# Financial Market Imperfections and the impact of exchange rate movements on exports

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**Abstract**

This paper analyzes empirically the role of financial market imperfections in the way countries' exports react to a currency depreciation. Using quarterly data for 27 developed and developing countries over the period 1990-2005, we find that the impact of a depreciation on exports will be less positive - or even negative - for a country if: (i) firms borrow in foreign currency ; (ii) they are credit constrained ; (iii) they are specialized in industries that require more external capital; (iv) the magnitude of depreciation or devaluation is large. This last result emphasizes the existence of a non-linear relationship between an exchange rate depreciation and the reaction of a country's exports when financial imperfections are observed. This offers a new explanation for the consequences of recent currency crises in middle income countries.

JEL Classification: F10, F32, F37

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# 1 Introduction

According to the standard theory in open macroeconomics, a real depreciation of the exchange rate should increase the volume of exports. Nevertheless, three conditions have to be verified so that the traditional competitiveness effect of the depreciation can be observed: (1) export prices are set in the exporter's currency and there is no pricing to market (2) the foreign demand is sufficiently elastic (Marshall-Lerner condition), and (3) the exporter's supply is also sufficiently elastic.

Previous studies have shown that those conditions are likely to be observed[1]. Nevertheless, several recent papers have underlined the non-systematic existence of a J-Curve or competitiveness effect[2]. In a recent study, Duttagupta and Spilimbergo (2004) show that exports did not increase right after the Asian 1997-1998 crisis. More generally, recent crises events (Argentina and Uruguay (2002), Brazil (1999)) point to the lack of reaction to exchange rate shocks. Our paper attempts to explain those stylized facts, by investigating in which measure the existence of financial market imperfections in the exporting country can modify the link between exchange rate movements and exports. Empirical results suggest that, even if the four previous conditions are verified, a depreciation can have a negative impact on exports in countries with a high level of financial market imperfections. Moreover, we also show that countries' specialization and the magnitude of the depreciation have to be taken into account in order to explain why the traditional competitiveness effect is not always observed.

The literature exploring the link between exchange rate and trade usually focuses on the exchange rate *volatility*[3], but very few papers have investigated the impact of exchange rate movements on exports, the latter usually being considered as trivial or traditional. Ma and Cheng (2003) test the influence of financial crises on international trade, by introducing crisis dummies in a gravity-like equation. Their findings are not clear-cut: currency crises dot no seem to have any effect in the short run - or they have only a slightly negative one - and the long run impact depends on the period considered. Campa (2001) tests the impact of exchange rate movements on South American countries' exports. The impact appears to be positive or non-significant, according to the specification. However, the author does not take into account control variables to capture demand and prices; the results should therefore be interpreted with great caution.

Recent studies in international trade have provided evidence of the existence of a sunk cost that firms have to pay to enter the export market. Using firm level data, several papers like Bernard and Wagner (1998) or Bernard and Jensen (2001) show that the export status of firms is very persistent over time. This result can be interpreted as the fact that firms having paid a sunk entry cost once for all have an incentive to remain on the export market in the following

[1] See for example Goldfajn and Werlang (2000).

[2] See Bahmani-Oskooee and Ratha (2004) for a literature review on the empirical existence of the J-curve.

[3] See Clark *et al.* (2004) for an exhaustive survey on the subject.

periods. Melitz (2003) incorporates an additional fixed entry cost in a model with heterogenous firms, and shows that only the most productive firms will be able to pay the entry cost and make a positive profit. Chaney (2005) develops a model where firms are heterogenous in terms of their productivity and their liquidity ex ante. The results indicate that liquidity constraints can prevent some productive firms to enter the export market. Financial mechanisms are therefore likely to explain some patterns related to the export status of firms. In particular, liquidity constrained firms have an incentive to borrow from financial intermediaries to pay the sunk or fixed cost and enter the export market. Therefore, financial market imperfections are also likely to influence the export status of firms.

Tornell and Westermann (2003) list three main financial market imperfections affecting middle income countries: the foreign currency borrowing associated with the issue of the currency mismatch, credit constraints, and systemic guarantees generating incentives to borrow in the foreign currency. Financial market imperfections are frequently observed in developing countries. In 2004, the Bank of Thailand published the results of a survey concerning the use of foreign sources of finance by 2,568 Thai non-financial firms. For this panel, foreign currency loans represented 68,9% of the total external debt. Different theoretical foundations have been proposed by several authors to explain this kind of behavior, and to explain why firms in emerging market countries do not hedge to absorb exchange rate shocks[4]. Eichengreen and Hausman (2000) suggest that the absence of hedging is likely to be a consequence of the "original sin: if a country's liabilities are denominated in foreign currency, this country is by definition unable to hedge. Note that we only consider here the "domestic" side of the well-known concept of "original sin", i.e. the incapacity, for a country, to borrow abroad in its own currency. Credit constraints, i.e. the fact that a firm's borrowing capacity is related to its current wealth rather than to the expected future profitability of current projects, are even more widespread. Numerous studies point out the existence of this problem in most developing and emerging market economies, especially for small firms[5]. Financial market imperfections are thus likely to concern a large share of a developing country's productive sector.

In this paper, we put forward the hypothesis that the level of foreign currency borrowing and credit constraints in the exporting country can affect the way in which a country's exports react to exchange rate movements. We also argue that the effect related to the level of financial market imperfections can be magnified by the extent of the depreciation or countries' specialization. Using quarterly data for 27 developed and developing countries over the period 1990-2005, we confirm that the impact of a depreciation on exports will be less positive - or even negative - if: (i) firms borrow in the foreign currency ; (ii) they are credit constrained ; (iii) they are specialized in industries that require more external capital; (iv) the magnitude of depreciation or devaluation is large. This last result confirms the existence of a non-linear

[4]See, among others, Rajan and Zingales (1998), McKinnon and Pill (1998), Burnside *et al.* (2001), Schneider and Tornell (2000) or Jeanne (2003).

[5]See Gelos and Werner (1999) and Terra (2003).

relationship between an exchange rate depreciation and the reaction of a country's exports. More generally, our work offers a new explanation for the consequences of recent currency crises on trade flows in middle income economies, and provide a finance-based explanation of a part of the so-called "exchange rate disconnect puzzle" as emphasized by Obstfeld and Rogoff (2000).

Our paper also contributes to the long-standing literature that focuses on trade elasticities to relative prices variations. Recent research has emphasized different factors that may lead to downard biases in traditional estimates of elasticities to real exchange rate variations. In particular, beyond the Goldstein and Kahn (1985) explanation based on the aggregation bias which arises in the computation of relative prices, the omission of elements such as vertical specialization, vertical integration and economic flexibility[6] has been found to explain - at least partly - the lack of reaction of trade volumes to exchange movements. In the same way, this paper provides strong empirical evidence of the significant role of financial market imperfections in modifying the effectiveness of exchange rate, thus leading to an important downward bias in trade elasticities.

The remainder of this paper is organized as follows. In the next section, we present the theoretical underpinnings and the empirical methodology. Section 3 discusses the data and the econometric issues. In section 4, we investigate how financial market imperfections can modify the link between exchange rate movements and exports. In section 5 we consider the elements that may magnify this relationship. Section 6 concludes.

# 2 Theory and Empirical Methodology

## 2.1 Theoretical Underpinnings

*Financial Market Imperfections*

There is an extensive literature that evaluates the influence of the local financial markets on emerging economies' macroeconomic performances. Economists have shown that a better access to credit improves countries' growth path ; however, financial development and financial opening could also generate weaknesses in the economy. According to Tornell and Westermann (2003), financial market imperfections are responsible for "boom-bust cycles as well as other macroeconomic patterns observed at higher frequencies across middle income countries". They also emphasize the fact that these *boom-busts* are not observed in countries with developed financial markets.

Financial market imperfections are likely to hit exporting firms, which have to pay a large

[6]See, among others, Chinn (2005), IMF (2007), Burgess and Knetter (1998).

fixed cost at the beginning of each period, in order to stay on the export market. In the meanwhile, firms wishing to enter have to pay a sunk cost, which is larger than the fixed cost paid by incumbent firms. The payment of a sunk or fixed cost forces the firm to borrow from external lenders, and this can contribute to the occurrence of boom-bust cycles in the economy if firms borrow in a foreign currency. Several studies have shown that exporting firms are characterized by a higher share of foreign currency debt[7]. Hence, taking financial market imperfections into account is particularly relevant for the analysis of the relationship between exchange rate and trade flows. Theoretical papers like Deardorff (2000) and Berman and Berthou (2006) show that when the currency depreciates, countries in which firms borrow in a foreign currency are more exposed to "balance-sheet effect" phenomena. If domestic firms' assets are denominated in the domestic currency and their debt in a foreign currency, a depreciation of the exchange rate reduces their solvability. In this configuration, repayment problems occur and output or exports are reduced if firms are unable to invest; some of them can be forced to exit the market if they cannot service their debt. In the periods following the depreciation, it is also likely that some firms wishing to enter or remain on the export market will not be able to do so, because of an increase in the borrowing cost in the foreign currency.

