Exchange Rate Movements, Skill-Content and Direction of Trade[1]

Mustafa Caglayan
School of Social Sciences
Heriot-Watt University
Edinburgh, UK
E-mail: m.caglayan@hw.ac.uk

Fırat Demir[2]
Department of Economics
University of Oklahoma
Norman, Oklahoma, USA 73019
E-mail: fdemir@ou.edu

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[2] Corresponding author. Tel: (+1) 405-325-5844

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Abstract

We examine real exchange rate effects on bilateral trade flows considering the skill-content and origin/destination of products. Exports with high-skill content are affected the least from exchange rate fluctuations. Yet, we show that who exports what and where matters. Exports from developing countries are affected by both the level and volatility of exchange rates. Furthermore, while trade flows between developed economies are also affected by exchange rate volatility, exports from developed to developing economies are not. These results hold for most skill-content categories except for high-skill goods. Overall, trade structure and economic development determine exchange rate effects on trade flows.

Key Words: Exchange rate movements; trade flows; skill-content; trade structure; gravity; country heterogeneity.

JEL Codes: F14; F31; O14; O24

1. Introduction

Empirical research on the relationship between exchange rate movements and trade flows has been abundant since the breakdown of the Bretton Woods agreement. This literature focusing, until recently, on total, bilateral as well as sector specific trade flows, has come to the conclusion that exchange rate volatility has either limited or no impact on aggregate trade flows (Arize et al., 2000; Sauer and Bohara, 2001; Grier and Smallwood, 2007; Caglayan and Di, 2010). The research on the level effects of exchange rate fluctuations is also as ambiguous (Berman et al., 2012; Caglayan and Demir, 2014; Hericourt and Nedoncelle, 2015; Anderson et al., 2016).

Building on advances in international trade theory, the focus of more recent analytical models has been on the role of firm or industry level heterogeneity and nonhomothetic preferences of consumers. Particularly, the trading environment, productivity, product quality, product-variety, income and preference similarities of importers and exporters as well as export diversification are shown to affect how international trade responds to exchange rate movements (Melitz and Ottaviano, 2008; Jaimovich and Merella, 2015; Chatterjee et al., 2013; Hallak, 2006, 2010). Likewise, country heterogeneity is shown to be another significant determinant of international trade. Developing countries, for example, are shown to be more sensitive to exchange rate movements given their higher exchange rate volatility and lack of self-insurance mechanisms in financial markets that could help cushion against exchange rate shocks. The disadvantages of developing country firms in relation to productivity, market access, know-how and size can also aggravate exchange rate effects, both in the first and second moments (Caglayan et al., 2013; Chatterjee et al., 2013; Vannoorenberghe et al., 2014). Particularly, as the majority of developing countries export mostly less-differentiated, lower quality, and lower technology-and-skill-intensive products, they lack the ability to adjust their prices to external shocks. Nevertheless, an examination of the data shows that there has been a significant increase in the technology-and-skill-intensity of Southern exports to destinations in North[1] and South, reflecting the growing importance of some emerging markets such as China, Brazil and South Korea.

In this paper, given the changes in the composition as well as in the origin and destination of traded goods over time, we examine the impact of exchange rate movements on trade structure (i.e. the skill-content of exports) after controlling for exporter and importer heterogeneity based on economic development levels. We classify technology-and-skill-intensity of exports based on Lall (2000) and examine real exchange rate effects on five product categories: high-skill intensive manufactures (*high-skill*), medium-skill intensive manufactures (*medium-skill*), low-skill intensive manufactures (*low-skill*), natural-resource-intensive manufactures (*resource-intense*), and primary products (*primary*). We implement a gravity equation, accounting for multilateral resistance terms, as suggested by Anderson and van Wincoop (2003), and use the resistance terms as in Baier and Bergstrand (2009). We estimate the model using the Poisson Pseudo-Maximum Likelihood (PPML) method of Silva and Tenreyro (2006). The data are comprised of bilateral trade flows between 172 countries at 4-digit level (SITC Rev.2) and cover the period of 1962-2012.

The results show that the skill-content of exports is important in understanding the trade effect of real exchange rate fluctuations. We find that while real depreciations have a significantly positive effect on bilateral total, medium-skill, low-skill, and resource-intense exports, they do not affect high-skill or primary good exports. Similarly, we find a significantly negative effect of real exchange rate volatility on total, low-skill, resource-intense and primary good exports, yet we detect no volatility effects on high or medium-skill products. These findings complement recent literature that highlights the importance of product quality, variety and productivity on trade flows.

[1] The North includes the high income OECD countries of Austria, Australia, Belgium, Canada, Denmark, Germany, Finland, France, Greece, Israel, Italy, Japan, Luxembourg, Netherlands, New Zealand, Norway, Portugal, Spain, Sweden, Switzerland, UK and US. The South includes the rest.

When we scrutinize results regarding the origin and destination of exports, we find that the effect of exchange rate movements differ significantly with the development levels of trading country pairs. In particular, we find that real depreciations have a significantly positive effect on total exports in all but South-North direction. Furthermore, while medium-skill exports react positively to real depreciations, high-skill exports do not in any direction. The case of low-skill, resource-intensive and primary good exports is highly heterogeneous and is dependent on the direction of exports. Yet, whenever the effect is significant, it is positive. Regarding exchange rate volatility, we find that it has a significantly negative effect on total exports, independent of the direction of trade. However, this effect, too, is highly heterogeneous across different skill intensities. High-skill exports, for example, are not affected by exchange rate volatility, except in South-North direction, where the effect is significantly negative. The weakest effects of volatility are found in the case of resource-intensive and primary good categories. Interestingly, except for the case of high-skill and primary good categories, volatility has a significantly negative effect on all types of trade between countries with similar incomes (i.e. South-South or North-North). As expected, volatility hurts exports from South to North the most and exports from North to South the least. Overall, these results suggest that who exports what and where matters under exchange rate shocks.

The next section presents a brief summary of the related literature. Section 3 discusses the data and the empirical methodology we follow. Section 4 provides the results while section 5 presents sensitivity analysis. Section 6 concludes and offers suggestions for future research.

2. Related Literature

Empirical research, which scrutinized total, sectoral or bilateral trade data has shown that exchange rate volatility effects on trade flows is either insignificant or negative but not robust.[2] The first moment effects

[2]Cushman (1983), Kenen and Rodrik (1986), Thursby and Thursby (1987), Dell'Ariccia (1999), and Grier and Smallwood (2007) report a negative effect of exchange rate volatility on trade. In contrast, Gagnon (1993), Baum et al. (2004), Baum and Caglayan (2010) and Tenreyro (2007)

of exchange rates on exports also remain unsettled as exchange rate depreciations are shown to increase exports for developing countries but not necessarily for others.[3] Nevertheless, as the analytical focus changed towards firms as primary agents in international trade and the firm level data became more available, empirical research has turned towards exploring factors that may affect firms' ability to start exporting or to expand the volume and spectrum of their exports. Particularly, firm heterogeneity in product variety, quality, commodity composition, productivity and firm size as well as importer heterogeneity with heterogenous preferences are shown to affect how firms respond to exchange rate movements. This shift in focus is most meaningful, as the aggregation of heterogeneous firms or sectors is shown to bias the effects of exchange rate changes on exports (Imbs and Mejean, 2015).

To this end, Melitz and Ottaviano (2008), Berman et al. (2012) and Martin and Rodriguez (2004) argue that high-productivity firms, enjoying lower demand elasticities, increase their mark-ups more than their export volumes in response to exchange rate depreciations. Likewise, Chatterjee et al. (2013) show that exchange rate depreciations lead firms to increase their product range while at the same time cause these firms to raise the prices of their core products. Vannoorenberghe et al. (2014) and subsequently Hericourt and Nedoncelle (2015) also provide evidence that exchange rate uncertainty does not affect large companies, which diversify their exports to a set of destinations. They also show that small companies are negatively affected from exchange rate volatility, forcing them to exit export markets. Thus, firms with higher productivity and of multiproduct variety are shown to respond differently to exchange rate fluctuations. As productivity increases, firms enjoy higher mark-ups, wider product variety, higher export market diversification, and face lower price elasticities, which affect their responses to exchange rate changes. For example if trade costs increase with an exchange rate depreciation, higher productivity

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argue that exchange rate volatility has an insignificant effect. Yet, Klein (1990), Kroner and Lastrapes (1993) and Caglayan et al. (2013) report both positive and negative effects.

