Exchange Rate Volatility and Trade: External Exchange Rate Volatility Matters

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Exchange Rate Volatility and Trade: External Exchange Rate Volatility Matters

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Abstract: Using World Bank's Exporter Dynamics Database, we investigate the role of external exchange rate volatility on export in addition to the effect of bilateral exchange rate volatility. The results show that while the bilateral exchange rate volatility has depressing effect on export, external exchange rate volatility generates trade-promoting effect. However, the magnitude of the effect depends on the trade intensity between countries and the economic development of the destination country. We further find strong asymmetric effect that both the trade-depressing effect of the bilateral volatility and trade-promoting effect of the external volatility are larger for exchange rate depreciations and for larger swings in the volatilities.

JEL classification: F14, F31, F41

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1. **Introduction**

Developments in exchange rate of other countries could have sizable impact on trade flow between two countries. For instance, export from Germany to Brazil could be affected from, among other factors, the exchange rate volatility between Euro and Mexican peso. An increase in the volatility of the Euro/Mexican peso exchange rate could induce German exporters to relocate their sales from Mexico to Brazil. Therefore, German export to Brazil could increase because of purely an increase in exchange rate volatility of Mexican peso while no particular development in Euro/Brazilian Lira occurs. However, the empirical literature on the trade effect of exchange rate volatility dismisses the role of external exchange rate developments, and focuses only on the role of bilateral exchange rate volatility.[5] As Cushman (1986) point out, external volatility could has sizeable effect on trade and omission of the external volatility could potentially bias the effect of bilateral exchange rate volatility on trade.[6]

In this paper, using recently launched Exporter Dynamics Database (EDD) of the World Bank with the detailed sector level cross-country export data, we investigate the role of exchange rate developments in external market on export in addition to the effects of the bilateral exchange rate developments. For this purpose, we calculate sector-level external exchange rate and its volatility for each sector and each country pairs and include these variables into an otherwise standard model used in the literature. Therefore, our study analyzes the effects of external exchange rate and external exchange rate volatility on sector level trade, in addition to bilateral exchange rate volatility. We extend our analysis to investigate the effect from different perspectives including (i) the role of trade intensity between country pairs (ii) the economic development of the destination countries, (iii) the changing effect during the Global Financial Crisis (GFC), and (iv) asymmetric effects where the asymmetries could stem from the direction of exchange rate changes (i.e. appreciation vs depreciations) and the size of the volatility (i.e. large vs small volatilities).

[5] McKenzie (1999) and Bahmani-Oskooee and Hegerty (2007) provides good literature surveys on the role of exchange rate volatility on trade.

[6] We prefer to use "external exchange rate volatility" term instead of "third-country-effect" of Cushman (1986) since we believe this term suites the notion better as we are using exchange rate of more than one external market.

To preview our results, we find significant trade-promoting effects of both external exchange rate and external exchange rate volatility in addition to the usual trade-depressing effects of bilateral exchange rate and its volatility. However, investigating the effect further, we find that while the external exchange rate generates trade-promoting effect to both advanced and developing destination countries, the effect of the external volatility has significant trade-promoting effect only for the advanced destination countries. The effects also magnify as trade weight between countries increases. The results further show the decreased effect of exchange rate and volatilities on export during and after the recent global financial crisis. Looking at the asymmetric effects, we find larger trade promoting effect of the volatility during depreciation of external exchange rate and during large-size volatilities compared to appreciations and small-size volatilities.

This paper contributes to the literature on the exchange rate and international trade in at least three aspects. The first contribution comes from the analysis of external exchange rate volatility on trade. The second contribution is the analysis of the asymmetric effects of both external and bilateral exchange rate volatilities on trade. The third contribution is the analysis of the effects of the global financial crisis on trade.

First, the analysis of the role of external exchange rate volatility on international trade is by itself an important contribution since there is a few number of studies on the role of external exchange rate volatility on export with narrow focuses on either a few countries or a specific region. The early study by Cushman (1986) provides both a theoretical foundation of the role of external exchange rate volatility and an empirical assessment of the effect by using country-level export data between some industrialized countries. The results of the paper indicate significant positive impact of external exchange rate volatility on the bilateral trade. Kumar and Dhawan (1991) test the external exchange rate volatility for Pakistan and find that the inclusion of the exchange rate volatility of other trading partners of Pakistan changes the significance of the effect of the bilateral exchange rate volatility. Bahmani-Oskooee and Xu (2012) analyze the effect of the real US dollar/Canadian dollar exchange rate on the trade flow between the US and China. Their results indicate significant short-run effects of the third country exchange rate on the trade flow between the US and China.

Examining the role of exchange rate volatility on export of five East Asian countries, Chit et al. (2010) confirm the presence of a significant trade-promoting effect of external exchange rate

volatility. Utilizing French firm-level data, Hericourt and Nedoncelle (2015) confirm the significant trade-promoting effects of the external exchange rate volatility at firm level. Soleymani et al. (2017) investigate the role of external exchange rate volatility for ASEAN-4 countries (Indonesia, Malaysia, Singapore and Thailand) and their five main trading partners. Their results reveal significant effect of the external exchange rate volatility on trade. In a very recent study, Tunc et al. (2017) also confirm the trade-promoting effect of the external exchange rate volatility on bilateral trade using the EDD.

