to enter and exit some markets across time, thus increasing volatility of exports. The explanation the authors put forward may be related to the reallocation behavior of some firms across destinations.

perspective, we provide a micro-founded rationale for Wei (1999)'s result that there is a negative effect of volatility on trade increasing with potential trade between countries. More precisely, our focus on firm heterogeneity concerning size and the number of destinations served unveils a potential explanation for the micro negative impact of exchange rate volatility. Common wisdom argues that big and/or multi-destination firms tend to be less financially constrained, and therefore, to have better access to hedging instruments, precisely against RER volatility: this would support the idea that exports from those firms should be more immune to exchange rate volatility. Actually, the empirical evidence we provide in this paper supports an opposite pattern: exports from big, multi-destination firms tend to react *more* to exchange rate volatility. This behavior may be rationalized through the lens of Markowitz (1952)'s portfolio theory: for a given level of profitability on each market, firms will tend to reallocate exports away from destinations characterized by higher, relative RER volatility, in order to hold the average risk level of their destinations portfolio constant. A logic consequence is that this behavior should be exacerbated when the number of destinations served increase, i.e. when the scope of possible reallocations is extended. More destination-diversified firms are therefore better able to handle exchange rate risks, with substantial implications for aggregate exports, as suggested by the simple counterfactual exercise we propose.

In the next section, we survey the different theoretical mechanisms underlying our approach, before presenting our database and discussing our general methodology in section 3. Section 4 presents the first set of results of the paper, starting with the intensive margin, then focusing on the extensive margin. Some robustness checks of those results are presented in section 5, before turning to a firm-destination-product analysis in section 6. Section 7 investigates the aggregate implications of the firm-level evidence. Section 8 concludes.

2. Real Exchange Rate Volatility, Firm Heterogeneity and Exports: Theoretical Background

Why should firms react negatively to bilateral RER volatility? One may think of two different kind of theoretical mechanisms. First, Bernard et al. (2011) show that the share of multi-product firms that export, the number of destinations for each product, and the range of products they export to each market all decrease in response to higher variable trade costs - in our case, increased RER volatility. Berthou and Fontagné (2013) document the impact of the introduction of the euro on the export decisions of French firms, the number of products exported, and average sales per product. Their results point to a diverse trade creation effect across euro area destinations: exports grew by 13% following the introduction of the euro for firms exporting to destinations characterized by lower monetary policy coordination (that is, higher exchange rate volatility) before 1999, with 20 percent of the effect due to an increase in the number of products exported. By contrast, no effect arises regarding the status of exporter or non exporter. Conversely, they find a negative effect on all three definitions of trade margins for euro area destinations with closer monetary policy coordination before 1999, indicating that the additional competitive pressure more than offset the benefits of zero volatility.

Second, another mechanism that is more focused on the sunk costs of exports (and therefore, especially appropriate for the for the entry of participation decision) may also be at work. On the one hand, export capacity may be considered a type of investment in intangible capital (such as R&D); on the other hand, exchange rate movements give rise to additional sunk costs (Greenaway and Kneller, 2007). The negative impact of exchange rate volatility on exports can be rationalized through the asymmetry of adjustment costs leading to investment irreversibility. When facing a real depreciation of its own currency, the current earnings of a firm rise. The firm may use this additional income to fund the sunk costs of entering new markets. However, once these investments are made, it is impossible to back out and recover what they cost, even in the case of an abrupt subsequent currency appreciation. Consequently, firms may be even more reluctant to take the chance of engaging in exports to markets characterized by highly volatile exchange rates.

To sum up, there is strong theoretical and empirical evidence that bilateral exports towards a specific destination are hampered by RER volatility of the same destination. But there are also many reasons to think that the RER volatility of the other served export markets will impact bilateral exports to a specific destination.

RER volatility in general equilibrium *Why should firms also respond to RER volatility in third-markets?* Influential papers have provided evidence that bilateral trade flows are affected not only by bilateral trade costs but also by trade costs with respect to third-markets. Lai and Trefler (2002) show the importance of correctly specifying general equilibrium price effects in response to varying trade costs, subject to heavy misspecification and evaluation problems. In a similar vein, Anderson and van Wincoop (2003) emphasize that trade between two regions is decreasing in their bilateral trade barrier relative to the average barrier of the two regions to trade with all their partners. In other words, "the more resistant to trade with all others a region is, the more it is pushed to trade with a given bilateral partner (p.1)." Therefore, they show that the correctly specified gravity equation should include an appropriate expression for this average trade barrier they term "multilateral resistance". Both papers point toward the necessity of accounting for third-markets effects when conducting (empirical) general equilibrium analysis. Transposed in our specific context, this highlights the need to take into account multilateral exchange rate volatility in all other markets served by the firm when examining bilateral exports towards a specific destination. This leads us to expect a trade-promoting effect of multilateral volatility, implying substitution of destinations at the firm-level.

How should firm size and number of destinations served impact these relationships between RER volatilities and export performance? There is a rapidly increasing number of papers that consider the behavior of firms that manufacture and export several products to several destinations. It is widely known that aggregate exports are concentrated in a small number of major players (Eaton et al., 2004) and that large exporters are involved in exporting more than one product to several destinations (Bernard et al., 2011; Eckel et al., 2011). Therefore, it makes sense that both dimensions (size and number of destinations) will shape exports flows response to changes in RER volatility. But in which direction? One may think that a firm that exports to a large set of destinations will face a larger risk, insofar as this firm is all the more exposed to changes in RER in many countries. On the contrary, a small firm that exports to a restricted set of countries straightforwardly faces a lower total risk. Focusing on the single firm dimension, exports and firm size are supposed to be related because of the number of destinations.

However, at firm-destination level, the picture may be quite different. How are firm-destination exports shaped by firm size? Conditional on the number of destinations, there is a trade-off between diversification and optimal reallocation of exports. On the one hand, firms that are big enough to be able to export to a large set of countries may also access financial instruments to hedge the aggregate RER volatility risks, depending on their risk aversion. Evidence consistent with this intuition can be found, among others, in Ito et al. (2015). They investigate how firms cope with exchange rate risk using survey data on a sample of a few hundred Japanese firms listed on the Tokyo Stock Exchange. Those firms are very likely to be bigger than other firms, and to have a good access to hedging instruments. Indeed, Ito et al. (2015) confirm that these firms combine a variety of tools (choice of invoicing currency, financial and operational hedge, exchange rate pass-through) to reduce the risk associated to exchange rate fluctuations.

Besides, in a world of imperfect financial markets with information asymmetries, a larger firm will have also easier access to external finance since it has more collateral (see e.g. Beck et al., 2005, for cross-country-evidence).[3] On the whole, bigger firms have simultaneously a better access to external finance and to hedging instruments. Therefore, if this effect is at play, there should be a strong positive correlation between firm size and the ability to hedge against volatility: firm size and the number of destinations should *dampen* the impact of RER volatilities on exporting behavior of these firms on a given market.

On the other hand, conclusion may be different if we think the allocation decisions of firms within the frame of the well-known Markowitz (1952, 1991)'s portfolio theory. In very simple terms, Markowitz's portfolio theory attempts to maximize portfolio expected return for a given amount of portfolio risk, or equivalently minimize risk for a given level of expected return, by carefully allocating the various assets that may or may not enter the portfolio. In our context, it means that, for a given level of profitability related to each destinations, firms will tend to reallocate exports to destinations that are subject to lower relative RER volatility, and this should be increasingly true with the number of destinations served.[4] As previously stated, firm size represents the other side of the same coin: while the number of destinations conditions the scope of the possible reallocations, size, as stated above, mirrors the ability of paying the costs for reallocating exports to relatively less volatile destinations. Therefore, if firms reallocate exports to destinations that are subject to lower RER volatility, this should also be increasingly true with the firm size. In a few words, if big, multi-destination firms reallocate their exports optimally according to portfolio theory, both firm size and the number of destinations should *magnify* the impact of both volatilities on export behavior.

[3]Recent papers (see Chaney, 2013, for a theoretical approach, and Berman and Héricourt, 2010, for empirical evidence, among others) also showed that this link between size and access to finance had direct implications for exporting behavior at the firm-level: bigger firms export more not only because they are more productive, but also because they are less credit-constrained and are consequently able to borrow to face the additional costs of exporting activities.

[4]This transposition of the concept of diversification in investing for firms' exporting behavior appears even more straightforward for the decision to export to new markets. Indeed, as stated previously, sunk costs of exports associated with export capacity may be considered a type of investment in intangible capital (such as R&D).

Key testable relationships Three main relationships can be derived from these various theoretical approaches for export performance that is, both the intensive (export value) and extensive margin (entry).

Testable Relationship 1: Export performance decreases with bilateral exchange rate volatility. We therefore expect the link between bilateral volatility, on the one hand, and the exported value and the entry decision, on the other hand, to be negative.

Testable Relationship 2: Export performance increases with multilateral exchange rate volatility. We therefore expect the link between multilateral volatility, on the one hand, and the exported value and the entry decision, on the other hand, to be positive.

Testable Relationship 3: The sign of the interaction between bilateral and multilateral RER volatilities on the one hand, and firm size/number of destinations on the other hand, cannot be *a priori* determined. We however expect those relations to be significant.

3. Data and Empirical Methodology

3.1. Data

Real exchange rate volatility

We compute two types of RER volatilities for a given firm-destination-year observation: a bilateral RER volatility and a multilateral RER volatility. The bilateral real exchange rate volatility, $Bil\_volat_{j,t}$, is computed as the yearly standard deviation of monthly log differences in the real exchange rate, which is defined as :

$$\mathsf{RER}_{j,m,t} = e_{j,m,t} \times \frac{p_{j,t}}{p_{\mathsf{dom},t}}$$

where $e_{j,m,t}$ is the nominal exchange rate of the domestic currency with respect to the destination j's currency at the end of month m of year t and $p_{j,t}$ is the CPI of country j in year t. Because we rely on an indirect quotation (that is, one unit of foreign currency equals e units of euros), we compute the real exchange rate as the nominal exchange rate of the euro with respect to the partner's currency, multiplied by the partner's consumer price (CPI) level and divided by the domestic CPI. Nominal exchange rate data are monthly average, and come from the IMF's IFS dataset.

Second, multilateral RER volatility is firm-level weighted average of bilateral RER volatilities in all other than j destinations c served by the firm i. In our main results, the weights are the destination's yearly average share in the firm total exports in all destinations served but j :

$$Multi\_volat_{ijt} = \sum_{c \neq j} \bar{\omega}_{ic} Bil\_volat_{c,t}$$

Alternatively, we also compute this multilateral RER volatility with shares computed as the destination's lagged share in the firm total exports in all destinations served but j :

$$Multi\_volat_{ijt} = \sum_{c \neq j} \omega_{ic,t-1} Bil\_volat_{c,t}.$$

Both weighting schemes are designed to tackle endogeneity issues (arising for example from self-selection into specific destinations), compared to a weighting scheme that would rely on time-varying, contemporaneous shares. On that ground, average weights are probably the more robust option. But lagged weights are also interesting, since they authorize time variation and therefore, the allocation (between markets) decisions of the firm to be fuelled in the computation of multilateral volatility. Besides, we show in some robustness exercise (see section 5.1.) that most of our results survive when we use a weighting scheme which is not firm-specific for computing multilateral volatility.

Finally, both bilateral and multilateral volatilities are taken in natural logarithms.

Trade data

We use firm-level trade data from the French customs over the period 1995-2009. This database reports exports for each firm, by destination and year over our sample period. It reports the volume (in tons) and value (in euros) of exports for each CN8 product (European Union Combined Nomenclature at 8 digits) and destination, for each firm located on the French metropolitan territory. Some shipments are excluded from this data collection. Inside the European Union, firms are required to report their shipments by product and destination country only if their annual trade value exceeds the threshold of 150,000 euros. For exports outside the EU all flows are recorded, unless their value is smaller than 1,000 euros or one ton. Those thresholds only eliminate a very small proportion of total exports.