Beyond to the pure foreign currency borrowing effect, several papers have shown that credit constraints limit firms' borrowing capacity after a negative exogenous shock on their cash flow. Among others, Aghion et al. (2001, 2005) define credit constraints as a relative independence between firm's borrowing capacity and the project's return, the former being more linked to the level of firm's assets or cash flow that can be used as collateral. We mentioned above that a depreciation of the domestic currency can lead firms to exit the export market if they are unable to service their debt contracted in a foreign currency. For the firms that remain on the export market, the increase in the value of repayments, if the firm had previously borrowed in the foreign currency, also generates a reduction in the cash flow. In addition, the depreciation decreases the value of firms' tangible assets in the foreign currency. In an environment where firms have to face credit constraints, borrowing opportunities are associated to the value of their collateral, which is often referred as the value of firms' assets and cash flow in the literature in finance. Hence, in an economy where firms borrow in the foreign currency, the depreciation of the domestic currency reduces the value of the collateral as well as the capacity of firms to further borrow in the foreign currency. This mechanism can therefore lead to numerous firms exits in the subsequent periods, while other domestic firms will not be able to enter the export market. The reduction in the borrowing capacity of domestic firms may also decrease the volume of exports by firms that remain on the export market. Consequently, we anticipate that the association of a high level of foreign currency borrowing and credit constraints deteriorates the reaction of exports to a currency depreciation. This feature should be especially due to a variation in the number of exporting firms, consecutive to the depreciation of the exchange rate.

[7]See for example Martinez and Werner (2002) for Mexican firms, Echeverry *et al.* (2003) for Chile and Kawai *et al.* (2003) for Korea.

Note that the existence of international or domestic safety net policies (IMF rescue packages, government bailout guarantees) can prevent those balance-sheets effects to occur, thus dampening the negative effect of an exchange rate depreciation. This argument is especially relevant during a crisis situation, when the government is often tempted to bail out firms facing repayment issues, in order to prevent the crisis from becoming systemic.

*Magnification Effects*

We saw above that a depreciation of the exchange rate can lead to firms exits because of balance sheet effects. We further list two kinds of mechanisms which are likely to magnify the financial effects of the depreciation. First, a country's specialization may have an effect through the degree of its firms' level of dependence on external finance. Indeed, Rajan and Zingales (1998) show that firms operating in some industries use more external finance. If the currency depreciates, the financial market imperfection mechanisms listed above should therefore be especially relevant for countries that are specialized in more financially dependent industries. Consequently, the reaction of export in those countries could be especially low, or even negative, because of a reduction in the number of exporting firms or a reduction in exports by firm.

The impact of an exchange rate depreciation might also be non-linear. A larger depreciation should have a more negative impact on the number of firms operating on the export market, because it increases the value of repayments for loans contracted in a foreign currency, which can lead to more firms exits. In addition, a larger depreciation should decrease the number of exporting firms as well as the volume of exports by incumbent firms, because it increases the cost of borrowing in a foreign currency and decreases the value of the collateral.

This mechanism can be related to the one described in the paper by Baldwin and Krugman (1989). In their setting, firms enter the export market if they observe a positive shock related to the exchange rate (in their case, a depreciation of the exchange rate implies the traditional competitiveness effect). Once firms have paid the sunk cost, they only exit the market if they face a large negative shock related to the exchange rate. In the context of an economy with widespread financial market imperfections, the mechanism should be reversed: once firms have paid the sunk cost, they should only exit if they face a negative shock related to a large depreciation of the domestic currency, leading to a large increase in the amount of the repayment obligations. More precisely, the balance-sheets effects may be observed for any magnitude of depreciation, but only large depreciations should lead firms to exit the export market. We therefore put forward the hypothesis that, if the economy if weaken by a high level of financial market imperfections, a small depreciation should lead to a pro-competitive effect, while a larger shock should magnify the balance sheet effect, leading to firms' exits. This argument, according to which the adjustment of the volume of exports after large devaluations depends on the variation of the extensive margin of trade - i.e. of the number of exporters, is supported by a recent paper of Blalock and Roy (2007), which show that the number of exporters significantly

decreased after the Asian crisis.

### 2.2 The Econometric Model

We make use of the methodology provided by Goldstein and Kahn (1978) and Goldstein and Kahn (1985) to estimate demand and supply export equations for a group of developing and developed countries. Whereas the traditional pro-competitive effect of a depreciation of the exchange rate is specifically associated with the demand side of the export equation, we provide an explanation of the non-response of exports to a currency depreciation through the supply side.

A depreciation involves a positive competitiveness effect on the demand side because it induces an increase in world demand for domestic goods, following a decrease in domestic relative prices. However, the same depreciation leads to a negative supply effect: our hypothesis developed above says that, if firms borrow in a foreign currency or are subject to credit constraints, a depreciation will induce a balance-sheet effect which can in turn reduce firms' production capacities or their ability to remain on the export market. Theoretically, the demand for home-produced goods should increase ; however, their is some risk that home supply decreases after the depreciation. The following equation stands for the demand side of the export equation:

$$logX_{it} = \alpha_0 + \alpha_1 log(PX_{it}) + \alpha_2 logPC_{it} + \alpha_3 logE_{it} + \alpha_4 logYW_{it} + \mu_{it} \quad (1)$$

where $X_{it}^d$ is the demand for exports from country i, $PX_{it}$ is country i's export price, $PC_{it}$ is the competitors' price, $E_{it}$ is the exchange rate - an increase of E means a depreciation of the local currency - and $YW_{it}$ is the revenue of all i's trade partner countries. We describe in details in Appendix the construction of each country's competitor price and trade partner revenue variables. We expect the sign of the coefficient on the exchange rate to be positive, i.e. a depreciation should lead to a decrease of the export price in the foreign currency. The export supply of country i can be expressed as follows :

$$logX_{it} = \beta_0 + \beta_1 logPX_{it} + \beta_2 logP_{it} + \beta_3 logY_{it} + \beta_4 logE_{it} * FMI + \beta_5 logE_{it} ME_{it} + \varepsilon_{it} \quad (2)$$

where $X_{it}^s$ is the export supply from country i, $PX_{it}$ its export price, $P_{it}$ the domestic producer price, $Y_{it}$ the domestic production, and $FMI$ the measure of financial market imperfections, i.e. foreign currency borrowing and credit constraints, as defined above. This last interaction term between financial market imperfections and the exchange rate enables us to take into account the way in which financial imperfections will modify the export supply conditions when the currency depreciates. Finally, the variable ME represents the magnification effects previously mentioned. We expect $\beta_1 > 0$, $\beta_2 < 0$ and $\beta_3 > 0$. Note that the coefficients on prices could be biased because of problems of aggregation, as discussed in Goldstein and Kahn (1985). However the study of the sign and value of price coefficients remains beyond the scope of our study. In addition, our hypothesis requires a negative effect of financial market imperfections when the

currency depreciates ($\beta_4 < 0$) - the depreciation will have a more negative impact on the export supply for a higher level of financial market imperfections in the economy. This negative impact may be magnified by the country's specialization and the extent of the depreciation ($\beta_5 < 0$). The equation above equivalent to :

$$logPX_{it} = b_0 + b_1 logX^s_{it} + b_2 logP_{it} + b_3 logY_{it} + b_4 logE_{it} * FMI + b_5 logE_{it} ME_{it} + \eta_{it} \quad (3)$$

From the combination of the export demand and supply equations, we obtain the equilibrium level of exports for country i:

$$logX_{it} = \gamma_0 + \gamma_1 logP_{it} + \gamma_2 logY_{it} + \gamma_3 logE_{it} * FMI + \gamma_4 logE_{it} ME_{it} + \gamma_5 logPC_{it} + \gamma_6 logE_{it} + \gamma_7 logYW_{it} + \nu_{it} \quad (4)$$

One can show that the coefficients of this expression are expected to be of the same sign as those discussed before : $\gamma_1, \gamma_3, \gamma_4 < 0$, and $\gamma_2, \gamma_5, \gamma_6, \gamma_7 > 0$. A depreciation of the exchange rate should lead to a pro-competitive effect through the demand side of the equation, and to a negative impact through the supply side, for a higher level of financial market imperfections in a given economy. Therefore, a depreciation should not always lead to an increase in exports, since the final effect depends on the level of firms' debt denominated in the foreign currency, and also on the influence of the level of credit constraints in the economy. This expectation is consistent with the evolution of exports in south east Asia after the 1997-98 crises.

