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Exchange Rate Volatility, Financial Constraints and Trade: Empirical Evidence from Chinese Firms

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Abstract

This paper studies how firm-level export performance is affected by Real Exchange Rate (RER) volatility and investigates whether this effect depends on existing financial constraints. Our empirical analysis relies on export data for more than 100,000 Chinese exporters over the 2000-2006 period. We confirm a trade-deterring effect of RER volatility. We find that the firms' decision to start exporting and the exported value decrease for destinations with a higher exchange rate volatility and that this effect is magnified for financially vulnerable firms. As expected, financial development seems to dampen this negative impact, especially on the intensive margin of export. These results provide micro-founded evidence suggesting that the existence of well-developed financial markets allow firms to hedge exchange rate risk. They also support a key role of financial constraints in determining the macro impact of RER volatility on real outcomes.

JEL-Code: F140, F310, L250.

Keywords: exchange rate volatility, financial development, exports.

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1 Introduction

The increasing volatility of exchange rates after the collapse of the Bretton Woods agreements has been a source of concern 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). Initial macroeconomic evidence on the effect of exchange rate volatility on trade has been however quite mixed, concluding to an effect which is either significant but small or insignificant (see Greenaway and Kneller, 2007, or Byrne et al., 2008, for a survey). Even Rose (2000), who finds a very large effect of currency union on international trade, concludes to a small effect of nominal exchange rate volatility. However, more recent works have emphasized that these results could be due both to an aggregation bias (Byrne et al., 2008, who study the impact of the nominal exchange rate volatility; Broda and Romalis[1], 2010, who focus on real exchange rate volatility)[2] and an excessive focus on richer countries with highly developed financial markets. Indeed, much more substantial negative effects of the real exchange rate volatility on trade are found for developing countries (Grier and Smallwood, 2007).

There is still a strong lack of firm-level evidence on the impact of exchange rate volatility on exporting behavior, and on how this relationship may be influenced by financial constraints, which are likely to be much stronger and more binding in developing countries. A careful firm-level study of these relationships may bring us some more clear-cut evidence regarding the exacerbating role of exchange rate volatility for export costs, and how financial development may help alleviate these additional costs. This paper aims at filling these gaps. We study the impact of Real Exchange Rate (RER) volatility on exporting behavior and the way financial constraints, together with financial development, shape this relationship at the firm level. Our empirical estimations rely on export data for more than 100,000 Chinese exporters over the 2000-2006 period. China is a highly relevant case for several reasons. Firstly, the country displays an especially high export rate given it size, leading to substantial exposure to exchange rate fluctuations. Secondly, China is interesting because it is characterized by a low financial development, but with a rather high regional heterogeneity, which will be useful to identify a non-linear effect of exchange rate volatility depending on credit constraints. Finally, the Chinese Yuan was strongly pegged to the US Dollar during practically the whole period considered,

[1]Broda and Romalis (2010) also address the issue on reverse causality between exchange rate volatility and trade. Once the problem is controlled for, they still find a negative impact of volatility on trade, though reduced.

[2]Although the volatility of the real exchange rate differs conceptually from that of the nominal exchange rate, as shown by Clark et al. (2004), they do not differ much in reality. In the literature, volatility indicators based on real or nominal exchange rate are used indifferently, with a strong preference for the former, however.

implying that the volatility we identify is truly exogenous to Chinese economic developments over all the considered period. More precisely, the Chinese exchange rate policy over the period is best described as a fixed peg versus the US Dollar until July 2005. The Chinese government then switched to a reference to a basket of other currencies. However, Frankel and Wei (2007) find the *de facto* regime remained a peg to a basket that put virtually all the weight on the Dollar. Subsequently, some weight was shifted to a few non-dollar currencies. In any case, the peg was still fairly strong in 2006.[3] The Chinese exchange rate policy is also characterized by limited convertibility and misalignment over the period. While impediments to convertibility may have reduced as China made shy attempts to internationalize the Yuan by the end of the 2000's, charges of undervaluation developed over the period. These two dimensions nevertheless apply to all exporters independently of the destination country, hence are not country-specific. Our econometric approach which focuses on the repercussions of RER volatility will exploit cross-country variations for firm exports accounting for these common specificities through time fixed effects.

We expect a negative impact of exchange rate volatility on trade through an increase in the variable and sunk costs of exporting. The former effect is implicitly addressed in Ethier (1973), and is the most intuitive one: exchange rate risk creates an uncertainty for the exporter's earnings in its own currency, which is similar to an increase in variable costs. But exchange rate volatility may also increase the sunk costs of exports, which can be seen as a form of investment in intangible capital. In practice, most investment expenditures are at least in part irreversible, i.e. made of sunk costs that cannot be recovered if market conditions turn out to be worse than expected. The combination of investment irreversibility and asymmetric adjustment costs induces a negative relationship between price volatility and investment (Pindyck 1988, 1991), especially in developing economies (see Pindyck and Solimano, 1993). In such a context, high volatility has consistently proved to reduce growth and investment, especially private investment (Ramey and Ramey, 1995, based on the volatility of output growth; Aizenman and Marion, 1999, focusing on RER volatility; Schnabl, 2007, who relies on nominal exchange rate volatility). Bloom et al. (2007) find similar results within a firm-level framework with partial irreversibility: higher uncertainty reduces the responsiveness of investment to a firm-level demand shock.

It is however only recently that the macro literature explicitly identified a relationship between credit constraints and the size of the impact of volatility. Aghion et al. (2009) show

[3]In any case, our results are unchanged when excluding the years 2005 and 2006. More details on this robustness check available upon request.

that the local financial development plays a key role in the magnitude of the repercussions linked to the exchange rate volatility. Relying on a panel of 83 countries over the 1960-2000 period, they show that the negative impact of RER volatility on productivity growth decreases with a country's financial development. Within an identical framework, but focusing on foreign currency (Dollar) liabilities, Benhima (2012) shows over a panel of 76 emerging and industrial countries between 1995 and 2004 that the higher the share of foreign currency in external debt, the more detrimental to growth RER volatility is. This tends to support the idea that the effect of RER volatility depends critically on the existence of credit constraints.

The link between volatility and export performance has been mostly investigated using macro, and less frequently, disaggregated data at the sectoral level.[4] Some papers do look at the impact of the RER on exporting firms (e. g., Berman et al., 2012, on France; Li et al., 2012, and Park et al., 2010, on China), but they focus on the impact of the exchange rate level rather than its volatility, and they do not account for the role of financial constraints. Firm-level studies of the impact of exchange rate volatility on economic or trade performance for developing countries are scarce. Carranza et al. (2003) find a negative impact of RER volatility on a sample of 163 Peruvian firms; Cheung and Sengupta (2012) 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. When coming to the role of credit constraints in modelling the impact of RER volatility, especially on export performance, research is almost nonexistent. To our knowledge, Caglayan and Demir (2012) is the only firm-level study connecting firm productivity, RER movements and the issue of access to external finance. Based on a data set of 1,000 private Turkish firms, their results support a negative impact of exchange rate volatility on productivity growth which is downplayed by a better access to external finance. We depart from these previous works by using a much wider data set of firms, by looking at whether firms move their exports away from partners characterized by higher exchange rate volatility, and more importantly, by investigating the presence of a non-linear effect of exchange rate volatility on performance depending on the level of financial constraints, in the Chinese context. The latter is apprehended through two complementary dimensions. First, we infer firm-level financial vulnerability from the financial dependence of their activities. This approach was pioneered by Rajan and Zingales (1998) and has proved to be a robust methodology to detect

[4]Some papers look at the impact of RER variations on Chinese trade, including: Marquez and Schindler (2007), Ahmed (2009), Freund et al. (2011) and Cheung et al. (2012).

credit constraints and assess their evolution (Kroszner et al., 2006, and Manova et al., 2011). Second, we exploit Chinese cross-provincial heterogeneity to study how financial development may mitigate both credit constraints and exchange rate volatility.

This paper contributes to the existing literature on various levels. First, we provide a micro-founded investigation of Aghion et al. (2009)'s prediction that exchange rate volatility is especially harmful to firms that have high liquidity needs when local financial development is low. Second, our methodology allows to circumvent a number of endogeneity problems which may have flawed some of the related studies. Indeed, the use of firm-level data mitigates the issue of reverse causality from trade to exchange rate volatility (cf. Broda and Romalis, 2010), and the well-known simultaneity bias between exporting behavior and financial proxies for credit constraints at the firm-level. It is very unlikely that a Chinese firm shock impacts exchange rate volatility or measures of financial dependence based on data from US firms. Besides, using cross-regional data within a single country instead of cross-country data makes the risk of confusion between financial development and other macro characteristics less severe. Third, our results give insight into what the main sources of the apparent lack of macro impact of exchange rate volatility could be: the level of financial constraints and financial development appears indeed more important than the aggregation bias to explain this puzzle. We find that the repercussions of RER volatility are not unconditional even at the micro level, and are mainly related to financial factors.

Our results are consistent with the aforementioned macro studies, especially Aghion et al. (2009): both the decision to start exporting and exported value decrease for destinations with higher exchange rate volatility. This export-deterring effect is magnified for financially vulnerable firms: for those most dependent on external finance, a 10% increase in RER volatility decreases the value exported by 14%, and the probability of entering by 3%. As expected, financial development seems to dampen this negative impact, especially on the intensive margin of export. These results are robust to various definitions of trade margins, measures of exchange rate volatility and financial dependence, subsamples, and to the inclusion of additional controls. We therefore provide micro support to the macro literature which points at financial development as a key determinant in identifying the impact of RER volatility on real outcomes.

In the next section, we survey the different theoretical mechanisms underlying our approach, before discussing our general methodology and presenting our database in section 3. In section 4, we start by presenting the results on the intensive margin, then on the extensive margin, before introducing some robustness checks and a general discussion of our findings. Section 5

concludes.

2 Exchange Rate Volatility, Financial Constraints and Exports: Theoretical Underpinnings

Our approach stands at the crossroads of two strands of the literature. Firstly, there is a rapidly increasing number of papers dealing with the behavior of firms which manufacture and export several products to several destinations. It is now 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 (Bernard et al., 2011; Eckel et al., 2011). Bernard et al. (2011) show that the proportion of multi-product firms that export, the number of destinations for each product, and the range of products they export to each market all increase in response to reduced variable trade costs. Even closer to our work is Berthou and Fontagné (2013), who 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 heterogeneous trade creation effect across euro area destinations: for those firms exporting to destinations characterized by lower monetary policy coordination (that is, higher exchange rate volatility) before 1999, exports grew by 12.8% following the introduction of the euro, with 20% of the effect being due to an increase in the number of products exported. By contrast, no effect arises regarding the decision to export. 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 did more than offset the benefits of zero volatility.

