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Contents

Abstract

This paper examines the impact of intra-Asia exchange rate volatility on intra-Asia trade in primary goods, intermediate goods, equipment goods, and consumption goods from 1980 to 2009. For Asia, the evidence shows that as intraregional exchange rate volatility increases, intraregional exports in these goods fall. This adverse impact is even more pronounced in the sub-region of Association of Southeast Asian Nations (ASEAN)+5 comprising ASEAN member countries plus the People's Republic of China; Hong Kong, China; Japan; the Republic of Korea; and Taipei,China; and especially among intermediate and equipment exports. Again, the impact magnifies in an even smaller sub-group excluding the smaller ASEAN economies. These results underline the significant impact of exchange rate volatility on the region's production networks. For South Asia, however, exchange rate volatility appears to have a positive impact on exports. Still, caution is warranted given that South Asian economies trade relatively little with each other.

Keywords: exchange rate volatility, trade, ASEAN, East Asia

JEL classification: F10, F14, F31

1. Introduction

The question of whether exchange rate volatility harms trade has long been a preoccupation of not just exporters and importers, but also policymakers and economists. The breakdown of the Bretton Woods exchange rate system in 1973 heralded the beginning of floating exchange rates, which many feared would destabilize international trade and harm economic growth. Even in Asia today, this view remains widespread among authorities whose economies adopt an export-oriented growth model. In recent years, the lack of exchange rate flexibility has taken even greater prominence, often times as criticism for contributing to global imbalances. While policymakers generally agree on the need to rebalance their economies and are cognizant of the merits of more flexible exchange rates, in practice the fear of losing competitiveness seems to have trumped these other considerations.

The empirical literature on this topic is vast reflecting the long history of floating exchange rate and its continued policy relevance.[1] The theoretical literature is more limited but still impressive. What stands out, however, is a lack of consensus both in theories and empirics on whether exchange rate volatility does or does not harm trade. This paper hopes to make further contributions to the empirical literature in several ways. First, its main focus is to examine intra-Asia exchange rate volatility and its impact on intra-Asia exports. It covers a large group of 18 economies from the Association of Southeast Asian Nations (ASEAN), East Asia, and South Asia from 1980 to 2009.[2] Typically, other studies on Asia only look at some of these economies or place them together with other emerging economies. And they analyze the effects of exchange rate volatility on trade with their main trading partners, which may or may not include other Asian economies. Second, instead of examining aggregate or total exports, this paper uses disaggregated data by stages of production, namely, exports of primary, intermediate, equipment, and consumption goods.[3] Lastly, it employs a relatively new panel estimation method—panel dynamic ordinary least squares (DOLS)—that accounts for cross-sectional and time series properties of data to obtain the long-run relationship of interest.

To preview the results, the paper finds that exchange rate volatility tends to harm exports in all four categories of goods. This finding holds when the economies are included in one Asian group, or separately either as ASEAN+5 or ASEAN-5+5, except for South Asia. The rest of the paper is structured as follows. Section 2 discusses the theories and empirical literature with a particular focus on Asia. Section 3 introduces the panel DOLS, various panel unit root tests, and the Pedroni cointegration tests. Section 4 looks at the data and estimation issues including the different measures of volatility.

[1] Bahmani-Oskooee and Hegerty (2007) review over 70 studies up to 2005.

[2] These are the five larger ASEAN economies known collectively as ASEAN-5 (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) and four smaller members (Brunei Darussalam, Cambodia, the Lao People's Democratic Republic [Lao PDR], and Viet Nam); the five East Asian economies (the People's Republic of China [PRC]; Japan; Hong Kong, China; the Republic of Korea; and Taipei,China); and the four South Asian economies (Bangladesh, India, Pakistan, and Sri Lanka). For brevity, ASEAN and East Asian economies are labeled as ASEAN+5, and ASEAN+5 and South Asia as Asia.

[3] This follows the classification of CEPII-CHELEM, the trade database used in this paper.

Section 5 presents the results for Asia as a whole, and separately for ASEAN and East Asia, and South Asia. Finally, section 6 concludes.

2. Brief Theoretical and Empirical Review

The theoretical literature has its roots in Clark (1973), who contends that a risk averse firm facing increased exchange rate volatility will reduce its exports due to the uncertainty in its future profitability. Other models show that the negative relationship between exchange rate volatility and trade may not always hold under different conditions. For example, the presence of hedging instruments or accessibility to mature forward markets (Ethier 1973, Baron 1976, and Broll 1994) can alleviate the impact of exchange rate volatility on trade. On the other hand, an opposite (positive) relationship can exist when highly risk averse firms faced with volatile exchange rates increase their exports due to stronger income over substitution effects (De Grauwe 1987), and when high costs are involved in entering and exiting export markets (Franke 1991, and Sercu and Vanhulle 1992).

The divided theoretical literature has motivated many empirical studies, which by and large remain inconclusive due to methodological reasons. Differences in country coverage, sample periods, model specifications, and estimation techniques, which have evolved along with the advancement in econometrics, make it difficult to establish a systematic relationship between exchange volatility and trade. Still, what is surprising is that even after so many years of empirical studies, there is no consensus on a standard measure of exchange rate volatility. Various measures have been used from the simplest to the more sophisticated: variance or standard deviation of the level or percentage change of the nominal or real exchange rate to autoregressive conditional heteroskedasticity (ARCH), generalized ARCH of the exchange rate, and forecasts of professional economists. In addition the different levels of data disaggregation used in different studies inhibit easy cross study comparisons. Some use aggregated trade data between one country and the rest of the world, while others use disaggregated data between two countries or disaggregated data by commodity or sector.

That said, studies using aggregated data on Asia seem to have lent more support for the volatility-harms-trade view. For example, using total export volume and a single equation time series method of cointegration and/or error correction model, Doroodian (1999) confirms the negative relationship between exchange rate volatility and exports in India, Malaysia, and the Republic of Korea; Doganlar (2002) finds the same in Indonesia, Malaysia, Pakistan, and the Republic of Korea; and Poon et al. (2005) find a long-run negative relationship in three of the East Asian countries they study (Japan, the Republic of Korea, and Singapore), and a positive relationship in two others (Indonesia and Thailand). More recent papers have employed panel data. Benassy-Quere and Lahreche-Revil (2003) use bilateral total export volume between 11 Asian and 23 Organisation for Economic Co-operation (OECD) countries in a gravity model setup. They find intra-Asia exchange rate volatility has no discernible impact on exports, but a negative relationship exists between Asia–OECD exchange rate volatility and exports. Meanwhile, Chit (2008) and Chit et al. (2010) also use bilateral total export volume, but adopt a different panel model specification that reconfirms the negative relationship

between exchange rate volatility and exports.[4] The major difference between the two papers is the country coverage. In Chit (2008), the author looks solely at bilateral exports among the key ASEAN–[People's Republic of] China Free Trade Area (ACFTA) members, namely, the People's Republic of China (PRC), Indonesia, Malaysia, the Philippines, and Thailand. In Chit et al. (2010), in addition to their earlier sample, bilateral exports of the same ACFTA countries with 13 industrialized countries are included.

Studies on Asia using disaggregated data at the product or sectoral level also tend to favor the volatility-harms-trade view. Both Thorbecke (2008) and Hayakawa and Kimura (2009) look at bilateral export volume at the product level. In Thorbecke's case, the focus is on electronic components, a key intermediate product that goes into making final electronic goods in the region's production networks. In Hayakawa and Kimura's case, the authors compare the impact on finished machinery goods (final goods) and machinery parts (intermediate goods). In terms of methodology, Thorbecke adopts a panel DOLS estimation technique on the five main ASEAN countries plus the PRC; Japan; the Republic of Korea; and Taipei,China; while Hayakawa and Kimura use a gravity model on the same set of countries except that Taipei,China is replaced by Hong Kong, China.[5] Thorbecke's results show a clear adverse impact from intra-Asian exchange rate volatility on exports of electronic components. Hayakawa and Kimura also find the same for both finished machinery goods and machinery parts, with the latter being more sensitive to higher volatility. In contrast to Thorbecke and Hayakawa and Kimura, this paper looks at export data at a disaggregated level that is higher than the specific product types examined by the former.