[3] See, for instance, Freund and Pierola (2012), Haddad and Pancaro (2010), and Rodrik (2008).

exporters are more likely to raise prices and pass on the cost to consumers than lower productivity ones (Chatterjee et al., 2013).

In this context, better risk diversification through a wider variety of exported products and export destinations allow firms to adjust their prices and increase their survival probabilities when they face negative exchange rate shocks. High productivity firms, for example, can continue to export even if their profit margins are hurt after a negative exchange rate shock as they can offset their losses using earnings from other markets. It is also suggested that better performing firms can respond to negative exchange rate shocks by increasing their productivity, which help dampen or even overcome the negative trade effects of such shocks (Ekholm et al., 2012). Therefore, exchange rate effects on aggregate trade flows, depending on the weight of high performance firms in total exports of a given country, can easily differ across countries.

In addition to productivity, product-variety and export market diversification differences, the quality and commodity composition of trade can also affect how exporters respond to exchange rate changes. Price and income elasticities, for example, decrease as we move from manufactures to primary goods and raw materials.[4] And yet, higher technology-and-skill-intensive and more specialized/differentiated manufactured goods have lower price and higher income elasticity of demand than lower technology-and-skill-intensive and less differentiated goods. Furthermore, price elasticities are expected to be lower in the early stages of a product's life cycle for new and technology intensive manufactures and higher in the later stages corresponding to standardized goods (Vernon, 1966). Consistent with these observations, Chen and Juvenal (2016) show that export prices increase more for higher quality goods after real depreciations, suggesting that pricing-to-market increases with quality. Thus, exchange rate movements are expected to affect trade flows differentially across both different product groups and different exporters and importers.

[4] Matsuyama (2000) and Markusen (2013) show that the South's comparative-advantage lies in goods that have low income elasticity of demand.

It is also possible that as exchange rate volatility increases (or as exchange rate appreciates) less productive firms with lower mark-ups quit the Northern markets where competition is tougher. They may, however, continue to export to Southern markets due to lower competition or higher preference similarity (i.e. Linder's hypothesis). Hallak (2010), for example, shows that countries with similar income levels trade more with each other. Similarities in factor endowments of trading partners may be another source of heterogeneity in exchange rate effects on trade as they are shown to affect export diversity (Regolo, 2013). If North–North and South–South trade is more diversified than North–South, as suggested by Regelo (2013), than volatility effects may differ across different country groups as they are across different firms. Given that consumer preference for quality is shown to be increasing in importer's income (Hallak, 2006; Crinò and Epifani, 2012), we expect exchange rate changes to have heterogeneous effects on trade flows. Chen and Juvenal (2016), for example, argue that export price elasticity to real exchange rates increases while export volume elasticity decreases with the quality of exports, and more so for higher income destination countries.

Another source of asymmetry is the problem of original sin and capital market imperfections with a lack of futures markets for hedging in currency markets, which increase developing country exporters' exposure to exchange rate shocks (Erten and Ocampo, 2016). We also find that exchange rate volatility is significantly higher for developing country currencies than it is for developed country currencies. The median level of annual standard deviation of monthly percentage changes in real exchange rates, for example, were more than twice higher in South-South and South-North directions than in North-North direction during the 1980s and 1990s.[5] Besides, financial system depth is highly shallow in most developing countries, exposing exporters to balance sheet shocks after sudden exchange rate movements. Thus, exchange rate shocks create higher entry barriers for developing country exporters, lowering their equilibrium levels of exports. Recent findings, which show that exporter entry and exit rates are higher

[5] More details are provided in the online Appendix.

and survival rates are lower among developing than developed country exporters support these arguments on exporter and importer heterogeneity based on development levels (Fernandes et al., 2016).

The empirical work on developing vs. developed country trade responses to exchange rate volatility has been limited. Arize et al. (2000), Sauer and Bohara (2001) and Grier and Smallwood (2007) show that exchange rate volatility has a significantly negative effect on developing country exports. In contrast Caglayan and Di (2010) concludes that this effect is either insignificant or negligible. To the best of our knowledge, however, Broad and Romalis (2010) and Caglayan et al. (2013) are the only papers that consider the effects of real exchange rate volatility on trade structure, conditional on the direction of trade. Broda and Romalis (2011) report that increasing volatility decreases trade in differentiated products, and significantly more so for developing than developed country exporters. Caglayan et al. (2013) separate exporting and importing countries based on income levels and tests the effects of exchange rate movements in first and second moments on bilateral manufactures exports. They report mixed results based on the direction of exports with some having positive, some negative and some no effects.

Overall, how trade flows respond to exchange rate changes appears to depend on the market and product structures as well as on the development levels of trading partners. Therefore, in this paper we contribute to the literature on the importance of skill-intensity of exports in relation to exchange rate movements. In our examination, we also consider exporter and importer heterogeneity based on country specific development levels.

3. Empirical methodology

To examine the impact of exchange rate movements on trade flows we use the following gravity equation after controlling for multilateral resistance terms (MRT).

$$lnX_{ijt}^{k} = \beta_1 + \beta_2 lnRER_{ijt} + \beta_3 \sigma_{ijt} + \gamma_i lnGravity_{ijt} + \rho_i MRT_{ijt} + V_t + \varepsilon_{ijt} \qquad (1)$$

where

$$lnGravity_{ijt} = \gamma_1 lnY_{it} + \gamma_2 lnY_{jt} + \gamma_3 lnPop_{it} + \gamma_4 lnPop_{jt} + \gamma_5 lnDist_{ij} + \gamma_6 ln(Area_i * Area_j) + \gamma_7 Lang_{ij} + \gamma_8 Adj_{ij} + \gamma_9 Landl_{ij} + \gamma_{10} ComCol_{ij} + \gamma_{11} CurCol_{ij} + \gamma_{12} Colony_{ij} + \gamma_{13} ComNat_i + \gamma_{14} PTA_{ijt}$$

In Eq. (1) X^k_{ijt} is the bilateral exports (in current USD) from country *i* to country *j* in product type *k* in year *t*. In the benchmark specification, the product type *k* stands for high, medium and low-skill manufactures, resource-intensive manufactures, and primary goods. *RER* is the annual average of monthly bilateral real exchange rates (an increase is a real depreciation). Sigma, σ_{ij}, is the annual exchange rate volatility, the measurement of which is discussed in the Data section. The term V_t is year fixed effects to control for global trends in trade flows and export unit prices. The final term, ε_{ijt}, is the error term.

The vector $Gravity_{ij}$ captures the gravity controls: *Y* is nominal GDP, *Pop* is total population, *Dist* is (km.) distance, *Area* is area in square km. *Landl* is the number of landlocked countries in the country pair (i.e. 0, 1, 2), *PTA* is a bilateral preferential trade agreement dummy. The vector $Gravity_{ij}$ also includes binomial controls that are equal to 1 if *i* and *j* share: i) a common official language (*Lang*); ii) have a common border (*Adj*); iii) have a common colonizer after 1945 (*ComCol*); iv) are in a colonial relationship (*CurCol*); v) have ever had a colonial link after 1945 (*Colony*); vi) were ever the same country (*ComNat*).