Secondly, there is growing empirical evidence that credit constraints impact exporting behavior (Manova, 2013; Greenaway et al., 2007; Berman and Héricourt, 2010; Minetti and Zhu, 2011). The first paper on this topic by Manova (2013) incorporates financial frictions into a heterogeneous-firm model, before bringing it to aggregate trade data. She finds that 20%-25% of the impact of credit constraints on trade are driven by reductions in total (domestically sold and exported) output. Of the additional, trade-specific effect, one third reflects limited firm entry into exporting, while two thirds are due to contractions in the sales of exporters. Both extensive and intensive margins are therefore affected by credit constraints. All the papers since consistently find that the effect is magnified when firms belong to industries relying more on external finance (Minetti and Zhu, 2011), and in developing countries (Berman and Héricourt,

2010) compared to developed ones (Greenaway et al., 2007).

Our paper explores the possibility of a negative impact of exchange rate volatility on trade, proportionally stronger for financially vulnerable firms - and consequently weaker with high levels of financial development. This can be generated by several mechanisms. One can think of exchange rate risk creating uncertainty for the earnings of the exporter, which is equivalent to uncertainty on variable trade costs. The results by Bernard et al. (2011) and Berthou and Fontagné (2013) show that all trade margins are potentially concerned. The existence of well-developed financial markets should allow agents to hedge exchange rate risk, thus dampening or eliminating its negative effect on trade. This effect has not been clearly established, whether empirically (Dominguez and Tesar, 2001) or theoretically (Demers, 1991), so it is interesting to see if micro data help deliver clearer insights.

Another mechanism, which is more focused on the sunk costs of exports and therefore especially fitted for the decision to export to new markets, may also be at work. On the one hand, export capacity may indeed be considered as a type of investment in intangible capital (like R&D); on the other hand, exchange rate movements themselves 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. But once these investments are made, it will be impossible to back out and recover what they cost, even in the case of an abrupt subsequent currency appreciation. If firms are credit constrained, they will face additional difficulties to fund new investments, and will be even more reluctant to take the chance to engage in exports to markets characterized by highly volatile exchange rates.

Several approaches may theoretically rationalize this mechanism. In Aizenman and Marion (1999), the introduction of credit rationing leads to a nonlinearity in the intertemporal budget constraint. In their framework, the supply of credit facing a developing country is bounded by a credit ceiling, independently from the level of demand. The credit ceiling hampers the expansion of investment in the high-demand state, without moderating the drop in investment in the low-demand state. Thus, this asymmetric pattern implies that higher volatility reduces the average rate of investment, and that this effect is magnified with credit constraints. An alternative mechanism is proposed in Aghion et al. (2009). Suppose an exporter faces fixed wage costs in the local currency. When the bilateral exchange rate vis-à-vis that of the exporting

market fluctuates, the exporter cannot completely pass the cost change through to the exporting market, because of competitive pressures, for example. Then, exchange rate volatility leads to fluctuations in profits, which can lower investments in an environment where external finance is more costly than internal finance. Then, following an exchange rate appreciation, the current earnings of firms decline. This reduces their ability to borrow in order to survive idiosyncratic liquidity shocks and thereby invest in the longer term. Depreciations have the opposite effect. However, the existence of a credit constraint implies that in general the positive effects of a depreciation will not fully compensate for the negative effects of an appreciation. By reducing the cost of external finance, financial development relaxes credit constraints and consequently should decrease the impact of volatility on the sunk cost activity, in our case exports.

We can summarize the testable predictions from these models for export performance, that is both the intensive (the export value) and the extensive (decision to start exporting) margin:

Testable Prediction 1. *Export performance decreases with exchange rate volatility. We therefore expect the link between volatility on the one hand and the exported value and the decision to start exporting to a market on the other hand, to be negative.*

Testable Prediction 2. *The negative impact of exchange rate volatility on export performance is magnified for financially vulnerable firms: export performance is disproportionately decreased by exchange rate volatility for those firms.*

Testable Prediction 3. *By relaxing credit constraints, financial development decreases the impact of exchange rate volatility on export performance, proportionally more for financially vulnerable firms.*

3 Data Sources and Empirical Methodology

3.1 Exchange Rate Volatility

Exchange rate volatility is computed as the yearly standard deviation of monthly log differences in the real exchange rate. Since we rely on an indirect quotation (that is, one unit of foreign currency equals X units of Yuan), we compute the real exchange rate as the nominal exchange rate of the Yuan with respect to the partner's currency multiplied by the partner's consumer price (CPI) level.[5] We hence do not divide by Chinese prices, because of the likely mediocre

[5]Monthly data on nominal exchange rates and prices are taken from the International Financial Statistics (IFS).

quality of Chinese CPI, which would bring useless additional noise in the estimates. Since our empirical specification will include year dummies (see section 3.4. "Empirical Specification" below), the impact on our estimates should be negligible: the Chinese CPI being common to all exporters, most of its variance is absorbed in these time fixed effects.

In order to make sure that our results are not dependent on a specific definition of volatility, we performed several robustness checks where alternative definitions of the exchange rate are used to build our volatility indicator (still using yearly standard deviation of monthly log differences): the nominal exchange rate, the real exchange rate computed as the nominal exchange rate of the Yuan with respect to the partner's currency multiplied by the partner's CPI and divided by Chinese CPI or the HP (Hodrick and Prescott, 1997) detrended real exchange rate. Finally, we also consider a specification where the standard deviation of the log-level of the real exchange rate is considered, instead of our benchmark measure of volatility.[6]

Since our empirical specification will include firm-destination fixed effects so as to mitigate endogeneity issue, the repercussions of RER volatility on firm export performance will be identified from the variation within a firm-destination over time. Our results will hence reflect how firms allocate resources to a given market over time. In unreported checks available upon request we verified that our findings are not sensitive to the source of variation we exploit for the RER volatility. When estimating a specification that concentrates on the variation across countries, we find that RER volatility is a significant determinant of how firms allocate resources across markets. We obtain a negative effect of RER volatility that is magnified for financially vulnerable firms.

3.2 Trade Data

The main data source is a database collected by the Chinese Customs. It contains Chinese firm-level yearly export flows by year, HS6 product and destination country, over the 2000-2006 period. It covers 113,368 exporting firms and 158 destinations.

3.3 Financial Vulnerability and Financial Development

We compute the firm-level financial vulnerability as the weighted average of the financial vulnerability of its activities, with the weights being the average share of the sector in the exports

[6]Our specification assumes that firms respond rather quickly to changes in RER volatility. This is consistent with the unreported results available upon request that indicate that when introducing both the contemporaneous volatility and the one-year lagged volatility to explain export decisions, the former is associated with greater statistical significance.

by the firm over our sample period.[7]

$$FinVuln^F = \sum_s \left(\frac{Exports_s^F}{\sum_s Exports_s^F} \times FinVuln_s \right) \quad (1)$$

We use three different measures of the financial vulnerability of a sector $FinVuln_s$, in line with other studies on the same topic. These variables are meant to capture the technological characteristics of each sector which are exogenous to the financial environment of firms, and determine the degree of reliance of the firms in each sector on external finance. While firms in all industries may face liquidity constraints, there are systematic differences across sectors in the relative importance of up-front costs and the lag between the time when production expenses are incurred and revenues are realized. We capture these differences with a measure of the external finance dependence in a sector (referred to hereafter as "financial dependence"), constructed as the share of capital expenditures not financed out of cash flows from operations. For robustness, we also use an indicator of the asset intangibility of firms. This measure is the ratio of intangible assets to fixed assets. It thus captures another dimension of the dependence of a firm on access to external financing: the difficulty to use assets as collateral in obtaining financing. As a third indicator, we follow Manova et al. (2011) who use the share of R&D spending in total sales (R&D), based on the fact that as a long-term investment, research and development often implies greater reliance on external finance.

As is standard practice in the literature, these indicators are computed using data on all publicly traded US-based companies from Compustat's annual industrial files; the value of the indicator in each sector is obtained as the median value among all firms in each sector. Indicators of the financial vulnerability of a sector are available for 27 3-digit ISIC sectors.[8] We borrow the values computed from Kroszner et al. (2006). As explained in Manova et al. (2011), the use of US data is not only motivated by the lack of data for most other countries, including China, but it has several advantages. Rajan and Zingales (1998) have pointed out that the United States has one of the most advanced and sophisticated financial systems, so that the values for US firms reflect the technology-specific component of external finance needs, or what can be called the finance content of an industry. It is likely that measuring these indices in the

[7] In unreported results available upon request, we verify that our results hold when measuring the financial vulnerability of a firm as the financial vulnerability of its main (ISIC) sector of activity, identified as the one with the greatest export share over the period. Also our findings remain when the main sector of activity or the weights are based on the first year for which the firm reports exports instead of the average over 2000-2006.

[8] We use a correspondence table between the international trade nomenclatures and the ISIC Rev. 2 categories, developed at the CEPII to match the Chinese HS 6-digit product codes with the ISIC 3-digit sector categories.

Chinese context would lead to different values, reflecting the fact that firms organize production differently in a credit-constrained environment. Thus, such measures would be endogenous to financial development in China, whereas measures based on data from US firms can be seen as exogenous in this respect.

In addition to these firm-sector indicators of financial vulnerability, we also use the level of financial development at the regional level. We thus adapt the methodology first used in Rajan and Zingales (1998), which consists in filtering the impact of financial liberalization by the financial vulnerability, in order to isolate its direct finance-related causal effect. We measure local financial development as the share of total credit over GDP in the province.[9]

Finally, descriptive statistics of key variables are given in Tables 1 and 2 below.

Table 1: Summary Statistics: Key Variables

Variable	Mean	Std. Dev.	Min	Max
Firm-country export value (million US $)	0.75	11.9	0.1	7,440
Nb of products exported (firm-country)	4.66	13.95	1	1329
RER volatility	0.02	0.02	.01	0.44
GDP (trillion US $)	1.54	2.98	0.1	13.7
Price index (effective exchange rate)	234.4	309.8	0.003	3549
Country-sector imports (billion US $)	14.0	28.8	0.01	271
External dependence	.37	.26	-0.45	1.14
Intangibility	0.08	0.05	0	0.43
R&D	0.02	0.02	0	0.09
Financial development (total credit/GDP, %)	1.14	0.47	0.58	3.31
Export start dummy (firm-country)	0.226	0.42	0	1

Notes: The summary statistics are computed on the 3,731,351 firm-country-year observations that make up our final regression sample used in Table 3 to study the intensive margin. The only exception is the statistics for the start dummy which is computed for the sample (8,801,335 observations) used in Table 7.