Firm-level characteristics We also use firm-level data contained in the dataset called "BRN" (Bénéfices Réels Normaux), which provides balance-sheet data i.e. value added, total sales, employment, capital stock and other variables. The period for which we have the data is from 1995 to 2009. The BRN database is constructed from reports of French firms to the tax administration, which are transmitted to INSEE (the French Statistical Institute). The BRN dataset contains between 650,000 and 750,000 firms per year over the period (around 60% of the total number of French firms). Importantly, this dataset is composed of both small and large firms, since no threshold applies on the number of employees. A more detailed description of the database is provided by Eaton et al. (2004, 2011). Depending on the year, these firms represent between 90% and 95% of French exports contained in the customs data. In most estimates, firm size is proxied by the size of the assets. As it is standard in the literature, we restrict the observations to firms belonging to manufacturing which excludes wholesalers. Finally, our identification strategy of multilateral volatility requires that we restrict also the sample to firms exporting to two destinations at least - for single destination exporters, multilateral volatility is by construction restricted to zero. Balance-sheet and customs data can be merged using the firm identifier (SIREN number) and the year. The dataset finally contains between 25,000 and 34,000 exporting firms per year and 137 destinations.

Macroeconomic variables The various macroeconomic variables come from the Penn World Tables and the IMF's International Financial Statistics.

3.2. Descriptive statistics

Summary statistics of key variables are given in Table 1. They are consistent with previous evidence about French firms: exporting firms are highly heterogeneous in their performance and size, implying a large variance in our data set. The average firm-country exported value is below 700,000 thousand euros, whereas the average number of employees and value of assets are also quite small: the average exporter is a small firm, with modest values of exports. The number of destinations served is also limited: around 20 on average, with a median below 14. The two measures of exchange rate volatility are of specific interest for our purpose. One can see that the mean and variance of the firm-level measure of bilateral volatility is 4 to 5 times higher than those of the standard bilateral one. This confirms there is substantial information to be taken from the volatility coming from the third markets served by the firm.

Table 1 – Summary statistics of the key variables

Variable	Mean	Std. Dev.	Min	Max
Firm-level variables				
Firm Export value (millions of Euros)	28.55	277.36	0.00	15,026.34
Firm-country Export value (millions of Euros)	0.69	14.68	0.00	8,561.12
Multilateral RER Volatility	0.08	0.10	3.25e-09	1.31
Start Dummy	0.18	0.39	0	1
Participation Dummy	0.38	0.49	0	1
Nb. of destinations served	20.88	17.85	2	126
Median Destination	13.77	1.31	12	16
Assets (Thousands of Euros)	197.1	5404.	0.01	1,266,499
Employment (nb. of employees)	343.13	3206	0	298,487
Macro variables				
GDP (Billions of US dollars)	1039.18	2,121.23	0.174	13,122.22
Price Index (Real Effective Exchange Rate)	0.72	0.45	7.49e-05	3.33
Bilateral RER volatility	0.02	0.02	0.001	1.31

Notes: The summary statistics are computed on the 3,902,979 firm-country-year observations that make up our final regression sample used in Table 2 to study the intensive margin. The only exception are the statistics for the start and participation dummies which are computed, respectively, on the 5,079,935 firm-country-year observations used in Table 6, and the 8,163, 660 firm-country-year observations used in Table 9.
Source: authors' computations from BRN, customs and IFS data.

3.3. Empirical strategy

We start by estimating the following specification:

$$\begin{aligned} \text{ExportPerf}_{ijt} &= \alpha \text{Bil\_volat}_{jt} + \beta \text{Assets}_{it-1} + \gamma \text{Multi\_volat}_{it} \\ &+ \delta \left(\text{Bil\_volat}_{jt} \times \text{Assets}_{it-1} \right) + \tau \left(\text{Multi\_volat}_{it} \times \text{Assets}_{it-1} \right) \\ &+ \phi Z_{jt} + \lambda_{ij} + \theta_t + \epsilon_{ijt} \end{aligned} \tag{1}$$

or alternatively, in order to dampen multicollinearity problems due the presence of multiple interactions:

$$\begin{aligned}
\text{ExportPerf}_{ijt} &= \alpha\text{Bil_volat}_{jt} + \beta\text{Assets}_{it-1} + \gamma\text{Multi_volat}_{ijt} + \kappa\text{Nb_dest}_{it-1} \\
&+ \delta\left(\text{Bil_volat}_{jt} \times \text{Nb_dest}_{it-1}\right) + \tau\left(\text{Multi_volat}_{ijt} \times \text{Nb_dest}_{it-1}\right) \\
&+ \phi Z_{jt} + \lambda_{ij} + \theta_t + \epsilon_{ijt}
\end{aligned} \tag{2}$$

where ExportPerf_{ijt} is a measure of the export performance of firm i for export destination j in year t. We consider three alternative measure of export performance: the intensive margin of exports is captured with the log of the free-on-board export sales to country j in year t while the extensive margin is defined by entry and participation. Entry and participation are respectively defined as $Pr(X_{ijt} > 0 \mid X_{ijt-1} = 0)$[5] and $Pr(X_{ijt} > 0)$.

Bil_volat_{jt} and $Multi\_volat_{ijt}$ are, respectively, bilateral and multilateral RER volatility. Note that our empirical strategy presumes the exogeneity of real exchange rate volatility, since it is very unlikely that a firm shock translates into a change in country-level exchange rate variations. This is a very standard assumption in the related empirical literature, made among others by Berman et al. (2012), Cheung and Sengupta (2013) or Héricourt and Poncet (2015).

As a control for the size of the firm, $Assets_{it-1}$ represents the logarithm of the assets of firm i which we lag one year, normalized by the yearly average assets in the sample (also lagged one year). Nb_dest_{it-1} represents the number (in logarithm) of export markets served by the firm, also lagged one year. Our conditioning set Z_{jt} consists of destination-year specific variables. In standard models of international trade, exports depend on the destination country's market size and price index. Therefore, Z_{jt} includes destination j's GDP and effective RER. Finally, firm-country fixed effects, λ_{ij}, and year dummies, θ_t, are also included. Sector(2-digits)-year fixed effects are included alternatively to year dummies in some specifications, in order to control for sector-specific business cycle.

We first focus on the unconditional effect of both bilateral and multilateral RER volatility on export performance, i.e., on a benchmark specification with δ and τ restricted to 0. Consistent with predictions 1 and 2 from section 2, we expect α to be negative, and γ to be positive. In a second step, we condition the impact of volatility first on size, then on the number of destinations served, by introducing the relevant interaction terms. The key parameters of interest are then δ (interactions with bilateral volatility) and τ (interactions with multilateral volatility): their signs and levels of significance will tell which of the two opposite potential behaviors (financial hedging or reallocation) mentioned in section 2 dominates. If the hedging behavior is the prevalent one, both parameters should have a sign opposite to their counterparts on bilateral and multilateral volatility, highlighting a dampening effect. Conversely, if firms exporting to several destinations take advantage on reallocation possibilities, δ and τ should have the same signs than, respectively, α and β.

Regressions are performed with the linear within estimator for the intensive margin and the

[5] In that set of regressions, our sample consists of a firm-country series of zeros followed by a decision to begin exporting. For a given firm-country, we can have several beginnings. For example, the subsequent export statuses 011001 become . 1 . . 01 in our sample, with . denoting a missing value.

linear probability model[6] for the extensive margin. Finally, Moulton (1990) shows that regressions with more aggregate indicators on the right-hand side could induce a downward bias in the estimation of standard errors. All regressions are thus clustered at the destination-year level using the Froot (1989) correction.

4. Results: Firm-Destination Analysis

We study the joint effects of both RER volatilities, firm size and number of destinations on the two margins of trade separately: the size of exports per firm for the intensive margin, and the decisions to start exporting (entry) for the extensive margin. For comparison purposes, we will also present results regarding export participation for the latter.

4.1. Intensive margin

Table 2 reports the estimation of the impact of bilateral and multilateral volatilities (with average weights) on the value exported by the firm. In columns (1) and (2), we regress the log of the total exports of the firms on the two unconditional volatilities, controlling for the size of the firm (Assets_{t-1}) and the two proxies for the destination's market size and price index. Column (1) includes year dummies and firm-country FE, while columns (2) includes both firm-country and sector-year dummies, where a sector is defined at the 2-digit level. Columns (3) includes the interaction between both volatilities and firm size, while column (4) investigates how the impact of both volatilities varies with the number of destinations. Both estimations are performed with year dummies and firm-country fixed effects. We perform the same exercise in columns (5) and (6) in which we drop the yearly dummies and include again the sector-year fixed effect.

Column (1) shows that bilateral exchange rate volatility does impact export performance on average (i.e., the α parameter of equation 1 is negative, as expected, and significant), but to a small extent: a 10% increase in bilateral volatility reduces the value exported by 0.3%. Symmetrically, we find a positive effect of the multilateral volatility (the parameter γ is positive and significant), that is the weighted sum of all the bilateral volatilities except country j, on the firm-level exports towards country j: a 10% increase in multilateral volatility raises the bilateral exports to the considered destination by 1.5% on average. We interpret this result as evidence supporting a pro-trade effect of increased RER volatility in other markets served by the firm, that is, a third-market effect as defined by Anderson and van Wincoop (2003). The multilateral volatility represents a trade resistance term in our specification.

[6] The LPM makes easier the estimation of models with many observations, fixed effects and dummies. Some robustness checks based on the conditional logit model delivered qualitatively identical results. More details on these checks are available upon request.

Table 2 – Intensive margin: baseline regression, whole sample, average shares

Dep. variable	$\ln X_{ijt}$							
Sample	whole						few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bilateral RER volatility	-0.027^a	-0.027^b	-0.030^a	0.090^a	-0.030^b	0.093^a	-0.032^a	-0.027^b
	(0.010)	(0.012)	(0.010)	(0.016)	(0.012)	(0.018)	(0.012)	(0.011)
Multilateral RER Volatility	0.145^a	0.144^a	0.178^a	-0.027^a	0.176^a	-0.027^a	0.094^a	0.234^a
	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Assets_{t-1}	0.506^a	0.498^a	0.525^a	0.408^a	0.518^a	0.400^a	0.380^a	0.511^a
	(0.008)	(0.009)	(0.013)	(0.007)	(0.015)	(0.008)	(0.016)	(0.014)
Country price index	0.068^a	0.067^a	0.066^a	0.060^a	0.065^a	0.058^a	0.065^a	0.069^a
	(0.018)	(0.021)	(0.018)	(0.018)	(0.021)	(0.021)	(0.019)	(0.020)
GDP	1.087^a	1.073^a	1.064^a	1.076^a	1.053^a	1.070^a	0.856^a	1.134^a
	(0.060)	(0.069)	(0.060)	(0.061)	(0.070)	(0.070)	(0.076)	(0.062)
Bil. RER Volatility $\times$ Assets_{t-1}			-0.020^a		-0.019^a		-0.019^a	-0.016^a
			(0.002)		(0.003)		(0.003)	(0.003)
Multi. RER Volatility $\times$ Assets_{t-1}			0.036^a		0.035^a		0.010^a	0.038^a
			(0.001)		(0.001)		(0.001)	(0.001)
Bil. RER Volatility $\times$ Nb Dest_{t-1}				-0.042^a		-0.042^a		
				(0.004)		(0.005)		
Multi. RER Volatility $\times$ Nb. dest				0.077^a		0.076^a		
				(0.001)		(0.001)		
Nb Dest_{t-1}				0.356^a		0.353^a		
				(0.019)		(0.022)		
Observations	3902979	3902979	3902979	3902979	3902979	3902979	1790669	2112310
R^2	0.035	0.801	0.037	0.043	0.801	0.802	0.018	0.043
Year Dummies	yes	no	yes	yes	no	no	yes	yes
Firm-country FE	yes							
Sector-year FE	no	yes	no	no	yes	yes	no	no
Cluster (country-year)	yes							
Firm-country dyads	1009352	1009352	1009352	1009352	1009352	1009352	641824	491521

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

Another way to interpret this result is as follows: trade flows at the intensive margin are driven by the *relative* RER volatility, insofar as our specifications include both the bilateral and multilateral volatilities. If a firm is able to allocate its exports, given the local market demand conditions, across many destinations, a increase in relative volatility will induce her to reallocate exports towards destinations with less volatile exchange rates. Results presented in column (2) are almost identical to those of column (1) : a change in the fixed effects structure of the estimation does not affect the main message from column (1).