MRT_{ij} denotes a vector of multilateral resistance terms as in Eq. (2) below. As pointed out by Anderson and van Wincoop (2003), bilateral trade between *i* and *j* is affected by country specific and time varying multilateral resistance from other trade partners. To overcome this issue, we follow Baier and Bergstrand (2009), who suggested a first-order log-linear Taylor series approximation of the MRT of the Anderson and van Wincoop (2003) model as follows:

$$MRT_{ijt} = \rho_1 MRlnDist_{ij} + \rho_2 MRln(Area_i * Area_j) + \rho_3 MRLang_{ij} + \rho_4 MRAdj_{ij} + \rho_5 MRLandl_{ij} + \rho_6 MRComCol_{ij} + \rho_7 MRCurCol_{ij} + \rho_8 MRColony_{ij} + \rho_9 MRComNat_{ij} + \rho_{10} MR\sigma_{ijt}$$

where each component (*x*) of *MRT* between *i* and *j* is calculated implementing:

$$MRT(x)_{ijt} = \left(\frac{1}{N}\right)\sum_{k=1}^{N}(x)_{ikt} + \left(\frac{1}{N}\right)\sum_{m=1}^{N}(x)_{mjt} - \left(\frac{1}{N^2}\right)\sum_{k=1}^{N}\sum_{m=1}^{N}(x)_{kmt} \quad (2)$$

Here the first (second) term is the mean (x) for country i (j) from its other trading partners k (m) except for j (i), and the last term is a constant. Note that the MRT of real exchange rate volatility variable ($MR\sigma_{ijt}$) captures the effects of volatility between i (j) and all other trade partners and the average volatility between all countries. We expect that volatility between country i and its other trading partners can also affect its exports to country j, after all volatility is a relative concept.

To estimate equation (1) we use the PPML method, which has been shown to consistently estimate the gravity equation for trade flows and is robust to different patterns of heteroskedasticity and measurement error (Silva and Tenreyro, 2006). To avoid estimation problems caused by the log-linearization of positive trade flows in gravity equations, we use positive trade flows in levels rather than in logs as our dependent variable. However, as widely noted, bilateral trade flows include a large number of zero and missing trade and the usual practice of censoring at zero-trade introduces a bias into the estimation. It is also not very clear how to differentiate zero flows from missing flows. To address these issues, following Silva and Tenreyro (2006), we also reestimate the model by inputting zeros for all missing trade flows between all country pairs.

3.1 Data

The trade data are obtained from the MIT Media Lab (2015), which is based on Feenstra et al. (2005) and UN COMTRADE, and include bilateral trade flows between 172 countries at 4-digit level (SITC4 Rev.2) for the period 1962-2012. To measure the skill-content of exports, we use Lall (2000) and classify exports according to their technology-and-skill-intensity into five categories: high-skill manufactures (*high-skill*), medium-skill manufactures (*medium-skill*), low-skill manufactures (*low-skill*), resource-intensive manufactures (*resource-intense*), and primary products (*primary*). In this setting, turbines, for example, are classified as high-skill while chemicals and clothing are classified as medium and low-skill, respectively. Petroleum products are included in the resource-intensive manufactures and crude petroleum is included in the primary products.[6] Table 1 provides summary statistics for the variables that are used in the regression analysis. The final dataset includes 425,686 country-year observations from 24,406 country pairs including 172 exporters and importers. The data on GDP, population and geographical location are from the World Bank's World Development Indicators (2015), when not available we used the GDP data from UNCTAD (2015). The data on geographical area, contiguity, common language, colonial past, bilateral distance, and common nationality are from BACI gravity dataset. The information on PTAs is from WTO (2015).

<Insert Table 1 Here>

The real exchange rate (RER) is equal to *EP*/P*, where *E* is the monthly bilateral average nominal exchange rates and *P** and *P* are importing and exporting country consumer price indexes (CPI) with a base period of January 2010. Thus, an increase in RER is a real depreciation of the home country currency. We calculated bilateral nominal exchange rates using the cross exchange rates of country *i* and *j* against the US dollar. The CPI and exchange rate series are both from the IMF's International Financial Statistics (2014). We then transformed bilateral nominal and real exchange rates into an index with December 2005 as the base period with a value of 100. The 12-month average of monthly values is our measure of annual real exchange rates. To measure volatility, we computed the annual standard deviation of monthly changes (i.e. logarithmic differences) in the real exchange rate index, $\sigma = stdev(lnRER_{ijt} - lnRER_{ijt-1})$, where t=1 … 12. This method helps avoid possible biases in the volatility measure because of any trend affects in exchange rate series. We should also note that the level of real exchange rate and its volatility between an exporter and an importer are not the inverse of each other due to the use of real exchange rate indices.

In Table 2, we provide a summary of the data with respect to income groups, including bilateral exchange rates and skill content of exports. We see that average exchange rate volatility is substantially higher in South-South, South-North and North-South directions than in North-North direction. The

[6] We provide the full list of product classification in the appendix.

dispersion of volatility is also significantly higher in these directions, reaching as high as 0.049 in South-South compared to 0.014 in North-North. We also find that the average share of high and medium-skill goods in bilateral trade is significantly higher for Northern than Southern exporters. For example, the average share of high-skill goods in bilateral exports is 8% in Southern as opposed to 14% in Northern exports. In contrast, on average, 24.7% of bilateral Southern exports are in primary goods as opposed to 12.8% for Northern exports. In addition, Southern countries have a much higher export market concentration, as shown by the Herfindahl Concentration Index (HCI).[7] The variation in HCI within the South is also higher with a standard deviation of 0.16, compared to 0.10 for the North.

<Insert Table 2 Here>

When we look at changes in the export structure in each direction of trade from 1962 to 2012 with ten-year intervals, several observations stand out, providing support to our analytical approach. First, we observe a significant change in the product composition of South-South and South-North exports whereby the share of high and medium-skill manufactures increased while the importance of resource-intensive and primary goods declined. For example, the share of high-skill goods, which was only 1.3% in South-South trade and 0.2% in South-North trade in 1962, increased to 23.9% and 18.8% in 2012, respectively. Furthermore, while the share of low-skill goods remained more or less stable in South-South trade, its share more than tripled in South-North trade. While we do not observe such significant changes in Northern exports to either direction, there are still substantial variations across years, particularly so regarding the increasing importance of high-skill goods. Interestingly, the share of medium-skill goods remained almost the same in North-South exports across five decades (i.e. around 40%) very much like the case with resource-intensive and primary goods. In the case of North-North trade, both resource-intensive and primary goods lost their shares while medium and high-skill goods increased theirs. There has also been a slight decline in the share of low-skill goods. Reflecting the uneven nature of North-South

[7] The HCI for a country will be closer to 1 when its export destinations are concentrated.

trade, over 58% of Northern exports to the South were medium and high-skill in 2012 while the same figure was around 40% for South-North exports.

Changes in cross-country variation of export structures since 1960s also support the need for a disaggregated analysis that controls for country and product heterogeneity across time. Among Southern exporters, for example, the cross-country variation in the share of high-skill (medium-skill) goods in total exports was a mere 0.5% (1.2%) back in 1962, reflecting relative homogeneity among Southern countries. Yet the same cross-country deviation for high-skill (medium-skill) export shares increased to 12.8% (14.4%) in 2012. To a lesser extent, we observe a similar change in low-skill good exports. These changes reflect increasing diversity among Southern exporters with a few earning the emerging market status and enjoying an increasing technology-and-skill-content in their exports. The North, however, compromise a much more homogenous set of countries, and therefore, we do not see radical changes in the standard deviation of their export shares for given product groups. For example, the standard deviation of primary products and natural resource intensive manufactures' export shares decreased from 23.9 and 18.7% in 1962 to 21.1 and 8.8% in 2012. Likewise, the deviation for low-skill goods fell from 12.3 to 7.9 during the same period. The figure for medium-skill manufactures remained the same (13.6 vs. 13.1) while it increased moderately from 4.1 to 7.5 for high-skill goods.

4. The impact of RER movements on skill content of exports

Table 3 presents the coefficient estimates and the corresponding robust standard errors clustered at the country-pair level from equation (1) where the dependent variable is positive levels of bilateral total (column 1), high-skill (column 2), medium-skill (column 3), low-skill (column 4), resource-intensive (column 5), and primary good (column 6) exports. Here, our main focus is on the parameters associated with *lnRER* and *Volatility*, i.e. the first and the second moments of bilateral real exchange rates. Yet, we also keep a close look at the gravity and MRT parameters to make sure that these estimates are meaningful and ultimately the model is correctly specified.