3. Methodology

The paper follows the methodology adopted by Thorbecke (2008). It starts with panel unit root tests on each variable, then panel cointegration tests on a theoretical specification comprising the variables of interest, and finally panel DOLS estimation on the relationship of interest given the presence of both unit root and cointegration. This strategy is similar to the exercise for non-panel, single country, time series analysis.

Three panel unit root tests are used: Im-Pesaran-Shin (IPS) (Im et al. 2003), Fisher-type Augmented Dickey-Fuller (ADF) (Choi 2001), and Hadri Lagrange Multiplier (LM) (Hadri 2000). The key difference between each test is how each calculates the unit root test statistics. For more details, see Baltagi (2005). A unique feature of the IPS and Fisher ADF tests is that they allow for different autoregressive (unit root) parameter in each panel—each parameter is panel specific. (This feature is not applicable to the Hadri LM test). In addition, both the IPS and Fisher tests cater to unbalanced data, but not the Hadri test. The null hypothesis for the IPS and Fisher tests is that all panels contain unit roots, while the alternatives state that some panels are or at least one panel is stationary.

[4] They estimate panel fixed- and random-effects on a specification motivated by the inclusion of some gravity variables.

[5] Actually, the authors examine a larger sample of 60 developing and developed economies. Since the focus here is on Asia, only the results for Asia are presented. That said, the overall results are not materially different from those presented here.

In both these cases, the rejection of the null implies the absence of unit roots: some panels are, or at least one panel is, stationary. In the Hadri test, however, the null and alternative hypotheses are reversed because standard unit root tests generally have low power against the alternative hypothesis of stationarity.[6]

This paper uses the Pedroni panel cointegration test (Pedroni 1999, 2004). Its essence is similar to the Engle-Granger framework for a single country time series, where the residuals of a regression involving unit root variables are tested for stationarity. If the residuals are stationary, then a cointegration (long-run relationship) exists between the variables of interest. The test produces 11 test statistics depending on how each is calculated and what are the alternative hypotheses. The first set of eight "panel" statistics calculated by pooling the residuals for the within-group regression is based on the alternative hypothesis of homogenous autoregressive parameter of the residuals, (ρ_i=ρ)<1, for all panels. The second set of four "group" statistics calculated by pooling the residuals of the between-group regression is based on the alternative hypothesis of heterogeneous autoregressive parameter of the residuals, ρ_i<1, for all panels. The first set of statistics is further split into two groups called "weighted" and "unweighted".[7] As suggested by Pedroni (2004), this paper only presents the latter because of better power in smaller samples. In all the test statistics, rejection of the null implies the presence of cointegration.

The imperfect substitution model (Goldstein and Khan 1985, and Rose 1991) provides the theoretical justification for the long-run export demand equation. When augmented with exchange rate volatility, the equation is a widely used specification in the applied literature, see for example, Dagonlar (2002), Chou (2000), and De Vita and Abbott (2004). The equation states that exports are dependent on foreign income, bilateral exchange rate, and exchange rate volatility. To estimate the equation given that the variables are non-stationary and cointegrated, the panel DOLS of Kao and Chiang (2000) is adopted. This entails estimating the following specification:

$$x_{ij,t} = \alpha_0 + \alpha_1 y_{j,t} + \alpha_2 e_{ij,t} + \alpha_3 v_{ij,t} + \sum_{k=-p}^{p} \beta_{y,k} \Delta y_{j,t+k} + \sum_{k=-p}^{p} \beta_{e,k} \Delta e_{ij,t+k} + \sum_{k=-p}^{p} \beta_{v,k} \Delta v_{ij,t+k} + \mu_{ij+} u_{ij,t},$$

where x_{ij} is the exports of country i to country j; y_j is the real GDP of country j (the importer); e_{ij} is the bilateral real exchange rate of i with respect to j; v_{ij} is a measure of exchange rate volatility; μ_{ij} is the country-pair fixed effects; u_{ij} is the residuals; p is the number of periods of leads and lags; Δ is the first difference; and $i,j = 1....N$, $t = 1....T$.[8]

The novelty of the panel DOLS is that it includes leads and lags of the first differences of the right-hand side variables. This addresses the endogeneity of regressors and autocorrelation concerns that are most prominent in long-run economic relationships. According to Kao and Chiang (2000), the estimators and test statistics of panel DOLS

[6] This idea is similar to the Kwiatkowski–Phillips–Schmidt–Shin (KPSS) test in a single time series.
[7] For more details, see footnote 4, Pedroni (2004).
[8] Thorbecke (2008) also uses the same specification, except that the foreign income variable is replaced by final electronic good exports from country j to the rest of the world. Recall, Thorbecke's goal is to examine the impact of exchange rate volatility at the product level, the case of electronic components.

have better sample properties than both panel OLS and panel fully modified OLS. Unlike panel DOLS, both the estimators and test statistics of panel OLS and panel fully modified OLS are biased in finite sample sizes and this bias does not disappear in large samples. This implies that not only are their estimates problematic, making the right inferences are also difficult. In contrast, the estimators of panel DOLS and the test statistics have no such problems, where the sequential limit theory approximates the limiting distribution of the estimators and the t-statistics very well.

The panel DOLS has been used in a variety of studies in recent years. Kim et al. (2005) and Adedeji and Thornton (2008) use it to test the savings–investment relationship in Asia and 50 developed and developing countries, respectively. Faruqee (2004) uses it to examine the impact of trade from the European Monetary Union on the euro area. Bayoumi et al. (2005) employ it to model the medium-term exchange rate equilibrium in 12 industrial countries. MacDonald and Ricci (2007) employ it to examine the determinants of long-run real exchange rates incorporating relative productivity and product market competition, while controlling for standard macroeconomic variables.

4. Data and Estimation Issues

With 17 economies in total,[9] and each economy exporting to the other 16, this translates to N=272 bilateral exporter–importer or country pairs. And with the data spanning from 1980 to 2009, this gives 8,160 total observations. Bilateral exports of all goods (primary, intermediate, equipment, and consumption) and real exchange rates are obtained from the CEPII-CHELEM database, a proprietary harmonized database based on the United Nations (UN) Commodity Trade (Comtrade) Statistics, the International Monetary Fund's (IMF) *Direction of Trade Statistics*, and national sources.[10] Appendix I provides more details on the composition of each good. Real GDP of importing country comes mainly from the World Bank's *World Development Indicators* and CEIC at constant 2000 prices. Nominal exchange rates are collected from the IMF's *International Financial Statistics*.

All bilateral exports are in real terms, deflated by the appropriate price indexes obtained from the US Bureau of Labor Statistics. The real exchange rates from CEPII-CHELEM are measured in purchasing power parity terms and expressed as US dollar–local currency. To obtain the bilateral real exchange rate of country i to j, the ratio of real exchange rate of j to i is taken. An increase in the bilateral real exchange rate in this case implies a real depreciation of the exporter's currency.

As per Thorbecke (2008), four volatility measures are also used. The first is the current year's volatility; the second, the previous year's volatility; the third, the current and previous years' volatility; and the last, the current, previous, and succeeding years' volatility. These different measures are meant to account for the argument that traders may not always react to contemporaneous exchange rate volatility. Some may be forward-looking while others not. Some prefer to just wait-and-see or are in the middle of contracts that cannot be easily changed. The annual volatility used is calculated as the

[9] In the database, Cambodia and the Lao PDR are treated as one country.
[10] For more details, see http://www.cepii.fr/anglaisgraph/bdd/chelem.htm.

coefficient of variation of the bilateral monthly nominal exchange rate of country i to j. This means 12 monthly observations are used to calculate the first two measures of volatility, 24 for the third, and 36 for the fourth. Note nominal exchange rates are preferred over real exchange rates as the latter also take into account the volatility of price levels. In any case, there is no clear consensus on this (Bahmani-Oskooee and Hegerty 2007). Finally, all data are transformed into natural logarithm. For more details on data sources and constructions, please refer to Appendix II.