Regression in columns (3) investigates whether firm size affects this relationship between both volatilities and export flows. We find that the coefficients δ and τ associated to the interacted terms between the two volatilities and firm size are signed identically to the average effects of the volatilities reported in column (1). That is, the larger the firm, in terms of assets, the larger the response to changes in RER volatility. Given a RER volatility shock, trade flows at the firm level will change all the more the firm is large. We interpret this a evidence for a magnifying effect of firm size on trade flows elasticity to RER volatility. We also find support for this magnifying effect for the multilateral volatility: the more trade resistance there is outside country j, the larger the exports towards j, and especially when the firm is large.

We perform a similar exercise in column (4) by including the interactive terms of both volatilities with the (log) number of destinations the firm is serving. The number of destinations is another proxy for the firm size that increase our ability to identify the reallocation behavior across destinations. We get another support for the exacerbating effect of both volatilities on exports volumes. The more destinations the firm exports to, the more negative the impact of bilateral volatility on exports. To give a sense of the effect, we can provide estimates of the quantitative impact on the top of the distribution of the number of destinations served. A 10% increase in bilateral volatility towards j decreases bilateral exports by 0.7% for firms located at the upper decile of the distribution, and by 1% for the upper percentile.[7]. Similarly, the trade-promoting effect of multilateral volatility appears also magnified by the number of markets served. Taking again coefficients from column (4), we compute that a 10% rise in multilateral volatility increases bilateral exports towards j by 2.7% (=0.1[-0.27+0.077×log(45)] at the upper decile, and by 3.1% (2.7% (=0.1[-0.27+0.077×log(84)] at the upper percentile.

Columns (5) and (6) replicate the specifications of columns (3) and (4) controlling for sector-year fixed effects. As it was the case for columns (1) and (2), results are qualitatively and qualitatively very similar, almost unchanged.

Finally, columns (7) and (8) split the sample around the (yearly) median of the number of destinations served by firms. Column (7) focuses on firms with a number of destinations lower or equal to the median, while column (8) narrows the sample around firms whose number of destinations is higher than the median. Consistently with previous results, the trade-deterring impact of relative exchange rate volatility on bilateral exports towards a considered destination is magnified for firms serving a number of destinations higher than the median: if coefficients on bilateral volatility are statistically undistinguishable between the two subsamples, the unconditional coefficient on multilateral volatility more than doubles when we consider the one

[7] The numbers of destination served at the upper decile and percentile are, respectively, 45 and 84. Taking the coefficients from column 4, we find that a 10% increase in bilateral volatility reduces exports by 0.1[0.09-0.042×log(45)]=-0.7% at the upper decile, and by 0.1[0.09-0.042×log(84)]=-1% at the upper percentile.

above the median. Besides, this third-market effect of multilateral volatility is even more stronger for big firms exporting to many destinations: the elasticity of the interaction between multilateral RER volatility and the log of assets multiplies by 4 for firms above the median.

All in all, there is evidence of a trade-deterring effect of bilateral volatility, and of a trade-promoting effect of multilateral volatility, both magnified for big firms, and firms with a high number of destinations. This tends to indicate that those firms seem to privilege a reallocation of exports between destinations, and thus experience a higher sensitivity of trade flows with respect to RER volatility.

We now turn to a similar exercise, based on the same specifications, but using another weighting scheme for the multilateral volatility. Previous results were based on a multilateral volatility computed using country shares averaged over the period. We now use the first lag of country shares as weights. Table 3 reports estimates including this alternative measure of multilateral volatility. Column (1) presents the results for a basic specification, and columns (2) and ((3) conditions the impact of both measures of volatility on size and number of destinations served. Finally, columns (4) and (5) divide the sample around the yearly median of the number of destinations served. All our results are qualitatively unchanged. Quantitatively, results regarding the trade-deterring effect of bilateral volatility are identical to the ones presented in Table 2; as for multilateral volatility, the trade-promoting effect also remains, even though its magnitude is lower than in the previous scheme. When investigating the conditional effects of both volatilities regarding firm size and the number of destinations in columns (2) to (5), results are very similar to those presented in Table 2.

Respectively replicating exactly the structure of table 2 and table 3, Tables 4 and 5 display estimates for a sample restricted to countries outside the Euro Area (EA). Practically, we exclude all firm-destinations pairs involving countries from the EA, characterized by zero nominal volatility over most of the studied period.[8] We do so in order to check if the inclusion of those countries exerts a significant bias on our main results. In any case, this impact appears to be limited: those estimates are very close to the ones on the whole sample. Unconditional impacts of both volatilities are almost identical to the ones estimated on the whole sample. Besides, effects are still magnified for bigger firms, and firms exporting to large number of destinations. However, the size of these effects is smaller concerning bilateral volatility: elasticities on interacted terms are lower than those found on the whole sample. Moreover, columns (7) and (8) in Table 4 and columns (4) and (5) in Table 5 show that firms exporting to a small number of destinations (below the median) do not react to bilateral volatility, whatever their size, and have slightly smaller reactions to multilateral volatility. These slight differences with the results on the whole sample could indicate that firms exporting to a low number of destinations reallocate their exports primarily to EA destinations when facing

[8] Clark et al. (2004) show that the volatility of the real and nominal exchange rates do not differ much in reality. Nominal exchange rates between Euro Area countries are fixed since January 1st 1999, bilateral RER volatility within the Euro Area should therefore be much lower than for other countries. For these countries, real exchange rate volatility is made of changes in the relative price levels, and is not driven by variations in nominal exchange rates. That is why Berman et al. (2012), in their study of the impact of RER variations on export margins, restrict their sample to destinations outside EA, to focus on destinations characterized by a sufficient level of variance of the real exchange rate.

increasing relative RER volatility: this fits well with the fact we have stronger reactions to both volatilities below the median number of destinations on the whole sample than the one excluding EA destinations.

Table 3 – Intensive margin: whole sample, lagged shares

Dep. variable			lnX_{ijt}		
Sample	whole	whole	whole	few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)
Bilateral RER volatility	-0.029^a	-0.030^a	0.066^a	-0.028^b	-0.031^a
	(0.010)	(0.010)	(0.015)	(0.011)	(0.010)
Multilateral RER Volatility	0.054^a	0.065^a	-0.069^a	0.034^a	0.064^a
	(0.002)	(0.002)	(0.003)	(0.002)	(0.002)
Assets$_{t-1}$	0.587^a	0.587^a	0.494^a	0.412^a	0.593^a
	(0.009)	(0.013)	(0.008)	(0.017)	(0.014)
Country price index	0.072^a	0.071^a	0.062^a	0.065^a	0.071^a
	(0.018)	(0.018)	(0.018)	(0.019)	(0.020)
GDP	1.068^a	1.056^a	1.088^a	0.858^a	1.109^a
	(0.060)	(0.060)	(0.059)	(0.077)	(0.061)
Bil. RER Volatility × Assets$_{t-1}$		-0.014^a		-0.018^a	-0.009^a
		(0.002)		(0.003)	(0.003)
Multi. RER Volatility × Assets$_{t-1}$		0.016^a		0.005^a	0.014^a
		(0.001)		(0.001)	(0.001)
Bil. RER Volatility × Nb Dest$_{t-1}$			-0.032^a		
			(0.004)		
Multi RER Volatility × Nb Dest$_{t-1}$			0.037^a		
			(0.001)		
Nb Dest$_{t-1}$			0.395^a		
			(0.021)		
Observations	3412467	3412467	3412467	1521651	1890816
R^2	0.025	0.026	0.032	0.013	0.029
Fixed effects			Firm-country		
Dummies			Year		
Firm-country dyads	919569	919569	919569	568704	463394

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

Table 4 – Intensive margin: non-euro sample, average shares

Dep. variable	ln X_{ijt}							
Sample	whole						few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bilateral RER volatility	-0.030^a	-0.029^a	-0.027^a	0.058^a	-0.026^b	0.059^a	-0.010	-0.025^b
	(0.009)	(0.011)	(0.009)	(0.016)	(0.011)	(0.018)	(0.011)	(0.010)
Multilateral RER Volatility	0.156^a	0.154^a	0.184^a	-0.051^a	0.182^a	-0.051^a	0.088^a	0.235^a
	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.004)	(0.003)	(0.004)
Assets_{t-1}	0.427^a	0.419^a	0.476^a	0.339^a	0.468^a	0.331^a	0.387^a	0.460^a
	(0.008)	(0.009)	(0.013)	(0.007)	(0.015)	(0.009)	(0.017)	(0.012)
Country price index	0.064^a	0.063^a	0.061^a	0.060^a	0.061^a	0.059^a	0.077^a	0.060^a
	(0.018)	(0.021)	(0.018)	(0.018)	(0.021)	(0.021)	(0.019)	(0.020)
GDP	1.168^a	1.153^a	1.148^a	1.150^a	1.134^a	1.138^a	0.962^a	1.220^a
	(0.063)	(0.074)	(0.063)	(0.063)	(0.074)	(0.074)	(0.082)	(0.065)
Bil. RER Volatility × Assets_{t-1}			-0.017^a		-0.017^a		-0.004	-0.017^a
			(0.002)		(0.003)		(0.003)	(0.002)
Multi. RER Volatility × Assets_{t-1}			0.043^a		0.042^a		0.010^a	0.050^a
			(0.001)		(0.001)		(0.001)	(0.001)
Bil. RER Volatility × Nb Dest_{t-1}				-0.029^a		-0.030^a		
				(0.005)		(0.006)		
Multi. RER Volatility × Nb Dest_{t-1}				0.085^a		0.084^a		
				(0.002)		(0.002)		
Nb Dest_{t-1}				0.415^a		0.414^a		
				(0.023)		(0.027)		
Observations	2497869	2497869	2497869	2497869	2497869	2497869	1107235	1390634
R^2	0.033	0.791	0.037	0.041	0.792	0.793	0.016	0.043
Year Dummies	yes	no	yes	yes	no	no	yes	yes
Firm-country FE	yes							
Sector-year FE	no	yes	no	no	yes	yes	no	no
Cluster (country-year)	yes							
Firm-country dyads	711494	711494	711494	711494	711494	711494	445293	349375

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level. ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

Table 5 – Intensive margin: non-euro sample, lagged shares

Dep. variable			lnX_{ijt}		
Sample	whole	whole	whole	few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)
Bilateral RER volatility	-0.033^a	-0.031^a	0.005	-0.011	-0.035^a
	(0.009)	(0.009)	(0.017)	(0.011)	(0.010)
Multilateral RER Volatility	0.053^a	0.062^a	-0.092^a	0.029^a	0.059^a
	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)
Assets$_{t-1}$	0.508^a	0.539^a	0.418^a	0.413^a	0.552^a
	(0.009)	(0.014)	(0.008)	(0.018)	(0.013)
Country price index	0.067^a	0.066^a	0.062^a	0.077^a	0.064^a
	(0.018)	(0.018)	(0.018)	(0.019)	(0.020)
GDP	1.161^a	1.149^a	1.156^a	1.022^a	1.188^a
	(0.063)	(0.063)	(0.063)	(0.085)	(0.064)
Bil. RER Volatility $\times$ Assets$_{t-1}$		-0.009^a		-0.001	-0.008^a
		(0.002)		(0.003)	(0.003)
Multi. RER Volatility $\times$ Assets$_{t-1}$		0.018^a		0.004^a	0.018^a
		(0.001)		(0.001)	(0.001)
Bil. RER Volatility $\times$ Nb Dest$_{t-1}$			-0.012^b		
			(0.006)		
Multi RER Volatility $\times$ Nb Dest$_{t-1}$			0.043^a		
			(0.001)		
Nb Dest$_{t-1}$			0.504^a		
			(0.027)		
Observations	2170819	2170819	2170819	923702	1247117
R^2	0.023	0.024	0.030	0.012	0.028
Fixed effects			Firm-country		
Dummies			Year		
Firm-country dyads	634157	634157	634157	634157	330268

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

4.2. Extensive Margin I: Entry

In this section, we assess the joint effect of RER volatility, firm size and the number of destinations served on the entry decision at the firm-country level. Table 6 replicates the structure of Table 2. The explained variable is now the decision for a firm to start exporting to market j, conditionally on not exporting the previous year. It is thus constructed as a change of export status at the firm-country level; it takes the value 1 when a firm exports to country j in year t but did not in year $t-1$.