Our study differs from early studies on the role of external exchange rate volatility on export from at least three dimensions. First, we are using sector-level external exchange rate volatility and sector level export data for each country pairs. However, no previous studies took into account sectoral differences while measuring external exchange rate volatility. Therefore, our study does not suffer from potential biases from aggregation of the data. Second, we use a comprehensive dataset that includes countries with different economic sizes and located in different regions of the world. Previous studies focused on either one country or a few countries in a specific region. Thus, our analysis is more comprehensive in terms of the coverage. Third, we investigate the relationship from a broader and a more comprehensive perspective including the role of trade-weights, the economic development of destination countries, and the global financial crisis.

Second, this paper contributes to the literature on the asymmetric effects of both bilateral and external exchange rate volatilities on trade. The asymmetric effect of the bilateral exchange rate volatility has been analyzed in the literature for a limited extent. The idea behind the existence of the asymmetric effect is that the response of trade to exchange rate volatility may not be the same for the exchange rate appreciations and depreciations (i.e. sign of the exchange rate changes) and for the small or large magnitudes of the volatility. Fang et al. (2009) list possible reasons for the asymmetric responses of trade to exchange rate volatility. In a very recent paper, Arize et al. (2017) find for the Latin American countries that trade reacts more strongly to depreciations than appreciations. Fang et al. (2009) reveal asymmetric effect of the bilateral exchange rate volatility with respect to appreciation versus depreciation on trade between some selected Asian countries and the US. Using a large data set of both developed and emerging countries, Grier and Smallwood (2013) find that while positive shocks to real exchange rate depress export substantially, negative shocks to exchange rate contribute to the export, with a smaller magnitude. As an extension of their

own study, Cheung and Sengupta (2013) find that Indian export reacts asymmetrically to exchange rate and its volatility.

We contribute to this strand of the literature by investigating the asymmetric effects of external exchange rate volatility in addition to the asymmetric effects of the bilateral exchange rate volatility. To the best of our knowledge, this paper is the first one investigating the asymmetric effects of the external exchange rate volatility on trade. In accordance with the existing literature, we test for the asymmetric effect of the volatility with respect to the sign of currency movements (i.e. appreciation versus depreciation) and with respect to size of the volatilities (i.e. large versus small volatilities) of the both bilateral and external exchange rates.

Third, our paper further contributes to the literature through investigating the role of the global financial crisis on the trade by focusing on the changes in the role of the exchange rates and their volatilities on trade before, during, and after the crisis. The dramatic decrease in international trade has been studied in some recent empirical studies in different aspects. Eaton et al (2016) argue that a shift in the final spending away from tradable sector accounts for the most of the decline in trade during the crisis. Chor and Manova (2012) and Bricongne et al. (2012) show the role of credit conditions on the collapse of the international trade during the crisis. Bricongne et al. (2012) show the larger negative effect of the crisis on small firms than the large ones. However, none of these papers investigates the effects of exchange rate developments on the trade during the global recession.

This paper contributes to this strand of the literature through analyzing the changes in the role of exchange rates and their volatilities on trade before, during, and after the crisis. While before the crisis, the global economy enjoyed the prosperity; during the crisis, economic growth and global trade plummeted; and after the crisis, both economic growth and global trade have only slightly improved. As international trade displays distinct features during these three distinct periods, the role of the exchange rate and its volatility on trade has certainly changed over this period. Therefore, it is important to understand the changes in the role of exchange rate developments on trade during these three different periods and the contribution of the exchange rate changes on the dramatic decline in the trade during the crisis.

The rest of the paper is organized in the following manner. Section 2 presents the model specifications and introduces the data. The results along with discussion are presented in Section 3. The last section concludes.

2. Model and Data

External exchange rate between an exporting country *i* and a destination country *j* in sector *s* at time *t* (EER_{ijst}) is calculated as the sum of trade-weighted exchanges rates between the exporting country *i* and it's all trading partners in sector *s* except for the destination country *j*. Similarly, external exchange rate volatility between an exporting country *i* and a destination country *j* in sector *s* at time *t* ($EERV_{ijst}$) is calculated as the sum of the trade-weighted exchange rate volatilities between the exporting country *i* and it's all trading partners in sector *s* except for the destination country *j*.

$$EER_{ijst} = \sum_{k \neq j,}^{N} tw_{ikst} BER_{ikst}$$

$$EERV_{ijst} = \sum_{k \neq j,}^{N} tw_{ikst} BERV_{ikst}$$

where the $BERV_{ikst}$ is the standard deviation of bilateral exchange rate for the last ten years.[7]

The sector level EER and $EERV$ for each country pair allows for more precise and accurate estimation since it eliminates aggregation biases. For instance, for a particular exporting country *i*, export partners could be different from one sector to another and using the same set of countries for both sectors would lead to biased estimation.