Having three different panel unit root tests are for robustness checks. In each test, different specifications are tried to ascertain the sensitivity of the overall result. This typically involves demeaning the series, including or excluding a drift or trend term, and changing the number of lag periods. For the Pedroni cointegration tests, the only variation done is to see whether the result holds when the time trend is excluded. For panel DOLS, the robustness check involves changing the leads and lags from (2,2) to (1,1). Panel DOLS (2,2) is estimated as the available data limit higher order specifications.[11] Still, by and large, results from panel DOLS (1,1) do not differ much. Kao and Chiang (2000) show that increasing the number of leads and lags can reduce the bias of the estimation. For comparison and completeness, panel fixed effects are also estimated.

5. Results

Results are presented by region. The first region covers all countries, Asia. Then it is broken into two sub-regions, ASEAN+5 and South Asia. To a large extent, it is more representative to focus the analysis at the sub-regional level. A few stylized facts motivate this. First, within ASEAN+5, intraregional trade has increased noticeably over the years (Figure 1). This has come at the expense of trade with the rest of the world, mostly developed economies; although the developed economies are still the major market. Second, ASEAN+5's trade with South Asia has remained relatively small over the years, capturing only 2.3% of total ASEAN+5 trade in 2009 (Figure 1). Third, while South Asia's trade with ASEAN+5 (mostly exports) has grown gradually over the years, trade within the sub-region has remained small at 2.7% of total South Asian trade in 2009 (Figure 2). Fourth, within ASEAN+5 it is also worthwhile to exclude the smaller ASEAN countries to focus the analysis on the region's production networks. This is the result of the expansion of international production fragmentation that has gained significant traction in the bigger ASEAN and East Asian economies. The trade share of the smaller ASEAN countries—Brunei Darussalam, Cambodia, the Lao People's Democratic Republic (Lao PDR), and Viet Nam—within Asia has mainly concentrated in primary goods (Figure 3).

The choice of goods included in this paper is motivated by the trends of intra-Asian trade (Figure 4). In particular, intermediate and equipment goods represented about half of total intraregional trade in 2009. Meanwhile, primary and consumption goods are also

[11] Thorbecke (2008) estimates a panel DOLS(1,1) but provides no specific justification. The choice of leads and lags to be included is somewhat arbitrary, unless perhaps the program can be modified to include selection criteria such as Akaike or Schwarz.

included as they represent the two extremes of the classification by stage of production in CEPII-CHELEM.

5.1 Asia (ASEAN+5 and South Asia)

A quick glance at Table 1, Panel A shows that the three panel unit root tests largely support the presence of unit root in all the variables. Put differently, they do not reject the null hypothesis of non-stationarity or unit root. That said, for exchange rate volatility there is some support for stationarity from the IPS and Fisher tests. Still, even in this case, the Hadri test overwhelmingly rejects the presence of stationarity. As mentioned above in each test, different specifications are varied to check for robustness. For the IPS and Hadri tests, the overall results do not matter with the different variations. For the Fisher test, including a drift term changes the significance of the overall results to that supportive of stationarity for all variables.

Given that most of the panel unit root tests find the variables are non-stationary, the Pedroni panel cointegration tests are carried out to establish whether there exists a cointegration relationship between each of the exports (primary, intermediate, equipment, and consumption goods) and the right-hand side variables (real GDP of importing country, bilateral real exchange rate, and exchange rate volatility). Table 2, Panel A shows the different test statistics overwhelmingly support the presence of cointegration in all goods. Most of the test results reject the null of no cointegration at the 1% level. Besides the specification with trend, the case without trend is also tried. Generally, in the latter, one or two of the test statistics turn insignificant, but there are still many more that reject rather than support the null hypothesis of no cointegration.

With the presence of cointegration ascertained, panel DOLS is estimated on each export category. For the variable of main interest the exchange rate volatility has a negative and mostly statistically significant impact on exports of all goods (Table 3). This is robust to different volatility measures, except for primary goods, where it is significant only when the volatility is measured as the previous year's (Volatility B), and the current and previous years' (Volatility C) coefficients of variation. This implies that, at least for primary goods, their exports are more influenced by past exchange rate volatility. Meanwhile, the real GDP of the importing country has the expected positive and significant impact on exports of all goods and under different volatility measures. On the other hand, the bilateral real exchange rate, aside from primary goods, has a significant negative relationship with exports.[12]

In contrast, if the estimations are carried out by panel fixed effects, the results are quite different, reflecting the biases and problems that Kao and Chiang (2000) point out. For example, the exchange rate volatility turns out to have a positive impact on exports of intermediate and equipment goods. While the bilateral real exchange rate has a positive instead of a negative impact on exports of most goods. The only variable that is similar to the estimates of panel DOLS is the real GDP of the importing country, which is always positive (Table 4).

[12] This seems counterintuitive and will be discussed in a later section.

5.2 ASEAN+5

Following the above steps, but now examining a smaller sample of ASEAN+5 economies, the battery of panel unit root tests also conclude the presence of unit root in all the variables (Table 1, Panel B). There is some support for stationarity in the exchange rate volatility from the IPS and Fisher tests, but not so from the Hadri test. These results are largely robust to the variations in each test's specification. A minor exception is that for the bilateral real exchange rate variable, the inclusion of the trend term in the IPS and Fisher tests is important in supporting non-stationarity. Still, the Hadri test with varying specifications continues to support non-stationarity in the variable. Meanwhile, the Pedroni panel cointegration tests provide support for the presence of cointegration in each good (Table 2, Panel B).

Results from the panel DOLS show the exchange rate volatility has a clear negative impact on exports of all goods (Table 5). The real GDP of the importing country has a clear positive impact on exports of all goods. While the bilateral exchange rate only has a positive impact on exports of primary goods; for other goods, a negative relationship is evident. These results are statistically significant and do not matter with the different volatility measures. In contrast to the larger sample of Asia (Table 3), two features stand out. First, the negative impact of exchange rate volatility on exports is stronger in ASEAN+5, especially in terms of intermediate and equipment goods. Second, the overall results are more robust to the different volatility measures.

On the other hand, results from the panel fixed-effects estimations are again quite different and lack significance (Table 4). Exchange rate volatility is the only statistically significant variable, but it has an opposite positive impact on exports of intermediate and equipment goods. Only the real GDP of the importing country has a consistently significant positive impact on exports of all goods. While the bilateral exchange rate has a statistically significant positive impact in primary and consumption goods only.

What is even more interesting is the exclusion of the smaller ASEAN countries, namely, Brunei Darussalam, Cambodia, the Lao PDR, and Viet Nam from ASEAN+5. When this is done, the negative impact of exchange rate volatility becomes much greater in intermediate, equipment, and consumption exports (Table 6). This suggests trade in the region's production networks is more susceptible to exchange rate volatility. Interestingly, the impact on primary exports has changed sign to become positive.

5.3 South Asia

For South Asia, the different panel unit root tests with varying specifications largely support the presence of unit root (Table 1, Panel C). Yet, for the exchange rate volatility the support for unit root is absent in the IPS and Fisher tests, while it is only present when the trend term is included in the Hadri test. Likewise, results of the Pedroni cointegration tests are more mixed (Table 2, Panel C). Still, by and large, there continues to be a confirmation of cointegration in the equations.[13]

[13] The weakest support is found for the relationship involving intermediate goods where the inclusion of the trend term is central in determining the existence of cointegration.

Results from the panel DOLS are also quite different and more mixed than the other groups (Table 7). Exchange rate volatility in South Asia has a positive instead of a negative impact on exports of all goods except for primary goods. Meanwhile, the bilateral real exchange rate also has a significant positive impact on exports of all goods except consumption goods where it is not significant. Interestingly, real GDP of the importing country is not important (mostly not significant). All these results are largely true regardless of the different volatility measures.