Table 6 – Extensive margin: entry, whole sample, average shares

Dep. variable	$Pr(X_{ijt} > 0 \quad \mid X_{ijt-1} = 0)$							
Sample	whole						few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bilateral RER volatility	-0.015^a	-0.014^b	-0.016^a	-0.006	-0.015^a	-0.005	-0.014^a	-0.016^a
	(0.005)	(0.006)	(0.005)	(0.005)	(0.005)	(0.006)	(0.005)	(0.005)
Multilateral RER Volatility	0.031^a	0.031^a	0.033^a	0.013^a	0.033^a	0.013^a	0.011^a	0.046^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Assets$_{t-1}$	0.062^a	0.062^a	0.063^a	0.051^a	0.063^a	0.051^a	0.033^a	0.063^a
	(0.001)	(0.001)	(0.002)	(0.001)	(0.003)	(0.001)	(0.003)	(0.003)
Country price index	0.017^a	0.017^a	0.017^a	0.017^a	0.017^a	0.017^a	0.008^b	0.024^a
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
GDP	0.123^a	0.123^a	0.123^a	0.118^a	0.122^a	0.118^a	0.090^a	0.137^a
	(0.017)	(0.019)	(0.017)	(0.017)	(0.019)	(0.019)	(0.018)	(0.017)
Bil. RER Volatility × Assets$_{t-1}$			-0.002^a		-0.002^a		-0.001^c	-0.001
			(0.001)		(0.001)		(0.001)	(0.001)
Multi. RER Volatility × Assets$_{t-1}$			0.002^a		0.002^a		-0.001^a	0.004^a
			(0.000)		(0.000)		(0.000)	(0.000)
Bil. RER Volatility × Nb Dest$_{t-1}$				-0.004^a		-0.004^a		
				(0.001)		(0.001)		
Multi. RER Volatility × Nb Dest$_{t-1}$				0.011^a		0.011^a		
				(0.000)		(0.000)		
Nb Dest$_{t-1}$				0.050^a		0.049^a		
				(0.004)		(0.004)		
Observations	5079935	5079935	5079935	5079935	5079935	5079935	2777215	2302720
R^2	0.022	0.279	0.022	0.025	0.279	0.281	0.009	0.018
Year Dummies	yes	no	yes	yes	no	no	yes	yes
Firm-country FE	yes							
Sector-year FE	no	yes	no	no	yes	yes	no	no
Cluster (country-year)	yes							
Firm-country dyads	940154	940154	940154	940154	940154	940154	658602	523626

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

Results are qualitatively in line with those found on the intensive margin. Concerning our first key relationship, we still find that bilateral volatility impacts the entry decision of the average firm (in column (1), the α parameter is negative and significant): a 10% increase in bilateral volatility of a considered destination reduces the probability of entering this destination by 0.2%. Similarly, the coefficient γ is significantly positive: a 10% rise in multilateral volatility increases the decision of entering the considered destination by 0.3%. Those results are confirmed in column (2) in which we adopt, as in the baseline table for the intensive margin, firm-country and sector-year fixed effects.

Adding interactive terms (columns (3) to (6)) shows that, as it was the case for the intensive margin, firm size and the number of destination heterogeneously affect the relation between entry and both bilateral and multilateral volatilities: δ and τ reflect a significant, magnifying effect of both proxies for firm performance of the impact of both volatilities on entry. However, the magnitude of the effect is very different from one measure of firm performance to another: column (3) show that firm size only very slightly magnifies the effect of bilateral and multilateral volatility on entry, the unconditional effects remaining basically identical to those showed in column (1). Conversely, it appears that the impact of relative RER volatility is mainly conditioned by the number of destinations served (column (4)). More specifically, a 10% increase in bilateral volatility towards j decreases bilateral the probability of entry by 0.15% for firms located at the upper decile and percentile of the distribution.[9]. Similarly, we compute that a 10% rise in multilateral volatility increases bilateral exports towards j by 0.5% (=0.1[0.013+0.011$\times$log(45)] at the upper decile, and by 0.6% (=0.1[0.013+0.011$\times$log(84)] at the upper percentile. Those results remain basically identical in specifications estimated with sector-year fixed effects (columns (5) and (6)). For illustrative purpose, we further investigate how the number of destinations affects entry behavior with respect to both volatilities in columns (7) and (8), by splitting the sample around the yearly median of the number of destinations served. Consistently with previous results, we find no asymmetric effect between the two samples with respect to bilateral volatility, whereas the coefficient on multilateral volatility is more than 4 times bigger above the median. The size of the firm seems to affect only marginally those impacts. This tends to support the idea that, among our two indicators of firm performance, the number of destinations is probably the most relevant one to capture the effect we want to point out: firms need to have a sufficient number of served destinations to be able to reallocate efficiently their entry decisions when facing increased RER volatility.

This set of results seems to point to a reallocation effect qualitatively similar to the one exhibited on the intensive margin: when firms export to a sufficiently large number of destinations, bilateral volatility displays a negative effect because firms have numerous other markets where to allocate their exports. The same mechanism plausibly explains the positive impact of multilateral volatility, which creates an incentive to enter a given market with relatively less volatility. However, it is worth noticing that effects on entry decision are quantitatively much smaller than on the intensive margin. Facing increased relative RER volatility, firms seem to adjust primarily the intensive margin, and extensive margin only to a lesser extent.

[9] Taking the coefficients from column (4), we find that a 10% increase in bilateral volatility reduces exports by 0.1[0.006-0.004$\times$log(45)]=-0.2% at the upper decile, and by 0.1[-0.06-0.004$\times$log(84)]=-0.2% at the upper percentile.

Table 7 – Extensive margin: entry, non euro sample, average shares

Dep. variable	$Pr(X_{ijt} > 0 \quad \mid X_{ijt-1} = 0)$							
Sample	whole						few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bilateral RER volatility	-0.006[b]	-0.006[b]	-0.007[a]	0.001	-0.007[a]	0.001	-0.005[b]	-0.008[b]
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
Multi. RER Volatility	0.031[a]	0.030[a]	0.033[a]	0.011[a]	0.033[a]	0.011[a]	0.010[a]	0.049[a]
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.001)
Assets$_{t-1}$	0.058[a]	0.058[a]	0.062[a]	0.046[a]	0.063[a]	0.046[a]	0.033[a]	0.061[a]
	(0.001)	(0.001)	(0.002)	(0.001)	(0.002)	(0.001)	(0.002)	(0.003)
Country price index	0.013[a]	0.013[a]	0.013[a]	0.013[a]	0.013[a]	0.013[a]	0.004	0.019[a]
	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)	(0.003)	(0.003)	(0.004)
GDP	0.140[a]	0.139[a]	0.140[a]	0.138[a]	0.139[a]	0.137[a]	0.113[a]	0.154[a]
	(0.014)	(0.016)	(0.014)	(0.014)	(0.016)	(0.015)	(0.013)	(0.016)
Bil. RER Volatility × Assets$_{t-1}$			-0.001[a]		-0.001[b]		-0.001	-0.001
			(0.001)		(0.001)		(0.001)	(0.001)
Multi. RER Volatility × Assets$_{t-1}$			0.003[a]		0.003[a]		-0.001[a]	0.005[a]
			(0.000)		(0.000)		(0.000)	(0.000)
Bil. RER Volatility × Nb Dest$_{t-1}$				-0.003[a]		-0.003[a]		
				(0.001)		(0.001)		
Multi. RER Volatility × Nb Dest$_{t-1}$				0.012[a]		0.012[a]		
				(0.000)		(0.000)		
Nb Dest$_{t-1}$				0.059[a]		0.058[a]		
				(0.003)		(0.004)		
Observations	4040193	4040193	4040193	4040193	4040193	4040193	2034450	2005743
R^2	0.020	0.263	0.020	0.023	0.263	0.265	0.006	0.017
Year Dummies	yes	no	yes	yes	no	no	yes	yes
Firm-country FE	yes							
Sector-year FE	no	yes	no	no	yes	yes	no	no
Cluster (country-year)	yes							
Firm-country dyads	713312	713312	713312	713312	713312	713312	478628	422572

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

[a], [b] and [c] respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

As we did for the intensive margin, we present results in Table 7 of a sample restricted to firm-country observations for destinations outside EA. We find that bilateral volatility has a significant but very low impact on entry decision on this sample, whether we consider the average impact (columns (1) and (2)) or condition it to measures of firm performance (columns (3) to (6)). Conversely, the impact of multilateral volatility, whether unconditional or varying with measures of firm performance, is almost identical to the one found on the whole sample. Splitting the sample around the yearly median number of destinations served, columns (7) and (8) confirm these outcomes. This evidence is in line with the one previously found on the intensive margin, and tends to support the idea that firms are more sensitive to bilateral volatility for their entry decision when the possibility of reallocation to an EA destination, characterized by a much smaller RER volatility, exists.

Table 8 – Extensive margin: Entry 2, whole sample, average shares

Dep. variable	$Pr(X_{ijt} > 0 \quad \mid X_{ijt-1} = 0, X_{ijt+1>0})$				
Sample	whole	whole	whole	few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)
Bilateral RER volatility	-0.010^a	-0.011^a	-0.002	-0.008^b	-0.011^b
	(0.004)	(0.004)	(0.003)	(0.004)	(0.004)
Multilateral RER Volatility	0.013^a	0.014^a	0.004^a	0.003^a	0.022^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Assets$_{t-1}$	0.031^a	0.030^a	0.026^a	0.017^a	0.038^a
	(0.001)	(0.002)	(0.001)	(0.002)	(0.002)
Country price index	0.012^a	0.012^a	0.012^a	0.006^a	0.016^a
	(0.003)	(0.003)	(0.003)	(0.002)	(0.003)
GDP	0.055^a	0.055^a	0.052^a	0.031^a	0.069^a
	(0.012)	(0.012)	(0.012)	(0.011)	(0.012)
Bil. RER Volatility × Assets$_{t-1}$		-0.001^a		0.000	0.000
		(0.000)		(0.000)	(0.000)
Multi. RER Volatility × Assets$_{t-1}$		0.001^a		-0.001^a	0.002^a
		(0.000)		(0.000)	(0.000)
Bil. RER Volatility × Nb. dest$_{t-1}$			-0.004^a		
			(0.001)		
Multi. RER Volatility × Nb. dest$_{t-1}$			0.005^a		
			(0.000)		
Nb. dest$_{t-1}$			0.016^a		
			(0.003)		
Observations	5079935	5079935	5079935	2777215	2302720
R^2	0.019	0.019	0.020	0.010	0.020
Fixed effects	Firm-country				
Dummies	Year				
Firm-country dyads	940154	940154	940154	658602	523626

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

In Table 8, we rely on an alternative definition to characterize entry. We follow Poncet and Mayneris (2013) when defining our dependent variable, now the probability to start exporting to destination j, while not being an exporter to j at $t-1$ and still being an exporter at $t+1$. Formally, this variable is $\Pr(X_{ijt} > 0 \quad | X_{ijt-1} = 0, X_{ijt+1} > 0)$. This definition is more conservative than the previous one, insofar as it corresponds to a more definitive entry. Results reported in Table 8 are qualitatively very similar to the ones presented previously. Quantitatively, they are smaller, elasticities decreasing by one third to one half. This constitutes further evidence that relative RER volatility does impact the entry decision of firms into a considered market, but to a more limited extent than the intensive margin.