Table 2: Descriptive Statistics for Financial Vulnerability Indicators

Distribution	External dependence	Intangibility	R&D
5%	0.01	0.01	0.004
10%	0.061	0.019	0.009
50%	0.326	0.074	0.019
90%	0.770	0.149	0.065
95%	0.838	0.160	0.070

Notes: The summary statistics are computed on the 3,731,351 firm-country-year observations that make up our final regression sample used in Table 3 to study the intensive margin.

[9]In robustness checks, we verified that our results were similar when using the ratio of deposits over GDP.

3.4 Empirical Specification

We estimate the following specification:

$$\begin{aligned} \text{ExportPerf}_{ijt}^{F} &= \alpha\ \text{RERVolatility}_{jt} + \beta\ \text{RERVolatility}_{jt} \times \text{FinVuln}^{F} \\ &+ \gamma\ \text{RERVolatility}_{jt} \times \text{FinDev}_{jt} + \delta\ \text{RERVolatility}_{jt} \times \text{FinVuln}^{F} \times \text{FinDev}_{it} \\ &+ \tau\ \text{FinVuln}^{F} \times \text{FinDev}_{it} + \eta\ \text{FinDev}_{it} + \phi Z_{jt} + \lambda_{j}^{F} + \theta_{t} + \epsilon_{ijt}^{F} \end{aligned} \tag{2}$$

where $\text{ExportPerf}_{ijt}^{F}$ is a measure of the export performance of firm F in province i for export destination j in year t. We use two alternative measures of export performance capturing the intensive and extensive margin of exports respectively, the log of the total free-on-board export sales towards destination j in year t, and the decision to start exporting to market j in year t. The later is constructed as a change of export status at the firm-country level, since it takes the value 1 when a firm exports to country j at time t whereas it did not at time $t-1$.[10]

Our regressions (performed with the linear within estimator for the intensive margin, and the conditional logit model for the extensive margin) include firm-country fixed effects λ_{j}^{F} and year dummies θ_{t}. Firm fixed effects capture the impact of local endowments and of sector-specific characteristics (including financial vulnerability). Our conditioning set Z is made of destination-year specific variables. In standard models of international trade, exports depend on the destination country's market size and price index. We use country j's GDP[11] and effective real exchange rate.[12] We also account for country j's demand for goods of the main sector of the firms (identified as the one with the highest export share over the period). We use the log of the total import value for the country-sector in the year taken from BACI.[13]

We first focus on the unconditional effect of volatility on export performance, i.e. on a benchmark specification with β restricted to 0. Consistently with prediction 1 from section 2, we expect therefore α to be negative. In a second step, we condition the impact of volatility on the financial vulnerability of a firm by introducing an interaction term between these two variables: prediction 2 leads to expect β to be negative. Note that the financial vulnerability

[10] In that set of regressions our sample consists of firm-country series of zeros followed by a decision to start exporting.

[11] GDP data come from the World Development Indicators.

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

[13] This data set, which is constructed using COMTRADE original data, provides bilateral trade flows at the product level (Gaulier and Zignago, 2010). BACI is downloadable from http://www.cepii.fr/anglaisgraph/bdd/baci.htm. Trade flows are aggregated up to the 27 3-digit ISIC sectors for which our indicators of the financial vulnerability of a sector are available.

variable alone does not appear, since it is captured by the firm-country fixed effects. We further modify our empirical specification in a third and final step to allow α and β to vary depending on the development of the local financial sector. In this case, our main parameters of interest are those on the double interaction between RER volatility and financial development (γ) and on the triple interaction between RER volatility, financial vulnerability and financial development (δ). Following prediction 3, both parameters should be positive.

Note also that the relative size and significance of α in comparison with the other parameters will give us interesting insight into the respective roles of the aforementioned aggregation bias and heterogeneity in terms of financial development. More precisely, a non-significant α compared to β, γ and δ will suggest that the impact of exchange rate volatility on exports is not unconditional, but emerges mainly because of the credit constraints of firms and low financial development.

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 province level[14] using the Froot (1989) correction.

4 Results

We study the joint effects of exchange rate volatility and financial constraints on both margins of trade, i.e. the size of exports by firm (the intensive margin) and the decision to start exporting (the extensive margin) separately.[15]

4.1 Intensive Margin

Table 3 presents the estimations of the impact of RER volatility on the value exported by firms. Column (1) reports the estimates of a specification based only on the two proxies for the destination countries' market size and price index (which are significant and display the expected positive signs), and column (2) investigates the unconditional relationship between RER volatility and export performance. Column (3) includes an alternative measure of market size, namely the country-sector imports, which appears positive and significant. The following columns add a variable interacting RER volatility with a measure of firm-level financial depen-

[14]Since the province level is the most aggregated one (i.e., with the smallest number of clusters) in our case, it gives the most possible conservative standard errors, and appears therefore as the safest choice we could make. Note that our results are mostly unchanged when standard errors are clustered at the destination country level.

[15]Robustness checks relying on alternative definitions for both margins are presented in the Appendix.

dence. Columns (2) and (3) show that exchange rate volatility appears negatively associated with export performance (i.e., the α parameter of Equation 2 is significant and negative).

We check the robustness of this negative relationship when volatility is computed based on the yearly standard deviation of monthly log differences of various definitions of the exchange rate. Results reported on Table 10 in the Appendix confirms that the unconditional impact of exchange rate volatility on the intensive margin is negative and significant (and quantitatively very close to our preferred definition of volatility), whether we consider a "full" RER where the Chinese CPI is introduced as the denominator (columns (1) and (2)), the nominal exchange rate (columns (3) and (4)), the log-level of RER (columns (5) and (6)) or the HP detrended version of our benchmark RER (columns (7) and (8)).[16]

Table 3: Intensive Margin, Exchange Rate Volatility and Financial Constraints

Dependent variable	Log Export value (firm-destination-year)					
	(1)	(2)	(3)	(4)	(5)	(6)
Financial indicator				Ext dep	Intang.	R&D
RER volatility (α)		-0.439^a	-0.305^a	0.402	0.123	0.153
		(0.119)	(0.106)	(0.246)	(0.183)	(0.172)
Ln country GDP	0.321^a	0.312^a	0.061	0.061	0.060	0.061
	(0.068)	(0.066)	(0.068)	(0.068)	(0.068)	(0.068)
Ln country price index	0.027^c	0.027^c	0.050^a	0.050^a	0.050^a	0.050^a
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Ln country-sector imports			0.357^a	0.356^a	0.357^a	0.356^a
			(0.014)	(0.014)	(0.014)	(0.014)
RER volatility $\times$ Fin. vulnerability (β)				-1.900^a	-5.686^a	-18.574^a
				(0.478)	(1.466)	(4.379)
Fixed effects	Firm-country and year					
R-squared	0.03	0.03	0.03	0.03	0.03	0.03
Observations	3,731,351					
Nb of firm-country pairs	1,128,873					

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Subsequent results suggest that the magnitude of this effect depends on the extent of the financial constraints. Indeed, columns (4) to (6) of Table 3 show that the interaction with financial vulnerability enters with a negative and significant coefficient, whatever the indicator of financial dependence used: external dependence in column (4), asset intangibility in column (5) and R&D intensity in column (6). Across our three indicators, we observe consistently that the negative impact of RER volatility on exports grows with financial vulnerability. These results suggest that the negative impact of exchange rate volatility on export performance is not unconditional, but is rather proportional to the degree of financial vulnerability.

These results are robust to various robustness checks. First, Table 10 also confirms an

[16]These results are also robust in specifications based on variables measured using two-year windows. This additional set of results is available upon request.

export-deterring effect of RER volatility that rises with financial vulnerability, whatever definition of volatility is used. Second, in unreported results available upon request, we check that the estimates of Equation 2 are robust to the inclusion of sector-year fixed effects, where the sector corresponds to the firm's main sector of activity, identified as the one with the greatest export share over the period. This allows to verify that although a large component of the variance in exchange rate volatility may be year-specific, our results do not solely reflect the sector-specific trends. The results are qualitatively identical.[17]

To illustrate these results, we can compare the decrease in the export performance due to RER volatility for firms at the 10^{th} and 90^{th} percentiles of the distribution of financial vulnerability. Table 2 above reports summary statistics on the distribution of the three indicators of financial vulnerability. Using coefficients from column (4) in Table 3 for the intensive margin, this means that, all things being equal, the effect of a 10% increase in RER volatility on export value is $0.1\times\ \alpha\ +\ 0.1\times\ \beta\ \times$ FinVuln. Hence, our results (α=0 and β=-1.90) suggest that the export value is reduced by 14 percent [-0.19 $\times$ 0.770] at the 90^{th} percentile of financial dependence and by 1.2 percent [-0.19 $\times$ 0.061] at the 10^{th} percentile.

In Table 4, we check the robustness of our results to the inclusion of additional controls. Financial vulnerability is measured using external dependence. The first five columns check that our measured impact of RER volatility does not simply capture the impact of the RER level. In column (1), the explanatory variables are restricted to RER volatility and RER level. Since 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, significant in both cases. The positive impact of the level of RER turns insignificant once in column 2 we adopt the benchmark specification from column (4) in Table 3 and add the macroeconomic variables for the destination country (GDP, import price, demand). In column (3), we add the interactive terms between financial vulnerability and both the level of RER and the volatility of RER. The former interactive term attracts a positive and significant coefficient. The reasoning is symmetrical to the one exposed concerning RER volatility: financially constrained firms disproportionately take advantage of a depreciating exchange rate. It however runs against findings in Desai et al. (2008) that suggest that lower financial constraints increase the ability of firms to expand activity during currency crises.

[17] In other unreported checks, we show that our results hold when adding interactions between year dummies and our proxy for financial vulnerability.

