

**The Role of Financial Sector Development on the Impact of Exchange Rate Volatility  
and Exports: Evidence from the emerging East Asian economies**

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**Abstract**

This paper empirically examines the role of financial sector development on the impact of exchange rate volatility on the exports of emerging East Asian economies – China, Indonesia, Malaysia, the Philippines and Thailand. Financial development of exporting countries is measured by a Financial Sector Development Index, which is the linear combination of the first principle component of three financial indicators suggested by Beck *et al.* (2000). A panel data set of five countries over the period 1990-2006 is estimated by using a GMM-IV estimation method. The results indicate that the effect of exchange rate volatility on exports is conditional on the level of financial sector development: the less financially developed an economy is, the more its exports are adversely affected by exchange rate volatility.

*Keywords:* East Asia; Exports; Exchange rate volatility; Financial Sector Development

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## 1. Introduction

Since the collapse of the Bretton-Woods system of fixed exchange rates, both real and nominal exchange rates among the countries have continued to fluctuate widely.<sup>1</sup> The liberalization of capital flows and the increasing movements of cross-border financial transactions have also tended to amplify the volatility of exchange rates among countries. The traditional belief is that the increased volatility of exchange rates has a negative impact on an economy. One key argument has been that exchange rate volatility could have negative effects on international trade, both directly through uncertainty and adjustments costs, and indirectly through its effect on the allocation of resources and government policies (Côte, 1994). This negative hypothesis is based on the view that an increase in risk arising from exchange rate volatility will lead risk averse individuals to shift from risky activities to less risky ones if hedging and other forms of protection are not available or prohibitively expensive.

For many countries the desire to mitigate the effects of exchange rate uncertainty has been an underlying rationale for the adoption of managed or fixed exchange rate regimes. The establishment of the European Monetary System, with the intent of controlling exchange rate volatility and avoiding large misalignments among European currencies, was an example of attempting to reduce exchange rate uncertainty, to promote intra-EU trade. Given that the effect of exchange rate volatility on trade has been such an important issue for the exchange rate policy of a country, numerous studies have attempted to substantiate the relationship between exchange rate volatility and trade.<sup>2</sup> Recent empirical studies have confirmed that exchange rate volatility has a negative effect on exports, especially for developing and emerging economies. (See, for example, Arize *et al.*, 2000; 2008; Chit, 2008; Dođnalar, 2002; Sauer and Bohara, 2001).

The earlier theoretical models (for example, Clark, 1973; Ethier, 1973; Kawai and Zilcha, 1986) concluded that, with perfect hedging opportunities, exchange rate uncertainty alone would have no impact on the volume of trade. Even in the absence of matured

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<sup>1</sup> Frömmel and Menkhoff (2003) empirically examine the volatility of major floating exchange rate for the period from 1973 to 1998 and find the evidence of increasing volatility for most currencies.

<sup>2</sup> See McKenzie (1999), Bahmani-Oskooee and Hegerty (2007) for a summary of the empirical literature.

financial markets with perfect hedging opportunities, Broll *et al.* (1999) asserts that an exporting firm can reduce its foreign exchange risk exposure via hedging activities in other currencies or financial assets which are highly correlated to the exchange rate. In line with these propositions, the existence of a developed financial market can be considered as a way in which the firm can protect itself against the risk arising from exchange rate uncertainty. For instance, an exporter from a country with developed financial markets can borrow foreign currency to finance their exporting activity with intent to avoid the foreign exchange risk.<sup>3</sup>

The high degree of financial sector development could dampen the real economic costs of exchange rate volatility. There are two mechanisms in which a developed financial sector could mitigate the effect of exchange rate volatility. Firstly, a greater degree of financial sector development could provide more effective ways of transferring risks arising from exchange rate volatility. Merton and Bodie (1995) emphasize that one of the main functions of a financial system is to facilitate the trading, hedging, diversifying and pooling of risk. As a result, a well-developed financial market may reduce the effect of exchange rate volatility on exports.