4.3. Extensive Margin II: Participation

We now turn to an alternative definition of the extensive margin, namely the participation decision of the firm, or the export status at the firm-destination level. The dependent variable is therefore defined as a dummy variable taking the value 1 when a firm exports to country j at time t, 0 otherwise. Table 9 replicates the structure of previous Table 8.

In a few words, the story remains basically identical to the one exhibited by results on entry decision in Table 6. The only noticeable difference relates to the size of the effects, which appears larger for participation. On average, a 10% increase in bilateral (respectively multilateral) RER volatility decreases (respectively increases) participation by 0.2% (respectively +0.4%). Adding relevant interactions show that those effects are slightly magnified by size, and much more substantially by the number of destinations served. The same 10% rise in bilateral RER volatility decreases participation by 0.4% at the 90th percentile, and by 0.5% at the 99th percentile. Similarly, a 10% increase in multilateral volatility boosts participation by 0.8% at the 90th percentile, and by 0.9% at the 99th percentile. Splitting the sample around the yearly median number of destinations served, columns (4) and (5) also display evidence of larger elasticities of participation to RER volatilities for firms serving many destinations.

Finally, these results on extensive margin (entry and participation) are robust to the used of lagged weights for the multilateral volatility variable.[10]

[10] More detailed on these additional estimates available upon request to the authors.

Table 9 – Extensive margin: Participation, whole sample, average shares

Dep. variable	$Pr(X_{ijt} > 0)$				
Sample	whole	whole	whole	few dest.	many dest.
	(1)	(2)	(3)	(4)	(5)
Bilateral RER volatility	-0.019^a	-0.020^a	0.010	-0.020^b	-0.020^a
	(0.007)	(0.007)	(0.006)	(0.008)	(0.006)
Multi. RER Volatility	0.043^a	0.048^a	0.005^a	0.013^a	0.054^a
	(0.001)	(0.000)	(0.000)	(0.000)	(0.001)
Assets$_{t-1}$	0.090^a	0.098^a	0.062^a	0.049^a	0.091^a
	(0.001)	(0.003)	(0.001)	(0.003)	(0.003)
Country price index	0.027^a	0.027^a	0.026^a	0.014^a	0.033^a
	(0.005)	(0.005)	(0.005)	(0.005)	(0.006)
GDP	0.161^a	0.160^a	0.155^a	0.101^a	0.194^a
	(0.027)	(0.027)	(0.027)	(0.027)	(0.025)
Bil. RER Volatility × Assets$_{t-1}$		-0.002^a		-0.002^a	-0.000
		(0.001)		(0.001)	(0.001)
Multi. RER Volatility × Assets$_{t-1}$		0.005^a		-0.001^a	0.007^a
		(0.000)		(0.000)	(0.000)
Bil. RER Volatility × Nb Dest$_{t-1}$			-0.013^a		
			(0.001)		
Multi. RER Volatility × Nb Dest$_{t-1}$			0.019^a		
			(0.000)		
Nb Dest$_{t-1}$			0.088^a		
			(0.005)		
Observations	8163660	8163660	8163660	3809569	4354091
R^2	0.031	0.032	0.042	0.009	0.021
Fixed effects	Firm-country				
Dummies	Year				
Firm-country dyads	1104138	1104138	1104138	752082	684616

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

5. Robustness Checks

5.1. Alternative weighting scheme for multilateral volatility

We start by testing whether the firm-specific measure of multilateral volatility we use is not biasing our estimation. Potential endogeneity problems may arise if firm selection across markets jointly determines export value and its portfolio of destinations, thus affecting multilateral RER volatility.

So as to tackle this problem, we use an alternative, both firm- and time-invariant, measure of multilateral RER volatility. We compute a multilateral RER volatility in which bilateral volatilities are aggregated with weights that are inversely related to distance between France and the importer country. Formally, we compute the distance-weighted multilateral RER volatility with respect to country j at time t as follows :

$$Multi\_volat_{jt} = \sum_{c \neq j} Dist_c^{-1} Bil\_volat_{c,t}$$

in which $Dist_c^{-1}$ is the inverse distance between France and country c[11]. With respect to the two other measures of multilateral RER volatility we previously used (with average and lagged firm-destination weights), this one is not firm-specific, thus excluding most of the self-selection problem. Yet, this is done at the expense of between-firm and time variation of multilateral RER volatility.

Results using this distance-related multilateral RER volatility are presented in table 10, which is made of two sets of four columns. The first set is focusing on the intensive margin of trade while the second investigates the entry decision. In each set, the specifications include the bilateral and multilateral volatilities that are also interacted with firm size in columns (1), (3), (5) and (7), and with the number of destinations in columns (2), (4), (6) and (8). For comparison purpose, standard errors are clustered at the country-year level in columns (1), (2), (5) and (6), and at the sector-year level in columns (3), (4), (7) and (8).

[11] We here use the GeoDist Datset from CEPII.

Table 10 – Multilateral volatility, distance-related shares

Dep. Variable	ln X_{ijt}				$Pr(X_{ijt} > 0 \mid X_{ijt-1} = 0)$			
Sample	(Whole)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Bilateral RER volatility	-0.023^c	0.043^a	-0.023^a	0.043^a	-0.015^a	-0.015^a	-0.015^a	-0.015^a
	(0.014)	(0.016)	(0.005)	(0.008)	(0.005)	(0.005)	(0.002)	(0.002)
Multilateral RER Volatility	0.395	0.591	0.395^c	0.591^a	0.059	0.070	0.059	0.070
	(0.680)	(0.686)	(0.206)	(0.198)	(0.186)	(0.187)	(0.054)	(0.051)
Assets$_{t-1}$	0.579^a	0.506^a	0.579^a	0.506^a	0.083^a	0.090^a	0.083^a	0.090^a
	(0.015)	(0.007)	(0.013)	(0.006)	(0.003)	(0.001)	(0.003)	(0.001)
Country price index	0.072^a	0.061^a	0.072^a	0.061^a	0.014^a	0.015^a	0.014^a	0.015^a
	(0.018)	(0.018)	(0.006)	(0.006)	(0.004)	(0.004)	(0.001)	(0.001)
GDP	1.067^a	1.107^a	1.067^a	1.107^a	0.125^a	0.123^a	0.125^a	0.123^a
	(0.060)	(0.059)	(0.025)	(0.024)	(0.017)	(0.017)	(0.006)	(0.006)
Bil. RER Volatility $\times$ Assets$_{t-1}$	-0.013^a		-0.013^a		-0.002^a		-0.002^a	
	(0.002)		(0.001)		(0.001)		(0.000)	
Multi. RER Volatility (distance related shares) $\times$ Assets$_{t-1}$	0.015^a		0.015^a		-0.001		-0.001	
	(0.004)		(0.004)		(0.001)		(0.001)	
Bil. RER Volatility $\times$ Nb Dest$_{t-1}$		-0.022^a		-0.022^a		0.002^c		0.002^a
		(0.005)		(0.002)		(0.001)		(0.000)
Multi. RER Volatility (distance related shares) $\times$ Nb Dest$_{t-1}$		0.005		0.005		-0.007^a		-0.007^b
		(0.010)		(0.011)		(0.002)		(0.003)
Nb Dest$_{t-1}$		0.246^a		0.246^a		0.006		0.006
		(0.026)		(0.029)		(0.006)		(0.008)
Observations	4058766	4058766	4058766	4058766	6562483	6562483	6562483	6562483
R^2	0.023	0.030	0.023	0.030	0.011	0.012	0.011	0.012
Year Dummies	yes				yes			
Firm-country FE	yes				yes			
Cluster (country-year)	y	y	n	n	y	y	n	n
Cluster (sector-year)	n	n	y	y	n	n	y	y
Firm-country dyads	1057720	1057720	1057720	1057720	1037689	1037689	1037689	1037689

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year (columns (1), (2), (5) and (6)) and sector-year levels (columns (3), (4), (7) and (8)).

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Overall, our main results remain unchanged: bilateral volatility still impacts negatively exports and entry towards the considered destination, and this impact is magnified for bigger firms, and those exporting to many destinations. Evidence regarding the unconditional pro-trade effect of multilateral RER volatility is slightly weaker: we find positive, and quite high, coefficients in all specifications, but standard errors are also large, leading to insignificant estimates in some cases. For the intensive margin, however, the unconditional pro-trade effect of multilateral volatility is supported in columns (3) and (4), and significantly increases with firm size in all cases. No significant effect arises with the number of destinations served. Evidence is more mixed regarding the extensive margin: the unconditional impact of bilateral volatility is negative and significant in all cases, whereas multilateral volatility, rightly signed, fails to be significant. Interacted terms with measures of firm performance are either insignificant or too small to have any relevant implication. On the whole, it is not surprising that this alternative set of estimated is marked by a lower significance on average: the measure of multilateral volatility used is a pure macro one, without any variance related to firm-level portfolio of exports. However, it is worth noticing that our key conclusion remains basically unharmed: relative RER volatility impacts negatively export performance towards a considered destination, and the size of this impact tend to increase with firm performance.

5.2. Potential omitted factors

Political risk We start by checking that the impact of RER volatilities on trade does not actually capture country-specific risks. It is now widely recognized that institutional quality is a strong determinant of trade at the aggregate level and at the firm level, insofar as trade is negatively associated to political and economic risks. We thus use the "Political Stability Estimate" variable from the World Governance Indicators dataset[12] on institutional quality to control for country-specific risks in our specification. This variable is an inverse measure of risks : an increase in the value of political stability is associated with a decrease in the risks associated with export activity in this country. In a similar fashion as we did with bilateral RER volatility, we have computed a multilateral measure of the political stability (with average firm-destination weights), which is a weighted sum of country- and time-specific political stability estimates.

We introduce those two measures, and their interactions with measures of firm performance, in estimations reported in Table 11[13], for both the intensive (columns (1) to (3)) and the extensive (columns (4) to (6)) margin. The inclusion of those measures does not change the significance of the coefficients associated to relative RER volatility : bilateral volatility is still found negatively associated to export performance (with a single exception: the unconditional impact on entry is now insignificant), and the multilateral RER volatility still has a pro-trade effect on export performance. Besides, once both RER volatilities are conditioned upon firm size and the number of destinations, previous results also remain: there is magnifying effect of both measures of firm performance, which is clearly stronger in the case of the number of destinations served. Quantitatively, it is striking to see how the inclusion of those variables of political risks only slightly affects the size of estimated elasticities: they are basically

[12] The dataset is available at: http://info.worldbank.org/governance/wgi/index.aspx.

[13] Note that the number of observations is smaller than in our baseline estimates, since information on political risk is not available for all countries in our dataset.

unchanged for the intensive margin, and marginally reduced for the extensive margin for the unconditional impact of bilateral volatility in column (4).

Therefore, this set of estimates shows that the inclusion of those measures does not affect our baseline results, and therefore, it is unlikely that our variables of RER volatility are a mere proxy for country-specific risks.