Table 4: Intensive Margin: Including RER in Level and Income Volatility

Dependent variable	Log Export value (firm-destination-year)									
Financial indicator	External dependence									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
RER volatility (α)	-0.636^a	-0.308^a	-0.036	0.399	0.223	-0.548^a	-0.238^c	0.272	0.520^c	0.504^c
	(0.151)	(0.103)	(0.255)	(0.243)	(0.217)	(0.184)	(0.125)	(0.314)	(0.282)	(0.278)
Ln country GDP		0.054		0.054	0.057		0.064		0.063	0.063
		(0.075)		(0.075)	(0.075)		(0.077)		(0.077)	(0.077)
Ln country price index		0.048^a		0.048^a	0.048^a		0.037^b		0.037^b	0.037^b
		(0.013)		(0.013)	(0.013)		(0.017)		(0.017)	(0.017)
Ln country-sector imports		0.357^a		0.356^a	0.355^a		0.407^a		0.406^a	0.406^a
		(0.014)		(0.014)	(0.014)		(0.017)		(0.017)	(0.017)
RER Volatility × Fin. vulnerability (β)			-1.612^a	-1.901^a	-1.427^a			-2.187^a	-2.025^a	-1.981^a
			(0.391)	(0.479)	(0.400)			(0.494)	(0.537)	(0.523)
Ln RER × Fin. vulnerability			0.477^a		0.465^a					
			(0.137)		(0.141)					
Ln RER	0.316^a	0.013	0.142^c	0.014	-0.158^a					
	(0.037)	(0.020)	(0.081)	(0.020)	(0.046)					
GDP volatility						-2.453^a	-1.721^a	-2.004^a	-1.721^a	-1.338^a
						(0.226)	(0.234)	(0.303)	(0.234)	(0.316)
GDP Volatility × Fin. vulnerability								-1.232^b		-1.057^c
								(0.532)		(0.565)
Fixed Effects	Firm-country and year									
R-squared	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03	0.03
Observations	3,731,351					3,158,760				
Number of firm-country pairs	1,128,873					952,132				

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Our results in columns (3) to (5) confirm that including the level of RER does not affect our main result of a negative β. In the remaining columns (6 to 10), we verify that RER volatility does not act as a mere proxy for economic fluctuations. We look at the repercussions of the volatility of the partner's GDP. It is computed as the standard deviation of year-to-year changes in quarterly GDP taken from the IFS. As argued by Baum et al. (2004) and Grier and Smallwood (2007), foreign income uncertainty may equally matter for trade. Consistently with their findings, GDP volatility enters with a negative sign: income volatility has a significant deterrent effect on the value exported. This inclusion does not however affect our benchmark result of a negative impact of RER volatility that grows with financial vulnerability. In columns (8) and (10), we further include the interactive term between GDP volatility and financial dependence. In column (10), it is significant only at the 10% level (the negative impact of income volatility seems to vary, but only weakly, with the level of credit constraints for a firm), while our main message on the impact of RER volatility is not altered: the interaction between RER volatility and financial dependence remains negative and significant.

Table 5 verifies that our results are robust to various changes in the sample. Here again, financial vulnerability is measured using external dependence. Column (1) restricts the sample to firms exporting to more than one country while column (2) concentrates on multi-product firms. The point estimates are virtually unaffected. In column (3), we exclude observations for Macao and Hong Kong since we are concerned that RER volatility may have different implications in the case of these two "Greater China" territories than in that of other international partners. Once again, the negative coefficient on the interactive term between RER volatility and financial vulnerability remains. In columns (4) to (7), we investigate whether our results vary across firm-level productivity, proxied as the number of products or the number of product-country pairs that a firm exports. This is done by regressing our main specification on subsamples divided around the median of our productivity proxies. Our main findings remain unchanged in all specifications, indicating that they apply to both low and high productivity firms.

We now ask whether recent developments in China's financial system have helped to reduce the export losses from real exchange rate uncertainty. As previously mentioned, Aghion et al. (2009) suggest that the effect of RER volatility depends critically on the level of local financial development. We modify our empirical specification to allow β in Equation 2 to vary depending on the development of the local financial sector.

Table 5: Intensive Margin: Controlling for Various Subsamples

Dependent variable	Log Export Value (firm-destination-year)						
Financial indicator	External dependence						
	(1) Country Nb>1	(2) Product Nb>1	(3) No HK or Macao	(4) High Nb products	(5) Low Nb products	(6) High Nb prod-dest	(7) Low Nb prod-dest
RER volatility (α)	0.384	0.359	0.435^{c}	0.799^{c}	0.179	0.507	0.391
	(0.244)	(0.270)	(0.228)	(0.394)	(0.204)	(0.336)	(0.250)
Ln country GDP	0.051	0.101^{c}	0.031	0.170^{b}	0.004	0.201^{a}	0.057
	(0.064)	(0.058)	(0.079)	(0.066)	(0.085)	(0.071)	(0.068)
Ln country price index	0.048^{a}	0.035^{b}	0.032^{b}	0.040^{b}	0.056^{a}	0.043^{b}	0.048^{a}
	(0.015)	(0.014)	(0.013)	(0.017)	(0.014)	(0.018)	(0.015)
Ln country-sector imports	0.355^{a}	0.333^{a}	0.342^{a}	0.312^{a}	0.409^{a}	0.313^{a}	0.355^{a}
	(0.013)	(0.013)	(0.015)	(0.013)	(0.020)	(0.012)	(0.014)
RER volatility $\times$	-1.866^{a}	-1.722^{a}	-1.921^{a}	-3.314^{a}	-0.968^{b}	-2.545^{a}	-1.892^{a}
Fin. vulnerability (β)	(0.467)	(0.602)	(0.466)	(0.927)	(0.382)	(0.722)	(0.478)
Fixed effects	Firm-country and year						
R-squared	0.03	0.04	0.03	0.02	0.04	0.03	0.03
Observations	3,659,052	2,019,033	3,472,215	1,836,309	1,895,042	1,862,175	3,719,937
Number of firm-country pairs	1,106,403	781,138	1,059,036	532,927	595,946	527,300	1,128,139

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Our main parameter of interest is that on the triple interaction between RER volatility, financial vulnerability and financial development (δ in Equation 2). We first split the provinces into two groups depending on whether their financial development is below or above the national median or the national mean in 2000 (the initial year of our sample). The corresponding results are reported in columns (1) and (2) of Table 6. The positive coefficient attracted by the interactive terms between RER volatility and financial vulnerability in the case of provinces which are highly developed financially indicate that the negative effect of RER volatility on the export value of firms is less present when credit is abundant. In the following columns, we use the time-varying proxy for financial development and interact it directly with RER volatility and financial dependence; the interaction between local financial development and financial dependence is also included. We also add the level of financial development and its interaction with RER volatility (the γ parameter) in columns (4) and (5). In column (5), we include province-year fixed effects to account for the time-varying characteristics of the local economy (including financial development, which drops as a consequence). In this way, any variable correlated with financial development which could impact the export performance of firms will be captured by these fixed effects, but should not affect our coefficients of interest (β, γ and δ), unless its effect runs through a financial channel.

Our results confirm our previously measured negative interaction between RER volatility and financial vulnerability, but suggest that the losses are mitigated by high local financial development. In all columns, we find that financial development dampens the negative impact of real exchange rate volatility on exports, the relaxation effect increasing with the level of sectoral financial dependence of firms: the triple interaction between RER, financial dependence and financial development is positive and significant. In other words, the positive offsetting effect of financial development on RER volatility is magnified by the financial constraints for firms. This result is in line with Aghion et al. (2009)'s observation that financial development reduces the magnitude of performance deterioration induced by RER volatility. Conversely, there is no evidence of an effect unconditional on financial constraints: the interaction between RER volatility and financial development (γ) is insignificant.

As an additional check, we verify in Table 12 in the Appendix that our main results hold when measuring the intensive margin based on the average export value for the firm-country pair, computed as the ratio of total export value over the number of products exported (expressed in natural logarithms). All our key results remain: the negative impact of RER volatility on the intensive margin increases with the credit constraints for firms, whatever definition of

Table 6: Intensive Margin: The Role of Financial Development

Dependent variable	Log Export value (firm-destination-year)				
Financial indicator	External dependence				
	(1)	(2)	(3)	(4)	(5)
RER volatility (α)	0.455^{c}	0.467^{c}	0.312	0.292	0.299
	(0.259)	(0.272)	(0.248)	(0.238)	(0.228)
Ln country GDP	0.059	0.059	0.057	0.059	0.049
	(0.069)	(0.069)	(0.068)	(0.068)	(0.069)
Ln country price index	0.050^{a}	0.050^{a}	0.050^{a}	0.049^{a}	0.050^{a}
	(0.014)	(0.014)	(0.014)	(0.014)	(0.015)
Ln country-sector imports	0.357^{a}	0.357^{a}	0.356^{a}	0.354^{a}	0.358^{a}
	(0.014)	(0.014)	(0.014)	(0.014)	(0.013)
RER Volatility × Fin. vulnerability (β)	-2.824^{a}	-2.875^{a}	-1.718^{a}	-1.622^{a}	-1.614^{a}
	(0.433)	(0.462)	(0.611)	(0.475)	(0.462)
RER Volatility × Financial vulnerability×	2.062^{a}				
High Fin. Devt (above median)	(0.589)				
RER Volatility × Financial vulnerability×		2.177^{a}			
High Fin. Devt (above mean)		(0.568)			
RER Volatility × High Fin. Devt (above median)	-0.015				
	(0.271)				
RER Volatility × High Fin. Devt (above mean)		-0.047			
		(0.260)			
RER Volatility × Financial vulnerability×			7.069^{a}	3.034^{b}	2.878^{b}
Fin. Devt (δ)			(1.981)	(1.234)	(1.160)
RER Volatility × Fin. Devt (γ)			-2.170^{a}	-0.666	-0.770
			(0.658)	(0.457)	(0.572)
Financial vulnerability× Fin. Devt				0.263^{c}	0.260^{c}
				(0.146)	(0.138)
Financial Development			0.087	-0.016	
			(0.061)	(0.056)	
Province-year fixed effects	no	no	no	no	yes
Fixed effects	Firm-country and year				
R-squared	0.03	0.03	0.03	0.03	0.03
Observations	3,731,351				
Number of firm-country pairs	1,128,873				

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

financial vulnerability is used (columns (2) to (4)). Finally, the relaxing effect of financial development also persists (columns (5) to (8)), with an even stronger significance compared to our preferred specification.

4.2 Extensive Margin

In this section, we assess the joint effect of RER volatility and financial constraints on the extensive margin of trade, i.e. how they affect entry decisions. Columns (1) to (6) of Table 7 replicate Table 3, the explained variable being now the decision for a firm to start exporting to market j. It is constructed as a change of export status at the firm-country level, since it takes the value 1 when a firm exports to country j in year t whereas it did not in year $t-1$. Once again, the unconditional impact of RER volatility (α parameter) appears negative and significant (columns (2) and (3)), but adding interactive terms with each of our measures of firm-level financial dependence shows that the magnitude of this effect is conditioned most of the time by the extent of financial constraints (columns (4) to (6)): the β parameter appears negative and highly significant, α becoming insignificant except when the financial dependence indicator is the share of R&D spending in total sales. Quantitatively, the impact of an unconditional 10% increase in exchange rate volatility (α parameter in column (3)) decreases the probability to start exporting by 1.29%.[18] Similarly, if we distinguish between firms at the 10^{th} and 90^{th} percentiles of the distribution of financial vulnerability, we can compare the decrease in the extensive margin due to RER volatility conditioning on financial vulnerability. Using coefficients α=0 and β=-2.233 from column (4), this means that, all things being equal, the negative effect of an additional 10% in RER volatility on the probability of entering is -3% [(0.1 × -2.233× 0.77)× 0.226 × (1-0.226)] at the 90^{th} percentile of financial dependence, compared to -0.24% [(0.1 × -2.233× 0.061)× 0.226× (1-0.226)] at the 10^{th} percentile.