# 3 Data and Econometric Issues

The detailed description of our data is given in appendix.

## 3.1 Measuring Financial Market Imperfections

The mechanism we have in mind requires that we find a measure of the foreign currency behavior of countries' firms as well as a proxy for the extent of credit constraints in the economy. Measuring countries' share of firms' debt denominated in the foreign currency is not simple. Several articles have used aggregated data; in particular, Eichengreen *et al.* (2003) and Burger and Warnock (2003) use the data provided by the Bank for International Settlements (BIS) to measure countries' proportion of bonds and securities that have been issued in a foreign currency. However, this kind of measure remains extremely imperfect, since it is calculated for the whole economy and does not enable us to distinguish between the public and private sectors. Jeanne (2003) uses this kind of aggregate measure as well as a direct measure of Foreign Currency Borrowing (FCB) by publicly listed firms. This last kind of data is of course much more satisfying ; however, it only covers a small range of countries in South America.

Our paper makes use of a direct measure of foreign currency borrowing, available for a wide range of countries[8]. The World Bank recently published a survey - the World Business Environment Survey (WBES, 2000) - that provides information on firms' activities in 80 countries. This comprehensive survey of over 10,000 firms covers firms' responses to multiple questions on the investment climate and business environment as shaped by domestic economic policy: governance; regulatory, infrastructural and financial impediments, as well as assessments on the quality of public services. Among other firm level data, the database indicates the origin of capital.

We use the WBES database to compute an average of the proportion of firms' debt denominated in the foreign currency, for each country in the sample. This variable is only available for the year 2000, so that we should consider it as a structural measure of firms' use of foreign currency loans. The data in our sample (see Table 7) indicates that some economies in South America and South East Asia - especially Argentina, Singapore and Indonesia - are characterized by a high degree of foreign currency borrowing, whereas this ratio is much lower in financial centers like the United Kingdom and the United States.

Several authors have worked on the credit constraints issue. Braun (2003) shows that industries with less tangible assets perform disproportionately better in terms of growth in countries with well-developed financial systems. In a related work, Manova (2005) shows that countries with better developed financial systems tend to export relatively more in sectors with fewer tangible assets that can serve as collateral. These two papers use the level of financial development as a proxy for the level of credit constraints in the economy; therefore, a better financial development should be associated with a lower level of credit constraints. In a related work, Aghion *et al.* (2005) use a financial development variable to evaluate the influence of credit constraints on countries' growth volatility.

Financial development is defined as the ratio of private credit to GDP, and is available online from Thorsten Beck's website at the Worldbank. This variable is also used in Rajan and Zingales (1998), among others. We take five-year (1990-1995) averages for the financial development variable[9]; this enables us to smooth the data and avoid short run variations and cyclical effects. Data indicate a wide range of financial development levels; South American countries like Argentina and Peru report very low ratios whereas Switzerland and Japan have the highest.

[8] In a first version of the paper, we also used aggregated measures of the FCB provided by the BIS and IMF statistics, but the coefficients on those variables in the regression suffered from a lack of robustness, and we decided to remove them. Such a lack of robustness is probably due to the aggregation problem suggested above.

[9] We also tried with other five-year average measure (1995-2000), and with yearly data. Even if the results remains qualitatively the same, we choose here to present the results computed from a five-year average measure of financial development in order to be able to simulate in a simple way the reaction of exports volume to an exchange rate depreciation in the different countries of our sample. More precisely, we compute at the end of the paper the predicted impact of a one standard-deviation increase in exchange rate on exports, based on actual data (given in Table 7, appendix) and estimated coefficients. Using a country-specific, instead of a country-time specific measure of financial development makes easier the computation of such simulations.

In contrast to previous works, we do not assume a linear relationship between credit constraints and financial development. Indeed, this relationship might be non-linear because credit constraints - as defined in the theoretical part of the paper - should not be observed at very low levels of financial development, since no credit market is in operation. Therefore, an increase in the level of financial development should only help to reduce the credit constraints after a sufficiently high level of financial development. We thus make use of countries' level of financial development as well as its square, in order to take into account this non-linear relationship between financial development and credit constraints.

### 3.2 Measuring the External Financial Dependence of Exports

We introduce a variable to account for countries' specialization and financial dependence of exports. Rajan and Zingales (1998) and Beck (2003) define external financial dependence as *the fraction of capital expenditures not financed with cash flow from operations*. They show that countries with a higher level of financial development have higher growth rates and trade levels in industries that are more dependent on the use of external funds.

In these papers, the external dependence of American industries is considered as being an optimal one, given the high level of financial development in the US and the low probability of firms to be financially constrained. The level of each industry's external financial dependence in the US should therefore represent the actual demand of external finance by those industries, in each country. Consequently, we apply this measure of external dependence to other sets of countries[10].

We use the data provided by Rajan and Zingales (1998) to build a structural financial dependence of exports measure, by country. Our variable takes into account countries' export specialization in 1995, which allows us to determine the extent of external finance countries' exporters have to obtain in order to export. More precisely, we compute, for each country in the sample, the contribution of each SITC one digit industry in the total of exports. This export structure is used to calculate the financial dependence of exports, thanks to the data provided by Rajan and Zingales (1998) at a disaggregated level.

### 3.3 Trade Model Data

We concentrate our analysis on the impact of exchange rate fluctuations on the export *volume*, in order to evaluate the real impact of exchange rate fluctuations, and avoid all possible noise due to export price variations. Specifically, if we postulate that the export price - in the domestic currency - does not adjust when the currency depreciates, then the depreciation reduces

[10]For more information about the optimal character of the external dependence of US industries, see Rajan and Zingales (1998).

this export price in the foreign currency. If the price elasticity of the foreign demand is low, the volume of exports will remain unchanged whereas the value of exports will be reduced in the foreign currency. Hence the use of export volumes seems to be justified and necessary. We construct our export volumes data set by taking the ratio of countries' total value of exports in USD to countries' export price index in USD. We also compute the GDP volume variable in the same way, by dividing the GDP value in the domestic currency by the GDP deflator in the domestic currency.

In addition to the variables described above, we use exchange rate data, country specific competitors' prices, producer prices and countries trading partners revenues[11]. We use domestic currency in terms of SDR for exchange rates series in order to take into account the competitiveness gains against other countries than United States[12]. It would have been better to use effective exchange rates, but quarterly data were only available for a small number of countries, so we kept exchange rates in terms of SDR. All these variables are from the IMF International Financial Statistics (IFS) database. We also use the Direction of Trade Statistics (DOTS) data to compute the competitors' price and trading partner revenue variables. All the details about the data and their construction are provided in the appendixes.

Our panel of data covers the period 1990-2005 for 27 developed and developing countries at a quarterly frequency. Unfortunately, data availability is an impediment that constrains us in the extension of the database. In particular, the use of export volume data requires the existence of export price series, and these data are only available for few countries from the IFS, especially at a quarterly frequency. Nevertheless, it seems essential to take into account the export *volume*, since we concentrate our analysis on the real effect of the depreciation.

### 3.4 Econometric issues

The literature in econometrics and macroeconometrics has recently concentrated on the issue of stationarity and cointegration in panel data. According to Breitung and Pesaran (2005), using panel data increases the statistical power of these tests. This especially explains why researchers, like Pedroni (2001), have tried to use these late developments in econometrics, to test for the Purchasing Power Parity hypothesis. Given that our data set covers a long time period at high frequency for macroeconomic variables, it is likely that at least some of the variables - and in particular the exchange rate - are non-stationary. We therefore test for the stationarity of our variables in panel, using the Fisher unit-root test developed by Maddala and Wu (1999). Fisher's test assumes that all variables are non-stationary under the null hypothesis against the

[11] Competitors' price and producer price indexes are respectively denominated in SDR and in the local currency; the combination of these price indexes with the exchange rate gives us the real exchange rate.

[12] Moreover, using SDR exchange rate, instead of USD exchange rate, allows to keep some variance in the exchange rate variable for countries in which the currency has been pegged to the USD during our considered period.

alternative that at least one variable in the panel is stationary. Unlike the Im *et al.* (1997) test, Fisher's test does not require a balanced panel. Results are provided in Appendix 7.2, and indicate that all series are I(1).