<Insert Table 3 Here >

Focusing on the first column of Table 3, we find that RER depreciation has a significantly positive and RER volatility has a significantly negative effect on bilateral total trade flows. However, as discussed in the previous section, these estimates are likely to suffer from an aggregation bias. In fact, as shown in columns (2)-(6), there is significant heterogeneity across different product groups. In column (2), we fail to find any significant effects of exchange rate movements on high-skill manufactures exports. This finding is consistent with research that has focused on high-skill products and firm level productivity. For instance, Chatterjee at al. (2013) and Martin and Mayneris (2015) argue that high-skill goods are produced by firms that run an efficient production line and employ high-skill employees. Furthermore, these firms are generally large and produce a wide spectrum of goods where the core product mark-ups are adjusted in response to exchange rate changes. Similarly, Berman et al. (2012) report that export volumes of higher performance firms are less sensitive to exchange rate fluctuations as these firms can absorb exchange rate movements in their markups. Chen and Juvenal (2016) find similar results for higher quality good exports.

In Column (3) we see that while a real depreciation has a significant and positive impact on medium-skill exports, volatility does not have any significant effect. This category of goods contains items such as passenger vehicles, engines, and chemicals, which require significant amount of skill content. Hence, the positive effect of a depreciation may be capturing the entry of some niche companies, which are less efficient than the existing ones, or the effects of expansion of product spectrum in larger producers that shift resources into new product lines. Exchange rate volatility may not be deterring trade for this category, because once the threshold to export is exceeded, these companies can absorb such volatility effects as long as a certain level of product quality is achieved.

Results in columns (4) and (5) provide evidence that a real depreciation has a positive and volatility has a negative effect on low-skill as well as resource-intensive exports. In this export category, we expect that in response to exchange rate depreciation smaller companies would increase their share in the market while new firms enter and large firms expand their spectrum of products as they relocate resources on product lines that they would not produce otherwise. To this end, Chatterjee et al (2013) suggest that following exchange rate depreciation the importance of less efficient products relative to core products increase. Hence, through a shift in resource allocation, low-skill and resource-intensive goods will be positively affected by real depreciations. In contrast volatility effects are negative, suggesting that less productive firms with smaller product and export market diversification and lower mark-ups quit the market or firms reallocate their production lines towards their core products.

The last column (6) shows the results for primary goods. For this category we find that real depreciation does not have a significant effect on exports but volatility does. Given the low export demand and supply elasticities of primary commodities, which are homogenous in nature with mostly vertical supply curves, at least in the short run, it is not surprising that real depreciation does not appear to have any significant effect on their exports. In contrast, as is the case with resource-intensive manufactures, volatility has a significantly negative effect, probably because of firms with lower mark-ups and smaller sizes exiting the market or reducing their market shares.

We should note that the parameter estimates associated with the standard gravity variables take the expected signs and they are within the range of estimates reported in the literature. These estimates confirm that countries with higher incomes, common borders, common colonial past or preferential trade agreements trade significantly more with each other.[8] We also find that countries that are distant, large in size (i.e. home country bias) and landlocked trade less. Furthermore, we find that exporter income is a more significant predictor of high and medium-skill manufactures exports with an almost twice-larger effect than for low-skill or primary products. The effects of importer incomes are more homogenous across product groups and range between 0.804 and 1.037. Being landlocked also does not appear to have any effect on exports of high or medium-skill manufactures while having the strongest negative effect on primary product exports and, to a lesser extent, resource-intensive and low-skill manufactures. This is

[8] Except for *Language*, *ComCol*, *CurCol*, *Col45*, and *Smctry*, which, mostly appear insignificant.

consistent with the expected effects of being landlocked in countries that concentrate on primary commodity exports, which experience high transportation costs. Interestingly, the effect of geographical distance, which is negative and significant across different product groups, is decreasing in skill intensity of exports and is the lowest for high-skill manufactures (-0.493) (column 2) and the highest for primary goods (-0.715) (column 6), suggesting that higher-skill goods can travel further away than others.[9] The larger negative effect of distance on resource-intense and primary goods is also consistent with the effect of being landlocked on these types of exports. A novel finding we have in Table 3 relates to the heterogeneous effects of preferential trade agreements on different product groups. In particular, we find that PTAs have the largest positive effect on high (0.448) and medium-skill manufactures (0.456) and the lowest on low-skill (0.201) and resource-intensive manufactures (0.353) while having no effect on primary goods exports (0.069). It should be noted that we do not display and discuss the gravity coefficient estimates in the subsequent tables, as they are similar.

We should remind that Table 3 includes the coefficient estimates for the resistance term on volatility, *MRVolatility*, which controls for the effects of volatility between *i* and the rest of the world, *j* and the rest of the world, and the average volatility between all other countries.[10] Estimating the model without this term would render our results biased as it would have ignored the effects of volatility with (and between) other trading partners as well as with the rest of the world. For example, country *i*'s exchange rate volatility with country *j* might be increasing but so could their volatility (both *i* and *j*'s) with all other countries. Besides, there might be a global increase in volatility among all currency pairs. We find that this term has a positive and significant effect on exports of *i* to *j* in low-skill, resource-intensive and primary products with no significant effect on high or medium-skill exports, suggesting that, for low-skill

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[9] Also see Martin and Mayneris (2015) who show that high-end variety firms export to more distant destinations than lower-end firms. They also find that distance has a much smaller and mostly insignificant effect on high-end exports.

[10] The coefficient estimates for other resistance terms are included in the online Appendix.

exports, firms shift their focus from high volatility countries to low volatility countries. The results are also consistent with the lack of any significant effect of bilateral volatility on high and medium-skill products. One final note is that, overall, the model explains around 50%-75% of the variation in trade flows.

4.1 Does exporter/importer development level matter? South vs. North

An ongoing debate in the literature is whether the development level or income/endowment similarity of trading partners affects the evolution of bilateral trade or trade structure. For example, even within the same product groups, Northern consumers are found to be more likely to import products from other Northern countries than from Southern ones, reflecting preference similarities or any differences in quality ladder between Northern and Southern producers (Linder, 1961; Hallak, 2010). Furthermore, we know that firms export higher quality versions of the same products to higher income partners and lower quality versions to lower income partners (Bastos and Silva, 2010). Export unit prices also happen to increase in exporter and importer incomes (Brambilla, Lederman and Porto, 2012; Benedetti and Borota, 2013; Manova and Zhang, 2015). Besides, firm heterogeneity, including productivity differences, is shown to be higher among developing country exporters than developed countries (Hsiel and Klenow, 2009). Therefore, how trade flows react to exchange rate movements may as well be conditional on the development levels of trading partners.

Given that both high-income (North) and medium-and-low-income (South) countries produce manufactures at all levels of skill content, though at different concentration levels (see Table 2), it is important to examine whether development levels create a wedge regarding the effects of exchange rate fluctuations on exports. Furthermore, as shown in Table 2, average (as well as median) RER volatility within South-South and between South-North is significantly higher with a greater cross-country variation than within North-North direction. Also, as documented in previous studies, average firm size, mark-up rates, productivity and product quality, firm experience, and product and destination diversification of exporters in developed economies exceed those in developing economies, which help explain why developing country exporters experience higher entry and exit rates and lower survival probabilities

(Anderson and Marcouiller, 2002; Belloc, 2006; Levchenko, 2007; Fernandes et al., 2016). Therefore, the effects of exchange rate movements on Southern exports may actually be different than those on Northern exports. The effects may also differ depending on the direction of trade as exporter heterogeneity and comparative disadvantage is lower between Southern exporters than it is between Southern and Northern ones. Besides, similarities in incomes, endowments and consumer preferences in South-South and North-North directions could alter the effects of exchange rate movements across low- and high-income economies when the skill content of exports changes.