Augmenting the EER and $EERV$, we use the following baseline empirical specification to analyze the effects of both bilateral and external exchange rate developments on sector level export:

$$\begin{aligned} lnExp_{ijst} = {} & \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnRCPI_{ijt} + \beta_4 lnNC_{ijst} \\ & + \beta_5 lnBER_{ijst} + \beta_6 lnBERV_{ijst} + \beta_7 lnEER_{ijst} + \beta_8 lnEERV_{ijst} \\ & + \mu_{ijs} + \tau_t + \varepsilon_{ijst} \end{aligned} \qquad (1)$$

[7] Our data set has 67.007 distinct sector and country-pair combinations. Therefore, calculating exchange rate volatility from GARCH-type models is not a handle able approach, as one GARCH model may not fit all combinations.

where the dependent variable $lnExp_{ijst}$ is the natural log of the export value from an exporting country *i* to a destination country *j* in a sector *s* at time *t*. $lnGDP_{it}$ and $lnGDP_{jt}$ are, respectively, the natural log of gross domestic products of exporting and destination countries at 2010 constant US dollars. $lnRCPI_{ijt}$ stands for the ratio of the exporting country consumer price index to the destination country consumer prices index at time *t*. $lnNC_{ijst}$ is the log of the number of exporters in sector *s* at country *i* exporting to destination country *j*. $lnBER_{ijst}$ and $lnBERV_{ijst}$ are bilateral exchange rate and its volatility between exporting and destination country pairs in sector *s* at time *t*. An increase in the BER indicates a depreciation of the destination country currency with respect to the currency of the exporting country. Bilateral exchange rate volatility is measured as the standard deviation of annual exchange rate of last ten years. Finally, μ_{ijs} and τ_t control the combination of exporting country, destination country, and sector fixed effect and time fixed effects, respectively. Due to the panel nature of the data, we perform Hausman test to determine whether the fixed-effect or the random-effect model is more suitable for our econometric specification. In all cases, the test favors the fixed-effect model over the random effect model.[8]

We expect a negative sign for the coefficient of the BER because depreciation of destination country currency usually depresses export to that particular market as the purchasing power of the country declines. Based on recent empirical literature, we also expect a negative coefficient of the BERV because an increase in the volatility causes uncertainty, which leads firms to reduce their sales to countries with increased exchange rate volatility. On the other hand, we expect positive effects of both the EER and EERV on export. Depreciations of currencies of destination countries other than the destination country *j* implies decreasing purchasing power of destinations countries other than the destination *j*. Similarly, increases in the volatilities of exchange rates of destination countries other than that of the destination country *j* implies relatively more stable exchange rate of country *j* compared to other destinations. In both cases, exporting firms in country i would prefer to relocate their export from other countries to destination county *j*.

We also assume that the effects of exchange rates and their volatilities could change depending on trade weights between countries. We would expect larger depressing effects of both the BER and BERV on export as the trade-weight between country pairs increases. Simply because it becomes

[8] We perform Fisher-type panel unit root test due to the unbalanced nature of the data. The tests for all variables reject the null hypothesis of unit root for the all variables.

more costly and difficult to hedge against exchange rate risk or relocate export from the high trade-weight-destination to other destinations, as the exporting country is more dependent on the destination country. Furthermore, in the presence of larger trade weight, we would expect magnifying positive effects of the EER and the EERV on export. A larger trade weight indicates that the destination market *j* is familiar to the exporting country and hence relocating export from other destinations to the high trade-weight-destination becomes much easier compared to a country with no or very low level of trade. Therefore, unfavorable external exchange rate developments would make export to the destination country *j* easier and cheaper in the presence of a large trade weight with the destination country *j*. For this reason, we introduce the interaction of exchange rates and their volatilities with trade weights in the following extended model:

$$\begin{aligned} lnExp_{ijst} = {} & \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnRCPI_{ijt} + \beta_4 lnNC_{ijst} \\ & + \beta_5 lnBER_{ijst} + \beta_6 lnBERV_{ijst} + \beta_7 lnEER_{ijst} + \beta_8 lnEERV_{ijst} \\ & + \beta_9 lnBER_{ijst} TW_{ijt} + \beta_{10} lnBERV_{ijst} TW_{ijt} + \beta_{11} lnEER_{ijst} TW_{ijt} \\ & + \beta_{12} lnEERV_{ijst} TW_{ijt} + \mu_{ijs} + \tau_t + \varepsilon_{ijst} \end{aligned} \quad (3)$$

where TW_{ijt} denotes the trade weight between an exporting country *i* and a destination country *j* at time *t*.