The second mechanism in which a developed financial sector could mitigate the effect of exchange rate uncertainty is that a higher level of financial sector development can provide better access to finance for exporting firms so that they can withstand the adverse impact of exchange rate volatility. Suppose that a firm's borrowing capacity is proportional to the degree of financial sector development of an economy. Then, the higher the degree of financial sector development, the higher the firm's ability to borrow and the more likely it is to survive adverse foreign exchange and price shocks that affect the firm's production and export. Recently, Chaney (2005) and Dekle and Ryo (2006) demonstrated that the liquidity constraint which is determined by the level of financial

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<sup>3</sup> One possible argument is that an exporter from a financially underdeveloped country can borrow foreign exchange from a financially developed country to avoid the foreign exchange risk. But, it has been well documented that borrowing from home country would be relatively cheaper because of the home country preference and lower costs of information and monitoring. In addition, foreign lender would charge higher risk premium as they are likely to have limited experience of local firms and laws, presumably because of a short history in lending to local firms (Iacoviello and Minetti; 2005). Therefore, borrowing from a foreign financial intermediary would be more costly and would not be an effective way of overcoming the foreign exchange risk.

sector development of an exporting country plays a vital role in determining its level of exports.

Although, there are numerous studies investigating the impact of exchange rate volatility on exports, there have been very few attempts to analyse the role of financial development in managing the risk of exchange rate uncertainty. Recently, Aghion *et al.* (2006) examines the role of financial sector development in the linkage between exchange rate volatility and productivity growth but not specifically on exports. The aim of this study is to investigate the role of financial sector development on the relationship between exchange rate volatility and the exports of emerging countries. This is particularly important for an emerging economy like China, which is currently receiving intense international criticism for its inflexible exchange rate system. If the impact of exchange rate volatility is more intense for a country with a low level of financial development, China should first speed up the financial sector reform before adopting a more flexible exchange rate, which will effectively lead to an increase in exchange rate volatility.<sup>4</sup>

The contribution of this study to the extant empirical literature is that it provides new insights into the relationship between exchange rate volatility and exports of the emerging East Asian economies by focusing on the interaction between exchange rate volatility and the level of financial development, instead of focusing on the trade impact of exchange rate volatility in isolation. The main hypothesis of the study is that the impact of exchange rate volatility is more negative at low levels of financial development; that is, the presence of a nonlinear effect of exchange rate volatility on exports. To the best of our knowledge, this is the first study that examines the role of financial sector development on the trade effects of exchange rate volatility.

The outline of the paper is as follows. Section 2 discusses the research methodology including model specification, construction of the Financial Sector Development Index (*FSDI*) and data sources. Section 3 presents and discusses the estimation results, and the final section draws conclusions.

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<sup>4</sup> Aghion *et al.* (2008) notes that switching from fixed to flexible exchange rate regime could lead to 50% increase in exchange rate volatility.

## 2. Methodology and Data

The impact of bilateral exchange rate volatility on the bilateral export flows of five emerging East Asian countries amongst themselves, as well as to 13 industrialized countries, is examined by using a panel data set of 85 cross-sectional observations for the period from 1990:Q1 to 2006:Q4. According to the IMF's Direction of Trade Statistics, these countries imported over 50% of the total export of sample countries in 2006. List of the importing countries and the share of export to these countries to the total export of sample countries are presented in Appendix A.

### 2.1. Model Specification

The majority of empirical studies that focus on the relationship between exchange rate volatility and bilateral trade employ the gravity model. In these studies, the gravity model is augmented with other factors that can promote or depress trade flows – such as sharing a common border, common language, membership of free trade area and exchange rate volatility (see for example, Anderton and Skudenly, 2001; Clark *et al.*, 2004; Dell'Araccia, 1999; Rose, 2000; Tenreyro, 2007). However, the theoretical foundations of the gravity model assume identical and homothetic preferences across countries and rely heavily on the concept of intra-industry trade of differentiated products.