To examine the effects of country specific heterogeneity with respect to the direction of exports, we divide the sample into four groups: South-South, South-North, North-South and North-North. We then repeat our investigation for each group separately. This approach also allows us to examine the stability of parameter estimates associated with the control variables for each sub-group in the sample. For brevity, we report only the coefficient estimates for the exchange rate variables.[11] Column (1) in Table 4 displays the impact of real depreciation on bilateral total trade flows for different origin/destination country development levels. We find that the effect is positive and significant in all directions except for exports from South to North. Column (2) for high-skill goods echoes the results presented in Table 3 where we reported no significant effect of RER depreciations on this group of exports. One difference with Table 3, however, is that RER depreciation is now found to improve developing country exports of high-skill manufactures to developed countries, though only at the 10% significance level. Given that a firm's efficiency-quality pair determines its profitability and its ability to cover the fixed cost of operation/exporting and its exit/export decisions (Fasil and Borota, 2012), a real depreciation may tip the balance for some small/niche firms so that they can now enter into the market. Alternatively, larger and more productive firms can expand their exports further after a depreciation (Chatterjee et al., 2013), boosting the overall high-skill exports of low-income countries to the North.

<Insert Table 4 Here >

[11] Full regression results are reported in the online Appendix.

Coefficient estimates for medium-skill exports in column (3) yield results that are very similar to those in Table 4. Here, we observe that regardless of the product origin/destination country, a real depreciation leads to an increase in medium-skill exports. Regarding the economic impact, the least affected pair here is exports from North to South (0.197***), and the most effected pair is exports from South to North (0.509***). It can be argued that Northern exports are not affected as much because Northern firms are larger and more productive, and therefore are not as sensitive to changes in relative prices. Whereas Southern firms are smaller, and new entries might be one reason why exports in this category increase more. Also, the economic effect of a real depreciation for trade flows between similar income countries appears to be similar to each other.

Column (4) shows the effect of RER depreciation on low-skill exports. This effect is significant for trade flows between South-South (at the 10% level) and North-South (at the 5% level), while being insignificant in South-North and North-North directions. The significant effect in North-South direction can be explained by referring to Chatterjee et al. (2013) who argue that depreciations raise the importance of noncore (less efficient) products relative to core products in firms' export baskets. In this context, depreciations help Northern exporters gain a competitive edge in products with low-skill content, for which the South has a comparative advantage. The low-skill products that North exports to South may also be of higher quality than those exported by the South. Hence, depreciations can increase Southern demand for such products more. We should also note that the economic effect of a depreciation on low-skill exports is quite close to that for medium-skill exports in North-South direction, highlighting a similar process for both types of goods. In contrast, the positive impact of depreciation on trade within South-South can result from small and new companies entering into the export market. As Southern countries export products with similar technology-and-skill-intensities and quality, it is not surprising that a real depreciation has a larger economic effect on these goods in South-South direction.

Column (5) shows that, regardless of direction of trade, a real depreciation increases the resource-intensive exports of Southern countries. The economic effect of depreciation on this product category is the largest for Southern exporters amongst all possible country-pair and product categories. This observation can be explained by entry of new companies into the export market. And yet, we also see that Northern exports of resource-intensive goods are not affected by exchange rate depreciations. Last, in the case of primary commodity exports in column (6), for which we did not observe any significant effect in Table 3, Northern exports appear to be significantly affected while Southern exports are not in any direction. Given that primary commodities account for only 13% of Northern exports and that the North is at a comparative disadvantage in these products over the South, a real depreciation can allow exporters a marginal edge to enter into export markets. For example, in the case of crude oil, developed country exporters such as Canada may benefit significantly from a real depreciation while Saudi Arabia would not. It is also possible that Northern countries have smaller supply side restrictions with more capital-intensive production structures than Southern exporters of primary goods. Therefore, they can adjust their export supplies better, at least in the short run, in the face of positive exchange rate shocks.

Overall, these findings are consistent with the results in Table 3: regardless of the origin/destination country development levels, high-skill products are not affected much by a real depreciation. For other categories, depreciations play a significant and positive but an asymmetric role, depending on the development levels of trading partners. It is also clear that except for primary commodity exporters, exchange rate depreciations help Southern countries expand their exports, regardless of products' skill content.

<Insert Table 5 Here >

Table 5 presents the effects of exchange rate volatility on trade flows. The results in column (1) show that volatility has a negative impact on *total* trade flows regardless of origin/destination country. Furthermore, exports from the South appear to be the most affected while those from the North to the South are the least affected from volatility. These results again can be explained by the presence of small and niche companies in South, which, as volatility increases, throw the towel and leave the export market. In contrast, large multi-product, multi-destination and higher productivity companies from the North, which also enjoy easier access to capital markets can absorb such shocks better. We should also note that for most of the product-skill categories the negative effect of volatility is higher in North-North direction than in the South-South direction.

Column (2) shows that in the case of high-skill goods, exchange rate volatility has a significantly negative effect on exports from South to North. Exports in other directions are either not affected or, as in the case of North-North exports, affected only very marginally, both economically and statistically. According to Fernandes et al. (2016) survival rates of entrants in export markets increase as countries develop. Hence, if volatility is an additional cost for new entrants, especially for young niche companies in developing economies that export sophisticated products to high-income countries, it will work as an additional entry barrier. The same process works for Northern exporters as well but probably not as severe so that the magnitude of the impact is smaller in the North than in the South.

Columns (3) and (4) present results for medium and low-skill exports. It appears that except for exports from North to South, exchange rate volatility has a significantly negative impact on these goods. Once again, the biggest impact is on trade flows from South to North, followed by North to North. As discussed before, Southern exporters are affected the worst possibly because of their certain disadvantages, be that their lower productivity, smaller size, less diversified product and destination market structures, or lack of financial hedging mechanisms to safeguard against exchange rate shocks. Also, Rauch (1999) argues that due to the heterogeneity of most manufactured products, sellers and buyers carry out a costly search process. Therefore, RER volatility deters new firm entries through higher sunk costs while encouraging exists among smaller and less productive firms. North-North exports are also affected significantly, possibly because of higher level of intra-industry trade, higher product substitution and competition among developed country firms. Supporting this argument, we find that North-South exports, except those in primary goods, are not affected by exchange rate volatility at all. This is indeed significant given that volatility has asymmetric effects on the very same trading partners depending on whether it is South-North or North-South.

The results in columns (5) and (6) for resource intensive manufactures and primary products suggest that the exports of high-income countries are affected the most from exchange rate volatility. First, we find that North-North exports of resource-intensive manufactures are affected the most while no such strong effect is present in other directions. Second, similar to the effects of a real depreciation on primary goods, only North-South exports to South are hurt by exchange rate volatility. This may be a result of higher cost of primary good production in the North with smaller flexibility in adjusting prices. The lack of comparative advantage of Northern exporters in primary goods may also be a factor in this result.

Overall, these results show that identifying the skill-content of exports help reveal heterogeneous trade responses to volatility. A few observations stand out here: For high, medium and low-skill exports, volatility has the most damaging effect in South-North direction while no such effect is found in the opposite North-South direction. Furthermore, South-South exports in low, medium and high-skill goods appear to be much less vulnerable to volatility than South-North exports. In fact, they appear to be significantly less affected than even North-North flows, both economically and statistically. Another observation is about the resource-intensive and primary good exports from the South, which appear to be quite insensitive to volatility. Exports of North to the South, however, are not affected by exchange rate volatility except for primary goods.

5. Sensitivity analysis

5.1 Zero and missing trade

There are a large number of zero and missing trade flows in the dataset (i.e. 38% of the sample). To tackle this issue, similar to Tanreyro (2007), we repeated the analysis using a balanced panel by inputting zeros for missing (and zero) trade observations between all possible trade partners that have ever recorded any positive trade during the period analyzed. In Table 6, we report only the coefficient estimates associated with the exchange rates from this exercise, while the remaining coefficient estimates are available in the online Appendix. Supporting our findings in Table 3, the coefficient estimates are very similar to those before and are almost identical. We also repeated the exercise reported in Tables 4 and 5 by inputting zeros for all missing and zero trade flows after controlling for the direction of exports. The unreported results, which are available in the online Appendix, were very similar to our earlier findings.