As before, we check in Table 11 in the Appendix the robustness of these results using the yearly standard deviation of monthly log differences from various definitions of the exchange rate (with the RER deflated by the Chinese CPI in columns (1) and (2), the NER in columns (3) and (4) and the HP-filtered RER in columns (7) and (8)).

[18] This figure is obtained from the derivative of the choice probabilities (Train, 2003). The change in the probability that a firm F will choose alternative X (start exporting) given a change in an observed factor $Z_{F,X}$ entering the representative utility of that alternative (and holding the representative utility of other alternatives (no exporting) constant) is $\beta_Z \times P_{F,X}(1-P_{F,X})$, with $P_{F,X}$ being the average probability that firm i will choose alternative X (start exporting). Based on an average probability to start exporting of 22.6%, our estimates suggest that the derivative of starting exporting with respect to an additional 10% in RER volatility is -1.29%= 0.1 × -0.735 × 0.226 × (1-0.226).

Table 7: Extensive Margin, Exchange Rate Volatility and Financial Constraints

Dependent variable	$Pr(X^F_{i,j,t} > 0 \mid X^F_{i,j,t-1} = 0)$									
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Financial indicator				Ext dep	Intang.	R&D	External dependence			
RER volatility (α)		-0.864^a	-0.735^a	0.094	0.019	-0.454^a	-0.779^a	-0.197	-0.702^a	0.024
		(0.099)	(0.080)	(0.226)	(0.190)	(0.153)	(0.079)	(0.209)	(0.130)	(0.230)
Ln country GDP	0.072	0.051	-0.219^a	-0.218^a	-0.220^a	-0.219^a	-0.267^a	-0.237^a	-0.252^a	-0.252^a
	(0.055)	(0.055)	(0.057)	(0.057)	(0.057)	(0.057)	(0.070)	(0.072)	(0.072)	(0.072)
Ln country price index	0.099^a	0.102^a	0.125^a	0.124^a	0.125^a	0.124^a	0.109^a	0.108^a	0.077^a	0.077^a
	(0.020)	(0.020)	(0.021)	(0.021)	(0.021)	(0.021)	(0.019)	(0.019)	(0.029)	(0.029)
Ln country-sector imports			0.379^a	0.378^a	0.379^a	0.379^a	0.379^a	0.372^a	0.395^a	0.394^a
			(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.053)	(0.053)
RER volatility × Fin. vulnerability (β)				-2.233^a	-9.852^a	-11.731^a		-1.462^a		-1.923^a
				(0.431)	(1.973)	(3.612)		(0.374)		(0.370)
Ln RER × Fin. vulnerability								1.252^a		
								(0.231)		
Ln RER							0.101^a	-0.377^a		
							(0.036)	(0.100)		
GDP volatility									0.076	0.950^c
									(0.193)	(0.574)
GDP volatility × Fin. vulnerability										-2.433^b
										(1.178)
Fixed effects	Firm-country and year									
Pseudo-R-squared	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20	0.20
Observations	8,801,335						8,801,335		6,996,782	
Nb of firm-country pairs	1,867,840						1,867,840		1,492,028	

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at province level; ^{a}, ^{b} and ^{c} denote respectively significance at the 1, 5 and 10% levels.

In columns (5) and (6) we verify that similar qualitative results are obtained when volatility is computed as the yearly standard deviations of the log-level of RER. In unreported additional checks, we show that our results also hold when adding interactions between year dummies and our proxies for financial vulnerability.[19] Overall, the negative impact of RER volatility on the probability to start exporting is magnified by financial vulnerability. In columns ((7) to (10)) of Table 7, we check as before the robustness of our results to the inclusion of additional macro controls, namely the log of RER and GDP volatility. The RER level enters positively and significantly (column (7)), and its interaction with financial vulnerability is also positive and significant (column (8)): financially constrained firms disproportionately take advantage of a depreciating exchange rate to enter the export market. In columns (9) and (10), GDP volatility fails to enter significantly, but its interaction with financial dependence is negative and significant: financially constrained firms are more harmed by the instability of foreign demand. In any case, these additional estimates do not affect our benchmark result of a negative impact of RER volatility that grows with financial vulnerability.

Table 8 checks the robustness of these results across various subsamples, financial vulnerability still being measured using external dependence. The results are unchanged for multi-destination (column (1)) and multi-product (column(2)) firms, as well as when observations for Macao and Hong Kong are excluded (column (3)): the β parameter remains negative and significant, and entry on the export market is still disproportionately more harmed by exchange rate volatility in the case of financially constrained firms. This result also holds when we divide the sample around the median of our proxies for firm-level productivity, the number of products exported (columns (4) and (5)) or the number of product-destinations by firm (columns (6) and (7)). Interestingly, the unconditional impact of RER volatility on entry (coefficient α) also remains negative and significant for firms with a low number of products or a low number of product-destinations: the probability to start exporting of low-diversified firms is also harmed by RER volatility, even for a zero financial vulnerability.

[19] We were not able to implement regressions using sector-year dummies to control more systematically for sector-specific trends, the latter being too numerous to allow the maximization of the log-likelihood function.

Table 8: Extensive Margin: Controlling for Various Subsamples

Dependent variable	$Pr(X^F_{i,j,t} > 0 \mid X^F_{i,j,t-1} = 0)$						
Financial indicator	External dependence						
	(1) Country Nb>1	(2) Product Nb>1	(3) No HK or Macao	(4) High Nb products	(5) Low Nb products	(6) High Nb prod-dest	(7) Low Nb prod-dest
RER volatility (α)	-0.295	-0.067	-0.274	-0.145	-0.616^b	-0.137	-0.570^b
	(0.198)	(0.317)	(0.194)	(0.287)	(0.278)	(0.295)	(0.226)
Ln country GDP	0.297^a	0.308^a	0.305^a	0.352^a	0.475^a	0.444^a	0.413^a
	(0.052)	(0.049)	(0.077)	(0.070)	(0.053)	(0.076)	(0.040)
Ln country price index	0.064^a	0.063^a	0.056^a	0.054^a	0.020	0.043^a	0.028
	(0.014)	(0.016)	(0.012)	(0.016)	(0.019)	(0.012)	(0.020)
Ln country-sector imports	0.417^a	0.356^a	0.403^a	0.335^a	0.491^a	0.384^a	0.451^a
	(0.036)	(0.041)	(0.036)	(0.040)	(0.026)	(0.039)	(0.033)
RER volatility $\times$	-1.622^a	-2.086^b	-1.607^a	-1.904^a	-1.067^a	-2.041^a	-1.167^a
Fin. vulnerability (β)	(0.378)	(0.814)	(0.384)	(0.594)	(0.367)	(0.578)	(0.410)
Fixed effects	Firm-country and year						
Pseudo-R-squared	0.10	0.11	0.10	0.07	0.13	0.07	0.12
Observations	4,617,726	1,684,176	4,496,413	2,276,599	2,341,127	2,304,527	2,313,199
Number of firm-country pairs	1,193,670	489,613	1,159,777	559,590	634,080	546,015	647,655

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 9: Extensive Margin: The Role of Financial Development

Dependent variable	$Pr(X^F_{i,j,t} > 0 \mid X^F_{i,j,t-1} = 0)$			
Financial indicator	External dependence			
	(1)	(2)	(3)	(4)
RER volatility (α)	-0.506	-0.577	0.029	-0.067
	(0.466)	(0.492)	(0.232)	(0.215)
Ln country GDP	-0.225^a	-0.226^a	-0.222^a	-0.220^a
	(0.052)	(0.051)	(0.053)	(0.053)
Ln country price index	0.122^a	0.122^a	0.124^a	0.124^a
	(0.021)	(0.021)	(0.021)	(0.021)
Ln country-sector imports	0.380^a	0.380^a	0.379^a	0.375^a
	(0.032)	(0.032)	(0.033)	(0.032)
RER Volatility × Fin. vulnerability (β)	-4.762^a	-4.885^a	-2.137^a	-1.777^a
	(1.268)	(1.277)	(0.724)	(0.360)
RER Volatility × Financial vulnerability×	4.385^b			
High Fin. Devt (above median)	(2.060)			
RER Volatility × Financial vulnerability×		4.487^b		
High Fin. Devt (above mean)		(2.025)		
RER Volatility ×	1.556			
High Fin. Devt (above median)	(1.091)			
RER Volatility ×		1.633		
High Fin. Devt (above mean)		(1.087)		
RER Volatility × Financial vulnerability×			6.503^b	-0.072
Fin. Devt (δ)			(3.000)	(1.679)
RER Volatility × Fin. Devt (γ)			-0.866	1.552^c
			(0.981)	(0.813)
Financial vulnerability× Fin. Devt				0.590
				(0.383)
Financial Development			0.358	0.127
			(0.230)	(0.186)
Fixed effects	Firm-country and year			
Pseudo-R-squared	0.20	0.20	0.20	0.20
Observations	8,801,335			
Number of firm-country pairs	1,867,840			

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

We complete this overview by examining the impact of local financial development heterogeneity on these results. Once again, we measure local financial development as the share of total credit over GDP in the province, and we perform estimations replicating the ones presented in Table 6.[20] We find that the triple interaction between exchange rate volatility, financial dependence and financial development (the δ parameter) is positive and significant in most specifications, whether we consider groups above the national mean/median of financial development in 2000 (columns (1) and (2)) or use the time-varying proxy for financial development (column (3)): the entry into export markets of financially constrained firms is less hampered by RER volatility when financial development is high. However, in column (4), the

[20]However, we cannot provide estimations including province-year fixed effects: the maximization of the log-likelihood function proved to be impossible.

significance switches from the δ to the γ parameter: financial development still reduces the negative impact of RER volatility, but independently of the level of financial constraints for firms. Overall, the evidence seems less strong than for the intensive margin, but the presumption that financial development reduces the magnitude of performance deterioration induced by RER volatility remains, along the lines of Aghion et al. (2009).