These results allow us to test for a cointegration relationship among our variables of interest. Pedroni (1999) developed a cointegration residual-based test procedure for dynamic panel with multiple regressors, which provides seven normally distributed statistics. The four panel-statistics require that the auto-regressive parameter be the same for all individuals, whereas the three group-statistics authorize the auto-regressive coefficient to vary among individuals in the panel. The null of no-cointegration (non-stationarity of the residuals within the relationship between our variables of interest) is rejected if the auto-regressive parameter is less than one. Results are provided in Appendix 7.3 and indicate that all but one statistic reject the null of no cointegration; this is strong evidence for the existence of a cointegration relationship between our variables.

We turn now to the estimation procedure of the long-run relationship, common to all individuals in the panel. Kao and Chiang (1997) and Mark and Sul (2002) show that the Dynamic Original Least Squares (DOLS) method of Stock and Watson (1993) outperforms both OLS and Fully Modified OLS when estimating a long run relationship between cointegrated variables. We thus estimate this long-run relationship using DOLS with one differentiated lead and one differentiated lag, which enables us to correct for serial correlation and the potential endogeneity of the regressors. We also introduce country fixed effects, and quarterly dummies to avoid seasonality bias. We therefore obtain a new specification of our model :

$$\begin{aligned} logX_{it} = \gamma_0 + \gamma_1 logP_{it} + \gamma_2 logY_{it} + \gamma_3 logE_{it} * FMI_{it} + \gamma_4 logE_{it} * ME_{it} + \gamma_5 logPC_{it} + \gamma_6 logE_{it} \\ + \gamma_7 logYW_{it} + \sum_{k=-1, k\neq 0}^{1} [\gamma_8 \Delta logP_{i,t-k} + \gamma_9 \Delta logY_{i,t-k} + \gamma_{10} \Delta (logE * logFMI)_{i,t-k} \\ + \gamma_{11} \Delta logPmW_{i,t-k} + \gamma_{12} \Delta logE_{i,t-k} + \gamma_{13} \Delta logYW_{t-k}] + \sum_{j=1}^{3} \lambda_j Q_j + \sum_{i=1}^{27} \eta_i C_i + \upsilon_{it} \end{aligned} \quad (5)$$

Where the $\Delta$ terms indicate first differences of the independent variables, with lags at orders k=[-1;1], $Q_j$ represents the quarterly dummies, and $C_i$ the countries' dummies. All of the following hypotheses about financial market imperfections are tested using this specification.

# 4 The Role of Financial Market Imperfections

## 4.1 Main results

The empirical estimation of the exports equation, therefore, contains two interaction terms that enable us to distinguish between foreign currency borrowing and credit constraint mechanisms. Our empirical methodology remains the same as in (5), but only reports our variables of interest:

$$logX_{i,t} = \gamma_0 + \gamma_1 logP_{it} + \gamma_2 logY_{it} + \gamma_3 logPC_{it} + \gamma_4 logE_{it} + \gamma_5 logE_{it} * logFCB_i$$
$$+\gamma_6 logE_{it} * logFD_i + \gamma_7 logE_{it} * (logFD_{it})^2 + \gamma_8 logYW_{it} + [...] + \upsilon_{it} \quad (6)$$

with FCB and FD respectively the foreign currency borrowing and financial development variables. We expect $\gamma_5$ to be negative: a larger level of a country's foreign currency borrowing should imply a more negative response of exports to a depreciation, since some firms will not be able to service their debt whereas others will not be willing to borrow in order to enter the export market, thus reducing the country's production and export capacity. An increase in the financial development variable is assumed to have a negative impact on exports at a low initial level ($\alpha_6 < 0$), and a positive impact beyond an intermediate level ($\alpha_7 > 0$).

Estimation results are reported in Table 1. Column A reports the basic specification, and does not take into account the financial market imperfections. This first specification indicates that the traditional variables in the export equations have coefficients with the right sign: national production and world demand for exports influence positively and significantly the volume of exports, while the price ratio has a positive impact : an increase in the competitor's price relative to the producer's price increases exports. The striking result comes from the coefficient on the exchange rate: a currency depreciation leads to an insignificant impact on the volume of exports, suggesting that the traditional competitiveness effect is not observed in our sample.

This first puzzling result related to the coefficient on exchange rate vanishes when we include financial imperfections. In column (D) we test the role of both foreign currency borrowing and credit constraints by introducing interacted terms. Note that the number of observations is lower than in the basic specification because the WBES database does not include all the countries in our sample. The estimated coefficient of the exchange rate term becomes significant, reflecting a positive competitiveness effect. On the other hand, financial market imperfections significantly modify the impact of a depreciation on exports. Those results suggest that the omission of financial market imperfections can lead to an important downward bias in the estimates of trade elasticities to exchange rate variations.

First, we find a negative impact of foreign currency borrowing: countries in which firms use a large share of foreign currency borrowing in their total financing will react more negatively to an exchange rate shock, which is consistent with the theory.

Table 1: Financial Market Imperfections

| | *All countries* | | | | | | *Developing countries only* | |
|---|---|---|---|---|---|---|---|---|
| Depvar: *Export Volume* | (A) | (B) | (C) | (D) | (E) | (F) | (G) | (H) |
| ***Traditional Variables*** | | | | | | | | |
| *GDP Volume* | 0.461*** | 0.350*** | 0.466*** | 0.363*** | 0.352*** | 0.394*** | 0.359*** | 0.316*** |
| | (0.051) | (0.061) | (0.044) | (0.051) | (0.051) | (0.048) | (0.078) | (0.059) |
| $\frac{CompetitorsPrice}{DomesticPrice}$ | 0.241*** | 0.255*** | 0.158** | 0.191*** | 0.178*** | 0.208*** | 0.310*** | 0.264*** |
| | (0.084) | (0.092) | (0.069) | (0.068) | (0.068) | (0.060) | (0.098) | (0.078) |
| *Foreign Demand* | 0.603*** | 0.596** | 0.490*** | 0.374** | 0.40** | 0.455** | 0.405* | 0.098 |
| | (0.178) | (0.233) | (0.141) | (0.169) | (0.176) | (0.196) | (0.240) | (0.155) |
| *Exchange rate* | 0.026 | 0.274* | 0.492*** | 1.033*** | 1.060*** | 1.310*** | 0.20 | 1.020*** |
| | (0.072) | (0.146) | (0.105) | (0.168) | (0.168) | (0.148) | (0.164) | (0.188) |
| ***Financial Variables*** | | | | | | | | |
| *Exch.Rate*FCB* | | -6.098*** | | -7.184*** | -7.326*** | -10.791*** | -6.313*** | -8.061*** |
| | | (2.141) | | (1.971) | (1.966) | (1.806) | (2.191) | (1.963) |
| *Exch. rate*fin.dvt* | | | -2.761*** | -4.520*** | -4.444*** | -5.578*** | | -4.637*** |
| | | | (0.349) | (0.606) | (0.613) | (0.638) | | (0.645) |
| $ER * (Fin.Dvt)^2$ | | | 2.625*** | 5.050*** | 4.885*** | 5.550*** | | 5.423*** |
| | | | (0.375) | (0.787) | (0.80) | (0.795) | | (0.874) |
| *Banking Crisis* | | | | | 0.027 | | | |
| | | | | | (0.030) | | | |
| *State Policies* | | | | | | -0.219*** | | |
| | | | | | | (0.046) | | |
| *State Pol.*Exch. Rate* | | | | | | 0.106*** | | |
| | | | | | | (0.014) | | |
| N | 1308 | 828 | 1336 | 828 | 828 | 828 | 592 | 604 |
| $R^2$ | 0.64 | 0.59 | 0.67 | 0.64 | 0.64 | 0.72 | 0.54 | 0.62 |
| Estimation method | DOLS | | | | | | DOLS | |

Note: Significance levels: *10%, **5%, ***1%. All variables in logarithms. Robust Standard Errors in parentheses. All regressions include time, countries, quarterly dummies, and differentiated lags. Intercept not reported. Regressions (E) and (F) for developing countries only.

Estimation (D) underlines the significant influence of the financial development as well. The coefficients on the interaction terms between the exchange rate and financial development variables confirm the existence of a non-linear relationship between credit constraints and financial development, which influences the reaction of countries to a depreciation: a better level of financial development is associated to a lower level of credit constraints, beyond an *intermediate* level of financial development. Therefore, a deeper financial market will improve the reaction of exports to a depreciation, but only if the country has a sufficiently high level of financial development. This *intermediate* level of financial development corresponds to a ratio of private credit over GDP equal to 0.56 which is consistent with the data. Beyond this ratio, a marginal increase in financial development will help countries to better react to a depreciation through a lower level of credit constraints. Besides this result, we see that countries located "below the threshold" should only be able to remove credit constraints through a very high increase in their level of financial development.