Since the current study focuses on the exports of emerging economies and their exports can generally be classified as inter-industry trade of homogenous products, the pure gravity model seems inappropriate for this study.<sup>5</sup> Bayoumi and Eichengreen (1995) also note that the relationship between trade and other economic characteristics might be different for industrial and developing countries because of the differences in the structure and nature of trade. Since the developed and developing countries have different

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<sup>5</sup> Majority of the export of the sample countries comprises of electrical equipment, computer/machinery, lubricants/fuels/oil, organic chemicals, plastics, fats & oils and rubber which are classified as inter-industry trade. Bayoumi and Mauro (1999) noted that some manufactured goods – for example computer chips – can be classified homogenous goods as they are taking on some of the characteristics of commodities.

structural circumstances and trade patterns, we use a model that combines the long-run export demand model with gravity variables instead of using a standard gravity model.<sup>6</sup> The empirical model employed in this paper is as follows:

$$X=f(Y^*,RP, VOL, Dist, CB, FTA)$$

where real exports ( $X$ ) are a function of importing country's GDP ( $Y^*$ ), relative prices ( $RP$ ), exchange rate volatility ( $VOL$ ), and a set of gravity variables – the distance between two countries ( $Dist$ ), sharing of a common border ( $CB$ ) and membership of a Free Trade Area ( $FTA$ ). In order to examine the direct effect of financial development and the interaction between the exchange rate volatility and the level of financial development, two more explanatory variables are added to the generalised gravity model.

## 2.2 The definition of the variables and data sources

Real exports are defined as the export values deflated by export price indices. However, export price indices are not available for the bilateral exports of the sample countries. Therefore, the values of bilateral exports expressed in current US dollars are deflated by using the US GDP deflator. Eichengreen and Irwin (1996), Yao and Zhang (2003) and Clark *et al.* (2004) also use the same procedure to deflate the export values denominated in the current U.S. dollar into constant prices by using US GDP deflator. Real exports from country  $i$  to country  $j$  ( $X_{ijt}$ ) are defined as follows:

$$X_{ijt} = \ln\left(\frac{Export_{ijt}}{USGDPD_t}\right),$$

where export values ( $Export_{ijt}$ ) is obtained from the IMF *Direction of Trade Statistics* database.

The real GDP of the importing country ( $Y_{ijt}$ ) is constructed as follows. The quarterly GDP in current prices is transformed into constant prices by using each country's deflator and then converted into a common currency (US dollar).

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<sup>6</sup> In fact, this model is similar to a generalised gravity model used by Aristotelous (2001). The only difference is that one of the gravity variables, exporting country's GDP, is excluded from the model because of endogeneity issue since exports are one component of the GDP.

Relative price ( $RP_{ijt}$ ) is represented by the ratio of the wholesale price index of the exporting country to the consumer price index of destination country expressed in the currency of exporting country. In fact, a more suitable relative price should be the ratio of the export price index of the exporting country to the consumer price index of the importing country. This type of relative price can represent the substitution effect more realistically as the importer compares the price of imports with the domestic price level. However, the export price index data are not readily available for the sample countries for the sample period.

Among the sample countries, Indonesia, Malaysia, the Philippines, and Thailand are members of the Association of South East Asian Nations (ASEAN). These countries established the ASEAN Free Trade Area (AFTA) in January 1992 to eliminate tariff barriers among them. Therefore, a dummy variable for membership of AFTA is included from 1993:Q1 onwards. In addition a dummy that represents the presence of a common border is included in order to control for the effect of sharing a common border on bilateral exports. Another gravity variable, distance, is represented by the shipping distance between two countries available from [www.portworld.com](http://www.portworld.com).

### *2.2.1 Measures of exchange rate volatility*

A variety of measures that represent exchange rate volatility have been employed in empirical studies.<sup>7</sup> In this study, the standard deviation of the first difference of the logarithm of the real exchange rate is used as a measure of exchange rate volatility. Dell'Araccia (1999) noted that this measure of exchange rate volatility is more suitable to use as a proxy of foreign exchange risk since it gives a larger weight to extreme volatility. When the exchange rate follows a constant trend it could be perfectly anticipated and so this measure will equal zero and hence would not be a source of exchange rate risk. Specifically, exchange rate volatility is measured as the standard deviation of the percentage changes of the real bilateral exchange rate over the interval of eight quarters, which is defined as:

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<sup>7</sup> See McKenzie (1999) for the survey of the different measures of exchange rate volatility employed in the empirical literature.

$$V_{ijt} = \sqrt{\sum_{t=1}^m (\Delta e_{ijt} - \Delta \bar{e}_{ijt})^2 / m - 1},$$

where  $\Delta e_{ijt}$  represents percentage change in the log of real bilateral exchange rate.<sup>8</sup> Real bilateral exchange rates are constructed by using the end of the period nominal exchange rate adjusted by the respective price levels of two countries. Quarterly nominal exchange rates and price levels are obtained from the IMF International financial statistics.<sup>9</sup>

### 2.2.2 Financial Sector Development

Beck *et al.* (2000) presented a comprehensive set of measures for financial intermediary development to quantify the development, structure and performance of financial sectors. This study employs three measures of financial sector development indicators by using the methodology suggested by Beck *et al.* (2000) but in the context of quarterly data.

The primary measure of the activity of financial intermediaries is the ratio of private credit by deposit banks and other financial institutions to GDP. This indicator, denoted by *PCR*, isolates credit issued to the private sector as opposed to credit issued to governments and public enterprises. Hence, it focuses on the mobilized savings that are directed to private firms. Levine *et al.* (2000) interprets that a higher level of *PCR* indicates the higher level of financial services and therefore greater financial intermediary development.

In order to measure the size of financial intermediaries Beck *et al.* (2000) proposed the ratio of deposit bank domestic assets to deposit bank domestic assets plus central bank domestic assets. This indicator, denoted by *CMB*, measures the degree to which the banks versus the central bank to allocate the economy's savings. The underlying rationale is that banks are more likely to identify profitable investments, monitor managers, facilitate risk management, and mobilize savings than central banks (Levine *et al.*, 2000).

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<sup>8</sup> The temporal window for the measure is eight quarters in order to stress the importance of medium-run uncertainty. The current volatility is calculated on the exchange rate movements during previous eight quarters in order to reflect the backward-looking nature of risk, that is, it is assumed that firms use past volatility to predict present risk (Dell'Aricea, 1999).

<sup>9</sup> For China, the data for quarterly CPI is not readily available for the whole sample period and the missing data are constructed by using Otani-Riechel method to transform the annual data obtained from *WDI* (World Development Indicators) and various Chinese Statistical Yearbooks into quarterly data.

Another measure of the size of financial intermediaries proposed by Beck *et al.* (2000) is the ratio of liquid liabilities to GDP. Liquid Liabilities, denoted by  $LQ$ , equals currency plus demand and interest-bearing liabilities of banks and other financial intermediaries divided by GDP. Liquid Liabilities has been used as a typical measure of ‘financial depth’, which represents the overall size of the financial intermediary sector (for example, Christopoulos and Tsionas, 2004).

Beck *et al.* (2000) argue that the financial sector development indicators used in this study can capture different aspects of the financial sector development process. However, each indicator has its own advantage and disadvantage. For example, whilst the  $CMB$  captures the structure of the financial system,  $LQ$  indicates the size of financial sector. Recently Mavrotas and Son (2006) and Ang and McKibbin (2007) suggest an eclectic indicator by using Principal Component Analysis technique. According to this technique, Financial Sector Development Index (FSDI) is the linear combination of the financial indicators,  $PCR$ ,  $CMB$ , and  $LQ$ :

$$FSDI_{i,t} = Z_{i,t} = a_{1i}PCR_{i,t} + a_{2i}CMB_{i,t} + a_{3i}LQ_{i,t}$$

where  $Z_{i,t}$  is the first principal component and coefficient vector calculated from the time-series data of each country.<sup>10</sup>

Summary statistics of the main variables are presented in Table 1. Among the sample countries, the real exchange rate of Indonesia exhibits relatively more volatility during the sample periods. It is interesting to point out that China has the third most volatile real exchange rate among the sample countries although its nominal exchange rate was pegged to the US dollar until July 2005. It seems that pegging to one currency still leaves the economy exposed to fluctuations in the other macroeconomic variables especially the price level which lead to the volatility of the real exchange rate. Another interesting point is that the  $FSDI$  of China is highest among the countries because of the high level of