We check how our results behave using the fact of simply *being* an exporter at the firm-destination-year level, instead of the decision to *start* exporting to a market, as the definition of the extensive margin: our dependent variable is therefore defined as a dummy variable taking the value 1 when a firm exports to country j at time t. Results which are still based on a conditional logit specification with firm-country fixed effects are reported in Table 13 in the Appendix. These results are qualitatively identical to the ones presented in Tables 7 and 9 above: we find some evidence of an unconditional negative impact of RER volatility (column (1)). This negative impact is once again magnified by firm-level financial dependence (columns (2) to (4)). Finally, there is still some evidence that financial development produces a significant relaxation effect in this context (columns (5) to (8)).

Finally, Table 14 in the Appendix reports the results of an alternative definition of the extensive margin, namely the (log) number of HS6 products shipped to a country, in the spirit of Manova et al. (2011). We still find a negative impact of RER volatility on export performance, which is magnified for financially vulnerable firms. The evidence is much weaker regarding the relaxing impact of financial development: the δ coefficient is correctly signed (positive), but fails to be significant.

4.3 Additional Robustness Tests and General Discussion

Our empirical work so far has exploited the variation in export performance over time and across destinations for firms of different sectors. Since a great proportion of the firms in our sample export goods to more than one ISIC 3-digit sector, in what follows we also use the variation across sectors, within firms. Our proxy for the intensive margin becomes the (log) export value of the firm for a given sector/country pair in a year. The extensive margin is defined as the (log) number of HS6 products for a given sector/country pair in a year. Otherwise identical to Equation 2, these regressions include firm-sector-country fixed effects, so that the coefficients are identified from the time-series variation within firm-sector-country triplets over time. Therefore, our estimates apprehend the way in which firms choose to allocate their limited financial resources in the various sector-country export markets in which they operate over time.

This ensures that our results are not driven by some endogenous sorting of single-sector firms into sectors and export markets for reasons other than credit constraints.[21] The results are reported in Tables 15 and 16, for the intensive and extensive margin respectively. In both cases, exchange rate volatility impacts export performance negatively, disproportionately more for financially vulnerable firms. There is still a relaxing impact of financial development for this specific definition of the intensive margin. However, no evidence of such an effect of financial development can be identified for the range of products exported.

In additional, unreported checks available upon request, we assess the robustness of our results to the exclusion of the USA as an export destination in the sample. This allows us to make sure that our results are not biased by the presence of the country toward which volatility is very reduced by construction during most of the period considered. Similarly, we perform additional estimates excluding the years 2005 and 2006 to verify that the switch from a pegging to the US Dollar only to a basket of several currencies in July 2005 does not impact our results. In both exercises, our results remain qualitatively identical.

Moreover, we verify that our results hold for exporters irrespective of their ownership structure (whether domestic or foreign) and irrespective of the export regime (whether ordinary or processing). We also perform estimations on a subsample excluding intermediary firms. Indeed, our measure of financial constraints may be less relevant for those firms which do not produce the goods they sell, since it is computed from information based on production technology. We follow Ahn et al.'s (2011) approach to identify them based on Chinese characters in the name of the firm which mean "importer", "exporter", and/or "trading" in English. [22] We also estimate specifications adding firm-country level imports from the countries where the firm is also exporting. In all these checks, once again, the negative impact of exchange rate volatility appears magnified for financially vulnerable firms, and relaxed by a high level of financial development.

Finally, we also verify that the differentiated impact of RER volatility depending on financial development does not simply reflect a correlation between financial development and trade costs. It could be that provinces with a more developed financial system also benefit from easier and cheaper international access: in this case, our results may rather identify an uncertainty related to distance. We replicate our benchmark result looking at the double interaction between RER volatility and financial dependence (column (4) of Tables 3 and 7) and the triple interaction

[21] In unreported results available upon request we verify that our main message holds when including both firm-sector-year fixed effects and country fixed effects, that is, when focusing on how firms allocate resources across countries for a given sector-year.

[22] In pinyin (Romanized Chinese), these phrases are: "jin4chu1kou3", "jing1mao4', "mao4yi4", "ke1mao4" and "wai4jing1".

depending on financial development (columns (3) and (4) of Tables 6 and 9) when adding interactive terms with three proxies for the geographical trade advantages that are coastal location, western location and distance to partner country[23], respectively. Our findings of a trade-deterring effect of RER volatility that is proportional to financial constraints and that is relaxed by financial development appear fully robust to these controls for geography.

Put together, Tables 3 to 9 shed new light on the joint role of exchange rate volatility and financial constraints on exporting behavior. Our results suggest that exchange rate volatility negatively impacts both the intensive (total value exported by firm and destination) and extensive (decision of a firm to start exporting to destination) margin, but that this impact is mainly conditioned on the extent of firm-level financial constraints. Our findings also support the idea that a higher financial development offsets this negative impact, both for the intensive margin and the probability of entering a new export market - but not for the range of products exported. Overall, these results give insight into what the main sources for the apparent lack of macro impact of exchange rate volatility could be: the level of financial constraints and financial development clearly dominate the aggregation bias hypothesis, since β and δ are regularly more significant than α. By doing so, we provide micro support to the macro literature pointing at financial development as a key determinant of the impact of RER volatility on real outcomes.

5 Conclusion

This paper relies on a firm-level database covering exporters from China to study how export performance is affected by real exchange rate volatility. Our empirical strategy investigates how RER volatility affects the extensive and intensive margins of firm-level exports to their international partners. The features of the Chinese exchange rate system that are common to all exporters and all destination markets such as limited convertibility and misalignment are controlled for through fixed effects. Our results suggest that even in the specific context of China's restricted and misaligned ER regime, volatility is a significant barrier to Chinese exporters' performance. We find a trade-deterring effect of RER volatility, which magnitude depends mainly on the extent of financial constraints. While firms tend to export less and to reduce their entry into destinations with higher exchange rate volatility, this negative effect is even stronger for financially vulnerable firms. Also, financial development appears to dampen this negative impact, especially on the intensive margin of export.

[23]We use GeoDist dataset (Mayer and Zignago, 2011), available at: http//www.cepii.fr/francgraph/bdd/distances.htm.

These results suggest that the development of credit markets would help firms to overcome the additional export (both variable and sunk) costs related to RER volatility. This could support the expansion of exports by firms, particularly to those destinations characterized by RER-related uncertainty. More generally, our study emphasizes that emerging countries should be careful when relaxing their exchange rate regime. Hard-fixed pegs for developing countries are certainly not always a panacea, but moving to a fully floating regime without the adequate level of financial development could also prove to be very hazardous for trade performance.

References

Aghion Philippe, Philippe Bacchetta, Romain Rancière and Kenneth Rogoff, 2009, "Exchange rate volatility and productivity growth : The role of financial development", *Journal of Monetary Economics*, 56, 494-513.

Ahmed, Shaghil, 2009, "Are Chinese Exports Sensitive to Changes in the Exchange Rate?" International Finance Discussion Papers 987. Board of Governors of the Federal Reserve System (U.S.).

Ahn JaeBin, Amit K. Khandelwal and Shang-Jin Wei, 2011, "The role of intermediaries in facilitating trade", *Journal of International Economics* 84, 73–85

Aizenman, Joshua and Nancy Marion, 1999, "Volatility and Investment: Interpreting Evidence from Developing Countries," *Economica*, London School of Economics and Political Science, vol. 66(262), May, pages 157-79.

Baum Christopher F., Mustafa Caglayan and Neslihan Ozkan, 2004, "Nonlinear effects of exchange rate volatility on the volume of bilateral exports," *Journal of Applied Econometrics*, vol. 19(1), pages 1-23.

Benhima Kenza, 2012, "Exchange Rate Volatility and Productivity Growth: The Role of Liability Dollarization", *Open Economies Review*, vol. 23(3), pages 501-529.

Berman Nicolas and Jérôme Héricourt, 2010, "Financial Factors and the Margins of Trade: Evidence from Cross-Country Firm-Level Data", *Journal of Development Economics* 93(2), pages 206-217.

Berman Nicolas, Philippe Martin and Thierry Mayer, 2012, "How do different exporters react to exchange rate changes? Theory, empirics and aggregate implications", *Quarterly Journal of Economics* 127(1): 437-492.

Bernard, A. B., Redding, S. J., and Schott, P. K., 2011, "Multiproduct Firms and Trade Liberalization,'", *The Quarterly Journal of Economics*, vol. 126(3), pages 1271-1318.

Berthou A., and L. Fontagné, 2013, "How do multi-product exporters react to a change in trade costs?", *Scandinavian Journal of Economics*, forthcoming.

Bloom Nick, Stephen Bond and John Van Reenen, 2007, "Uncertainty and Investment Dynamics", *Review of Economic Studies*, Wiley Blackwell, vol. 74(2), pages 391-415.

Broda Christian and John Romalis, 2010, "Identifying the Relationship Between Trade and Exchange Rate Volatility", NBER Chapters, in: Commodity Prices and Markets, East Asia Seminar on Economics, Volume 20, pages 79-110. National Bureau of Economic Research, Inc.

Byrne Joseph P., Fiess, Norbert and Ronald MacDonald, 2008, "US trade and exchange rate volatility: A real sectoral bilateral analysis," *Journal of Macroeconomics*, vol. 30(1), pages 238-259.

Caglayan Mustafa and Firat Demir, 2012, "Firm Productivity, Exchange Rate Movements, Sources of Finance and Export Orientation," MPRA Paper 37397, University Library of Munich, Germany.

Cheung Yin-Wong, Menzie D. Chinn and XingWang Qian, 2012. "Are Chinese Trade Flows Different?," NBER Working Papers 17875, National Bureau of Economic Research, Inc.

Cheung Yin-Wong and Rajeswari Sengupta, 2012. "Impact of exchange rate movements on exports: an analysis of Indian non-financial sector firms," MPRA Paper 43118, University Library of Munich, Germany.

Clark Peter, Natalia Tamirisa and Shang-Jin Wei, 2004, "A New Look at Exchange Rate Volatility and Trade Flows", IMF Occasional Paper #235, International Monetary Fund: Washington DC.

Demers, Michel, 1991, "Investment under Uncertainty, Irreversibility and the Arrival of Information over Time," *Review of Economic Studies*, Wiley Blackwell, vol. 58(2), pages 333-50, April.

Desai Mihir A., C. Fritz Foley and Kristin J. Forbes, 2008, "Financial Constraints and Growth: Multinational and Local Firm Responses to Currency Depreciations", *Review of Financial Studies*, 21 (6), p. 2857-2888.