The role of financial market imperfections in the way countries' exports react to an exchange rate depreciation is robust to the different specifications - columns (B) and (C). This confirms our main result : taking financial market imperfections into account enables us to remove the striking initial result on the coefficient of the exchange rate; a country characterized by few financial market imperfections should experience a positive competitiveness effect, as expected in theory. Typically, countries like Indonesia which are characterized by an intermediate level of financial development and a high level of foreign currency borrowing, will react very negatively to an exchange depreciation because of larger balance-sheets effects.

In Columns (G) and (H) we only consider developing countries. The results are still consistent with our hypotheses, even if the negative effects of financial imperfections are magnified. The interesting point comes from the significance of the interaction terms' coefficients. Indeed, one can suppose that the existence of financial market imperfections is an element that characterizes developing and emerging countries as two different homogenous groups. On the contrary, our results suggest that important differences exist *within* the group of developing countries, regarding financial markets. Indeed, if there were no significant difference between those countries, the estimated coefficient of the interacted term between financial market imperfections and the exchange rate would become insignificant. Some developing countries have a sufficiently low level of financial imperfections to obtain a positive competitiveness effect after a currency depreciation, while others do not. Thus, the negative coefficient on the interaction between financial market imperfections and exchange rate should not only be seen as a result of the different levels of financial market development between developing and developed countries; the data in appendix indicate that this kind of heterogeneity is also observed within the group of developing countries and is likely to explain countries' different paths of recovery following the recent currency crises.

As we consider an important number of emerging countries in our sample that have experienced during the period twin crises during the period we consider, it seems necessary to control for the occurrence of banking crises, this kind of event being likely to affect even countries characterized by a high level of financial development. We include in estimation (E) a banking crisis dummy; the data comes from Caprio and Klingebiel (2002). The inclusion of the banking crisis dummy does not modify the results, but its coefficient is insignificant. We investigate in the next section how the impact of such events may be magnified by countries' specialization toward financially dependent sectors.

In column (F) we include a variable that aims at capturing the influence of bailout guarantees and rescue policies. As mentioned in the theoretical section, the existence of such interventions, in particular when a financial crisis is underway, may dampen the balance-sheets effects - and thus the significance of the interacted terms between our financial variables and exchange rate - since they may prevent some firms to exit the export market after a depreciation. We use the data from Honohan and Klingebiel (2003) on interventions and policy tools after financial crises, more precisely, we construct a binary variable which is unity when one of the following conditions is verified: (i) government issued an explicit blanket guarantee to depositors and creditors after the onset of the crisis; (ii) government aid was provided to bank borrowers, helping them to service their debt. The data covers most of our the countries used in our sample. Consistently with theory, the interaction term between this variable and exchange rate is positive and significant, while the coefficient on our two measures of financial market imperfections have a more negative sign.

### 4.2 Robustness

The above-mentioned results may be biased due to omitted variables correlated to our regressors, in particular firms' share of foreign denominated debt and financial development. Several country-specific elements may both be correlated with those variables and influence the relationship between exchange rate movements and exports. To check the robustness of our results, we include in this section several controls. Recent literature has emphasized the significant role of several factors in explaining the low estimates of trade volumes to prices and exchange rate variations (see among others Chinn (2005), IMF (2007), Burgess and Knetter (1998)). Following their results, we check in this section the robustness of our results by controlling for (i) vertical specialization (important share of imported inputs); (ii) vertical integration (important share of vertically integrated firms'); (iii) economic flexibility (both product and labor markets).

The detailed description of the computation of the robustness variable is given in appendix.

*Vertical Specialization.* The effect of an exchange rate depreciation may be more negative in countries using an important share of imported inputs because of the increase in the prices of these inputs. At the same time, firms may prefer to borrow in foreign currency because they need to import intermediate goods for their production. The significant coefficient on the inter-

Table 2: Financial Market Imperfections, Robustness

| Depvar: *Export Volume* | (A) | (B) | (C) | (D) | (E) | (F) |
|---|---|---|---|---|---|---|
| ***Traditional Variables*** | | | | | | |
| *GDP Volume* | 0.382*** | 0.507*** | 0.40*** | 0.519*** | 0.510*** | 0.423*** |
| | (0.059) | (0.062) | (0.057) | (0.059) | (0.066) | (0.063) |
| $\frac{CompetitorsPrice}{DomesticPrice}$ | 0.473*** | 0.629*** | 0.473*** | 0.628*** | 0.624*** | 0.506*** |
| | (0.084) | (0.087) | (0.085) | (0.087) | (0.106) | (0.098) |
| *Foreign Demand* | 0.411*** | 0.319** | 0.303** | 0.182 | 0.207 | 0.270 |
| | (0.145) | (0.142) | (0.141) | (0.139) | (0.163) | (0.166) |
| *Exchange rate* | 2.836*** | 0.666 | 4.056*** | 1.528** | 1.431* | 2.418*** |
| | (0.386) | (0.548) | (0.432) | (0.620) | (0.796) | (0.669) |
| ***Financial Variables*** | | | | | | |
| *Exch.Rate*FCB* | | -12.414*** | | -13.942*** | -14.532*** | -17.781*** |
| | | (2.307) | | (2.514) | (3.068) | (2.766) |
| *exch. rate*fin.dvt* | | | -2.918*** | -4.413*** | -4.471*** | -4.287*** |
| | | | (0.819) | (0.839) | (1.018) | (0.777) |
| $Exch.Rate * (Fin.Dvt)^2$ | | | 2.780** | 5.136*** | 5.163*** | 3.617*** |
| | | | (1.210) | (1.248) | (1.353) | (1.105) |
| *Banking Crisis* | | | | | 0.036 | |
| | | | | | (0.032) | |
| *State Policies* | | | | | | -0.014 |
| | | | | | | (0.050) |
| *State Pol.*Exch. Rate* | | | | | | 0.071*** |
| | | | | | | (0.017) |
| ***Controls*** | | | | | | |
| *Exch.Rate*VS* | -0.019*** | -0.035** | -0.014 | -0.014 | -0.012 | -0.016 |
| | (0.006) | (0.018) | (0.020) | (0.019) | (0.020) | (0.017) |
| *Exch.Rate*VI* | 1.537*** | 2.655*** | 1.841*** | 3.035*** | 3.098*** | 1.413*** |
| | (0.224) | (0.297) | (0.240) | (0.318) | (0.413) | (0.478) |
| *Exch.Rate*LMR* | -2.755*** | -2.815*** | -4.133*** | -3.979*** | -3.969*** | -3.154*** |
| | (0.340) | (0.372) | (0.418) | (0.406) | (0.589) | (0.567) |
| *Exch.Rate*PMR* | -2.130*** | -1.678*** | -1.898*** | -1.248*** | -1.246*** | -0.033 |
| | (0.310) | (0.311) | (0.313) | (0.325) | (0.357) | (0.379) |
| N | 547 | 547 | 547 | 547 | 547 | 547 |
| $R^2$ | 0.74 | 0.76 | 0.76 | 0.78 | 0.78 | 0.82 |
| Estimation method | DOLS | | | | | |

Note: FCB: Foreign Currency borrowing; VS: Vertical Specialization; VI: Vertical Integration: LMR: Labor Market Rigidities; PMR: Product Market Rigidities; Significance levels: *10%, **5%, ***1%. All variables in logarithms. Robust Standard Errors in parentheses. All regressions include time, countries, quarterly dummies, and differentiated lags. Intercept not reported. Regressions (E) and (F) for developing countries only.

action between foreign currency borrowing and exchange rate may thus be capturing the rise in production costs due to the increasing price of intermediate goods following exchange rate depreciation. To account for this bias, we construct a country-year specific measure of vertical specialization based on US input-output matrix and countries specialization. More precisely, we first compute the value of imported inputs of 9 SITC industries using the US input-output matrix in 1990. We then use this value and construct for each country-year a measure of vertical specialization using the methodology of Hummels *et al.* (2001).

*Vertical Integration.* As vertically integrated firms may be less credit constrained than others, the omission of this element may lead to a downward bias in the coefficients of the interaction terms between financial development and exchange rate. To capture this effect, we construct a country-specific measure of vertical integration based on the combination of sectoral estimates of vertical integration of Acemoglu et al. (2006) and on countries' export specialization - with a method similar to the one used for external financial dependence.

*Economic flexibility.* Product and labor market rigidities may decrease trade's elasticities to exchange rate movements. To ensure the robustness of our results, we introduce in the previous specification two different interacted terms, between exchange rate and respectively product and labor market rigidities. These two variables are country-specific and constructed from the WBES database with a methodology similar from the one used to compute the foreign currency borrowing index.