We further investigate the relationship between the exchange rate volatilities and export by focusing on the asymmetric effects where the asymmetries could be from either exchange rate appreciation versus depreciation or large versus small changes in the volatilities. For the first type of the asymmetry, we generate four dummy variables: $ABER$, $DBER$, $AEER$, and $DEER$ for the appreciation of BER, depreciation of BER, appreciation of EER, and depreciation of EER, respectively. If the value of an exchange rate (either BER or EER) is lower than the value of the previous year, then we label it as an appreciation of the exchange rate and otherwise depreciation. In the following extended model, we interact these dummy variables with exchange rate volatilities.

$$\begin{aligned} lnExp_{ijst} = {} & \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnRCPI_{ijt} + \beta_4 lnNC_{ijst} \\ & + \beta_5 lnBER_{ijst} + \beta_6 lnBERV_{ijst} ABER + \beta_7 lnBERV_{ijst} DBER \\ & + \beta_8 lnEER_{ijst} + \beta_9 lnEERV_{ijst} AEER + \beta_{10} lnEERV_{ijst} DEER + \mu_{ijs} \\ & + \tau_t + \varepsilon_{ijst} \end{aligned} \quad (3)$$

In the second type of the asymmetry, we again generate four dummy variables: $LBERV$, $SBERV$, $LEERV$, and $SEERV$ for large changes in BERV, small changes in BERV, large changes in EERV, and small changes in EERV, respectively. If exchange rate volatility (BERV or EERV) is larger than the mean value of the volatility, we label it as a large volatility and otherwise a small volatility. We include the interactions of these dummy variables with the exchange rate volatilities in the following extended model:

$$\begin{aligned} lnExp_{ijst} = {} & \beta_0 + \beta_1 lnGDP_{it} + \beta_2 lnGDP_{jt} + \beta_3 lnRCPI_{ijt} + \beta_4 lnNC_{ijst} \\ & + \beta_5 lnBER_{ijst} + \beta_6 lnBERV_{ijst} LBERV + \beta_7 lnBERV_{ijst} SBERV \\ & + \beta_8 lnEER_{ijst} + \beta_9 lnEERV_{ijst} LEERV + \beta_{10} lnEERV_{ijst} SEERV \\ & + \mu_{ijs} + \tau_t + \varepsilon_{ijst} \end{aligned} \quad (4)$$

The export data come from the Exporter Dynamics Database (EDD) that is recently provided by the World Bank.[9] The original data set covers 572774 observations of two-digit Harmonized Commodity Description and Coding Systems (HS) level and destination-specific data on export value. After excluding countries with missing exchange rate, and the top and bottom 1 percentile of the sample, we end up with 386,669 observations. Our sample covers two-digit HS sector-level and destination-specific export value for 31 exporting (three advanced and 28 developing) and 103 destination (31 advanced and 72 developing) countries for the period of 1997 to 2014. This large data set covers many exporting and destination countries with different degrees of economic development, locating in different regions of the world, and having high and low levels of both exchange rates and exchange rate volatilities. Therefore, our data set is comprehensive in terms of country coverage. The list of countries is displayed in Table 1. We use the IMF World Economic Outlook Database for the classification of countries into advanced and developing groups. All macroeconomic data including GDP, exchange rates, and consumer price indices come from the IMF database.

Table 2 displays some relevant descriptive statistics. The mean sector-level export value is more than 6 million USD with the lowest and highest values of 0.003 and 233 millions of USD. The average number of exporters in a typical sector is 18 firms with the lowest number of 1 firm and the maximum number of 96 firms which indicates that the data set cover sectors with perfect

[9] Please refer to Cebeci et al. (2012) for more information about the Exporter Dynamics Database.

monopoly to almost perfect competition. The average trade-weight between exporting and destination countries is 0.032 with the highest weight of 0.912 between Dominic Republic and the U.S. in 2002. The bilateral and external exchange rates varies considerably across countries ranging from one to seven digits, so we provide the descriptive statistics of the exchange rate volatilities taken their natural logarithm first. The large dispersion in the volatilities shows the wide coverage of the dataset.

3. Results

We present the estimation results of the baseline model in Table 3. According to the results, economic activity in both exporting and destination countries have positive contribution to the sector-level export. An increase in the exporting country consumer price index relative to the destination country consumer price index has a negative impact on the export to the destination country because relatively higher inflation in the exporting country makes exporting goods more expensive for the destination country and hence reduces demand in the destination country for such goods. Furthermore, as the number of exporters increase, the volume of export also increases indicating the role of extensive margin on export.

According to the results presented in the first column of the table, the bilateral exchange rate (BER) has a depressing effect on sector-level export. More specifically, a 10 percent depreciation of the destination country currency with respect to the exporting country currency depresses export by 0.53 percent. This significant depressing effect robust to the inclusion of the volatility of exchange rate in the second column and external exchange rate and its volatility in the subsequent columns. Furthermore, the effect of the volatility of the bilateral exchange rate (BERV) is also negative, meaning that an increase in the BERV depresses sector-level export from the exporting country to the destination country. Quantitatively, an increase in the BERV by 10 percent lowers the trade to the destination country by 0.17 percent on average. This result is in line with the recent empirical literature that agreed on the depressing effect of exchange rate volatility on export (Cheung and Sengupta (2013), Hericourt and Poncet (2013), Solakoglu et al. (2008), Hericourt and Poncet (2013), Kandilov (2008), Tunc and Solakoglu (2016), Tunc et al. (2017)).

The effects of the external exchange rate and its volatility are presented in the third and fourth columns of the table. The positive effect of the EER means that, depreciation of currencies of all

trading partner of an exporting country *i* except for the currency of the destination *j* lead to more export to the destination country *j*. More concretely, if in sector *s,* exchange rates of all destination countries of exporting country *t* increase by 10 except for the exchange rate of destination country *j*, then export from the exporting country *i* in sector *s* to the destination country *j* will increase by 0.66 percent. Moreover, the effect of the volatility of external exchange rate is also significantly positive, albeit its magnitude is small. A 10 percent increase in the EERV will increase export to the destination country *j* by 0.07 percent.