Dominguez Kathryn M. E. and Linda L. Tesar, 2001. "A Reexamination of Exchange-Rate Exposure," *American Economic Review*, American Economic Association, vol. 91(2), pages 396-399.

Eaton, Johnathan, Kortum, Samuel, and Francis Kramarz, 2004. "Dissecting trade: Firms, industries, and export destinations," *American Economic Review*, 94(2), pages 150–154.

Eckel, C., Iacovone, L., Javorcik, B., and P. Neary, 2011, "Multi-product firms at home and away: Cost versus quality-based competence", CEPR Discussion Papers No. 8186.

Ethier, Wilfred, 1973. "International Trade and the Forward Exchange Market," *American Economic Review*, American Economic Association, vol. 63(3), pages 494-503.

Frankel, Jeffrey and Shang-Jin Wei, 2007, "Assessing China's Exchange Rate Regime", NBER Working Paper No. 13100.

Freund Caroline, Chang Hong and Shang-Jin Wei, 2011, "China Trade Response to Exchange Rate", mimeo.

Froot, Kenneth, 1989. "Consistent covariance matrix estimation with cross-sectional dependence and heteroskedasticity in financial data", Journal of Financial and Quantitative Analysis, vol. 24, pages 333–335.

Gaulier Guillaume and Soledad Zignago, 2010, "BACI: International Trade Database at the Product-Level. The 1994-2007 Version," Working Papers 2010-23, CEPII research center.

Greenaway, David. and Richard A. Kneller, 2007. "Firm heterogeneity, exporting and foreign direct investment", *Economic Journal*, 117(517), F134–F161

Hodrick, Robert and Prescott, Edward, 1997, "Post-war U.S. business cycles: An empirical investigation", *Journal of Money, Credit and Banking*, 29 (1), 1-16.

Kevin B. Grier and Aaron D. Smallwood, 2007. "Uncertainty and Export Performance: Evidence from 18 Countries," *Journal of Money, Credit and Banking*, Blackwell Publishing, vol. 39(4), pages 965-979, 06.

Kroszner, Randall, Laeven, Luc and Daniela Klingebiel, 2007, Banking Crises, Financial Dependence, and Growth, *Journal of Financial Economics* 84(1), 187-228.

Li Hongbin, Hong Ma, Yuan Xu and Yanyan Xiong, 2012, "How do exchange rate movements affect Chinese exports? A firm-level investigation", mimeo, School of Economics and Management, Tsinghua University.

Manova Kalina, Shang-Jin Wei and Zhiwei Zhang, 2011, "Firm exports and multinational activity under credit constraints", NBER Working Paper No. 16905. China.

Manova Kalina, 2013, "Credit Constraints, Heterogeneous Firms, and International Trade", *Review of Economic Studies*, forthcoming.

Marquez Jaime and John W. Schindler, 2007, "Exchange-rate Effects on China's Trade", *Review of International Economics*, 15, No. 5, pp. 837-853.

Mayer, Thierry and Soledad Zignago, 2011, "Notes on CEPII's Distances Measures : The GeoDist Database", CEPII working paper N 2011-25.

Minetti, Raoul and Zhu, Susan Chun, 2011, "Credit constraints and firm export: Microeconomic evidence from Italy," *Journal of International Economics*, vol. 83(2), pages 109-125.

Moulton, Brent R., 1990, "An illustration of a pitfall in estimating the effects of aggregate variables on micro unit", *The Review of Economics and Statistics* 72 (2), 334–338.

Park Albert, Dean Yang, Xinzheng Shi and Yuan Jiang, 2010, "Exporting and Firm Performance: Chinese Exporters and the Asian Financial Crisis," *The Review of Economics and Statistics*, MIT Press, vol. 92(4), pages 822-842, November.

Pindyck, Robert S., 1988, "Irreversible Investment, Capacity Choice, and the Value of the Firm," *American Economic Review*, 78 (5), 969-85.

Pindyck, Robert S., 1991, "Irreversibility, Uncertainty, and Investment," *Journal of Economic Literature*, American Economic Association, vol. 29(3), 1110-48.

Pindyck Robert S. and Andrés Solimano, 1993, "Economic Instability and Aggregate Investment," in: *NBER Macroeconomics Annual 1993*, vol. 8, pages 259-318 National Bureau of Economic Research, Inc.

Rajan, Raghuram G. and Luigi, Zingales, 1998, "Financial Dependence and Growth," *American Economic Review*, American Economic Association, vol. 88(3), pages 559-86, June.

Ramey, Garey and Valerie A. Ramey, 1995, "Cross-Country Evidence on the Link between Volatility and Growth", *American Economic Review*, American Economic Association, vol. 85(5), pages 1138-51, December.

Rose, Andrew, 2000, "One money, one market: the effect of common currencies on trade", *Economic Policy*, vol. 15(30), pages 7-45.

Schnabl Gunther, 2007, "Exchange rate volatility and growth in small open economies at the EMU periphery", European Central Bank working paper, 773.

Stiglitz, Joseph E. and Weiss, Andrew, 1981, "Credit Rationing in Markets with Imperfect Information," *American Economic Review*, American Economic Association, vol. 71(3), pages 393-410, June.

Train, Kenneth, 2003, *Discrete Choice Methods with Simulation.* Cambridge University Press: Cambridge.

Appendix

Table 10: Export Performance and Alternative Definitions of ER Volatility: Intensive Margin

Dependent variable	Log export value (firm-destination-year)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Volatility indicator	NER × $p_{jt}/p_{China,t}$		NER		Level RER		HP-filtered RER	
Financial indicator		Ext dep		Ext dep		Ext dep		Ext dep
Volatility (α)	-0.321^a	0.464	-0.332^a	0.378	-0.191^a	0.107	-0.210^a	-0.001
	(0.098)	(0.296)	(0.098)	(0.244)	(0.054)	(0.103)	(0.074)	(0.142)
Ln country GDP	0.061	0.061	0.060	0.060	0.062	0.062	0.131^b	0.063
	(0.068)	(0.068)	(0.068)	(0.068)	(0.069)	(0.069)	(0.056)	(0.070)
ln country price index	0.049^a	0.050^a	0.049^a	0.050^a	0.048^a	0.048^a	0.049^a	0.049^a
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Ln country-sector imports	0.357^a	0.356^a	0.357^a	0.356^a	0.357^a	0.356^a	0.348^a	0.357^a
	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)	(0.014)
Volatility ×		-2.111^a		-1.905^a		-0.806^a		-0.553^b
Fin. Vulnerability (β)		(0.647)		(0.492)		(0.207)		(0.203)
Fixed effects	Firm-country and year							
R-squared	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03
Observations	3,731,351							
Number of firm-country pairs	1,128,873							

Notes: Export performance is defined as the firm-country-level. NER: Nominal Exchange Rate. p_{jt}: partner's consumer price level. $p_{China,t}$: Chinese consumer price level. RER: Real Exchange Rate defined as the nominal exchange rate of the Yuan with respect to the partner's currency multiplied by the partner's consumer price level. Level RER: volatility is computed as the yearly standard deviations of the log level of RER. Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 11: Export Performance and Alternative Definitions of ER Volatility: Extensive Margin

Dependent variable	$Pr(X^F_{i,j,t} > 0 \mid X^F_{i,j,t-1} = 0)$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Volatility indicator	NER × $p_{jt}/p_{China,t}$		NER		Level RER		HP-filtered RER	
Financial indicator		Ext dep		Ext dep		Ext dep		Ext dep
Volatility (α)	-0.801^a	0.232	-0.754^a	0.078	-0.393^a	.174	-0.179^b	0.298
	(0.071)	(0.330)	(0.070)	(0.226)	(0.055)	(0.228)	(0.078)	(0.229)
Ln country GDP	-0.219^a	-0.218^a	-0.220^a	-0.219^a	-0.212^a	-0.212^a	-0.206^a	-0.207^a
	(0.057)	(0.057)	(0.057)	(0.057)	(0.056)	(0.056)	(0.056)	(0.056)
ln country price index	0.124^a	0.124^a	0.125^a	0.124^a	0.120^a	0.119^a	0.122^a	0.122^a
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)
Ln country-sector imports	0.379^a	0.378^a	0.379^a	0.378^a	0.380^a	0.379^a	0.381^a	0.381^a
	(0.033)	(0.033)	(0.033)	(0.033)	(0.033)	(0.032)	(0.032)	(0.032)
Volatility ×		-2.804^a		-2.243^a		-1.524^b		-1.323^c
Fin. Vulnerability (β)		(0.783)		(0.450)		(0.654)		(0.676)
Fixed effects	Firm-country and year							
Pseudo R-squared	0.03	0.03	0.03	0.03	0.03	0.04	0.03	0.03
Observations	3,731,351							
Number of firm-country pairs	1,128,873							

Notes: Export performance is defined as the firm-country-level. NER: Nominal Exchange Rate. p_{jt}: partner's consumer price level. $p_{China,t}$: Chinese consumer price level. RER: Real Exchange Rate defined as the nominal exchange rate of the Yuan with respect to the partner's currency multiplied by the partner's consumer price level. Level RER: volatility is computed as the yearly standard deviations of the log level of RER. Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 12: Firm-Country Export Performance and RER Volatility: Alternative Indicator of Intensive Margin

Dependent variable	Log average export value (firm-dest.-year)=total exp. value / Nb of exp. prod.							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial indicator		Ext dep	Intang.	R&D int	External dependence			
RER volatility (α)	-0.198^a	0.304^c	0.095	0.167	0.503^a	0.504^a	0.237	0.220
	(0.065)	(0.155)	(0.109)	(0.104)	(0.144)	(0.149)	(0.169)	(0.147)
Ln country GDP	-0.025	-0.025	-0.025	-0.025	-0.026	-0.026	-0.026	-0.025
	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)	(0.052)
Ln country price index	0.023^c	0.023^c	0.023^c	0.023^c	0.023^c	0.023^c	0.023^c	0.023^c
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
Ln country-sector imports	0.290^a	0.289^a	0.290^a	0.289^a	0.289^a	0.289^a	0.289^a	0.287^a
	(0.019)	(0.018)	(0.019)	(0.018)	(0.018)	(0.018)	(0.018)	(0.018)
RER Volatility × Fin. vulnerability (β)		-1.349^a	-3.890^a	-14.796^a	-2.181^a	-2.196^a	-1.215^b	-1.137^a
		(0.346)	(1.094)	(3.571)	(0.274)	(0.278)	(0.472)	(0.341)
RER Volatility × Financial vulnerability × High Fin. Devt (above median)					2.003^a			
					(0.702)			
RER Volatility × Financial vulnerability × High Fin. Devt (above mean)						2.020^a		
						(0.698)		
RER Volatility × High Fin. Devt (above median)					-0.484			
					(0.430)			
RER Volatility × High Fin. Devt (above mean)						-0.480		
						(0.434)		
RER Volatility × Financial vulnerability × Fin. Devt (δ)							6.061^a	2.743^a
							(1.695)	(0.827)
RER Volatility × Fin. Devt (γ)							-1.780^a	-0.543^c
							(0.639)	(0.311)
Financial vulnerability × Fin. Devt								0.216^c
								(0.125)
Financial Development							-0.004	-0.088^b
							(0.023)	(0.035)
Fixed effects	Firm-country and year							
R-squared	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Observations	3,731,351							
Number of firm-country pairs	1,128,873							