We include in equation 6 four additional interaction terms, to determine how much vertical specialization, vertical integration, product and labor market rigidities can modify the impact of exchange rate movements on exports. We expect the coefficient on vertical specialization to be positive - less credit constraints and lower balance-sheet effects for vertically integrated countries -, and the others to be negative.

Results are given in table 2. The number of observations is lower here due to lack of data availability for the computation of some of the control variables. When they are significant, the estimated coefficients on the controls have the expected sign. Interestingly, the coefficients on the exchange rate term in column (A) becomes positive when we include these controls, suggesting that financial market imperfections are not the only explanation for the lack of reaction of exports to exchange rate movements. Consistently with recent literature, the inclusion of those control also leads to an increase in the relative prices coefficient, suggesting that their omission may both contribute to explain the low estimates of trade elasticities to prices and exchange rate variations. In column (F), we find an elasticity of 2.41 on exchange rate. This elasticity however remains very theoretical, since it corresponds to the reaction of exports to a depreciation of the exchange rate, in an economy where there would be no financial market imperfections, no vertical specialization, no vertical integration, and no rigidities on the labor and product markets. Thus, many actual characteristics in the exporting country may influence

the reaction of exports to variations in the exchange rate. Nevertheless, this elasticity can be compared to other estimation results in the literature. Using a similar estimation technique, Chinn (2004) finds an elasticity of 2.28 on the real exchange rate for the US exports to the rest of the world. Interestingly, this high elasticity is found for a country where financial market imperfections are supposed to be very low, and where product and labor markets are quite flexible.

Most importantly, our variables of interest remain highly significant, even when controlling for these elements. This confirms the key role of balance-sheet effects in explaining the reaction of trade to exchange rate movements. Finally, our results are robust to different other specifications, including the removal of countries with fixed exchange rate, and to the consideration of two different sub-periods (1990-1997 and 1998-2005). Those results are available upon request.

# 5 The Role of Amplification Effects

Following our assumptions in the theoretical underpinnings section of the paper, we investigate the role of the financial dependence of exports and the role of the magnitude of the depreciation, in the way a country's exports react to an exchange rate shock. We already mentioned that countries characterized by a high level of financial dependence of exports should be more sensitive to financial market imperfection channels when the currency depreciates, since firms have to use a higher share of external capital. Moreover, we consider here the potential non-linear effect of the exchange rate depreciation by introducing a squared exchange rate term. Our analysis leads us to estimate the following equation[13]:

$$\begin{aligned} logX_{i,t} = \gamma_0 + \gamma_1 logP_{it} + \gamma_2 logY_{it} + \gamma_3 logPC_{it} + \gamma_4 logE_{it} + \gamma_5 logYW_{it} \\ + \gamma_6 logE_{it} * logFCB_i + \gamma_7 logE_{it} * logFD_{it} + \gamma_8 logE_{it} * (logFD_i)^2 \\ + \gamma_9 logE_{it} * logED_i + \gamma_{10}[logE_{it} * logE_{it}] + [...] + \upsilon_{it} \end{aligned} \quad (7)$$

where ED represent the degree of External financial Dependence of exports. We expect $\gamma_9$ to be negative - more financially dependent countries should react more negatively to a depreciation of the exchange rate. Moreover, we expect a positive sign on the coefficient of exchange rate and a negative sign on the coefficient of the square of the exchange rate, so that the result should report an inverted "U-shaped" curve to describe the impact of exchange rate on the volume of exports.

Our results are reported in estimations A and C of Table 3. These regressions indicate that, while the coefficient on the exchange rate is always positive - indicating a pro-competitive effect of the depreciation - the coefficient on the interaction term with the financial dependence is negative and highly significant, suggesting that the financial market imperfections channel is

[13]Once again, to facilitate clearer reading, we do not report in this equation the lead / lagged variables, nor the dummies.

magnified when countries have a more financially dependent structure of exports. We can see from table 7 (appendix) that Singapore, Thailand and Malaysia are more financially dependent than Brazil, Argentina and Colombia; this would be an explanation for the low degree of response of the South-East Asian volume of exports, after the currency crises that occurred in the region in 1997-98, as described in Duttagupta and Spilimbergo (2004). Estimation (B) includes an interaction term between the banking crisis dummy and external financial dependence, which is negative and significant: as expected, specialization toward financially dependent sectors both magnifies the negative impact of a currency depreciation and banking crises on exports. Even in countries with a high structural level of financial development, a banking crisis may have a very negative impact on trade when the country is specialized in such industries.

Moreover, the coefficient on the exchange rate is always positive and significant while the square of the exchange rate has a significant negative influence (column(C)). This confirms the negative impact of large depreciations, that contribute to amplify the financial market imperfections channel. This result contributes to the literature on the specificity of large exchange rate swings in comparison to smaller shocks. In particular, Baldwin and Krugman (1989) show that, given that firms have to pay a sunk cost to enter the export market and another fixed cost at the beginning of each period in order to stay, only large exchange rate movements will be likely to modify significantly the profitability of the export activity, and thus the entry and exit behavior of firms that will stay durably in or out. Our empirical estimation provide results consistent with a new mechanism regarding this theory. Since the export activity is associated with a fixed cost paid at the beginning of each period, firms have to borrow in order to enter[14]. As a consequence, a large depreciation of the exchange rate should not lead to the entry of new firms if the country is characterized by a high degree of financial market imperfections : the large depreciation will enhance the foreign currency borrowing channel through a higher value of repayments, as well as the credit constraints channel through a lower level of cash flow and borrowing capacity, for the firms that have previously borrowed in a foreign currency. Of course, we should expect the theoretical result provided by Baldwin and Krugman (1989) if the local financial market was perfectly working; however, the existence of financial market imperfections help us understand why a large exchange rate depreciation should lead to a lower increase - or a decrease - of exports, in emerging market economies.

The idea according to which this non-linearity in the relationship between exchange rate movements and trade is indeed due to financial market imperfections is confirmed by the inclusion of an interaction term between the square of the exchange rate and the foreign currency borrowing variable, whose estimated coefficient is negative and significant (column (D)). Moreover, this estimation both suggests that the non-linear effect of exchange rate movements on trade comes from financial imperfections (the coefficient on the square of the exchange rate becomes positive) and that the negative balance-sheets effects of exchange rate variations on exports are only observed for sufficiently high magnitudes of depreciation (the coefficient on the interacted

[14]Of course, the extent of borrowing depends on the industry we consider.

Table 3: Magnification effects

| | | | | | *Robustness* | | |
|---|---|---|---|---|---|---|---|
| Depvar: *Export Volume* | (A) | (B) | (C) | (D) | (E) | (F) | (G) |
| ***Traditional Variables*** | | | | | | | |
| *GDP Volume* | 0.405*** | 0.395*** | 0.353*** | 0.393*** | 0.585*** | 0.550*** | 0.499*** |
| | (0.067) | (0.067) | (0.059) | (0.058) | (0.060) | (0.056) | (0.066) |
| $\frac{CompetitorsPrice}{DomesticPrice}$ | 0.308*** | 0.290*** | 0.135* | 0.174** | 0.631*** | 0.594*** | 0.355*** |
| | (0.070) | (0.070) | (0.076) | (0.078) | (0.101) | (0.096) | (0.101) |
| *Foreign Demand* | 0.163 | 0.166 | 0.417** | 0.379** | -0.080 | -0.045 | 0.40** |
| | (0.187) | (0.189) | (0.171) | (0.155) | (0.127) | (0.144) | (0.155) |
| *Exchange rate* | 2.757*** | 2.779*** | 0.993*** | 0.727*** | 6.261*** | 5.886*** | 3.977*** |
| | (0.282) | (0.268) | (0.169) | (0.191) | (0.830) | (0.839) | (0.733) |
| ***Financial Variables*** | | | | | | | |
| *exch.rate*FCB* | -19.127*** | -18.991*** | -6.637*** | -0.032 | -35.198*** | -33.863*** | 29.143*** |
| | (2.339) | (2.283) | (1.856) | (2.153) | (2.552) | (2.474) | (10.448) |
| *exch. rate*fin.dvt* | -4.782*** | -4.913*** | -3.430*** | -3.760*** | 1.196 | -0.130 | -6.496*** |
| | (0.583) | (0.563) | (0.779) | (0.760) | (0.970) | (1.046) | (1.127) |
| $exch.rate * (fin.dvt)^2$ | 6.606*** | 6.709*** | 3.805*** | 4.155*** | 1.382 | 1.799 | 6.607*** |
| | (0.774) | (0.757) | (0.953) | (0.942) | (1.171) | (1.147) | (1.311) |
| ***Magnification Variables*** | | | | | | | |
| *exch.rate*ext.dep* | -6.753*** | -6.693*** | | | -14.377*** | -12.980*** | |
| | (0.873) | (0.830) | | | (1.208) | (1.346) | |
| *Banking Crisis* | | 0.222** | | | | 0.368*** | |
| | | (0.092) | | | | (0.128) | |
| *Banking Cr.*ext.dep* | | -0.699** | | | | -1.344*** | |
| | | (0.278) | | | | (0.332) | |
| $exch.rate^2$ | | | -0.011* | 0.027* | | | 0.195*** |
| | | | (0.006) | (0.015) | | | (0.037) |
| $exch.rate^2 * FCB$ | | | | -0.826** | | | -3.088*** |
| | | | | (0.343) | | | (0.851) |
| Observations | 828 | 828 | 828 | 828 | 547 | 547 | 547 |
| $R^2$ | 0.71 | 0.71 | 0.64 | 0.65 | 0.84 | 0.85 | 0.82 |
| Estimation method | | | DOLS | | | DOLS | |