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<sup>10</sup> The first principal component of a set of variables is a weighted average of the variables in which the weights are chosen to make the composite variable reflect the maximum possible proportion of the total variation in the set. For example, the financial sector development for China is estimated as:  $FSDI_{China,t} = 0.5754 PCR_{China,t} + 0.5612 CMB_{China,t} + 0.5908 LQ_{China,t}$  and this linear combination reflect the 93.5% of the total variation.

liquid liabilities ( $LQ$ ). Correlation statistics reveals that the relationship between exchange rate volatility and exports is negative whilst the correlation between financial sector development and exports is positive.

[INSERT TABLE 1 ABOUT HERE]

### 2.3. Method of Estimation

A growing number of studies utilize panel estimation techniques to examine the relationship between exchange rate volatility and bilateral trade. This study employs a panel-data set of five emerging East Asian countries for the period from 1990 to 2006. The use of panel data can eliminate the effects of omitted variables that are specific to individual cross-sectional units but stay constant over time (Hsiao, 1999). This advantage is important for the current study since cross-country structural and policy differences may have a significant impact on their bilateral trade. By using panel data, unobservable cross-sectional specific effects can be accounted for either via a fixed effects or random effects specification. Specifically, the regression equation to be estimated is:

$$X_{ijt} = \theta_t + \alpha_{ij} + \beta_1 Y_{jt} + \beta_2 RP_{ijt} + \beta_3 V_{ijt} + \beta_4 FSDI_{jt} + \beta_5 V_{ijt} * FSDI_{it} + \beta' Z_{ijt} + \varepsilon_{ijt}$$

where  $X_{ijt}$  denotes the real value of aggregate exports from country  $i$  to  $j$  at time  $t$ ;  $Y_{jt}$  is the real GDP of importing country  $j$  at time  $t$ ;  $RP_{ijt}$  is the relative price of the exporting country  $i$  and importing country  $j$  at time  $t$ ;  $FSDI_{it}$  is the index of financial sector development of exporting country  $i$  at time  $t$ ;  $V_{ijt}$  is the volatility of real bilateral exchange rate between  $i$  and  $j$  at time  $t$ ;  $Z_{ijt}$  represents a set of gravity variables and  $\varepsilon_{ijt}$  is a random error term.  $\beta_1$  and  $\beta_4$  are expected to be positive and,  $\beta_2$  and  $\beta_3$  are expected to be negative. According to the hypothesis, the coefficient of the interaction term,  $\beta_5$ , is expected to be positive so that the impact of exchange rate volatility  $\beta_3 + \beta_5 * FSDI_{it}$  is more negative at low levels of financial sector development.<sup>11</sup>

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<sup>11</sup> For a regression equation with multiplicative term, the interaction effect can be estimated by taking partial derivatives for the variable of interest (See, Hargens, 2006).

The dummy variable  $\alpha_{ij}$  represents the unobservable country-pair specific effect. These fixed effect variables can control for cultural, economic, and institutional country-pair specific factors that are constant over time and are not explicitly represented in the model. Note that the intercept is allowed to change over time in order to account for the effects of omitted variables that are specific to each time period but are the same for all country-pairs. For example, the temporal effects of technological changes or oil price shocks will be captured by the time-variant intercept. Dell’Ariccia (1999) has shown that any changes in world GDP will be captured by the time-variant intercept.

One important point to note is the possible inverse relationship between real exchange rate volatility and trade, that is, an increase in the level of trade between two countries may lead to more stable bilateral real exchange rate. Hau (2002) and Bravo-Ortega and Giovanni (2005) demonstrate that a high degree of economic integration might lead to more stable real exchange rates. In this case exchange rate volatility cannot be treated as an exogenous variable, and the estimates of Ordinary Least Square (OLS) regression would tend to produce a bias. Tenreyro (2007) points out that the potential endogeneity is one of the main problems that cast doubt on the findings of previous empirical studies which utilise OLS regression. In order to control for the potential endogeneity, we use the Instrumental Variables (IV) estimation approach. Following Frankel and Wei (1993) and Clark *et al.* (2004) we use the standard deviation of the relative money supply as an instrument for the real bilateral exchange rate volatility. The justification is that relative money supply and bilateral exchange rates are highly correlated, but monetary policies are less affected by trade considerations than exchange rate policies.