Again, the panel fixed effects provide a rather different picture (Table 4). The exchange rate volatility is consistently negative and insignificant, while only the real GDP of importing country is consistently positive and statistically significant for all goods.

5.4 Discussion

In sum, for Asia and ASEAN+5, exchange rate volatility appears to harm exports of primary, intermediate, equipment, and consumption goods. In fact, the effect seems to be more pernicious on the region's production networks as the negative impact is most stark on intermediate and equipment exports among a smaller grouping of ASEAN-5+5, that is, without the smaller ASEAN economies. In this group the (negative) magnitude of the exchange rate volatility is far larger than any of the other coefficients. It is the largest in equipment followed by intermediate and consumption exports. In contrast, for South Asia, exchange rate volatility seems to help trade. In general, the relative unimportance of intra-South Asian trade suggests caution is necessary when interpreting this and other results for South Asia.

Real income of the importing country has the expected and intuitive positive sign in Asia and ASEAN+5. Yet, its absolute magnitude is typically smaller than that of the bilateral real exchange rate and exchange rate volatility, thus highlighting the importance of exchange rate issues in trade.

At the surface, the negative coefficient of the bilateral real exchange rate appears to be counterintuitive.[14] This is evident for all exports except primary goods in Asia and ASEAN+5. (In South Asia, the opposite is found). Note, a rise in the bilateral real exchange rate of i to j implies a real depreciation of i's (exporter) currency vis-à-vis j's currency, which conventionally would suggest a rise in exports of i to j—a positive coefficient. There are several plausible reasons for this negative relationship. One is the J-curve effect where an initial depreciation of an exporter's currency may not immediately lead to a rise in exports as it takes time for quantity to adjust to lower prices due to, say, terms stipulated in the previous contract. To address this, a 1-year lagged bilateral real exchange rate is included together with the contemporaneous bilateral real exchange rate, yet in this case the lagged term continues to be negative. This and the fact that the data used are of annual frequency suggest that the J-curve effect may not be that prevalent.

[14] Thorbecke (2008) also shares the same finding. While the definition of relative prices may differ, De Grauwe (1987), Cushman (1988), Pozo (1992), and McKenzie and Brooks (1997), among others, also find the same.

Another plausible explanation comes from the pattern and extent of trade involving the region's production networks.[15] A depreciation of an exporter's currency is symmetrical to an appreciation of an importer's currency. When this happens, the demand for the importer's products falls since they have become more expensive. In turn, this will translate into lower demand for parts and components/intermediate products from the importer, resulting in the fall in exports of these goods. This argument fits the results for intermediate and equipment goods well, but to a lesser extent for consumption goods. In any case, these differences are perhaps reflected in the magnitude of the exchange rate volatility, which is largest for intermediate and equipment exports, followed by consumption exports, in both Asia and ASEAN+5.

Finally, the negative signed bilateral real exchange rate may be due to the different measure or definition used. If instead the variable is measured as the bilateral nominal exchange rate multiplied by the ratio of foreign wholesale prices and domestic wholesale prices, a more commonly used indicator for relative prices, the estimated coefficient becomes statistically insignificant, though it is still negative. (For primary goods, the coefficient is still positive, but for the rest of the goods, they are negative).[16]

6. Conclusions

This paper attempts to answer the question of how intra-Asia exchange rate volatility affects intra-Asia exports at the disaggregated levels of primary, intermediate, equipment, and consumption goods. It covers a large group of 18 economies from ASEAN, East Asia, and South Asia over the period 1980–2009 using a relatively new time series econometric technique of panel DOLS. For Asia and ASEAN+5, exchange rate volatility is found to be harmful to exports in all goods. This adverse impact is stronger in smaller groups, such as ASEAN+5 and even more so in ASEAN+5 without Brunei Darussalam, Cambodia, the Lao PDR, and Viet Nam. In addition, the adverse impact is most evident among intermediate and equipment goods.

These findings highlight the particularly pernicious effect of intraregional exchange rate volatility on the region's production networks. On the other hand, intra-South Asian exchange rate volatility has a positive impact on intra-South Asian trade. However, the positive impact is likely to be minimal considering the very small share of intraregional to total trade. Overall, these results do not really matter with the different volatility measures. Meanwhile, the results from panel fixed effects are markedly different in terms of sign and significance.

Given that intraregional exchange rate volatility hurts intraregional trade, and that increasing intraregional trade helps redress global payment imbalances, it follows that policymakers should be concerned about volatility. What is most striking is that the adverse impact is concentrated in intermediate and equipment goods, the two most heavily traded products in the region and key components to the region's production

[15] The author thanks Willem Thorbecke for pointing this out.
[16] The results are not presented here but are available from the author. They refer to ASEAN+5 since data were only collected for this group.

networks. As such, the need for greater exchange rate cooperation and coordination among regional economies deserves closer policy consideration.

References

O. Adedeji and J. Thornton. 2008. International Capital Mobility: Evidence from Panel Cointegration Tests. *Economic Letters.* 99 (2). pp. 349–352.

M. Bahmani-Oskooee and S. W. Hegerty. 2007. Exchange Rate Volatility and Trade Flows: A Review Article. *Journal of Economic Studies.* 34 (3). pp. 211–255.

B. H. Baltagi. 2005. *Econometric Analysis of Panel Data*. Third Edition. West Sussex, England: John Wiley & Sons Ltd.

D. Baron. 1976. Fluctuating Exchange Rates and the Pricing of Exports. *Economic Inquiry*. 14. pp. 425–438.

T. Bayoumi, H. Faruqee, and J. Lee. 2005. A Fair Exchange? Theory and Practice of Calculating Equilibrium Exchange Rate. *IMF Working Paper*. 229.

A. Benassy-Quere and A. Lahreche-Revil. 2003. Trade Linkages and Exchange Rates in Asia: The Role of [the People's Republic of] China. *CEPII Working Paper*. 21.

U. Broll. 1994. Foreign Production and Forward Markets. *Australian Economic Papers*. 62. pp. 1–6.

M. M. Chit. 2008. Exchange Rate Volatility and Exports: Evidence from the ASEAN–[People's Republic of] China Free Trade Area. *Journal of Chinese Economic and Business Studies*. 6 (3). pp. 261–277.

M. M. Chit, M. Rizov, and D. Willenbockel. 2010. Exchange Rate Volatility and Exports: New Empirical Evidence from the Emerging East Asian Economies. *The World Economy*. 33 (2). pp. 239–263.

I. Choi. 2001. Unit Root Tests for Panel Data. *Journal of International Money and Finance*. 20. pp. 249–272.

W. L. Chou. 2000. Exchange Rate Variability and [People's Republic of] China's Exports. *Journal of Comparative Economics*. 28. pp. 61–79.

P. Clark. 1973. Uncertainty, Exchange Risk, and the Level of International Trade. *Western Economic Journal*. 11. pp. 302–313.

D. O. Cushman. 1988. US Bilateral Trade Flows and Exchange Risk during the Floating Period. *Journal of International Economics*. 24 (3–4). pp. 317–330.

P. De Grauwe. 1987. Exchange Rate Variability and the Slowdown in Growth of International Trade. *International Monetary Fund Staff Papers*. 35 (1). pp. 63–84.

G. De Vita and A. Abbott. 2004. Real Exchange Rate Volatility and US Exports: An ARDL Bounds Testing Approach. *Economic Issues*. 9 (1). pp. 69–78.

M. Doganlar. 2002. Estimating the Impact of Exchange Rate Volatility on Exports: Evidence from Asian Countries. *Applied Economics Letter*. 9. pp. 859–863.

K. Doroodian. 1999. Does Exchange Rate Volatility Deter International Trade in Developing Countries? *Journal of Asian Economics*. 10. pp. 465–474.