Additional omitted variables

We then test the robustness of our results, at both trade margins, to the inclusion of additional macroeconomic variables, which may be considered also as omitted factors. Results are presented in Table 12. Columns (1) to (5) report estimates on the intensive margin, and columns (6) to (10) (exactly symmetric to the previous ones) focus on entry decision. Columns (1) to (3) and (6) to (8) check that our measured impact of RER volatility does not simply capture the impact of the RER level. In columns (1) and (6), the explanatory variables are restricted to RER volatility and RER level. Because we rely on an indirect quotation, an increase in the level of the exchange rate, implying a depreciation, is expected to have a positive impact on export performance. This intuition is confirmed: RER volatility and RER level enter with reverse signs, negative and positive, respectively, which are significant in both cases. In columns (2) and (7), both multilateral RER volatility and its counterpart for RER level are introduced, not modifying our central result regarding third-market effects (the positive impact of multilateral volatility on bilateral exports). Finally, our results remain in columns (3) and (8) when adding our proxy for firm size and the macroeconomic variables for the destination country (GDP and price index).

In columns (4)/(5) and (9)/(10), we add to our baseline specification the age of the firm and the market potentials. The first is correlated with financial factors, size and productivity (see for example Cooley and Quadrini, 2001, for a theoretical approach to this correlation), and could therefore be a relevant, alternative explanation for our results. Extensively used in empirical exercises, the second generally captures a substantial part of the "multilateral resistance term". When including our measure of multilateral RER volatility on top of this market potential in the regression, this allows us measuring what comes in addition to the standard resistance term.[14] In any case, the inclusion of both variables leaves our results mainly unchanged: both the negative effect of bilateral volatility and the third-market effect embodied by multilateral volatility remain significantly present on average. Besides, interactions between our measures of volatility and firm performances are still significantly signed in direction of a magnifying effect, the only exception being the interactions involving bilateral volatility for the extensive margin.

[14]Note that we get a negative coefficient associated to firm age for the intensive margin. This is consistent with the "learning by exporting" or the sequential exporting hypothesis (see Albornoz et al., 2012). We may observe here the fact that in order to export to larger markets, firms have to export, ex ante, to many small countries, leading to increased trade flows at the firm level, but lower average flows per destination when firm age increases. This does not need to be incompatible with the positive sign we get on this age variable at the extensive margin: the story is just not the same. Here, the positive sign of age reflects that older firm are more productive and have a better access to external finance, giving them better ability to face the sunk entry costs of export.

Table 11 – Political stability, real exchange rate volatility and trade

Dep. Variable		ln X_{ijt}			$Pr(X_{ijt} > 0 \quad \| X_{ijt-1} = 0)$	
Sample		Whole			Whole	
	(1)	(2)	(3)	(4)	(5)	(6)
Bilateral RER volatility	-0.024^b	-0.029^b	0.077^a	-0.005	-0.007^b	0.001
	(0.012)	(0.012)	(0.019)	(0.004)	(0.003)	(0.005)
Multilateral RER Volatility	0.147^a	0.183^a	-0.040^a	0.030^a	0.032^a	0.012^a
	(0.003)	(0.003)	(0.003)	(0.000)	(0.000)	(0.000)
Political Stability	0.059^a	0.062^a	-0.026	0.007	0.007	-0.002
	(0.015)	(0.015)	(0.023)	(0.005)	(0.005)	(0.005)
Multilateral Political Stability	0.039^a	0.046^a	0.104^a	0.015^a	0.014^a	0.039^a
	(0.003)	(0.003)	(0.007)	(0.001)	(0.001)	(0.003)
Assets$_{t-1}$	0.490^a	0.522^a	0.389^a	0.059^a	0.058^a	0.049^a
	(0.009)	(0.014)	(0.008)	(0.001)	(0.003)	(0.001)
Country price index	0.060^a	0.056^a	0.048^a	0.017^a	0.017^a	0.016^a
	(0.018)	(0.017)	(0.017)	(0.004)	(0.004)	(0.004)
GDP	1.046^a	1.025^a	1.026^a	0.106^a	0.104^a	0.099^a
	(0.069)	(0.069)	(0.069)	(0.019)	(0.019)	(0.019)
Bil. RER Volatility × Assets$_{t-1}$		-0.017^a			-0.002^a	
		(0.003)			(0.001)	
Multi. RER Volatility × Assets$_{t-1}$		0.039^a			0.002^a	
		(0.001)			(0.000)	
Pol. Stab. × Assets$_{t-1}$		0.016^a			0.001	
		(0.003)			(0.001)	
Multi. Pol. Stab. × Assets$_{t-1}$		-0.006^a			-0.004^a	
		(0.001)			(0.000)	
Bil. RER Volatility × Nb dest$_{t-1}$			-0.036^a			-0.003^a
			(0.005)			(0.001)
Multi. RER Volatility × Nb dest$_{t-1}$			0.083^a			0.011^a
			(0.001)			(0.000)
Pol. Stab.× Nb. dest$_{t-1}$			0.031^a			0.004^a
			(0.006)			(0.001)
Multi. Pol. Stab. × Nb. dest$_{t-1}$			-0.020^a			-0.010^a
			(0.002)			(0.001)
Nb dest$_{t-1}$			0.395^a			0.054^a
			(0.024)			(0.004)
Observations	2808487	2808487	2808487	3855011	3855011	3855011
R^2	0.034	0.037	0.042	0.023	0.023	0.026
Year Dummies		yes			yes	
Firm-country FE		yes			yes	
Cluster (country-year)		yes			yes	
Firm-country dyads	903975	903975	903975	887798	887798	887798

Political stability data is extracted from the "The Worldwide Governance Indicators" dataset
Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.
^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 12 – Controlling for additional omitted factors

Dep. Variable			ln X_{ijt}					$Pr(X_{ijt} > 0 \mid X_{ijt-1} = 0)$		
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RER level	0.387^a	0.375^a	0.341^a			0.055^a	0.052^a	0.039^a		
	(0.044)	(0.043)	(0.048)			(0.012)	(0.012)	(0.014)		
Bilateral RER volatility	-0.026^b	-0.029^a	-0.026^b	-0.031^a	0.028	-0.015^a	-0.015^a	-0.013^b	-0.019^b	-0.015^c
	(0.010)	(0.010)	(0.010)	(0.012)	(0.017)	(0.005)	(0.005)	(0.005)	(0.008)	(0.008)
Multilateral RER level		0.130^a	0.112^a				0.043^a	0.041^a		
		(0.002)	(0.002)				(0.001)	(0.001)		
Multilateral RER Volatility		0.102^a	0.088^a	0.144^a	-0.021^a		0.019^a	0.017^a	0.025^a	0.009^a
		(0.002)	(0.002)	(0.003)	(0.003)		(0.000)	(0.000)	(0.000)	(0.001)
Assets$_{t-1}$			0.448^a	0.519^a	0.384^a			0.047^a	0.070^a	0.054^a
			(0.007)	(0.015)	(0.010)			(0.001)	(0.004)	(0.002)
Country price index			-0.038^c	0.054^b	0.052^b			0.006	0.012^b	0.012^b
			(0.021)	(0.022)	(0.023)			(0.006)	(0.006)	(0.006)
GDP			0.951^a	1.208^a	1.194^a			0.102^a	0.098^b	0.095^b
			(0.059)	(0.112)	(0.112)			(0.017)	(0.039)	(0.039)
Bil. RER Volatility × Assets$_{t-1}$				-0.011^a					-0.000	
				(0.002)					(0.001)	
Multi. RER Volatility × Assets$_{t-1}$				0.031^a					0.002^a	
				(0.001)					(0.000)	
Real Market Pot. (HM04)				0.133^a	0.139^a				0.072^b	0.072^b
				(0.037)	(0.037)				(0.028)	(0.028)
Age of the firm				-0.019^a	-0.033^a				0.010^a	0.009^a
				(0.004)	(0.004)				(0.003)	(0.003)
Bil. RER Volatility × Nb dest$_{t-1}$					-0.020^a					-0.002
					(0.005)					(0.001)
Multi. RER Volatility × Nb. dest$_{t-1}$					0.065^a					0.009^a
					(0.001)					(0.000)
Nb. dest$_{t-1}$					0.390^a					0.045^a
					(0.022)					(0.006)
Observations	3902979	3902979	3902979	2165543	2165543	5079935	5079935	5079935	2834175	2834175
R^2	0.005	0.032	0.042	0.025	0.029	0.006	0.029	0.031	0.022	0.023
Fixed effects	Firm-country									
Dummies	Year									

Intercept not reported. Real Market Potential computed following Head and Mayer (2004). Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level. [a], [b] and [c] respectively denote significance at the 1%, 5% and 10% levels.

5.3. Subsamples and data restrictions

We now check that self-selection into specific markets is not biasing our results. In table 13, we report estimates on the intensive margin from regressions we performed excluding BRICS countries (Brazil, Russia, India, China and South Africa) from our sample (columns (1) to (3)), then excluding OECD countries in columns (4) to (6). We finally exclude the top 25 % of GDP growth distribution observations and result are presented in the last three columns. Columns (1) to (3) and (7) to (9) check that self-selection into fast-growing markets is not biasing our results, while columns (4) to (6) concentrate on firms which do not export to similar destinations (OECD countries) in which self-selection would be less of an issue. We perform the same exercise for the entry decision, and we present results in Table 14, which replicates exactly the structure of Table 13. Our results remain qualitatively and quantitatively immune to these alternative samples: the negative impact of bilateral volatility and the positive impact of multilateral volatility on bilateral exports remain identical on average - only the average impact of bilateral volatility on entry appears reduced on the sample excluding fast-growing countries (column (7) in Table 14), compared to our benchmark estimation. Besides, the amplifying effect of size and number of destinations on both volatilities is also persistent across all samples for both margins of trade, in proportions very similar to our baseline results.

Table 13 – Investigating self selection into - intensive margin - average weights

Dep. Variable					Ln X_{ijt}				
Sample	BRICS excl.	BRICS excl.	BRICS excl.	OECD excl.	OECD excl.	OECD excl	top 25% excl.	top 25% excl.	top 25% excl.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bilateral RER volatility	-0.025^b	-0.029^a	0.092^a	-0.032^a	-0.028^b	0.086^a	-0.033^a	-0.034^a	0.066^a
	(0.011)	(0.011)	(0.016)	(0.011)	(0.011)	(0.017)	(0.012)	(0.012)	(0.018)
Multilateral RER Volatility	0.144^a	0.176^a	-0.024^a	0.134^a	0.163^a	-0.068^a	0.147^a	0.180^a	-0.035^a
	(0.002)	(0.002)	(0.003)	(0.003)	(0.003)	(0.004)	(0.003)	(0.002)	(0.003)
Assets$_{t-1}$	0.509^a	0.526^a	0.412^a	0.354^a	0.398^a	0.270^a	0.505^a	0.542^a	0.407^a
	(0.008)	(0.013)	(0.007)	(0.006)	(0.013)	(0.006)	(0.008)	(0.014)	(0.007)
Country price index	0.075^a	0.072^a	0.066^a	0.027	0.025	0.024	0.067^a	0.064^a	0.059^a
	(0.016)	(0.016)	(0.016)	(0.020)	(0.020)	(0.020)	(0.022)	(0.022)	(0.022)
GDP	0.975^a	0.953^a	0.964^a	0.958^a	0.950^a	0.943^a	1.335^a	1.307^a	1.317^a
	(0.059)	(0.059)	(0.060)	(0.067)	(0.068)	(0.068)	(0.084)	(0.084)	(0.086)
Bil. RER Volatility × Assets$_{t-1}$		-0.020^a			-0.017^a			-0.017^a	
		(0.002)			(0.003)			(0.003)	
Multi. RER Volatility × Assets$_{t-1}$		0.035^a			0.043^a			0.037^a	
		(0.001)			(0.001)			(0.001)	
Bil. RER Volatility × Nb dest$_{t-1}$			-0.042^a			-0.039^a			-0.035^a
			(0.004)			(0.006)			(0.004)
Multi. RER Volatility × Nb dest$_{t-1}$			0.075^a			0.084^a			0.080^a
			(0.001)			(0.002)			(0.001)
Nb dest$_{t-1}$			0.349^a			0.338^a			0.404^a
			(0.020)			(0.026)			(0.022)
Observations	3758390	3758390	3758390	1510847	1510847	1510847	3030018	3030018	3030018
R^2	0.034	0.036	0.042	0.028	0.033	0.036	0.035	0.038	0.044
Fixed effects					Firm-country				
Dummies					Year				
Firm-country dyads	967334	967334	967334	479096	479096	479096	851487	851487	851487

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample in terms of number of destinations served.