Panel data estimation methods can eliminate the effects of omitted variables that are specific to individual cross-sectional units but stay constant over time. However, individual effects may vary over time as a result of omitted macroeconomic shocks. For instance, the sample countries may respond differently to time-varying unobservable macroeconomic shocks. This could lead to a potential problem of heteroskedasticity.<sup>12</sup> Tenreyro (2007) demonstrates that when residuals are heteroskedastic, the estimated coefficient of OLS will be a bias. In order to control for the heteroskedasticity arising

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<sup>12</sup> For our model, the presence of groupwise heteroskedasticity in the OLS residuals is tested; the modified Wald statistics reject the null hypothesis of homoskedasticity.

from time-varying omitted variables and potential endogeneity of exchange rate volatility, we use the Generalised Method of Moments (GMM) estimation technique with instrumental variable. Baum *et al.* (2003) state that if there is heteroskedasticity, the GMM estimator is more efficient than the simple IV estimator but if heteroskedasticity is not present, the GMM estimator is still no worse asymptotically than the IV estimator.

### 3. Empirical Results

The majority of previous empirical studies have shown that real exchange rate volatility has a negative impact on the exports of developing countries. An interesting question is whether the level of financial development plays any significant role on the impact of exchange rate volatility on exports. To estimate the role of financial sector development on the effect of exchange rate volatility, a measure of exchange rate volatility and an interaction term with exchange rate volatility and financial development is added to a generalised gravity model. A panel data set consisting of the exports of five emerging East Asian economies for the period 1990:Q1 to 2006:Q4 is estimated by using a GMM-IV estimation technique.

Although panel data analysis has particular advantages in examining the impact of exchange rate volatility, the longer time dimension of the panel data in this study may lead to the problem of non-stationarity, and spurious regression. Baltagi (2001) notes that for macro-panels with large  $N$  (numbers of cross-sectional observations) and larger  $T$  (length of time series) nonstationarity deserves more attention. Im *et al.* (2003) propose a panel unit root testing procedure based on averaging individual unit root test statistics of the series across the panel. Table 2 reports the results of *IPS* panel unit-root test suggested by Im *et al.* (2003). The results of the test reject the null of non-stationarity in all series of the panel.<sup>13</sup> Since all variables are level stationary, it can be concluded that a long-run relationship among the variables exists and the estimation results are not spurious.

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<sup>13</sup> Karlsson & Löthgren (2000) has demonstrated that, for a panel data set with larger  $T$ , the *IPS* test has high power and there is potential risk of concluding that the whole panel is stationary even when there is only a small proportion of series in the panel is stationary. Therefore, another panel unit-roots test suggested by Hadri (2000) is also conducted. According to Hadri's LM test, all variables are integrated of order 1. However, further test of panel cointegration suggested by Pedroni (1999) confirms that all variables are

[INSERT TABLE 2 ABOUT HERE]

### ***3.1 The impact of Exchange rate volatility on exports***

Table 3 presents estimation results of the impact of bilateral exchange rate volatility on the exports of ACFTA member countries. The first column reports the results of the random-effects panel data estimation which estimates the effect of exchange rate volatility on exports along with a set of control variables. However, because of the potential problem of endogeneity, the relative money volatility between the two countries is used as an instrument for exchange rate volatility.<sup>14</sup> The second column reports the results of GMM-IV estimation techniques. The Hansen *J* – statistics and the Cragg-Donald F-statistics confirm that relative money volatility is a valid instrument for the exchange rate volatility. In order to estimate the effects of time invariant gravity variables (distance between two countries and membership of free trade area), which have been wiped out by the GMM-IV estimation, the Generalised Two Stage Least Square Instrumental Variable (G2SLS-IV) method is also employed and the results are presented in the third column.