We interpret this result as an important comprehensive empirical supports for the existence of the third-country effect discussed by Cushman (1986) on trade flow between countries. Trade between two countries is affected not only from the bilateral exchange rate and its risk but also from exchange rate developments in external market. The relatively stable exchange rate and its volatility compared to other countries have positive impact on the export to the county, similar to the findings of Hericourt and Nedoncelle (2015) and Tunc et al. (2017). However, the effect of the exchange rate changes of external environment have smaller effect on export than the bilateral exchange rate changes as the former one has indirect effect while the latter one affect export directly. The results further indicate that contrary to Cushman (1986), the omission of the external exchange rate or its volatility does not change the significance or the magnitudes of the effects of the bilateral exchange rate and its volatility.

Next, we analyze the effects of the exchange rates and volatilities for the extended model that augments the baseline model with the interaction of the exchange rate and volatilities with trade weights. We expect magnifying depressing effects of the BER and BERV as trade weight increases because large trade-weights indicate a more dependent exporting country on the destination country and so any negative shock to the exchange rate of the destination country would hurt the export of the exporting country largely. On the other hand, in the presence of large trade-weights, we could expect larger trade-promoting effect of EER and EERV as it would be easy to relocate export from other countries to the destination country that already has large trade-weight and have relatively more stable exchange rate compared to the other partners of exporting country.

The first column of the Table 4 shows the interaction of the trade weight with the BER and BERV. According to this result, the trade depressing effects of the BER and BERV increases as trade-weight increases. A larger trade-weight indicates that the exporting country is more dependent on

the destination country and hence makes the exporting country more vulnerable to negative shocks of exchange rate of the destination country. The results, therefore, support the argument that, having more and more export partners with low trade weights with each would be a natural partial hedge against shocks to bilateral exchange rate and its volatility.

The second column of the table present the results for the interaction of trade weight with the EER and EERV. According to the results, large trade-weight increases the trade promoting effects of the EER and EERV on export from exporting country *i* to destination country *j*. In the presence of a large trade-weight, a relatively stable exchange rate in destination country *j* would induce exporter to move their export from other destinations to that destination. Comparing the effects, we observe that larger trade-weight has more influence on the effects of bilateral exchange rate developments on export than the effects of external exchange rate developments as the former one has direct effect while the latter one has indirect effect.

Extensions

In the following part, we perform some analysis to elaborate further the effects of the bilateral and external exchange rates and their volatilities on export. We begin by splitting the sample according to the economic development of destination countries using IMF World Economic Outlook Database. Usually exchange rates of advanced economies are more stable and display less volatility compared to the exchange rates of developing countries. Therefore, we would expect larger trade effects of exchange rate developments on export to the developing destination countries than to the advanced destination countries.

The estimations results of each sub-samples are reported in Table 5. According to the results, the BER has 12 times larger depressing effect on export to developing destination countries than export to the advanced destination countries. Export to a developing country declines on average by 4 percent in response to a 10 percent depreciation of its currency while for the same-size depreciation the export to a typical advanced country declines by only 0.33 percent. The fact that currencies of developing countries depreciate more often and with larger magnitudes than the currencies of advanced countries justifies this differential response of export to exchange rate movements. The results further indicate that the BERV has significant and albeit similar-size effects on the export

to both types of destination countries. A 10 percent increase in the BERV depresses export to both country types by about 0.12 percent.

The EER displays similar trade-promoting effects on export to both advanced and developing destination countries. Export to the two country types increases by 0.60 and 0.71 percent respectively in response to a 10 percent increase in the EER. On the other hand, the effect of BERV is significant only for the advanced destination countries, suggesting that firms relocate their sales to advanced countries rather than developing countries if EERV increases.

The difference on the effect of BERV between country types could possibly stem from the large movements and unstable exchange rates in the developing countries compared to the advanced countries. In addition, well-developed forward markets in advanced economies provides hedging instruments to reduce the negative exposure of unexpected exchange rate movements. However, such markets do not exist or are not working well in developing countries. Therefore, in such countries export is exposed more to volatility.

The positive effect of the EERV for advanced and no effect for developing destination countries could be explained by the expected duration of the relative stability of exchange rate in the destination country. It is more likely that lower exchange rate volatility of an advanced country will prevail for an extended period. However, it should be more difficult to increase export to a developing destination country when its exchange rate volatility is lower than other destination countries since it is less likely that the exchange rate volatility will stay low for a developing country for an extended period so as to a sustainable trade relationship to emerge.