W. Ethier. 1973. International Trade and the Forward Exchange Market. *American Economic Review*. 63 (3). pp. 494–503.

H. Faruqee. 2004. Measuring the Trade Effects of EMU. *IMF Working Paper Series*. 154.

G. Franke. 1991. Exchange Rate Volatility and International Trading Strategy. *Journal of International Money and Finance*. 10. pp. 292–307.

M. Goldstein and M. S. Khan. 1985. Income and Price Effects in Foreign Trade. In R. W. Jones and P. B. Kenen, eds. *Handbook of International Economics*. Amsterdam: North-Holland.

K. Hadri. 2000. Testing for Stationarity in Heterogeneous Panel Data. *Econometrics Journal*. 3. pp. 148–161.

K. Hayakawa and F. Kimura. 2009. The Effect of Exchange Rate Volatility on International Trade in East Asia. *Journal of the Japanese and International Economies*. 23. pp. 395–406.

K. S. Im, M. H. Pesaran, and Y. Shin. 2003. Testing for Unit Roots in Heterogeneous Panels. *Journal of Econometrics*. 115. pp. 53–74.

C. Kao and M. H. Chiang. 2000. On the Estimation and Inference of a Cointegrated Regression in Panel Data. *Advances in Econometrics*. 5. pp. 179–222.

H. Kim, K. Y. Oh, and C-W. Jeong. 2005. Panel Cointegration Results on International Capital Mobility in Asian Economies. *Journal of International Money and Finance*. 24. pp. 71–82.

R. MacDonald and L. Ricci. 2007. Real Exchange Rates, Imperfect Substitutability and Imperfect Competition. *Journal of Macroeconomics*. 29. pp. 639–664.

M. McKenzie and R. D. Brooks. 1997. The Impact of Exchange Rate Volatility on German-US Trade Flows. *Journal of International Financial Markets, Institutions and Money*. 7 (1). pp. 73–87.

P. Pedroni. 1999. Critical Values for Cointegration Tests on Heterogeneous Panels with Multiple Regressors. *Oxford Bulletin of Economics and Statistics*. Special Issue. pp. 653–670.

———. 2004. Panel Cointegration: Asymptotic and Finite Sample Properties of Pooled Time Series Tests with an Application to the PPP Hypothesis. *Econometric Theory*. 20. pp. 597–625.

W-C. Poon, C-K. Choong, and M. S. Habibullah. 2005. Exchange Rate Volatility and Exports for Selected East Asian Countries. *ASEAN Economic Bulletin*. 22 (2). pp. 144–159.

S. Pozo. 1992. Conditional Exchange-Rate Volatility and the Volume of International Trade: Evidence from the Early 1900s. *Review of Economics and Statistics*. 74. pp. 325–329.

A. Rose. 1991. The Role of Exchange Rates in a Popular Model of International Trade. *Journal of International Economics*. 30. pp. 301–316.

P. Sercu and C. Vanhulle. 1992. Exchange Rate Volatility, International Trade, and the Value of Exporting Firms. *Journal of Banking and Finance*. 16. pp. 155–182.

W. Thorbecke. 2008. The Effect of Exchange Rate Volatility on Fragmentation in East Asia: Evidence from the Electronics Industry. *Journal of the Japanese and International Economies*. 22. pp. 535–544.

Table 1: Panel Unit Root Tests: Results by Region

	Im-Pesaran-Shin[1]	Fisher[2]	Hadri[3]
A. Asia (ASEAN+5 and South Asia)			
Real primary good exports of *i* to *j*	1.59	10.55	40.76
Real intermediate good exports of *i* to *j*	10.38	15.73	57.73
Real equipment good exports of *i* to *j*	0.80	2.15	54.38
Real consumption good exports of *i* to *j*	5.07	7.94	54.94
Real GDP of *j*	10.05	12.22	68.49
Bilateral real exchange rate of *i* and *j*	4.76	8.27	50.28
Volatility of bilateral nominal exchange rate[4]	-42.64*	-12.13*	8.58
B. ASEAN+5			
Real primary good exports of *i* to *j*	0.55	5.88	30.59
Real intermediate good exports of *i* to *j*	9.30	12.47	43.86
Real equipment good exports of *i* to *j*	7.30	8.50	42.36
Real consumption good exports of *i* to *j*	7.15	9.33	42.23
Real GDP of *j*	2.95	3.89	52.00
Bilateral real exchange rate of *i* and *j*	2.96	5.96	38.66
Volatility of bilateral nominal exchange rate[4]	-28.89*	-8.60*	6.46
C. South Asia			
Real primary good exports of *i* to *j*	-1.76**	1.63	5.30
Real intermediate good exports of *i* to *j*	0.69	-0.41	8.87
Real equipment good exports of *i* to *j*	-0.86	0.74	8.84
Real consumption good exports of *i* to *j*	-1.48***	0.85	9.69
Real GDP of *j*	1.50	2.47	14.57
Bilateral real exchange rate of *i* and *j*	1.43	0.58	12.11
Volatility of bilateral nominal exchange rate[4]	-14.08*	-3.12*	1.72

Note: All variables are in natural logarithm. Sample starts from 1980, except for exchange rate volatility (1984) in order to match the start of the dong series.

[1] Refers to W-t-bar statistic calculated based on a maximum of two lags chosen by the Akaike Information Criterion (AIC) with individual specific effects, a linear time trend, and demeaned series.

[2] Refers to inverse normal Z-statistic from the Augmented Dickey Fuller (ADF) unit root test with two lags, individual specific means, a linear time trend, and demeaned series.

[3] Refers to the z-statistic with robust standard errors from Bartlett kernel with two lags, a linear time trend, and demeaned series. Unlike the other tests, the null hypothesis of the Hadri test refers to all panels being stationary. Hence, unlike the other tests, rejection of the null implies the presence of unit roots. However, for ease of comparison, the conventional interpretation is adopted, that is, asterisks are used to indicate the support for stationarity or in the absence of asterisks the support for unit root.

[4] Based on current year volatility.

Table 2: Panel Cointegration Tests: Results by Region

	Primary Goods	Intermediate Goods	Equipment Goods	Consumption Goods
A. Asia (ASEAN+5 and South Asia)				
Panel v-statistic	-29.79*	-3.06*	-9.09*	-3.13*
Panel ρ-statistic	5.24*	13.29*	12.92*	12.92*
Panel PP-statistic	-8.28*	8.30*	7.15*	6.11*
Panel ADF-statistic	-6.15*	3.15*	2.27**	-1.66***
Group ρ-statistic	8.72*	13.52*	12.13*	15.50*
Group PP-statistic	-18.21*	5.69*	-15.51*	-1.14
Group ADF-statistic	-15.41*	-8.01*	-13.05*	-6.91*
B. ASEAN+5				
Panel v-statistic	-26.67*	-1.91***	-8.00*	-2.43**
Panel ρ-statistic	3.86*	10.49*	10.47*	9.84*
Panel PP-statistic	-5.88*	7.78*	6.78*	4.83*
Panel ADF-statistic	-4.53*	3.89*	2.96*	-0.98
Group ρ-statistic	7.66*	11.65*	10.60*	12.22*
Group PP-statistic	-10.60*	-1.52	-6.14*	0.97
Group ADF-statistic	-8.98*	-3.65*	-4.73*	-2.28**
C. South Asia				
Panel v-statistic	-0.36	-0.28	-1.48	-1.07
Panel ρ-statistic	-0.52	1.61	-2.11**	1.79***
Panel PP-statistic	-3.37*	0.68	-6.75*	-0.76
Panel ADF-statistic	-2.44**	-1.71***	-3.35*	-4.14*
Group ρ-statistic	1.35	3.15*	0.00	0.71
Group PP-statistic	-2.16**	1.23	-8.31*	-3.90*
Group ADF-statistic	-3.98*	-2.14**	-7.11*	-3.86*

Note: Each column indicates the results for panel cointegration tests of real primary goods, real intermediate goods, real equipment goods, or real consumption goods on the real bilateral exchange rate, real gross domestic product (GDP) of importer, and the same year exchange rate volatility. All variables are in natural logarithm. Sample starts from 1984. Each specification includes an intercept, a trend term, a lag length chosen automatically by the Akaike Information Criterion (set at a maximum of three), and Newey-West bandwith based on Bartlett kernel. The panel statistics presented are the unweighted statistics. *, **, and *** refer to 1%, 5%, and 10% levels of significance, respectively.