[INSERT TABLE 3 ABOUT HERE]

The results provide evidence that exchange rate volatility has a significant negative impact on the exports of emerging East Asian economies. This result is consistent with most of the previous studies which find a negative impact of exchange rate volatility on bilateral exports of emerging and developing economies (for example, Arize, *et al.*, 2000; 2008; Chit, 2008; Dođnalar, 2002; Sauer and Bohara, 2001).

### ***3.2 The role of financial sector development***

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cointegrated, which support the existence of a long-run relationship among the variables. The results are not presented in the paper to conserve the space, but available upon request from authors.

<sup>14</sup> In order to test whether the instrument is uncorrelated with error term, that is to conduct Hansen-*J* test, the number of instruments excluded from the regression need to exceed the number of included endogenous variables (Baum *et al.*, 2003). Therefore, variables representing the relative volatility of money and a lagged value are used as instrumental variables in the two stages least square estimation technique.

Table 4 presents the role of financial sector development on the trade effect of exchange rate volatility. As explained in the methodology section, an exporting country's financial development is measured by a Financial Sector Development Index which is the linear combination of three financial indicators suggested by Beck *et al.* (2000). The first and second columns show the results of the impact of exchange rate volatility along with financial development and a set of control variables by using G2SLS-IV and GMM-IV estimation techniques. When including a variable representing the level of financial sector development of an exporting country, the results provide evidence that the level of financial sector development has a significant positive impact on the volume of real exports.

[INSERT TABLE 4 ABOUT HERE]

The third and fourth regressions add a variable interacting the exchange rate volatility and the measure of financial sector development in order to test the main prediction: the non-linear effects of exchange rate volatility on exports, that is, the effect of exchange rate volatility on exports is conditional on the level of financial sector development. The results of the regressions show that the interaction term of exchange rate volatility and financial sector development is positive and significant. All other control variables are statistically significant and show expected sign except the relative price variable which is positive. In addition, the hypothesis that the combined interacted and non-interacted coefficients of exchange rate volatility equal to zero is tested by using a Wald test and the statistic is significant at the 1% level. This indicates that the less financially developed an economy is the more negative impact of exchange rate volatility on trade.

The role of financial sector development in dampening the impact of exchange rate volatility can be estimated from the results. For example, China's Financial Sector Development Index is around 1.16 in 1990. At that level of financial sector development, 1 percent increase in exchange rate volatility would reduce its exports by about 2 percent. In 2006, the Financial Sector Development Index reached around 2, and the negative impact of exchange rate volatility has vanished. For the least financially developed country of the sample, Indonesia, whose Financial Sector Development Index is around

0.68 for 2006, 1% increase in exchange rate volatility would lead to 3.1% reduction of its exports.<sup>15</sup>

### **3.3 Robustness tests**

The results presented in Table 4 provide evidence that the level of financial development plays an important role in mitigating the adverse impact of exchange rate volatility on exports in Emerging East Asian economies. As a robustness check we estimate the model using two alternative measures of exchange rate volatility – moving average standard deviation (MASD) and Generalised Auto-Regressive Conditional Heteroskedasticity (GARCH) conditional volatility. The results presented in Table 5 confirm that the effect of exchange rate volatility on exports is conditional on the level of financial sector development.

[INSERT TABLE 5 ABOUT HERE]

As another robustness test, we employ three alternative financial sector development indicators, these being the ratio of private credit by deposit banks and other financial institutions to GDP (*PCR*), liquid liabilities divided by GDP (*LQ*), and the ratio of deposit bank domestic assets to deposit bank domestic assets plus central bank domestic assets (*CMB*). The results are presented in Table 6 and we find that the nonlinear effects of exchange rate volatility still hold. Only in the GMM-IV regressions which use *PCR* and *CMB* as measures of financial sector development the interaction term are not significant at conventional levels.

[INSERT TABLE 6 ABOUT HERE]

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<sup>15</sup> The overall impact of exchange rate volatility is computed as  $\beta_3 + \beta_5 * FSDI_{it}$  (see footnote 8).