Next, we investigate the changes in the effects of the exchange rate and volatilities on export before, during, after the GFC of 2008 as these three distinct periods display different figures for economic growth and international trade. For this analysis, we split our sample into three sub-periods: (i) before the GFC (1997-2007), (ii) during the GFC (2008-2009), and (iii) after the GFC (2010-2014). The estimation results for each period are reported in Table 6. The comparison between the three periods shows that the BER has the largest depressing effect on trade during the crisis, which is almost 9 times larger than the depressing effect observed before the crisis. However, after the crisis, we do not observe any significant effect of the BER on trade. Similarly, the trade-deterring effect of the BERV is more than 4 times larger during the crisis than the pre-crisis period and not

significant at all after the crisis. The comparisons of the BER and BERV for these time periods clearly show the severeness of the crisis on the international trade. The results also indicate the decreasing trade-promoting effect of the EER during the crisis with a slight increase after the crisis. However, we do not observe any significant effect of the EERV in the separate sub-samples.

Our results show that in addition to the reasons of the decline of the international trade during the crisis such as credit constraints, the weakened demand and increased uncertainty in markets, we show that exchange rate developments (i.e. both depreciations and volatility) have sizable role on the observed decline on the international trade. Furthermore, together with sluggish recovery, the massive quantitative easing policies around the world after the crisis that had put pressure on exchange rates have removed the effects of exchange rates on trade after the crisis.

Finally, we look at the asymmetric effects of exchange rates and their volatilities on export. We focus on two types of asymmetries: (i) the asymmetric effect with respect to the sign of the exchange rate (i.e. appreciation versus depreciation) and (i) the asymmetric effect with respect to the size of the volatility (i.e. large versus small volatilities).

The estimation results for the asymmetry with respect to appreciation and depreciation are displayed in the first two columns of the Table 7. The results indicate that, the trade-deterring effect of the BERV is higher during the periods of depreciation of destination currency than the effect observed during the periods of appreciation. A Wald test suggests that the difference between the coefficients is statistically significantly different than 0. We know that depreciation of destination country currency hurts export to this country as it reduces the purchasing power of the country. In addition to the depreciation, an increase in the volatility of exchange rate hurts export even more. Therefore, the negative effect of BERV on trade magnifies during the periods of depreciation. On the other hand, during the periods of appreciation of destination county currency, export increases to this country as the purchasing power increases and so the negative impact of the volatility is limited.

The trade-promoting effect of the EERV is also larger during the periods of depreciation of the EER than the effect observed during the periods of appreciation of the EER. In the presence of EER depreciation, the purchasing power of other destinations decrease which leads firms to relocate their export to the destination country *j* the currency of which is not depreciated. On top

of this, an increase in the EERV further encourage exporters to increase their sales to this destination. In other words, while EERV increases export to the destination country *j*, depreciation of EER leads to more export to the destination. On the other hand, during the appreciation of EER, an increase in the EERV has lesser positive impact on export because the appreciation of the EER limits the positive impact of the EERV.

The last two columns of the table display the results for the asymmetric effects with respect to large and small changes in the exchange rate volatilities. The results indicate that the trade-depressing effects of the BERV seem to be larger during periods of larger volatilities than the effect observed during the periods of low volatilities. However, a Wald test suggests that the coefficients are not statistically different from each other. Therefore, we conclude that, the trade-depressing effect of the BERV does not significantly change with respect to large versus small changes in the volatility. The last column of the table shows the asymmetric effects of EERV with respect to the size of the volatility. The results reveal that the EERV has significant trade-promoting effect on export to destination country in the presence of large volatilities in the EER while the effect of the volatility on export is not significant in the other case. Overall, these results point out the presence of asymmetric effects of exchange rate volatility: depreciations and large changes in exchange rate volatilities generate larger effects on export than appreciations or small changes in the volatilities.

Conclusion

Following the argument of Cushman (1986) that exchange rate volatilities of other countries could have impact on trade between two countries, we investigate the effects of both bilateral and the external exchange rate volatilities on trade from different aspects using destination- and sector-specific Exporter Dynamics Database of the World Bank. The main findings of the paper suggest that while bilateral exchange rate volatility depresses trade between two countries, external exchange rate volatility displays significant positive contribution to the trade between them. However, the effect of the bilateral volatility is larger than the effect of the external volatility since the former one has direct effect while the latter one has indirect effect.

Furthermore, the effects change depending on the trade weight between countries. Large trade weight magnifies the trade-depressing effect of the bilateral exchange rate volatility. Therefore, it is better to diversify exporting destination with well-balanced export share with each destination

to reduce the exposure of the volatility on trade. In this respect, a possible extension of the study is to analyze, in a more comprehensive fashion, the role of both bilateral and external exchange rate volatilities on trade with balanced and unbalanced export share across partner countries.

Looking at the asymmetric effect, our results show that the response of trade to both the bilateral and external exchange rate volatilities are asymmetric. The trade effects of the volatilities are larger for depreciations of currencies and large volatilities of exchange rate than appreciations and low volatilities. This paper focuses on the existence of such asymmetries rather than its possible sources. Future work can analyze and quantify the asymmetric trade-effect of the volatility for different sources of the asymmetries, as it is possible that the asymmetric effects could be different for different sources of the asymmetries. Finally, our finding that exchange rate and volatility has contributed to the decrease of the international trade during the crisis can be further elaborated with more disaggregated or with country-specific analysis.