Table 14 – Investigating self selection into - extensive margin : entry - average weights

Dep. Variable	$Pr(X_{ijt} > 0 \quad \vert X_{ijt-1} = 0)$								
Sample	BRICS excl.	BRICS excl.	BRICS excl.	OECD excl.	OECD excl.	OECD excl	top 25% excl.	top 25% excl.	top 25% excl.
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Bilateral RER volatility	-0.015^a	-0.017^a	-0.006	-0.007^a	-0.008^a	0.001	-0.006^c	-0.007^b	0.003
	(0.005)	(0.005)	(0.005)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)
Multilateral RER Volatility	0.031^a	0.033^a	0.013^a	0.031^a	0.034^a	0.009^a	0.030^a	0.033^a	0.013^a
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Assets$_{t-1}$	0.063^a	0.062^a	0.052^a	0.055^a	0.062^a	0.042^a	0.063^a	0.064^a	0.052^a
	(0.001)	(0.003)	(0.001)	(0.001)	(0.002)	(0.001)	(0.001)	(0.003)	(0.001)
Country price index	0.018^a	0.018^a	0.018^a	0.006^b	0.006^b	0.006^c	0.015^a	0.015^a	0.015^a
	(0.004)	(0.004)	(0.004)	(0.003)	(0.003)	(0.003)	(0.004)	(0.004)	(0.004)
GDP	0.109^a	0.109^a	0.104^a	0.138^a	0.138^a	0.136^a	0.134^a	0.134^a	0.129^a
	(0.017)	(0.017)	(0.017)	(0.015)	(0.015)	(0.015)	(0.018)	(0.018)	(0.018)
Bil. RER Volatility $\times$ Assets$_{t-1}$		-0.002^a			-0.001^b			-0.002^a	
		(0.001)			(0.001)			(0.001)	
Multi. RER Volatility $\times$ Assets$_{t-1}$		0.002^a			0.003^a			0.002^a	
		(0.000)			(0.000)			(0.000)	
Bil. RER Volatility $\times$ Nb dest$_{t-1}$			-0.004^a			-0.004^a			-0.004^a
			(0.001)			(0.001)			(0.001)
Multi. RER Volatility $\times$ Nb dest$_{t-1}$			0.011^a			0.013^a			0.011^a
			(0.000)			(0.000)			(0.000)
Nb dest$_{t-1}$			0.049^a			0.059^a			0.051^a
			(0.004)			(0.003)			(0.003)
Observations	4829724	4829724	4829724	2865043	2865043	2865043	3978427	3978427	3978427
R^2	0.022	0.022	0.024	0.020	0.020	0.023	0.020	0.020	0.022
Fixed effects	Firm-country								
Dummies	Year								
Firm-country dyads	898923	898923	898923	487099	487099	487099	846243	846243	846243

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

few dest. and many dest. mean respectively above and below the median of the sample

in terms of number of destinations served.

6. Widening the Scope: Firm-Destination-Product Results

Up to now, we have focused on exports at the firm-destination level, in order to focus on the potential reallocation behavior of firms exclusively between destinations. In this section, we go another step further by investigating the third-market effects induced by RER volatility in the firm-destination-product dimension. In other words, we now use the information on Harmonized System six-digit (HS6) products exported by each firm to study if and how the reallocation behavior in terms of destinations we provided evidence for also emerges at this dimension. There are many reasons to believe that the product-mix may be an additional margin for firm exports. Recently, many papers, such as Mayer et al. (2014), have investigated the product mix of exports and have for instance emphasized the prominent role of the best-product at the firm-destination level.

In order to investigate to question, we regress the following equations at the firm-destination-product level:

$$\begin{aligned} \ln \mathrm{X}_{ijtp} &= \alpha \mathrm{Bil\_volat}_{jt} + \beta \mathrm{Assets}_{it-1} + \gamma \mathrm{Multi\_volat}_{ijt} \\ &+ \delta \left(\mathrm{Bil\_volat}_{jt} \times \mathrm{Assets}_{it-1}\right) + \tau \left(\mathrm{Multi\_volat}_{ijt} \times \mathrm{Assets}_{it-1}\right) \\ &+ \phi Z_{jt} + \lambda_{ijp} + \theta_t + \epsilon_{ijt} \end{aligned} \tag{3}$$

and

$$\begin{aligned} \ln \mathrm{X}_{ijtp} &= \alpha \mathrm{Bil\_volat}_{jt} + \beta \mathrm{Assets}_{it-1} + \gamma \mathrm{Multi\_volat}_{ijt} + \kappa \mathrm{Nb\_dest}_{it-1} \\ &+ \delta \left(\mathrm{Bil\_volat}_{jt} \times \mathrm{Nb\_dest}_{it-1}\right) + \tau \left(\mathrm{Multi\_volat}_{ijt} \times \mathrm{Nb\_dest}_{it-1}\right) \\ &+ \phi Z_{jt} + \lambda_{ijp} + \theta_t + \epsilon_{ijt} \end{aligned} \tag{4}$$

where $\ln \mathrm{X}_{ijtp}$ is the log level of exports for firm i and HS6 digit product p at time t towards country j. We add to both specifications firm-destination-product fixed effects λ_{ijp}.

Besides, we also study the effects of RER volatilities on the extensive margin at the product level by estimating the following equations:

$$\begin{aligned} \ln \mathrm{Nb\ products}_{ijt} &= \alpha \mathrm{Bil\_volat}_{jt} + \beta \mathrm{Assets}_{it-1} + \gamma \mathrm{Multi\_volat}_{ijt} \\ &+ \delta \left(\mathrm{Bil\_volat}_{jt} \times \mathrm{Assets}_{it-1}\right) + \tau \left(\mathrm{Multi\_volat}_{ijt} \times \mathrm{Assets}_{it-1}\right) \\ &+ \phi Z_{jt} + \lambda_{ijp} + \theta_t + \epsilon_{ijt} \end{aligned} \tag{5}$$

and

$$\begin{aligned}\ln \text{Nb products}_{ijt} &= \alpha \text{Bil\_volat}_{jt} + \beta \text{Assets}_{it-1} + \gamma \text{Multi\_volat}_{ijt} + \kappa \text{Nb\_dest}_{it-1} \\ &+ \delta \left(\text{Bil\_volat}_{jt} \times \text{Nb\_dest}_{it-1}\right) + \tau \left(\text{Multi\_volat}_{ijt} \times \text{Nb\_dest}_{it-1}\right) \\ &+ \phi Z_{jt} + \lambda_{ijp} + \theta_t + \epsilon_{ijt}\end{aligned} \tag{6}$$

where $\ln \text{Nb products}_{ijt}$ is the log-number of products exported by firm i towards j at period t.

Table 15 reports the results of the estimations of export volumes (columns (1) to (8)) and the number of exported products (columns (9) to (11)). Regarding export volumes, there are three sets of regressions. In columns (1), (2) and (3), regressions are performed on the whole sample. Columns (4), (5) and (6) restrict the sample to a set of observations where product-mix is shut off, i.e. we consider only the firm-destination combinations for which the firm exports only one product over the whole period. We keep the observations only for the main exported (in value) product exported by the firm at the word level in columns (7) and (8).

Turning more specifically to the whole sample, results reported in columns (1) to (3) are qualitatively identical to those reported for firm-country observations in table 2. On average, bilateral RER volatility decreases exports towards the considered destination (α is negative and significant), while multilateral RER volatility boosts them (γ is positive and significant). Once again, these impacts are magnified for bigger firms, and those exporting to a larger set of destinations (δ and τ are always strongly significant). Quantitatively, effects are less sizeable than at the firm-country level, especially regarding the third-market effect embodied by the multilateral volatility (elasticities are divided by 2 or 3). Evidence of a reallocation behavior at the intensive margin by big, multi-destination firms is still there, but with a more limited extent.

Focusing now on single product firms (columns (4), (5) and (6)), the picture slightly changes: bilateral volatility does not impact exports on average, but there is still evidence of an increasingly negative impact for big and multi-destination firms. Regarding multilateral volatility, evidence supports a positive impact for all firms on average, and once again magnified by firms' size and number of destinations served. Quantitatively, elasticities are (very) slightly higher than on the whole sample. Results on the main product exported at the world level (columns (7) and (8)) are mostly identical, with quite close elasticities. Those results emphasize that there is definitely an intensive margin adjustment in the product-destination dimension, regardless of the definition.

Finally, columns (9) to (11) provide estimates on the extensive margin at the product-destination level. The (log) number of HS6 products exported by the firm is negatively associated to the bilateral volatility, and positively to the multilateral volatility: α and γ are significant and negative and positive, respectively. This is true on average (column (9)), but the size of the impact of multilateral volatility is significantly reduced. Besides, there is some (quantitatively weak) evidence that these effects increase with size (column (10)) and number of destinations (column (11)). Comparing this set of results with those regarding entry in Table 6 shows that effects are quantitatively close, in any case smaller than what can be found on the intensive margin. Firms tend to adjust the number of products to variations of relative RER volatility (i.e., to both bilateral and multilateral), and this adjustment does increase with size or number of destinations, but to a limited extent compared to the value exported.

Put together, this set of results at the firm-destination-product level deliver a couple of interesting, additional insights to the firm-country evidence displayed before. Facing increased relative RER volatility, multiproduct firms reallocate sales across destinations, using both the intensive and the extensive margin: for a given destination, they decrease the average exported value and the number of exported products. Quantitatively, the adjustment is identical when considering bilateral volatility, but is twice lower for the number of exported products when considering multilateral volatility.

Table 16 replicates exactly the structure of Table 15 on a sample of firm-country-product observations excluding EA members. Results are overall very similar to those on the full sample. Qualitatively, they are strictly identical. Quantitatively, on can see that elasticities involving multilateral volatility (either the unconditional impact or the interactions with size and number of destinations) are higher in columns (9), (10) and (11) than their counterparts in Table 15; conversely, estimates regarding bilateral volatility (either the unconditional impact or the interactions with size and number of destinations) are smaller in columns (1), (2) and (3) from Table 16. Therefore, it seems that on this specific sample, firm adjust (slightly) more at the extensive than at the intensive margin: when facing a volatility shock, multiproduct firms reallocate sales by decreasing less the average exported value, and decreasing a bit more the number of exported products, compared to the whole sample.