Table 3: Panel Dynamic Ordinary Least Squares (DOLS): Asia (ASEAN+5 and South Asia)

	Volatility A	Volatility B	Volatility C	Volatility D
Primary Goods				
Real GDP of *j*	0.1712*	0.1710*	0.1709*	0.1715*
Bilateral real exchange rate	0.3711*	0.3725*	0.3730*	0.3678*
Volatility of exchange rate	-0.0233	-0.2661*	-0.1492*	-0.0496
Intermediate Goods				
Real GDP of *j*	0.3238*	0.3228*	0.3205*	0.3190*
Bilateral real exchange rate	-1.1900*	-1.1853*	-1.1757*	-1.1755*
Volatility of exchange rate	-0.8887*	-1.1713*	-0.9958*	-0.8762*
Equipment Goods				
Real GDP of *j*	0.3110*	0.3100*	0.3080*	0.3062*
Bilateral real exchange rate	-1.1951*	-1.1904*	-1.1816*	-1.1790*
Volatility of exchange rate	-0.7738*	-0.9140*	-0.8577*	-0.8573*
Consumption Goods				
Real GDP of *j*	0.2201*	0.2195*	0.2186*	0.2183*
Bilateral real exchange rate	-0.6198*	-0.6169*	-0.6131*	-0.6148*
Volatility of exchange rate	-0.3837*	-0.5557*	-0.4436*	-0.3557*

Note: Panel DOLS (2,2) are estimated with bias corrected standard errors. This specification is based on each dependent variable as indicated above and the right-hand side variables of real gross domestic product (GDP) of the importing country, bilateral real exchange rate, and different volatility measures corresponding to different column results. The values presented are the estimated coefficients of the contemporaneous right-hand side variables. All variables are in natural logarithm. Sample starts from 1984. Volatility A is the volatility of the current year; B, previous year; C, current and previous years; and D, previous, current, and next years. *, **, and *** refer to 1%, 5%, and 10% levels of significance, respectively.

Table 4: Panel Fixed Effects: Results by Region

	Asia	ASEAN+5	South Asia
Primary Goods			
Real GDP of *j*	0.2770*	0.3533*	0.2341**
Bilateral real exchange rate	0.0915**	0.1110**	0.3218
Volatility of exchange rate	-0.0052	-0.0087	-0.1866
Intermediate Goods			
Real GDP of *j*	0.6668*	0.9219*	0.3040*
Bilateral real exchange rate	0.0883***	0.0868	0.4907
Volatility of exchange rate	0.2504*	0.4132*	-0.0910
Equipment Goods			
Real GDP of *j*	0.6806*	0.9676*	0.1450***
Bilateral real exchange rate	0.0528	0.1173	0.0894
Volatility of exchange rate	0.3056*	0.5273*	0.2365
Consumption Goods			
Real GDP of *j*	0.3773*	0.5256*	0.1958**
Bilateral real exchange rate	0.0945**	0.1237**	0.1930
Volatility of exchange rate	0.0500	0.1270	0.0880

Note: ASEAN+5 refers to Brunei Darussalam; Cambodia; the People's Republic of China; Hong Kong, China; Indonesia; Japan; the Republic of Korea; the Lao People's Democratic Republic; Malaysia; the Philippines; Singapore; Taipei,China; Thailand; and Viet Nam. South Asia refers to Bangladesh, India, Pakistan, and Sri Lanka. Asia refers to ASEAN+5 and South Asia. A panel fixed effects model is estimated with autocorrelation- and heteroskedasticity-corrected standard errors. The specification is based on each dependent variable as indicated above and the right-hand side variables of real GDP of the importing country, bilateral real exchange rate, and the current year exchange rate volatility. All variables are in natural logarithm. Sample starts from 1984. *, **, and *** refer to 1%, 5%, and 10% levels of significance.

Table 5: Panel Dynamic Ordinary Least Squares (DOLS): ASEAN+5

	Volatility A	Volatility B	Volatility C	Volatility D
Primary Goods				
Real GDP of *j*	0.1977*	0.1969*	0.1959*	0.1969*
Bilateral real exchange rate	0.6281*	0.6340*	0.6389*	0.6254*
Volatility of exchange rate	-0.3460*	-0.7539*	-0.5237*	-0.3539*
Intermediate Goods				
Real GDP of *j*	0.4234*	0.4213*	0.4167*	0.4130*
Bilateral real exchange rate	-1.1685*	-1.6729*	-1.6506*	-1.6500*
Volatility of exchange rate	-1.5137*	-1.9276*	-1.6100*	-1.5014*
Equipment Goods				
Real GDP of *j*	0.4004*	0.3981*	0.3938*	0.3896*
Bilateral real exchange rate	-1.5538*	-1.5411*	-1.5195*	-1.5150*
Volatility of exchange rate	-1.4101*	-1.6914*	-1.4863*	-1.5127*
Consumption Goods				
Real GDP of *j*	0.2900*	0.2886*	0.2866*	0.2853*
Bilateral real exchange rate	-0.8607*	-0.8528*	-0.8429*	-0.8466*
Volatility of exchange rate	-0.7626*	-1.0508*	-0.8155*	-0.7230*

Note: As per Table 3.

Table 6: Panel Dynamic Ordinary Least Squares (DOLS): ASEAN+5 without Brunei Darussalam, Cambodia, the Lao PDR, and Viet Nam

	Volatility A	Volatility B	Volatility C	Volatility D
Primary Goods				
Real GDP of *j*	0.2006*	0.2042*	0.2036*	0.2005*
Bilateral real exchange rate	1.7272*	1.7195*	1.7075*	1.7139*
Volatility of exchange rate	5.2018*	4.0787*	2.9592*	2.8504*
Intermediate Goods				
Real GDP of *j*	0.3098*	0.3097*	0.3110*	0.3153*
Bilateral real exchange rate	-1.0767*	-1.0654*	-1.0655*	-1.0863*
Volatility of exchange rate	-2.6425*	-3.5873*	-2.7826*	-2.9251*
Equipment Goods				
Real GDP of *j*	0.3375*	0.3368*	0.3392*	0.3456*
Bilateral real exchange rate	-1.1355*	-1.1237*	-1.1236*	-1.1452*
Volatility of exchange rate	-4.2510*	-5.0142*	-4.2773*	-4.5505*
Consumption Goods				
Real GDP of *j*	0.3186*	0.3195*	0.3191*	0.3207*
Bilateral real exchange rate	-0.4139*	-0.4100*	-0.4074*	-0.4174*
Volatility of exchange rate	-1.9658*	-2.8816*	-1.6722*	-1.5277*

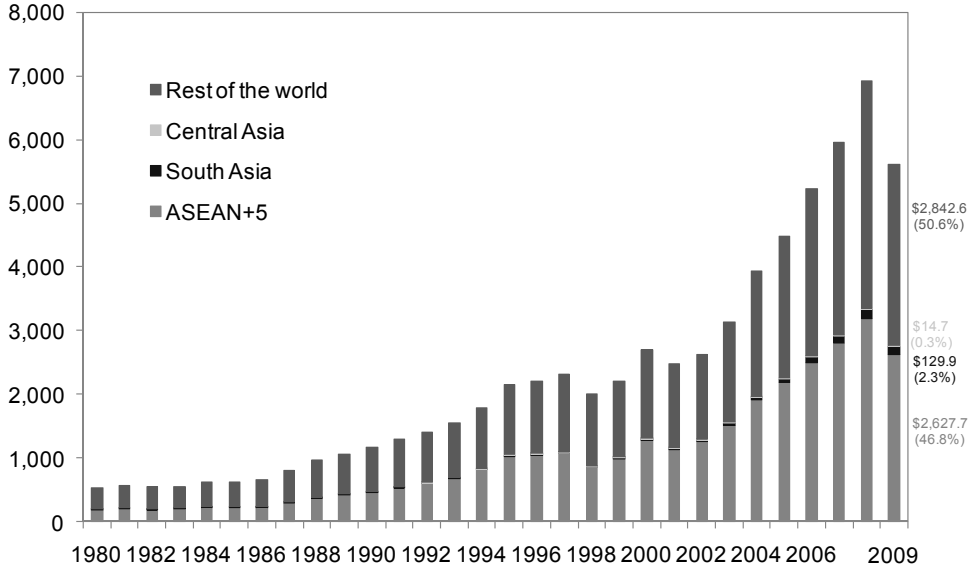
Note: As per Table 3.