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Table 1: Country List

Exporting Countries		Destination Countries		
Advanced	**Developing**	**Advanced**	**Developing**	
Denmark	Bolivia	Australia	Algeria	Latvia
Norway	Bulgaria	Austria	Antigua and Barbuda	Lesotho
Portugal	Cameroon	Belgium	Argentina	Macedonia, FYR
	Chile	Canada	Armenia	Malawi
	Colombia	Cyprus	Bahamas, The	Malaysia
	Costa Rica	Czech Republic	Bahrain	Mexico
	Cote d'Ivoire	Denmark	Belize	Moldova
	Croatia	Finland	Bolivia	Morocco
	Dominican Republic	France	Brazil	Nicaragua
	Egypt, Arab Rep.	Germany	Bulgaria	Nigeria
	Gabon	Greece	Burundi	Pakistan
	Georgia	Hong Kong, China	Cameroon	Panama
	Iran, Islamic Rep.	Iceland	Central African Republic	Papua New Guinea
	Kuwait	Ireland	Chile	Paraguay
	Macedonia, FYR	Israel	China	Peru
	Malawi	Italy	Colombia	Philippines
	Mexico	Japan	Costa Rica	Poland
	Moldova	Korea, Rep.	Cote d'Ivoire	Romania
	Morocco	Luxembourg	Croatia	Russian Federation
	Nicaragua	Malta	Dominica	Samoa
	Pakistan	Netherlands	Dominican Republic	Saudi Arabia
	Paraguay	New Zealand	Ecuador	Sierra Leone
	Peru	Norway	Egypt, Arab Rep.	Solomon Islands
	Romania	Portugal	Equatorial Guinea	South Africa
	South Africa	Singapore	Fiji	Thailand
	Uganda	Slovak Republic	Gabon	Togo
	Uruguay	Spain	Gambia, The	Trinidad and Tobago
	Zambia	Sweden	Georgia	Tunisia
		Switzerland	Ghana	Turkey
		United Kingdom	Grenada	Uganda
		United States	Guyana	Ukraine
			Hungary	United Arab Emirates
			India	Uruguay
			Indonesia	Venezuela
			Iran, Islamic Rep.	Vietnam

	Kuwait	Zambia

Countries are classified into Advanced and Developing using the IMF World Economic Outlook Database

Table 2: Descriptive Statistics

Variable	Obs.	Mean	Std. Dev.	Min	Max
GDP of Exporting Countries (billion USD)	287	157.868	225.369	5.094	1137.590
GDP of Destination (billion USD)	1736	580.038	1661.451	0.364	16177.500
Export Value (million USD)	386669	6.169	20.686	0.003	233.225
Share of Top 5% Exporters	386669	18.60	16.11	1	1.000
Number of Exporter	386669	0.493	0.279	0.009	1.000
Trade-weight	386669	0.032	0.076	0.000	0.912
Log Bilateral Exchange Rate Volatility	19036	-0.769	4.215	-28.891	20.520
Log External Exchange Rate Volatility	386669	0.687	2.741	-33.434	15.274

The number of observation for the bilateral exchange rate volatility shows that we have 19036 observations for the product of number of exporting country, destination country, and years.

Table 3: Main Estimation

VARIABLES	(1)	(2)	(3)	(4)
GDP(Destination)	1.211***	1.215***	1.229***	1.231***
	(0.045)	(0.045)	(0.045)	(0.045)
GDP(Origin)	1.213***	1.202***	1.244***	1.240***
	(0.057)	(0.057)	(0.057)	(0.057)
Relative CPI	-0.314***	-0.303***	-0.295***	-0.297***
	(0.025)	(0.025)	(0.025)	(0.025)
Number of Exporters	0.028***	0.028***	0.025***	0.024***
	(0.002)	(0.002)	(0.002)	(0.002)
Bilateral Exc. Rate	-0.053***	-0.066***	-0.067***	-0.066***
	(0.009)	(0.009)	(0.009)	(0.009)
Bilateral Exc. Rate Vol.		-0.017***	-0.016***	-0.016***
		(0.003)	(0.003)	(0.003)
External Exc. Rate			0.064***	0.064***
			(0.004)	(0.004)
External Exc. Rate Vol.				0.007**
				(0.003)
Observations	386,669	386,669	386,669	386,669
Number of panelid	67,007	67,007	67,007	67,007
Hausman	6556	6607	6115	6178
haus_p	0	0	0	0

All variables are in the form of their natural logarithm. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 4: Trade-Weights Estimation

VARIABLES	(1)	(2)	(3)
GDP(Destination)	1.221***	1.199***	1.180***
	(0.045)	(0.045)	(0.045)
GDP(Origin)	1.208***	1.259***	1.230***
	(0.057)	(0.057)	(0.057)
Relative CPI	-0.314***	-0.296***	-0.314***
	(0.025)	(0.025)	(0.025)
Number of Exporters	0.024***	0.024***	0.024***
	(0.002)	(0.002)	(0.002)
Bilateral Exc. Rate	-0.044***	-0.075***	-0.054***
	(0.010)	(0.009)	(0.010)
Bilateral Exc. Rate Vol.	0.003	-0.016***	0.005
	(0.004)	(0.003)	(0.004)
External Exc. Rate	0.063***	0.058***	0.057***
	(0.004)	(0.004)	(0.004)
External Exc. Rate Vol.	0.006**	0.006**	0.005*
	(0.003)	(0.003)	(0.003)
Trade-Weight*Bilateral Exc. Rate	-0.025***		-0.026***
	(0.002)		(0.002)
Trade-Weight*Bilateral Exc. Rate Vol.	-0.017***		-0.018***
	(0.002)		(0.002)
Trade-Weight*External Exc. Rate		0.008***	0.009***
		(0.002)	(0.002)
Trade-Weight*External Exc. Rate Vol.		0.007***	0.008***
		(0.001)	(0.001)
Observations	386,669	386,669	386,669
Number of panelid	67,007	67,007	67,007
Hausman	8110	7291	9400
haus_p	0	0	0