Table 15 – Product dimension: whole sample, average shares, firm-country-product FE

Dep. Variable	ln X_{ijpt}								Nb products		
Sample	Whole	Whole	Whole	Single prod.	Single prod.	Single prod.	Main prod. World	Main prod. World	Whole	Whole	Whole
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Bilateral RER Volatility	-0.022^b	-0.010	0.082^a	-0.012	-0.019^b	0.056^a	-0.020^c	0.044^b	-0.020^a	-0.014^a	0.025^a
	(0.011)	(0.011)	(0.014)	(0.009)	(0.009)	(0.018)	(0.011)	(0.017)	(0.004)	(0.004)	(0.009)
Multilateral RER volatility	0.083^a	0.087^a	0.013^a	0.089^a	0.104^a	0.015^a	0.134^a	0.009^a	0.047^a	0.050^a	-0.029^a
	(0.002)	(0.002)	(0.004)	(0.002)	(0.002)	(0.003)	(0.002)	(0.003)	(0.001)	(0.001)	(0.002)
Assets$_{t-1}$	0.408^a	0.374^a	0.331^a	0.366^a	0.348^a	0.313^a	0.447^a	0.390^a	0.207^a	0.198^a	0.108^a
	(0.009)	(0.012)	(0.008)	(0.009)	(0.013)	(0.008)	(0.013)	(0.007)	(0.003)	(0.006)	(0.003)
Country price index	0.030	0.030	0.017	0.039^a	0.039^a	0.036^b	0.063^a	0.059^a	0.088^a	0.088^a	0.074^a
	(0.019)	(0.019)	(0.019)	(0.014)	(0.014)	(0.014)	(0.020)	(0.020)	(0.011)	(0.011)	(0.011)
GDP	0.923^a	0.923^a	0.976^a	0.960^a	0.951^a	0.937^a	1.283^a	1.287^a	0.306^a	0.304^a	0.361^a
	(0.074)	(0.074)	(0.073)	(0.056)	(0.057)	(0.058)	(0.067)	(0.067)	(0.036)	(0.036)	(0.033)
Bil. RER Volatility × Assets$_{t-1}$		-0.014^a			-0.013^a		-0.017^a			-0.007^a	
		(0.002)			(0.002)		(0.002)			(0.001)	
Multi. RER Volatility × Assets$_{t-1}$		0.012^a			0.012^a		0.021^a			0.009^a	
		(0.001)			(0.001)		(0.001)			(0.000)	
Bil. RER Volatility × Nb dest$_{t-1}$			-0.019^a			-0.020^a		-0.016^a			-0.008^a
			(0.003)			(0.003)		(0.003)			(0.002)
Multi. RER Volatility×Nb dest$_{t-1}$			0.014^a			0.027^a		0.031^a			0.014^a
			(0.001)			(0.001)		(0.001)			(0.001)
Nb dest$_{t-1}$			0.129^a			0.144^a		0.203^a			0.239^a
			(0.013)			(0.016)		(0.014)			(0.009)
Observations	16376410	16376410	16376410	1886136	1886136	1886136	2840197	2840197	16376410	16376410	16376410
R^2	0.014	0.014	0.016	0.018	0.018	0.020	0.030	0.033	0.041	0.043	0.087
Fixed effects	Firm-country-product										
Dummies	Year										
Firm-country-prod. triads	6212348	6212348	6212348	1089066	1089066	1089066	932551	932551	6212348	6212348	6212348

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.

^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 16 – Product dimension: no-EA sample, average shares, firm-country-product FE

Dep. Variable					ln X_{ijpt}					Nb products	
Sample	Whole	Whole	Whole	Single prod.	Single prod.	Single prod.	Main prod. World	Main prod. World	Whole	Whole	Whole
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)
Bilateral RER Volatility	-0.018^b	-0.010	0.028^c	-0.011	-0.012	0.004	-0.017^c	0.076^a	-0.014^b	-0.009^c	0.025^b
	(0.009)	(0.009)	(0.014)	(0.007)	(0.007)	(0.016)	(0.009)	(0.017)	(0.006)	(0.006)	(0.010)
Multilateral RER Volatility	0.084^a	0.089^a	0.001	0.083^a	0.102^a	0.004	0.137^a	-0.014^a	0.056^a	0.060^a	-0.044^a
	(0.002)	(0.002)	(0.005)	(0.002)	(0.003)	(0.005)	(0.003)	(0.004)	(0.001)	(0.001)	(0.002)
Assets$_{t-1}$	0.297^a	0.313^a	0.237^a	0.276^a	0.299^a	0.231^a	0.402^a	0.324^a	0.173^a	0.190^a	0.083^a
	(0.010)	(0.013)	(0.008)	(0.010)	(0.015)	(0.010)	(0.014)	(0.008)	(0.004)	(0.007)	(0.003)
Country price index	0.038^b	0.037^b	0.033^c	0.040^a	0.039^a	0.040^a	0.067^a	0.066^a	0.074^a	0.074^a	0.067^a
	(0.017)	(0.017)	(0.017)	(0.014)	(0.014)	(0.014)	(0.020)	(0.020)	(0.011)	(0.011)	(0.011)
GDP	1.045^a	1.041^a	1.059^a	0.979^a	0.969^a	0.963^a	1.372^a	1.377^a	0.512^a	0.509^a	0.532^a
	(0.069)	(0.068)	(0.070)	(0.055)	(0.054)	(0.054)	(0.070)	(0.070)	(0.041)	(0.041)	(0.037)
Bil. RER Volatility × Assets$_{t-1}$		-0.008^a			-0.008^a		-0.018^a			-0.004^a	
		(0.002)			(0.003)		(0.003)			(0.001)	
Multi. RER Volatility × Assets$_{t-1}$		0.017^a			0.018^a		0.029^a			0.013^a	
		(0.001)			(0.001)		(0.001)			(0.001)	
Bil. RER Volatility × Nb dest$_{t-1}$			-0.009^a			-0.004		-0.023^a			-0.008^a
			(0.003)			(0.004)		(0.004)			(0.002)
Multi. RER Volatility × Nb dest$_{t-1}$			0.018^a			0.026^a		0.037^a			0.020^a
			(0.001)			(0.002)		(0.001)			(0.001)
Nb Ddst$_{t-1}$			0.169^a			0.183^a		0.189^a			0.264^a
			(0.013)			(0.016)		(0.015)			(0.011)
Observations	8622914	8622914	8622914	1273213	1273213	1273213	1652051	1652051	8622914	8622914	8622914
R^2	0.014	0.014	0.016	0.017	0.018	0.019	0.032	0.034	0.032	0.035	0.067
Fixed effects						Firm-country-product					
Dummies						Year					
Firm-country-prod. triads	3851235	3851235	3851235	830294	830294	830294	594653	594653	3851235	3851235	3851235

Intercept not reported. Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.
^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

7. Aggregate implications

In this section, we perform a simple empirical exercise that aims at providing aggregate implications of the previous firm-level evidence. In this exercise, focusing exclusively on the intensive margin of trade, we want to assess how much exporting to many destinations distorts aggregate trade flows response to RER volatility. We use the following decomposition of trade flows with respect to changes in the RER volatility.

We denote by X_t the aggregate value of exports at time t and is defined as: $X_t = \sum_i \sum_j x_{ijt}$where x_{ijt} is the value exported by firm i to country j at time t.

We can decompose the aggregate response of trade flows X_{ijt}:

$$dX_t = \sum_i \sum_j \sum_\lambda \left(\frac{dx_{ijt}}{dRERvolat_{ij}} \right)^\lambda \frac{X^\lambda}{X} dRERvolat_{ij}$$

where $\lambda = \{H, L\}$ is the type of firms. We note $\left(\frac{dx_{ijt}}{dRERvolat_{ij}} \right)^\lambda = \alpha^\lambda$ which the elasticity of firm-level trade flows for λ-type firms.

We suppose that there are two types of firms: firms exporting to a large set of countries, that is, larger than the median number of destinations, and firms that export towards few destinations. We have provided evidence in the previous sections that those firms do not act similarly. Firms that export to a large set of countries seem to be more sensitive to RER volatilities changes than firms exporting to few destinations. The explanation lies in the fact that those high-performance firms are able to reallocate their exports away from destinations characterized by high RER volatility. This results leads us to consider that $\alpha^H \neq \alpha^L$.

Therefore, in the empirical exercise, we distinguish two aggregate values of exports at time t, one for type H firms (X_t^H) and another one for type L firms (X_t^L). By relating the gap between the two aggregate exports with the different responses of trade flows with respect to RER volatility across the two types H and L, we infer the trade creation generated by having a large set of destinations to export to.

In order to capture both the trade-deterring effect of bilateral volatility and the pro-trade effect of multilateral volatility, we compute a relative measure of RER volatility which is the ratio of the bilateral volatility over the multilateral volatility. This measure captures the relative incentive to export to a destination, conditional on other control variables.

We then regress the following equation :

$$ln(x_{ijt}) = \alpha \text{RelativeRERvolat}_{ijt} + \phi Z_{jt} + \lambda_{ij} + \theta_t + \epsilon_{it}$$

where all variables are as previously defined. Results are presented in Table 17. This regression is in the flavor of previous estimations, but it provides the advantage of capturing the effect of both volatilities in one coefficient. We regress this equation for the two types of firms and we get two elasticities $\alpha^H = -0.187$ and $\alpha^L = -0.075$.

In this exercise, we want to know how much aggregate exports are sensible to relative RER volatility and to the fact that some firms have less options for reallocation. In order in to do so, we assess

Table 17 – Estimates with explicit Relative RER

	(1)	(2)
Dep. variable	ln X_{ijt}	
Sample	few dest.	many dest.
Relative_volat_avg	-0.075^a	-0.183^a
	(0.002)	(0.004)
Assets_{t-1}	0.432^a	0.522^a
	(0.009)	(0.007)
Country price index	0.058^a	0.054^b
	(0.021)	(0.021)
GDP	0.856^a	1.086^a
	(0.073)	(0.062)
Observations	1790669	2112310
R^2	0.017	0.038
Fixed effects	Firm-country	
Dummies	Year	
Firm-country dyads	641824	491521

Intercept not reported.
Heteroskedasticity-consistent (White correction) standard errors, in parentheses, are clustered at the country-year level.
^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

which part of the gap between X_t^H and X_t^L can be attributed to the fact that firms serving a high (above the median) number of destinations have a higher elasticity of trade flows to relative RER volatility. Doing so allows us to compute the potential additional trade flows with respect to existing relative RER volatility in the data.

We find that if all firms were exporting to a large set of countries, thus favoring exports reallocation across destinations, then aggregate export flows response following observed changes in the RER volatility would have increased by 6.6% with respect to the observed flows. This is consistent with the view that allowing firms to reallocate exports across destinations significantly increases aggregate trade flows, insofar as these firms, even if they face bilateral RER volatility, still export towards other destinations.

8. Conclusion

Relying on a large French firm-level database combining balance-sheet and export information over the period 1995-2009, this paper shows that export performance is affected by both bilateral and multilateral real exchange rate volatility (that is, the weighted volatility of all destinations served by firms). A positive change in the latter all things equal increases both extensive and intensive margins to a considered destination, but the effect is quantitatively more substantial for export blows than for entry. Furthermore, it appears that firm size and the number of destinations tend to amplify the negative effect of bilateral RER volatility on exports, and the positive effect of multilateral volatility. For a given level of profitability, firms will tend to reallocate exports away from destinations characterized by higher, relative RER volatility. This allows them holding the average risk level of their destinations portfolio constant, a behavior consistent with Markowitz (1952)'s portfolio theory in finance. Our results then support that more destination-diversified firms are better able to handle exchange rate risks, with significant implications for aggregate exports: a simple empirical, counterfactual exercise shows that aggregate exports would have been 6.6% larger if all firms were able to reallocate exports across a sufficiently high number of destinations.

These effects are robust to a number of checks and various specifications. In particular, estimations performed on a subsample of firms exporting exclusively outside the Euro Area shows a similar pattern, but with slightly smaller effects compared to the whole sample, especially for firms exporting to a low number of destinations. This suggests that those firms reallocate their exports primarily to EA destinations when facing increasing relative RER volatility.

Overall, these results emphasize that big, multi-destination firms hedge against exchange rate volatility through diversification, rather than (but not excluding) using hedging financial instruments. Interesting avenues for future research would be to study the exact types of combinations between the two used by multi-destination firms, and the differences between small and big firms. To that purpose, collection of extensive firm-level data regarding the use of hedging instruments would allow making an important step forward.

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