Table 7: Panel Dynamic Ordinary Least Squares (DOLS): South Asia

	Volatility A	Volatility B	Volatility C	Volatility D
Primary Goods				
Real GDP of *j*	-0.0001	0.0007	0.0005	0.0006
Bilateral real exchange rate	0.7781*	0.7783*	0.6536*	0.7835*
Volatility of exchange rate	0.7446	0.3208	0.4222	0.3395
Intermediate Goods				
Real GDP of *j*	-0.0930	-0.0930	-0.0955***	-0.0984***
Bilateral real exchange rate	1.1027*	1.0113*	1.0917*	1.0915*
Volatility of exchange rate	2.5234*	2.6593*	2.4975*	2.8836*
Equipment Goods				
Real GDP of *j*	-0.0413	-0.0410	-0.0421	-0.0424
Bilateral real exchange rate	0.3256**	0.3306**	0.3238**	0.3267**
Volatility of exchange rate	2.1192*	1.5581*	1.6054*	1.3846*
Consumption Goods				
Real GDP of *j*	-0.0605	-0.0596	-0.0608	-0.0607
Bilateral real exchange rate	0.1578	0.1651	0.1594	0.1635
Volatility of exchange rate	2.4098*	1.4269*	1.5986*	1.2133**

Note: As per Table 3.

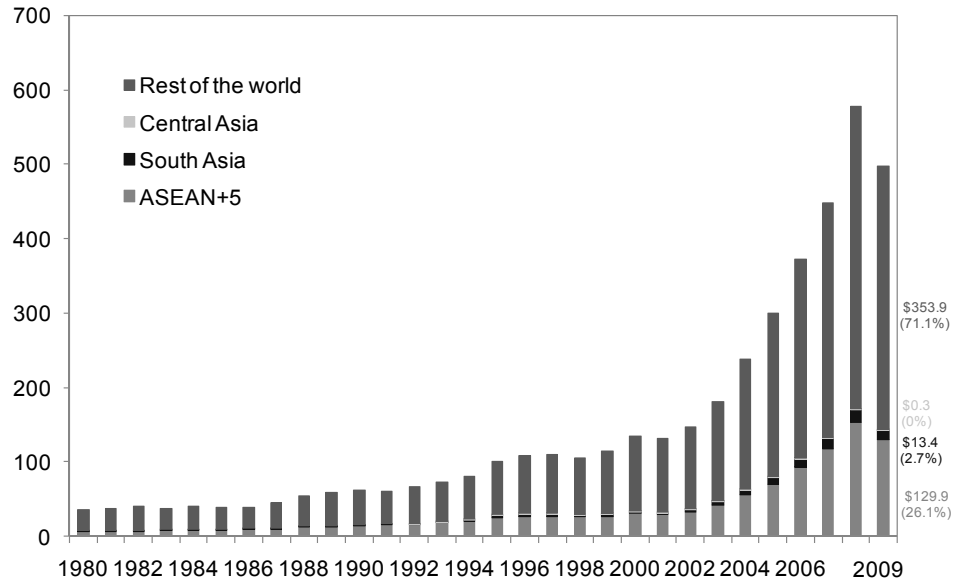
Figure 1: Total Trade between ASEAN+5 and Select Trade Partners
($ billion)



Note: Total trade refers to sum of exports to and imports from trade partners. ASEAN+5 refers to Brunei Darussalam, Cambodia, the People's Republic of China; Hong Kong, China; Indonesia; Japan; the Republic of Korea; the Lao People's Democratic Republic; Malaysia; the Philippines; Singapore; Taipei,China; Thailand; and Viet Nam. Central Asia refers to Kazakhstan and the Kyrgyz Republic. South Asia refers to Bangladesh, India, Pakistan, and Sri Lanka. Numbers on the right refer to share of total trade in 2009.

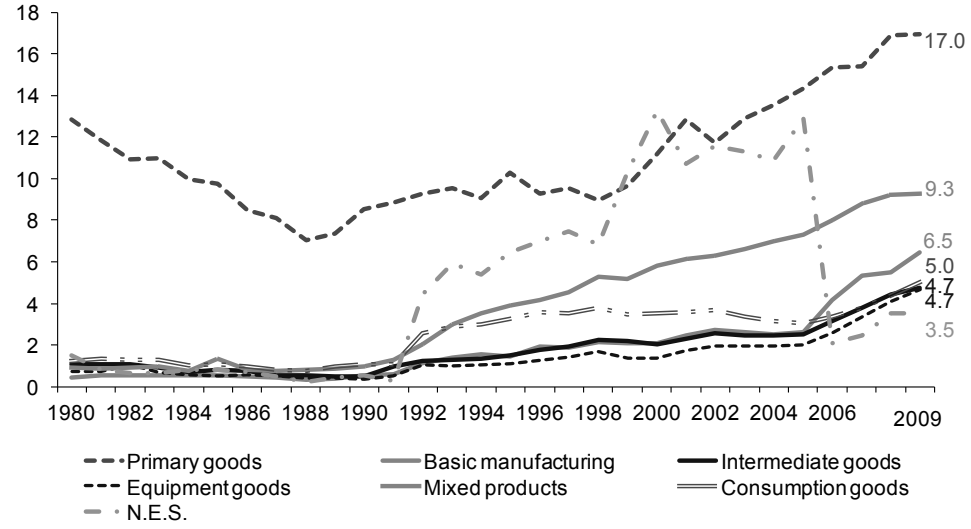
Source: CEPII-CHELEM.

Figure 2: Total Trade between South Asia and Select Trade Partners
($ billion)



Note and source: As per Figure 1.

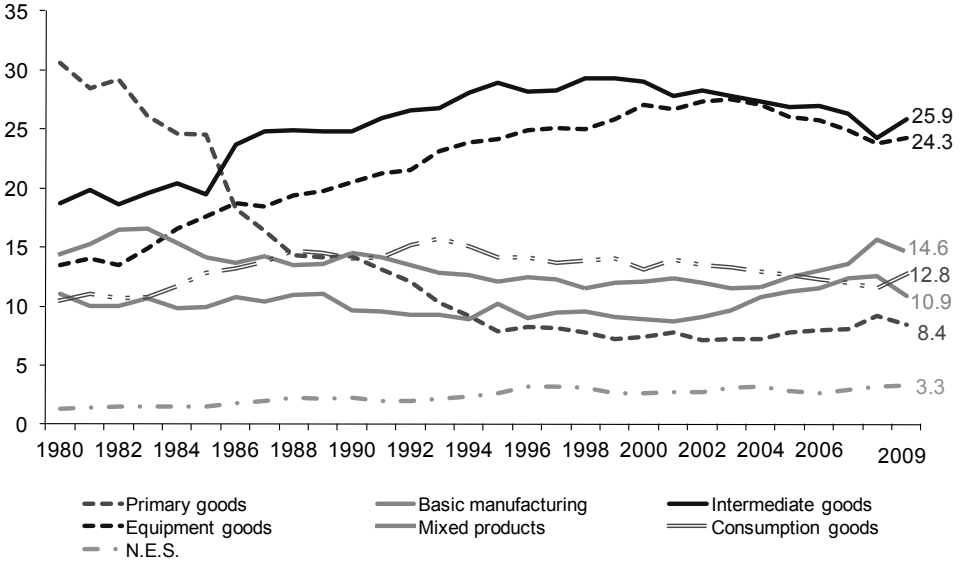
Figure 3: Share of BCLV to Intra-Asia Trade by Type of Goods (%)



Note: BCLV refers to Brunei Darussalam, Cambodia, the Lao People's Democratic Republic, and Viet Nam. N.E.S refers to not elsewhere classified. Asia refers to BCLV; the People's Republic of China; Hong Kong, China; Indonesia; Japan; the Republic of Korea; Malaysia; the Philippines; Singapore; Taipei,China; and Thailand.