<Insert Table 6 Here >

5.2 Alternative classifications of technology-and-skill-intensity of exports

Are our results sensitive to the measurement of skill-and-technology-intensity of exports? To answer this question we adopted the OECD (2011) export classification as an alternative method. OECD (2011) divides manufacturing industries into four categories based on their R&D intensities: high-technology, medium high-technology, medium low-technology, and low-technology.[12] We classify all other remaining products under "others," which are mostly primary goods. Aircraft and spacecraft, for example, are included in high-technology category while food products are included in the low-technology group. The results reported in Table 7 are similar to those in Table 3. We do not detect any effect of real exchange rate depreciation on high-technology exports under the OECD classification, either. We also find that medium-high and medium-low products are positively affected by exchange rate depreciation. Products that are classified as "others", as in primary goods in Table 3, do not seem to respond to exchange rate movements. Regarding the volatility variable, similar to our earlier findings, we do not detect any significant effect on high, medium-high or medium-low technology manufactures. Low-technology manufactures and others, however, appear to be significantly hurt by exchange rate volatility. Overall, these robustness checks verify our earlier findings: exchange rate effects depend on the skill content of exports.

<Insert Table 7 Here >

Next, we repeat this exercise after controlling for the direction of trade. Part A of Table 8 reports the effects of real exchange rate levels on trade structure in each direction of flows. Here, we find a pattern similar to that in Table 4. Except for exports from North-South direction, real depreciation has no effect on high-technology exports. Medium-high-technology exports, however, are highly and positively responsive

[12] The OECD (2011) classification is based on ISIC Rev.3. We used concordance tables to match the products with the SITC Rev. 2 codes. The product codes are given in the online Appendix.

to depreciation. Low-technology exports do not appear to be affected by exchange rate movements. There are also products that are affected only in one direction. Medium-low-technology goods, for example, are affected only in South-South and South-North directions while "other" exports, similar to primary goods category in Table 4, are positively affected only in North-North and North-South directions.

<Insert Table 8 Here >

Part B of Table 8 shows the effect of exchange rate volatility. Overall the results are similar to those in Table 5. Independent of direction, high-technology exports do not appear to be affected from exchange rate volatility. The only statistically significant effect (at the 10% level) is in North-South direction, and it is *positive*. Except for low-technology exports, North-South trade is not affected by exchange rate volatility, and even in that case the economic impact is three times smaller than in South-North exports. For medium-high technology goods, the effect is negative and significant in all directions but North-South. For medium-high and low-technology goods, volatility hurts trade most in South-North direction with an economic effect that is two-five times larger than in any other directions.

5.3 Additional robustness checks

In this section we report a wide-range of additional sensitivity tests, starting with the measurement of the real exchange rate variable. First, as an alternative, we used the exchange rate misalignment of Rodrik (1998) and replaced the annual real exchange rate variable with the residuals from the following linear model:

$$e_{ijt} = \alpha_0 + \alpha_1 y_{it} + \alpha_2 y_{jt} + V_t + K_{ij} + \varepsilon_{ijt}^{PPP} \quad (3)$$

In Eq. (3), ε_{it} is the log of the real exchange between country *i* and *j* at time *t*, y_{it} (y_{jt}) is the log of real GDP per capital for country *i* (*j*) (i.e. Balassa-Samuelson effect), V_t is a full set of time dummies and K_{ij} is country-pair fixed effect.[13] Additionally, we estimated equation (3) for each country *i* against its trading

[13] We also run models excluding country and time fixed effects.

partners separately. In that case the country-pair fixed effects were replaced by partner country (*j*) fixed effects.

Second, we repeated the analysis using nominal exchange rates, which are highly correlated with real exchange rates. This strategy brings in the added benefit of offering a longer panel because we are not restricted by the availability of CPI series, which are missing for some years in some countries. Third, we experimented with an alternative volatility measure, which is the standard deviation of percentage change in monthly real exchange rates over the same month of previous year. Fourth, we employed one period-lagged exchange rate level and its volatility.[14] Our main results remain unchanged in all these tests.

Next, we looked into the sample selection issue and repeated our benchmark regressions after limiting the sample to those countries that have populations greater than one million. We also limited the sample to: (1) before year 2000 (since there may be a bias in trade values from merging Feenstra (2005) with the COMTRADE series by the MIT lab); (2) after 1973 (because of structural changes in global exchange rate arrangements after the collapse of Bretton Woods system); (3) before 2012 to remove the possibility of some trade data being misreported in the last year of the sample. The (unreported) results from these exercises were similar to our earlier results and they are available in the online Appendix.

6. Conclusion

In this paper, we examine the extent to which exchange movements affect trade flows considering the heterogeneity in the skill content of traded goods and in the development levels of trading partners. We first show that the level and volatility of real exchange rates have significantly different effects on trade across different product groups. In particular, we show that neither a RER depreciation nor its volatility has any affect on trade flows of high-skill content products. In contrast depreciations positively and significantly affect medium and low-skill and resource-intense products, while not affecting primary good exports. In addition, volatility has negative effects on low-skill, resource-intensive and primary goods.

[14] Baum et al. (2004) argue that the effects of exchange rate volatility could be delayed up to a year.

When we control for the origin/destination of exports, we find that a real depreciation has a positive effect for most of the time, except for high-skill content exports. However, the significance and size effect of depreciation depend on the direction trade flows. Turning to volatility effects, we find that it is negative with the strongest effect being found in South-North direction and in high, medium and low-skill goods. For the most part, except for primary goods, North-South exports stand out as the least affected from volatility. For medium, low and resource-intensive manufactures, within country-group volatility seems to be having a strongly negative effect on trade flows.

Our findings have significant policy implications. First, we present evidence that who exports what and where matters. If, as our findings suggest, exchange rate movements affect different groups of products differently than there is a strong incentive for policy makers to try to curb excess volatility in exchange rates depending on their export structures. Secondly, if exchange rate volatility is more harmful to the South than the North, than the causes of this asymmetry as well as its remedies are of significant interest for industrial and trade policy in the South. Is this difference due to (actual or perceived) product quality differences, weak market power, lack of hard currency or the original sin problems in the South? Can further skills-and-quality-upgrading, developing specialized production niches, or financial development, including stable long-term financing sources and currency hedging instruments, help eliminate this asymmetry? Lastly, our findings contribute to the ongoing debates on the use of exchange rates as an industrial policy tool to stimulate growth. Based on our findings, we argue that (developing) countries that are climbing up the value-chain in international trade may benefit more from focusing on policies other than exchange rate undervaluation to help their high-skill exporters.

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Table 1: Summary Statistics

Variable	Obs	Mean	Std. Dev	Min	Max
$lnExp_{ijt}$	425,686	15.040	3.875	-0.030	27.353
$lnExp_{High}$	300,984	13.026	3.882	-0.030	26.387
$lnExp_{Medium}$	331,745	13.764	3.952	-0.030	26.187
$lnExp_{Low}$	345,351	13.216	3.771	-0.030	26.349
$lnExp_{Resource}$	342,066	13.931	3.626	-0.030	25.433
$lnExp_{Primary}$	322,329	13.998	3.515	-0.030	26.139
RER_{ijt}	425,686	4.612	0.412	1.110	8.691
$Volatility_{ijt}$	425,686	0.033	0.048	0.000	1.320
lnY_{it}	222,963	24.471	2.238	18.154	30.320
lnY_{jt}	222,963	24.326	2.319	18.154	30.320
$lnPop_{it}$	222,963	16.200	1.860	10.666	21.009
$lnPop_{jt}$	222,963	16.099	1.927	10.666	21.009
$Contig_{ij}$	222,963	0.024	0.153	0.000	1.000
$Language_{ij}$	222,963	0.145	0.352	0.000	1.000
$Comcol_{ij}$	222,963	0.086	0.280	0.000	1.000
$Curcol_{ij}$	222,963	0.000	0.020	0.000	1.000
$Col45_{ij}$	222,963	0.011	0.105	0.000	1.000
$Smctry_{ij}$	222,963	0.012	0.108	0.000	1.000
$Landl_{ij}$	222,963	0.292	0.499	0.000	2.000
$lnDist_{ij}$	222,963	8.641	0.830	2.349	9.899
$lnArea_{ij}$	222,963	23.847	3.430	8.482	32.769
PTA_{ijt}	222,963	0.178	0.382	0.000	1.000