Note: Significance levels: *10%, **5%, ***1%. All variables are in logarithms. Robust Standard Errors are in parentheses. Estimations (E) to (G) includes the same controls as estimation of table 2. All regressions include time, countries, quarterly dummies, and differentiated lags. One differentiated lead and lag are introduced for each independent variable. Intercept is not reported.

term between exchange rate and foreign currency borrowing becomes insignificant).

The last three columns in table 3 includes the four controls presented in the previous section (cf. table 2), and confirm the stability and the significance of the coefficients presented in the previous estimations. On the basis of the estimated coefficients in (A), we compute the estimated impact of a one standard-deviation increase (i.e. depreciation) in exchange rate value on the volume of export for each country of the sample, by using the actual countries' characteristics given in table 7 (Appendix). Our results in table 4 put into numbers the different reactions across countries. The larger competitiveness effect is found for Peru and Ecuador, for which exports are found to increase respectively by 20 and 57% after a one-standard deviation increase in exchange rate. This result can be understood by taking into account both the very low level of financial development and the low degree of external dependence of these countries, mostly specialized in primary goods. As mentioned above, countries with a very low level of financial development will not face credit constraints. In these countries, firms are more constrained by the scarcity of capital than by the amount of collateral they need to provide to financial institutions. Thus, even if the share of firms' level of foreign currency borrowing is high, the traditional competitiveness effect may be observed in those countries, especially if exports do not heavily rely on finance. The simulation also indicates that exports are predicted to decrease after an exchange rate depreciation in most of emerging economies, which combine an intermediate level of financial development together with a high level of foreign currency borrowing and a high external dependence of exports. Interestingly, these estimates give a quite realistic picture of what happened in middle-income countries' after recent currency crises: while exports increased after the crisis in Turkey, they fell in Indonesia, Thailand, Argentina or Brazil. Finally, the reaction of industrial countries, such as United States or United Kingdom, is found to slightly positive. Their high degree of external dependence prevents them from having a strong expansionary effect of the depreciation, but the high development of their financial markets, and their very low propensity to borrow in the foreign currency, decrease the risk for domestic firms of facing negative balance-sheets effects. Note however that the low impact of exchange rate movements on exports that we find for developed countries in the simulation can be the result of a lower standard deviation of the exchange rate for those countries, as compared to developing economies that have faced larger exchange rates shocks over the period.

## 6 Conclusion and Directions for further Research

This paper examines how financial factors determine the reaction of countries' exports to exchange rate variations. In particular, we consider the role of countries' financial market imperfections, i.e. foreign currency borrowing and credit constraints. We also investigate the role of the financial structure of exports and the extent of the depreciation as magnification factors. Taking these financial factors into account allows us to better understand why some currency

Table 4: Effect of one standard deviation increase in exchange rate on export volume

| | | | |
|---|---|---|---|
| Argentina | **-0,25** | Brazil | **-0,25** |
| Canada | **-0,02** | Hong Kong | 0,05 |
| Colombia | **-0,31** | Ecuador | 0,57 |
| Hungary | **-0,14** | Indonesia | **-0,19** |
| Malaysia | **-0,06** | Peru | 0,20 |
| Philippines | **-0,01** | Poland | 0,05 |
| Singapore | **-0,08** | Thailand | **-0,09** |
| Turkey | 0,02 | UK | 0,01 |
| USA | 0,03 | | |

Source: Authors' computations from actual values of foreign currency borrowing, financial development and external dependence given in appendix, and estimated coefficients of column (A), table 3.

crises did not generate an increase in the volume of exports, as the traditional theory would expect.

Our results indicate that financial market imperfections have a negative impact on the reaction of countries' exports to the depreciation. While the level of foreign currency borrowing always has a negative impact when the shock happens, the level of financial development - which is inversely related to the level of credit constraints - has a positive impact beyond an *intermediate* level of financial development, which is consistent with our data. Our results explain why exports did not increase after the currency crises that occured in Latin America at the end of the 1990's, since countries like Argentina and Brazil are characterized by low levels of financial development and high levels of foreign currency borrowing.

We also show that amplification effects are in action: a more financially dependent structure of exports and a larger depreciation are associated with a more negative reaction of exports, since these two variables amplify the financial market imperfections channel. Here, the financial dependence of exports is especially useful in explaining why South-East Asian economies did not demonstrate an increase in exports after the currency crisis in 1997.

Our results have several policy implications. They stress in particular the importance of considering financial factors when studying the expected impact of exchange rate movements on trade, especially when an exchange rate depreciation or devaluation is expected to kick-start an economy in period of recession. Our results emphasize the fact that such a depreciation or devaluation can either improve the trade balance or magnify the recession by decreasing the volume of exports, the final result depending principally on firms' financial behavior and country's specialization.

All our results are consistent with the hypothesis that the more negative reaction of the aggregate volume of exports to a currency depreciation, is a consequence of the existence of financial market imperfections that lead to a decrease in the extensive margin. Whereas a little depreciation leading to a small increase in the debt service can be balanced at the firm level by an increase in the demand for home produced goods abroad, large depreciations will lead to large firms exits of firms that will not benefit from the pro competitive effect.

Further research should intend to better measure the variations in the extensive and intensive margins of trade consecutive to an exchange rate variation, using firm level data.

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# 7 Appendix

## 7.1 Data Appendix

The sample covers quarterly data between the first quarter of 1990 and the first quarter of 2005. We provide a complete description of the variables and the data source below:

**Volume of Exports:** Export prices are used to deflate export revenues in order to obtain the volume of exports. Exports' value and export price indexes are both denominated in USD. As we reported above, export price indexes at a quarterly frequency are only available for a restricted number of countries ; this is the main reason why our database only contains 27 countries. All these data are available online from the IMF International Financial Statistics (IFS).

**Volume of GDP:** In the same way, we compute GDP volumes for each country as a ratio between the value of GDP and the GDP deflator. When the latter was unavailable, we used the country's Consumer Price Index. All these data also come from the IFS.

**Trading Partners Revenue:** We have computed an index foreign demand based on the country's trading partners. The index is computed as follows:

$$YW_i = \sum_{k=1}^{N} \omega_{ij} X_{ij} \qquad with \qquad \omega_{ij} = \frac{X_{ij}}{X_i}$$

where $X_{ij}$ represents total exports of country i to country j, and $\omega_{ij}$ the share this trade flows with respect to the total exports of country i. Bilateral trade data comes from the DOTS database.

**Prices:** Producer Price Indexes come from the IFS, and are denominated in the local currency. In addition, we constructed an index of competitors' prices as a weighted average of countries' trading partners import prices. More precisely, we used the following methodology so as to compute our competitors' price indexes:

$$PC_i = \sum_{k=1}^{K} \sum_{j=1, j\neq i}^{J} s_k s_j P X_{jk} \qquad with \qquad s_k = \frac{X_{ik}}{X_i} \qquad and \qquad s_j = \frac{X_{jk}}{X_{Jk}}$$

where $CP_i$ is country i's competitor price index given its K trading partner countries ; $s_k$ is the share of country k in i's total exports ; $s_j$ is the share of country j in k's total imports ;

and $PX_{jk}$ is the bilateral export price from country j to country k. Since this last variable is not available at a quarterly frequency, we adapt this *ideal* competitor price index in order to match the available data. We therefore use the following competitor price index :

$$PC_i = \sum_{k=1}^{K} s_k PM_k$$

Where $PM_k$ is country k's import price at a quarterly frequency, as reported in the IFS. $s_k$ is calculated for the year 2000 from the DOTS trade data. The $CP_i$ remains imperfect since it does not take into account exporting countries' specialization; however, it better fits price dynamics than a world import price.