Source: CEPII-CHELEM.

Figure 4: Intra-Asia Trade by Type of Goods (%)



Note: N.E.S refers to not elsewhere specified. Asia comprises Bangladesh; Brunei Darussalam; Cambodia; the People's Republic of China; Hong Kong, China; India; Indonesia; Japan; the Republic of Korea; the Lao People's Democratic Republic; Malaysia; Pakistan; the Philippines; Singapore; Sri Lanka; Taipei,China; Thailand; and Viet Nam.

Source: CEPII-CHELEM.

Appendix I

CEPII-CHELEM Classification of Goods

CEPII-CHELEM classifies trade into 71 product types. These products can be grouped into different categories by: stage of production (as adopted in this paper); chain; section; and sector or industry. Under the stage of production, the list also includes three goods not covered in this paper: basic manufacturing, mixed products, and not elsewhere specified (n.e.s). For each good/product, mapping to the United Nations Harmonized System (HS) Codes 2007 is available from CEPII-CHELEM.

The following products are grouped under:

Primary Good
Iron ores and scrap; non-ferrous ores and scrap; unprocessed minerals; coal (including lignite and other primary energy products); crude oil; natural gas (including all petroleum gases); cereals; other edible agricultural products; and non-edible agricultural products.

Intermediate Good
Tubes and first-stage processing products; yarns and fabrics; articles in wood; paper and pulp; large metallic structures; miscellaneous hardware; engines, turbines and pumps; electronic components; vehicle components; fertilizers; paints, colorings and intermediate chemical products n.e.s; plastics, fibers and synthetic resins; and rubber articles (including tires).

Equipment Good
Agricultural equipment; machine tools; construction and public works equipment; specialized machines; arms and weaponry; precision instruments; telecommunications equipment; computer equipment (including office equipment); heavy electrical equipment; electrical apparatus (including passive devices); commercial vehicles and transport equipment (including public transport vehicles and railway equipment); ships (including oil rigs); and aeronautics.

Consumption Good
Clothing (with fabrics as the main input); knitwear (made directly from yarns); carpets and textile furnishings; toys, sports equipment and miscellaneous manufactured articles; watch and clock-making; optics and photographic and cinematographic equipment; consumer electronics; domestic electrical appliances; cars (including motorcycles); toilet products, soaps and perfumes (including chemical preparations n.e.s.); pharmaceuticals; cereal products; preserved meat and fish products; preserved fruit and vegetable products; beverages; and manufactured tobaccos.

Appendix II

Data Description, Sources and Transformations

The following data for 18 Asian economies are collected. The economies are the nine members of the Association of Southeast Asian Nations (ASEAN) members: the main five (Indonesia, Malaysia, the Philippines, Singapore, and Thailand) and its four smaller members (Brunei Darussalam, Cambodia, the Lao People's Democratic Republic (Lao PDR), and Viet Nam); the five East Asian Economies: the People's Republic of China (PRC); Japan; Hong Kong, China; the Republic of Korea; Taipei,China; and the four South Asian economies: Bangladesh; India; Pakistan; and Sri Lanka.

Variable	Period, Source, Description	Notes
Real primary, intermediate, equipment and consumption goods	1980–2009. CEPII-CHELEM: Exports of each good from country *i* to country *j*, USD million.	To obtain the real values, the nominal bilateral exports are divided by its corresponding producer price index obtained from US Bureau of Labor Statistics: Crude materials (WPUSOP1000); intermediate materials, supplies and components (WPUSOP2000); capital equipment (WPUSOP3200); and finished consumer goods (WPUSOP3100).
Real GDP	1980–2009. *World Development Indicators* (WDI): Real GDP of importing country *j* in constant 2002 USD million. CEPII-CHELEM: Real GDP of Cambodia and the Lao PDR (as one entity) in constant 2005 USD prices. Taipei,China; Directorate-General of Budget, Accounting and Statistics: Real GDP in constant 2001 local currency.	The primary data source is the WDI and supplemented by national sources to extend missing observations. In particular for: • Brunei Darussalam, growth rates for 2008-2009 are obtained from the Department of Economic Planning and Development; • Hong Kong, China, the growth rate for 1980 is obtained from the Census and Statistics Department; • Singapore, the growth rate for 1980 (in chain-linked, constant 2000 prices) is obtained from Ministry of Trade and Industry; • Viet Nam, the growth rates for 1980-1983 (in chain-linked, constant 1994 prices) are obtained from the General Statistical Office. For Taipei,China, the real GDP series is in constant 2001 prices and converted to USD using the average annual exchange rate obtained from the country's central bank. Since the real GDP series in constant 2001 prices has been discontinued after 2008, data for 2009 are computed using the growth rate found in the new series (based on constant 2006 prices).

Variable	Period, Source, Description	Notes
Bilateral real exchange rate	1980–2009. CEPII-CHELEM: Annual real exchange rate of country *i*, exporter, and country *j*, importer.	To obtain the bilateral real exchange rate of exporter to importer, the real exchange rate of importer is divided by the real exchange rate of exporter: $brer_{ij} = \frac{rer_{USD/j}}{rer_{USD/i}} = \frac{1}{\frac{ner_{j/USD} / PPP_{j/USD}}{ner_{i/USD} / PPP_{i/USD}}}$, where $rer_{USD/j \text{ or } i}$ is the real exchange rate in USD to importer or exporter currency; $ner_{j \text{ or } i/USD}$ is the nominal exchange rate in importer or exporter currency to USD; and $PPP_{j \text{ or } i/USD}$ is the purchasing power parity in importer or exporter currency to USD.
Exchange rate volatility	1980 to 2009, except Viet Nam from 1984. IMF *International Financial Statistics*: Monthly average nominal exchange rate, local currency to USD (Similar data for Taipei,China are sourced from its central bank).	To obtain the bilateral nominal exchange rate, the exchange rate of exporter is divided by that of importer. The bilateral exchange rate volatility is as calculated as the coefficient variation: $Vol.A = \frac{\sigma_{i/j,t}}{\mu_{i/j,t}}$, where $Vol.A$ is the current year's coefficient of variation; $\sigma_{i/j,t}$ is the standard deviation of the monthly bilateral nominal exchange rate of exporter to importer; and $\mu_{i/j,t}$ is the mean of the monthly bilateral nominal exchange rate of exporter to importer. Note three other measures of volatility are also calculated based on different time periods of bilateral nominal exchange rate: previous year; current and previous years; and previous, current and next years. Note since Cambodia and the Lao PDR are treated as one entity in CEPII-CHELEM and the Cambodian riel nominal exchange rate series is only available from 1990, the Laotian kip nominal exchange rate is used instead. The series is available for the full sample period.

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Intra-Asia Exchange Rate Volatility and Intra-Asia Trade
Evidence by Type of Goods

This paper examines the impact of intra-Asia exchange rate volatility on intra-Asia trade in primary goods, intermediate goods, equipment goods, and consumption goods from 1980 to 2009. For Asia, the evidence shows that as intraregional exchange rate volatility increases, intraregional exports in all these goods fall. This adverse impact is even more pronounced in the sub-region of Association of Southeast Asian Nations (ASEAN)+5 (the People's Republic of China; Hong Kong, China; Japan; the Republic of Korea; and Taipei,China) and especially among intermediate and equipment exports. These results have useful policy implications on the maintenance of exchange rate stability in the region.

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