Notes: *Exp* is total exports (in current USD) from country *i* to *j* at time *t*. Exp_{High}, Exp_{Medium}, Exp_{Low}, $Exp_{Resource}$ and $Exp_{Primary}$ refer to exports of high-skill, medium-skill, low-skill, resource-intensive, and primary goods. *RER* is annual average bilateral real exchange rate, *Volatility* is annual bilateral real exchange rate volatility; Y_i (Y_j) are nominal GDP (in USD) in country *i* (*j*); Pop_i (Pop_j) is total population of country *i* (*j*); *Contig* is a binary variable equal to 1 if *i* and *j* share a common border; *Language* is a binary dummy variable equal to 1 if *i* and *j* share a common language;. *ComCol*, *CurCol*, *Colony*, *Col45* each is a binary variable equal to 1 if *i* and *j* had a common colonizer after 1945, are in a colonial relationship, have ever had a colonial link, and have had a colonial relationship after 1945, respectively. *Smctry* is a binary variable if *i* and *j* were the same country; *Landl* is the number of landlocked countries (0, 1, 2), *Dist* is the distance between the *i* and *j*; *Area* is the log products of areas of country *i* and *j* (sq. km.); *PTA* is if *i* and *j* has signed a preferential trade agreement.

Table 2: Summary Statistics on South vs. North

Variable	Obs	Mean	Std. Dev	Min	Max
$lnRER_{ijt}$	425,686	4.612	0.412	1.110	8.691
$RER^{South\text{-}South}$	228,564	4.613	0 .408	1.110	8.691
$RER^{South\text{-}North}$	86,728	4.549	0.428	1.197	7.167
$RER^{North\text{-}South}$	88,311	4.671	0.430	2.106	8.602
$RER^{North\text{-}North}$	22,083	4.606	0.238	3.567	5.643
$Volatility_{ijt}$	425,686	0.033	0.048	0.000	1.320
$Volatility^{South\text{-}South}$	228,564	0.035	0.049	0.000	1.320
$Volatility^{South\text{-}North}$	86,728	0.033	0.048	0.000	1.315
$Volatility^{North\text{-}South}$	88,311	0.033	0.048	0.000	1.315
$Volatility^{North\text{-}North}$	22,083	0.019	0.014	0.001	0.239
$Exp^{High}/Total^{South}$	369,328	8.0	19.3	0	100
$Exp^{High}/Total^{North}$	113,364	14.4	16.9	0	100
$Exp^{Medium}/Total^{South}$	369,328	14.8	25.4	0	100
$Exp^{Medium}/Total^{North}$	113,364	32.1	22.9	0	100
$Exp^{Low}/Total^{South}$	369,328	16.0	27.0	0	100
$Exp^{Low}/Total^{North}$	113,364	13.1	15.3	0	100
$Exp^{Resource}/Total^{South}$	369,328	18.8	29.0	0	100
$Exp^{Resource}/Total^{North}$	113,364	21.2	20.7	0	100
$Exp^{Primary}/Total^{South}$	369,328	24.7	35.7	0	100
$Exp^{Primary}/Total^{North}$	113,364	12.8	20.6	0	100
HCI	5,385	0.179	0.152	0.003	0.960
HCI^S	4,294	0.199	0.157	0.003	0.960
HCI^N	1,091	0.103	0.101	0.022	0.680

Notes: $RER^{South\text{-}South}$, $RER^{South\text{-}North}$, $RER^{North\text{-}South}$, and $RER^{North\text{-}North}$ refer to annual average RER between Southern and Northern country pairs. $Volatility^{South\text{-}South}$, $Volatility^{South\text{-}North}$, $Volatility^{North\text{-}South}$, $Volatility^{North\text{-}North}$ refer to RER volatility between Southern and Northern country pairs. $Exp^{High}/Total^{South}$, $Exp^{High}/Total^{North}$, $Exp^{Medium}/Total^{South}$, $Exp^{Medium}/Total^{North}$, $Exp^{Low}/Total^{South}$, $Exp^{Low}/Total^{North}$, $Exp^{Resource}/Total^{South}$, $Exp^{Resource}/Total^{North}$, $Exp^{Primary}/Total^{South}$, $Exp^{Primary}/Total^{North}$ refer to the share of high, medium, low, resource-intensive and primary goods in bilateral exports from the South and the North. *HCI* is the Herfindahl Concentration Index. HCI^S (HCI^N) is the HCI for the South (North).

Table 3: Exchange Rate Volatility and Trade Structure

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	High	Medium	Low	Resource	Primary
$lnRER_{ijt}$	0.169***	-0.039	0.362***	0.276***	0.328***	-0.052
	(0.055)	(0.078)	(0.074)	(0.083)	(0.064)	(0.120)
$Volatility_{ijt}$	-7.893**	-4.621	-3.535	-18.00***	-8.149***	-7.285**
	(3.390)	(6.946)	(3.546)	(6.354)	(2.114)	(3.592)
lnY_{it}	0.850***	1.060***	1.121***	0.578***	0.800***	0.525***
	(0.022)	(0.042)	(0.043)	(0.026)	(0.031)	(0.041)
lnY_{jt}	0.916***	1.037***	0.804***	1.013***	0.809***	0.920***
	(0.031)	(0.053)	(0.040)	(0.066)	(0.023)	(0.042)
$lnPop_{it}$	0.0014	0.029	-0.117***	0.451***	-0.124***	-0.113*
	(0.033)	(0.057)	(0.045)	(0.044)	(0.047)	(0.059)
$lnPop_{jt}$	-0.084***	-0.062	0.032	-0.135***	-0.030	-0.185***
	(0.029)	(0.052)	(0.029)	(0.049)	(0.031)	(0.046)
$Contig_{ij}$	0.396***	0.192	0.531***	0.573***	0.278***	0.294*
	(0.132)	(0.207)	(0.155)	(0.178)	(0.097)	(0.159)
$Language_{ij}$	0.120	0.136	0.044	0.154	0.063	0.0181
	(0.100)	(0.153)	(0.127)	(0.148)	(0.103)	(0.165)
$Colony_{ij}$	0.234**	0.342***	0.038	0.142	0.449***	0.069
	(0.091)	(0.113)	(0.143)	(0.154)	(0.103)	(0.210)
$Comcol_{ij}$	0.341	0.416	0.317	0.093	0.819***	0.285
	(0.222)	(0.376)	(0.215)	(0.361)	(0.191)	(0.311)
$Curcol_{ij}$	0.628	0.831	0.946*	1.196	0.985**	-0.725
	(0.519)	(0.555)	(0.512)	(0.747)	(0.459)	(0.681)
$Col45_{ij}$	0.003	-0.160	0.074	0.440*	-9.07e-05	-0.021
	(0.233)	(0.283)	(0.266)	(0.250)	(0.217)	(0.365)
$Smctry_{ij}$	0.313	0.295	0.191	0.393	0.138	0.444
	(0.264)	(0.321)	(0.247)	(0.317)	(0.236)	(0.415)
$Landl_{ij}$	-0.174***	0.115	-0.048	-0.144*	-0.452***	-0.640***
	(0.062)	(0.089)	(0.087)	(0.080)	(0.076)	(0.107)
$lnDist_{ij}$	-0.595***	-0.493***	-0.584***	-0.514***	-0.671***	-0.715***
	(0.039)	(0.058)	(0.049)	(0.057)	(0.038)	(0.061)
$lnArea_{ij}$	-0.101***	-0.241***	-0.114***	-0.184***	-0.078***	0.145***
	(0.014)	(0.028)	(0.016)	(0.019)	(0.017)	(0.023)
PTA_{ijt}	0.286***	0.448***	0.456***	0.201**	0.353***	0.069
	(0.057)	(0.092)	(0.073)	(0.084)	(0.056)	(0.098)
MRVolatility	5.086	-6.257	0.593	9.724**	6.579***	7.564**
	(3.227)	(6.513)	(3.661)	(4.292)	(2.187)	(3.547)
MRT	Yes	Yes	Yes	Yes	Yes	Yes
Year fe	Yes	Yes	Yes	Yes	Yes	Yes
Observations	425,686	300,984	331,745	345,351	342,066	322,329
R-squared	0.759	0.619	0.742	0.588	0.669	0.506