Notes:Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 13: Firm-Country Export Performance and RER Volatility: Alternative Indicator of Extensive Margin (I)

Dependent variable	$Pr(X^F_{i,j,t} > 0)$							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial indicator		Ext dep	Intang.	R&D int	External dependence			
RER volatility (α)	-0.638^a	0.517	0.154	-0.156	-0.347	-0.496	0.389	0.215
	(0.115)	(0.318)	(0.201)	(0.250)	(0.620)	(0.736)	(0.312)	(0.308)
Ln country GDP	0.249^a	0.249^a	0.248^a	0.249^a	0.236^a	0.233^a	0.237^a	0.241^a
	(0.056)	(0.056)	(0.056)	(0.056)	(0.053)	(0.053)	(0.051)	(0.051)
Ln country price index	0.045^a	0.045^a	0.046^a	0.045^a	0.044^a	0.044^a	0.045^a	0.045^a
	(0.017)	(0.017)	(0.017)	(0.017)	(0.016)	(0.016)	(0.017)	(0.017)
Ln country-sector imports	0.345^a	0.345^a	0.345^a	0.345^a	0.347^a	0.347^a	0.347^a	0.343^a
	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.024)	(0.023)	(0.023)
RER Volatility × Fin. vulnerability (β)		-3.169^a	-10.343^a	-20.378^a	-7.172^a	-7.683^a	-3.019^a	-2.330^a
		(0.624)	(1.700)	(6.387)	(1.692)	(1.670)	(1.044)	(0.481)
RER Volatility × Financial vulnerability × High Fin. Devt (above median)					6.456^a			
					(2.462)			
RER Volatility × Financial vulnerability × High Fin. Devt (above mean)						7.092^a		
						(2.262)		
RER Volatility × High Fin. Devt (above median)					2.307			
					(1.530)			
RER Volatility × High Fin. Devt (above mean)						2.357		
						(1.535)		
RER Volatility × Financial vulnerability × Fin. Devt (δ)							11.958^a	1.124
							(4.575)	(1.859)
RER Volatility × Fin. Devt (γ)							-2.324	1.576^c
							(1.418)	(0.831)
Financial vulnerability × Fin. Devt								0.856^c
								(0.474)
Financial Development							0.581	0.253
							(0.367)	(0.321)
Fixed effects	Firm-country and year							
Pseudo R-squared	0.12	0.12	0.12	0.12	0.12	0.12	0.12	0.12
Observations	15,070,749							
Number of firm-country pairs	2,179,037							

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 14: Firm-Country Export Performance and RER Volatility: Alternative Indicator of Extensive Margin (II)

Dependent variable	Log Nb of products exported (firm-destination-year)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial indicator		Ext dep	Intang.	R&D int	Ext dep			
RER volatility (α)	-0.106^{c}	0.098	0.029	-0.013	-0.048	-0.037	0.075	0.071
	(0.061)	(0.108)	(0.086)	(0.095)	(0.240)	(0.249)	(0.100)	(0.103)
Ln country GDP	0.086^{a}	0.086^{a}	0.086^{a}	0.086^{a}	0.085^{a}	0.085^{a}	0.083^{a}	0.084^{a}
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.020)	(0.020)
Ln country price index	0.026^{a}	0.026^{a}	0.026^{a}	0.026^{a}	0.026^{a}	0.026^{a}	0.026^{a}	0.026^{a}
	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
Ln country-sector imports	0.067^{a}	0.067^{a}	0.067^{a}	0.067^{a}	0.067^{a}	0.067^{a}	0.067^{a}	0.067^{a}
	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)	(0.012)
RER Volatility × Fin. vulnerability (β)		-0.551^{a}	-1.795^{a}	-3.778^{b}	-0.642^{a}	-0.679^{a}	-0.503^{a}	-0.486^{a}
		(0.162)	(0.611)	(1.754)	(0.219)	(0.244)	(0.164)	(0.153)
RER Volatility × Financial vulnerability×					0.059			
High Fin. Devt (above median)					(0.267)			
RER Volatility × Financial vulnerability×						0.157		
High Fin. Devt (above mean)						(0.282)		
RER Volatility ×					0.469			
High Fin. Devt (above median)					(0.560)			
RER Volatility ×						0.432		
High Fin. Devt (above mean)						(0.557)		
RER Volatility × Fin. vulnerability× Fin. Devt (δ)							1.008	0.291
							(0.651)	(0.520)
RER Volatility × Fin. Devt (γ)								0.047
								(0.031)
Financial vulnerability× Fin. Devt							-0.390	-0.123
							(0.269)	(0.256)
Financial Development							0.090^{c}	0.072
							(0.045)	(0.050)
Fixed effects	Firm-country and year							
R-squared	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Observations	3,731,351							
Number of firm-country pairs	1,128,873							

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 15: Firm-Sector-Country Export Performance and RER Volatility: Intensive Margin

Dependent variable	Log export value (firm-sector-destination-year)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial indicator		Ext dep	Intang.	R&D int	Ext dep			
RER volatility (α)	-0.246^b	0.433^c	0.029	0.207	0.484^b	0.521^b	0.321	0.335
	(0.100)	(0.213)	(0.174)	(0.177)	(0.224)	(0.244)	(0.205)	(0.204)
Ln country GDP	0.098	0.097	0.098	0.098	0.094	0.095	0.096	0.089
	(0.070)	(0.070)	(0.070)	(0.070)	(0.069)	(0.070)	(0.069)	(0.068)
Ln country price index	0.041^a	0.041^a	0.041^a	0.041^a	0.040^a	0.041^a	0.041^a	0.038^a
	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.011)	(0.013)
Ln country-sector imports	0.316^a	0.315^a	0.316^a	0.315^a	0.315^a	0.315^a	0.312^a	0.312^a
	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)	(0.013)
RER Volatility × Fin. vulnerability (β)		-1.828^a	-3.470^c	-18.719^a	-2.351^a	-2.773^a	-1.565^a	-1.594^a
		(0.464)	(1.719)	(5.282)	(0.474)	(0.445)	(0.415)	(0.419)
RER Volatility × Financial vulnerability ×					2.905^a			
High Fin. Devt (above median)					(0.823)			
RER Volatility × Financial vulnerability ×						2.062^b		
High Fin. Devt (above mean)						(0.782)		
RER Volatility ×					-0.465			
High Fin. Devt (above median)					(0.399)			
RER Volatility ×						-0.111		
High Fin. Devt (above mean)						(0.246)		
RER Volatility × Fin. vulnerability × Fin. Devt (δ)							2.607^b	2.569^b
							(1.080)	(1.049)
RER Volatility × Fin. Devt (γ)							-0.489	-0.614
							(0.484)	(0.561)
Financial vulnerability × Fin. Devt							0.316^c	0.309^c
							(0.177)	(0.168)
Financial Development							-0.074	
							(0.061)	
Fixed effects	Firm-sector-country and year							
Province-year fixed-effects	no	no	no	no	no	no	no	yes
R-squared	0.02	0.02	0.02	0.02	0.02	0.02	0.02	0.02
Observations	8,701,658							
Number of firm-country-sector triads	4,774,027							

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.

Table 16: Firm-Sector-Country Performance and RER Volatility: Extensive Margin

Dependent variable	Log Nb of products exported (firm-sector-destination-year)							
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Financial indicator		Ext dep	Intang.	R&D int	Ext dep			
RER volatility (α)	-0.031	0.121^{c}	0.015	0.060	-0.029	-0.069	0.108^{c}	0.107^{c}
	(0.035)	(0.060)	(0.055)	(0.064)	(0.162)	(0.186)	(0.062)	(0.061)
Ln country GDP	0.048^{b}	0.048^{b}	0.048^{b}	0.048^{b}	0.046^{b}	0.047^{b}	0.047^{b}	0.047^{b}
	(0.021)	(0.021)	(0.021)	(0.021)	(0.021)	(0.022)	(0.021)	(0.021)
Ln country price index	0.029^{a}	0.029^{a}	0.029^{a}	0.029^{a}	0.029^{a}	0.029^{a}	0.029^{a}	0.029^{a}
	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)	(0.005)
Ln country-sector imports	0.056^{a}	0.056^{a}	0.056^{a}	0.056^{a}	0.056^{a}	0.056^{a}	0.056^{a}	0.056^{a}
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)
RER Volat. $\times$ Fin. vuln. (β)		-0.408^{a}	-0.574	-3.727^{b}	-0.439^{b}	-0.442^{b}	-0.388^{a}	-0.379^{a}
		(0.089)	(0.448)	(1.511)	(0.165)	(0.177)	(0.103)	(0.093)
RER Volat. $\times$ Fin. vuln.$\times$					-0.159			
High Fin. Devt (above median)					(0.304)			
RER Volat. $\times$ Fin. vuln.$\times$						-0.171		
High Fin. Devt (above mean)						(0.277)		
RER Volat. $\times$					0.524			
High Fin. Devt (above median)					(0.459)			
RER Volat. $\times$						0.605		
High Fin. Devt (above mean)						(0.476)		
RER Volat. $\times$ Fin. vuln.$\times$ Fin. Devt (δ)							0.579	0.247
							(0.393)	(0.236)
RER Volat. $\times$ Fin. Devt (γ)							-0.183	-0.059
							(0.124)	(0.154)
Fin. vuln. $\times$ Fin. Devt								0.021
								(0.022)
Fin. Devt							0.057^{c}	0.050
							(0.032)	(0.034)
Fixed effects	Firm-sector-country and year							
R-squared	0.01	0.01	0.01	0.01	0.01	0.01	0.01	0.01
Observations	8,701,658							
Number of firm-country-sector triads	4,774,027							

Notes: Heteroskedasticity-robust standard errors are reported in parentheses. Standard errors are clustered at the province level; ^{a}, ^{b} and ^{c} respectively denote significance at the 1%, 5% and 10% levels.