All variables are in the form of their natural logarithm. Robust standard errors in parentheses.
*** p<0.01, ** p<0.05, * p<0.1

Table 5: Results for Country-type Sub-samples

VARIABLES	Advanced Dest.	Developing Dest.
GDP(Destination)	0.887***	1.037***
	(0.097)	(0.069)
GDP(Origin)	1.160***	1.467***
	(0.080)	(0.087)
Relative CPI	-0.397***	-0.453***
	(0.053)	(0.036)
Number of Exporters	0.029***	0.019***
	(0.003)	(0.003)
Bilateral Exc. Rate	-0.033***	-0.402***
	(0.010)	(0.029)
Bilateral Exc. Rate Vol.	-0.013***	-0.012*
	(0.004)	(0.006)
External Exc. Rate	0.060***	0.071***
	(0.005)	(0.005)
External Exc. Rate Vol.	0.007**	-0.001
	(0.003)	(0.005)
Observations	196,194	190,475
Number of panelid	31,542	35,465
Hausman	4322	2419
haus_p	0	0

All variables are in the form of their natural logarithm. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 6: Estimation Results: Before, During, and After the GFC

VARIABLES	Before the Crisis	During the Crisis	After the Crisis
GDP(Destination)	1.133***	1.649***	1.414***
	(0.077)	(0.165)	(0.114)
GDP(Origin)	1.097***	1.182***	1.364***
	(0.112)	(0.212)	(0.168)
Relative CPI	-0.274***	-0.084	0.231**
	(0.034)	(0.141)	(0.100)
Number of Exporters	0.017***	0.004	0.001
	(0.003)	(0.006)	(0.003)
Bilateral Exc. Rate	-0.041***	-0.342***	-0.004
	(0.009)	(0.078)	(0.062)
Bilateral Exc. Rate Vol.	-0.024***	-0.101***	-0.018
	(0.005)	(0.038)	(0.014)
External Exc. Rate	0.077***	0.017**	0.031***
	(0.005)	(0.008)	(0.006)
External Exc. Rate Vol.	0.003	0.018	0.004
	(0.003)	(0.017)	(0.009)
Observations	197,329	66,976	122,364
Number of panelid	49,282	39,681	49,587
Hausman	3442	1003	1494
haus_p	0	0	0

All variables are in the form of their natural logarithm. Robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 7: Asymmetric Effects

VARIABLES	(1)	(2)	(3)	(4)
GDP(Destination)	1.228***	1.230***	1.232***	1.238***
	(0.045)	(0.045)	(0.045)	(0.045)
GDP(Origin)	1.234***	1.237***	1.235***	1.252***
	(0.057)	(0.057)	(0.057)	(0.057)
Relative CPI	-0.292***	-0.299***	-0.294***	-0.292***
	(0.025)	(0.025)	(0.025)	(0.025)
Number of Exporters	0.028***	0.028***	0.028***	0.028***
	(0.002)	(0.002)	(0.002)	(0.002)
Bilateral Exc. Rate	-0.067***	-0.066***	-0.066***	-0.066***
	(0.009)	(0.009)	(0.009)	(0.009)
External Exc. Rate	0.063***	0.063***	0.064***	0.064***
	(0.003)	(0.004)	(0.003)	(0.004)
External Exc. Rate Vol.	0.007**		0.007**	
	(0.003)		(0.003)	
Bilateral Exc. Rate Vol.		-0.016***		-0.016***
		(0.003)		(0.003)
AppDummy*Bilateral Exc. Rate Vol.	-0.015***			
	(0.003)			
DepDummy*Bilateral Exc. Rate Vol.	-0.025***			
	(0.003)			
AppDummy *External Exc. Rate Vol		0.006**		
		(0.003)		
DepDummy *External Exc. Rate Vol		0.010***		
		(0.003)		
LargeVolDummy* Bilateral Exc. Rate Vol.			-0.022***	
			(0.005)	
SmallVolDummy* Bilateral Exc. Rate Vol.			-0.015***	
			(0.003)	
LargeVolDummy* External Exc. Rate Vol.				0.009***
				(0.003)
SmallVolDummy* External Exc. Rate Vol.				0.002
				(0.003)
Observations	386,669	386,669	386,669	386,669
Number of panelid	67,007	67,007	67,007	67,007
Hausman	6363	6843	6149	6161
haus_p	0	0	0	0

All variables are in the form of their natural logarithm. Robust standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$