Notes: The dependent variable is the level of nominal non-zero bilateral exports from country *i* to *j*. All regressions include a full set of year fixed effects. *Total* refers to total exports, *High*, *Medium*, and *Low* refer to high, medium and low technology and skill intensive manufactures exports, *Resource* and *Primary* refer to resource-intensive manufactures and primary goods exports. *MRVolatility* is the multilateral resistence term for real exchange rate volatility (*Volatility*). For other variable definitions, refer to Table 1. *, **, and *** refer to significance at 10%, 5% ad 1% levels. *Year fe* is year fixed effects, and *MRT* is the multilateral resistance terms. Standard errors in parenthesis are clustered at country-pair level.

Table 4: Exchange rate depreciation, trade structure and direction of trade

$lnRER_{ijt}$	(1)	(2)	(3)	(4)	(5)	(6)
	Total	High	Medium	Low	Resource	Primary
South-South	0.247***	0.063	0.336***	0.306*	0.496***	0.131
	(0.088)	(0.180)	(0.100)	(0.173)	(0.093)	(0.123)
Observations	228,564	136,817	160,086	167,299	163,735	150,749
R-squared	0.686	0.696	0.717	0.739	0.473	0.251
South-North	0.091	0.422*	0.509***	0.094	0.567***	-0.161
	(0.114)	(0.217)	(0.130)	(0.112)	(0.158)	(0.168)
Observations	86,728	60,760	65,249	73,119	73,398	75,667
R-squared	0.832	0.861	0.871	0.901	0.645	0.398
North-South	0.146**	-0.014	0.197***	0.172**	0.073	0.377***
	(0.062)	(0.084)	(0.075)	(0.068)	(0.079)	(0.125)
Observations	88,311	81,609	84,409	82,895	82,874	73,881
R-squared	0.864	0.827	0.874	0.842	0.578	0.721
North-North	0.329**	0.163	0.434**	0.190	-0.054	0.942**
	(0.132)	(0.167)	(0.195)	(0.185)	(0.174)	(0.384)
Observations	22,083	21,798	22,001	22,038	22,059	22,032
R-squared	0.911	0.816	0.835	0.865	0.875	0.809

Notes: The dependent variable is the level of positive bilateral exports (in current USD). The reported coefficient estimates are for the (log) level of real exchange rate. All regressions include the same set of (unreported) gravity controls and fixed effects as in Table 3.

Table 5: Exchange rate volatility, trade structure and direction of trade

	(1)	(2)	(3)	(4)	(5)	(6)
Volatility$_{ijt}$	Total	High	Medium	Low	Resource	Primary
South-South	-7.632***	2.765	-10.33***	-9.702***	-5.402*	-7.695
	(2.295)	(6.129)	(2.524)	(2.861)	(3.215)	(5.123)
South-North	-15.52***	-26.16***	-19.50***	-38.67***	-5.899	1.328
	(5.446)	(9.661)	(4.973)	(4.677)	(6.701)	(8.351)
North-South	-5.097*	-3.923	-0.651	-0.987	-1.249	-17.31***
	(2.883)	(3.876)	(3.367)	(3.155)	(6.485)	(4.866)
North-North	-9.799***	-5.675*	-15.65***	-10.12***	-8.646***	-3.702
	(2.557)	(3.381)	(5.164)	(2.877)	(2.635)	(5.166)

Notes: Number of observations and R-squared are given in Table 5 for each product group and in each direction of trade. The dependent variable is the level of positive bilateral exports (in current USD). The reported coefficient estimates are for the exchange rate volatility. All regressions include the same set of gravity controls and fixed effects as in Table 3.

Table 6: Missing and zero trade

	(1)	(2)	(3)	(4)	(5)	(6)
	Total	High	Medium	Low	Resource	Primary
$lnRER_{ijt}$	0.166***	-0.023	0.365***	0.290***	0.336***	-0.040
	(0.055)	(0.078)	(0.072)	(0.086)	(0.065)	(0.119)
$Volatility_{ijt}$	-7.929***	-4.985	-3.614	-16.71***	-7.724***	-6.341***
	(3.000)	(6.848)	(3.549)	(5.304)	(1.501)	(2.145)
Gravity Terms	Yes	Yes	Yes	Yes	Yes	Yes
Year fe	Yes	Yes	Yes	Yes	Yes	Yes
MRT	Yes	Yes	Yes	Yes	Yes	Yes
Observations	678,592	678,592	678,592	678,592	678,592	678,592
R-squared	0.758	0.615	0.741	0.593	0.663	0.509

Notes: The dependent variable is the level of bilateral exports between all possible country pairs and includes missing and zero trade flows, which are recorded as zero. *, **, and *** refer to significance at 10%, 5% ad 1% levels. For other variable definitions refer to Table 4.

Table 7: OECD classification

	(1)	(2)	(3)	(4)	(5)
	High	Medium-high	Medium-low	Low	Others
$lnRER_{ijt}$	0.158	0.292***	0.371***	0.122*	0.061
	(0.129)	(0.087)	(0.049)	(0.069)	(0.098)
$Volatility_{ijt}$	1.565	-8.989	-3.612	-13.16**	-6.627**
	(6.857)	(5.817)	(2.957)	(5.938)	(3.334)
Gravity Terms	Yes	Yes	Yes	Yes	Yes
Year fe	Yes	Yes	Yes	Yes	Yes
MRT	Yes	Yes	Yes	Yes	Yes
Observations	220,042	316,133	337,391	373,404	356,384
R-squared	0.547	0.661	0.797	0.646	0.486

Notes: The dependent variable is the level of positive bilateral exports. The reported coefficient estimates are for the effects of real exchange rate and real exchange rate volatility. All regressions include the same set of gravity controls as in previous tables.

Table 8: OECD classification and direction of trade

	(1)	(2)	(3)	(4)	(5)
	High	Medium-high	Medium-low	Low	Others
		Part A: exchange rate levels (*$lnRER_{ijt}$*)			
South-South	0.135	0.343***	0.422***	0.194	0.190
	(0.253)	(0.116)	(0.079)	(0.160)	(0.116)
South-North	0.166	0.554***	0.700***	0.142	-0.098
	(0.226)	(0.196)	(0.124)	(0.102)	(0.164)
North-South	0.332***	0.245***	0.092	-0.026	0.271**
	(0.069)	(0.083)	(0.068)	(0.072)	(0.121)
North-North	0.134	0.477**	0.0814	0.164	0.751**
	(0.191)	(0.210)	(0.134)	(0.149)	(0.294)
		Part B: Exchange rate volatility (*$Volatility_{ijt}$*)			
South-South	2.871	-5.851*	-7.492***	-4.323	-8.009
	(9.502)	(3.355)	(2.109)	(4.167)	(4.993)
South-North	-1.976	-31.35***	-6.978	-31.42***	-1.212
	(9.416)	(7.645)	(6.041)	(5.259)	(7.485)
North-South	7.504*	-5.373	1.569	-10.15***	-11.34
	(4.026)	(3.622)	(3.152)	(3.313)	(8.792)
North-North	-1.437	-17.55***	-8.014***	-11.13***	-2.748
	(3.162)	(5.627)	(2.796)	(2.849)	(4.083)

Notes: The dependent variable is the level of positive bilateral exports. The reported coefficient estimates are for the effects of real exchange rate and real exchange rate volatility. All regressions include the same set of gravity controls as in previous tables.