**Exchange Rate:** The exchange rate data come from the IFS. We consider the number of each country's currency units for one unit of SDR - an increase in the exchange rate term means a depreciation of the currency. We choose the SDR value of the exchange rate rather than the dollar one in order to better take into account the competitiveness effect of a currency depreciation. In addition, we should note that effective exchange rates were not available at a quarterly frequency for a sufficiently large number of countries.

**Foreign Currency Borrowing:** We constructed indexes of countries' level of foreign currency borrowing, using the WBES database provided by the Worldbank online. From this database, we more precisely learn which share of exporting firms' total external debt is denominated in a foreign currency, and compute a simple average of firms' foreign currency borrowing ratio in each country. Results are reported in table 7. Since the WBES database mostly includes small and medium size firms, ratios are quite low. Nevertheless, the ranking of countries in respect to this ratio is consistent with previous empirical studies ; in particular, the level of foreign currency borrowing in Argentina - a very "dollarized" economy - is by far higher than that level in the United States.

**Financial Development:** The data are availlable from Thorsten Beck's website. We use the ratio of Private Credit on GDP, and take five-years averages in order to smooth the data and avoid short-run variations and cyclical effects.

**Financial External Dependence:** We use the sectoral data of Rajan and Zingales (1998). These authors define the financial external dependence as the fraction of capital expenditures not financed with cash flows from operations. The authors computed levels of external dependence for 27 ISIC US industries. We use this data to compute a structural financial dependence of exports for each country, according to the share of each sector in the country's total exports. Sectoral trade data come from the COMTRADE dataset (United Nations). Rajan and Zingales

(1998) use the ISIC classification, the construction of the external dependence indicator thus requires the conversion of ISIC codes to SITC ones. The computed index is simply:

$$ED_i = \sum_{j=1}^{k} \alpha_{ij} ED_j$$

where $\alpha_{ij}$ is the share of sector j in the exports of country i, and $ED_j$ the external financial dependence of the sector as given by Rajan and Zingales (1998).

**Vertical Specialization index:**

We first compute for each country in our sample the value of imported inputs for 9 SITC industries. For this work, we use the 1990 input-ouput table of the United States (available from the OECD), assuming that each country in our sample has the same production technology. From this table we obtain the share of each input k which is used in the production of each of the 9 output sectors p, $\theta_{kp}$. For each output category, we can therefore define the value of intermediate imports as follows:

$$MI_p = \sum_{k=0}^{8} \theta_{kp} \times M_k$$

Where $MI_p$ is the value of imported inputs dedicated to the production of the output category p, and $M_k$ is the value of imports in each input category k (from the COMTRADE database, UN). We then follow Hummels, Ishii and Yi (1999) and propose to measure the degree of vertical specialization at the industry level as follows:

$$VS_p = \left( \frac{MI_p}{Y_p} \right) \times X_p$$

Where $VS_p$ is the vertical specialization indicator, which can be associated to the imported content of exports. $MI_p$ is the value of imported inputs in output category p (as computed above), $Y_p$ is the domestic production in the same category (from the UNIDO database, UN), and $X_p$ is the value of exports. Hummels, Ishii and Yi (1999) argue that measuring the degree of vertical specialization at the aggregate level requires to normalize the export content of exports by the aggregate value of exports to take into account the composition effects. We therefore compute our Vertical Specialization index as follows:

$$VS_{index} = \frac{\sum_{p=0}^{8} VS_p}{\sum_{p=0}^{8} X_p}$$

This index is computed for each year and exporting country in our sample. We alternatively compute a mean vertical specialization index, taking the mean of the $VS_{index}$ over the period.

**Vertical Integration:** We use the sectoral estimates of Acemoglu *et al.* (2005). Following

a methodology similar to Rajan and Zingales (1998) for external financial dependence, these authors estimate industry-level vertical integration based on the characteristics of the US economy. We use this data to compute a structural vertical integration level of exports for each country, according to the share of each sector in the country's total exports. As for external financial dependence, the sectoral trade data come from the COMTRADE dataset (United Nations). The computed index is simply:

$$VI_i = \sum_{j=1}^{k} \alpha_{ij} VI_j$$

where $\alpha_{ij}$ is the share of sector j in the exports of country i, and $VI_j$ the vertical integration of the sector as given by Acemoglu *et al.* (2005).

**Labor and Product Market Rigidities:** We construct indexes of countries' level of labor and product market rigidities, using the WBES database provided by the Worldbank online. In this database is available qualitative information of the extent of product and labor market rigidities faced by the firms in each country. The index ranges from 1 (regulations as a small obstacle) to 5 (high obstacle). As for foreign currency borrowing, we than compute a simple average of labor and product market rigidities for each country.

Additionally, we also ran further robustness checks using different proxies: cost of hiring and firing workers from Botero *et al.* (2004) as a proxy for product market rigidities, number of steps to start a new business from Djankov *et al.* (2002) as a proxy for product market rigidities. In both cases, our results were unchanged but the estimated coefficients on those variables were most of the time insignificant.

## 7.2 Stationarity Tests

Table 5: Fisher Stationarity Tests

| Variable | Number of Lags | *Without Trend* | | *With Trend* | |
|---|---|---|---|---|---|
| | | Chi-2 | Probability | Chi-2 | Probability |
| *Volume of Exports* | 3 | 54,7371 | 0,4465 | 29,7221 | 0,9971 |
| *Volume of GDP* | 4 | 63,4225 | 0,1782 | 49,7318 | 0,7481 |
| *Exchange Rate* | 3 | 57,2273 | 0,3563 | 39,3344 | 0,933 |
| *World Imports* | 6 | 2,0261 | 1 | 41,0676 | 0,9023 |
| *Producer Price* | 4 | 69,5416 | 0,0757 | 54,1325 | 0,4693 |
| *Competitors Price* | 4 | 60,7022 | 0,2471 | 17,2438 | 1 |
| $\frac{CompetitorsPrice}{ProducerPrice}$ | 3 | 61,185 | 0,2358 | 20,4149 | 1 |

The number of lags is obtained by minimizing the Bayesian criteria for each variable and each individual, and then taking the average for each variable.

## 7.3 Cointegration test

Table 6: Pedroni cointegration test

| | |
|---|---|
| *panel v-stat* | 2.33939 |
| *panel rho-stat* | -8.58166 |
| *panel pp-stat* | -11.87111 |
| *panel adf-stat* | -3.18544 |
| *group rho-stat* | -8.53852 |
| *group pp-stat* | -14.73760 |
| *group adf-stat* | -0.75360 |

Results for 27 individuals and 61 time periods, for a cointegration relationship between the volume of exports (dependent variable) and four regressors : the volume of GDP, the exchange rate, world imports, and the ratio competitor price/producer price. All statistics are distributed N(0,1) under null of unit root or no cointegration

Table 7: Descriptive Statistics

| Country | Foreign currency borrowing | Financial Development | External Dependence |
|---|---|---|---|
| Argentina | 0.08 | 0.15 | 0.26 |
| Australia | - | 0.79 | 0.27 |
| Brazil | 0.04 | 0.27 | 0,28 |
| Canada | 0.02 | 0.80 | 0.38 |
| Colombia | 0.06 | 0.30 | 0.23 |
| Ecuador | 0.03 | 0.19 | 0.17 |
| Hong Kong | 0.01 | 1.35 | 0.42 |
| Hungary | 0 | 0.3 | 0.38 |
| Indonesia | 0.04 | 0.47 | 0,23 |
| Israel | - | 0.58 | 0.39 |
| Japan | - | 2.06 | 0.56 |
| Jordan | - | 0.58 | 0.42 |
| Korea | - | 1.07 | 0.48 |
| Latvia | - | 0.10 | 0.26 |
| Malaysia | 0.03 | 1 | 0.46 |
| New Zealand | - | 0.83 | 0.23 |
| Norway | - | 0.92 | 0.24 |
| Peru | 0.06 | 0.09 | 0.14 |
| Philippines | 0.03 | 0.28 | 0.24 |
| Poland | 0.04 | 0.17 | 0.33 |
| Singapore | 0.07 | 0.8 | 0.53 |
| South Africa | - | 0.53 | 0.26 |
| Switzerland | - | 2.05 | 0.55 |
| Thailand | 0.05 | 1.02 | 0.37 |
| Turkey | 0.03 | 0.12 | 0.27 |
| United Kingdom | 0.01 | 1.12 | 0.48 |
| United States | 0.01 | 1.49 | 0.49 |

Sources : External Dependence data from Rajan and Zingales (1998). Foreign currency borrowing : authors computations from WBES (Worldbank) data. Financial Development: WorldBank.