#### **4. Conclusions**

This paper examines the role financial sector development plays in determining the impact real exchange rate volatility has on the exports of five emerging East Asian countries. The findings suggest that the effect of exchange rate volatility on exports is conditional on the level of financial sector development: the more financially developed an economy, the less its exports are adversely affected by exchange rate volatility. The nonlinear effect of exchange rate volatility still holds when alternative measures of exchange rate volatility and financial sector development are used. Our results are consistent with the notion that financial sector development provides the mechanism for firms to mitigate the effects of exchange rate volatility and in so doing stimulates export growth. These findings should act as a spur to those countries lagging behind in the level of financial sector development to speed up this process.

Our results also provide important implications for the choice of exchange rate regime for the sample countries which have been implementing export promotion policies for their economic growth and development, and regional integration. Whilst exchange rate flexibility has desirable properties as a 'shock absorber' to dampen the impact of real shocks, on average it still has an adverse effect on the exports of the financially less developed economies. Therefore, emerging East Asian economies should adopt managed exchange rate regimes, instead of a fully flexible regime, while they are attempting to reform their financial sector.

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**Table 1. Summary statistics and Pearson correlation coefficients**

Panel A: Summary Statistics

		<b>Exports</b>	<b>Volatility</b>	<b>PCR</b>	<b>LQ</b>	<b>CMB</b>	<b>FSDI</b>
<b>China</b>	<b>Mean</b>	20.3501	0.0729	1.0277	1.2264	0.9640	1.8607
	<b>Std. Dev</b>	1.4939	0.0503	0.2296	0.3686	0.0229	0.3601
	<b>Max</b>	24.6000	0.3592	1.4410	1.8177	0.9886	2.4468
	<b>Min</b>	16.1628	0.0170	0.5754	0.5145	0.9260	1.1569
<b>Indonesia</b>	<b>Mean</b>	19.1381	0.1005	0.3519	0.4415	0.8521	0.8381
	<b>Std. Dev</b>	1.63711	0.0916	0.1488	0.0652	0.1263	0.1916
	<b>Max</b>	22.3099	0.3993	0.6953	0.6120	0.9974	1.1734
	<b>Min</b>	4.6363	0.0038	0.1625	0.3087	0.6156	0.5811
<b>Malaysia</b>	<b>Mean</b>	19.5032	0.0574	1.1356	1.1056	0.9755	0.9267
	<b>Std. Dev</b>	1.3859	0.0366	0.2448	0.2151	0.0181	0.2794
	<b>Max</b>	22.6719	0.3292	1.5828	1.3760	0.9963	1.3073
	<b>Min</b>	15.7134	0.0017	0.5827	0.5798	0.9390	0.2554
<b>Philippines</b>	<b>Mean</b>	18.2261	0.0701	0.3566	0.4812	0.8653	0.9128
	<b>Std. Dev</b>	1.6410	0.0365	0.1110	0.0980	0.0729	0.1389
	<b>Max</b>	21.8714	0.3349	0.6025	0.6075	0.9620	1.1333
	<b>Min</b>	14.5025	0.0041	0.1908	0.2950	0.6330	0.6759
<b>Thailand</b>	<b>Mean</b>	19.4463	0.0630	1.0828	0.9364	0.9825	1.5773
	<b>Std. Dev</b>	1.2321	0.0482	0.2746	0.1767	0.0081	0.2466
	<b>Max</b>	22.2580	0.3478	1.7076	1.1442	0.9961	2.1358
	<b>Min</b>	16.6582	0.0074	0.5847	0.5810	0.9627	1.0853
<b>All Countries</b>	<b>Mean</b>	19.3327	0.0728	0.7909	0.8382	0.9279	1.2231
	<b>Std. Dev</b>	1.6356	0.0583	0.4149	0.3848	0.0872	0.4867
	<b>Max</b>	24.6000	0.3993	1.7076	1.8177	0.9974	2.4468
	<b>Min</b>	4.6363	0.0017	0.1625	0.2950	0.6156	0.2554

Panel B: Pearson correlation coefficients

	<i>Exports</i>	<i>Volatility</i>	<i>PCR</i>	<i>CMB</i>	<i>LQ</i>
<i>Exports</i>	1				
<i>Volatility</i>	-0.1099	1			
<i>PCR</i>	0.3303	-0.1157	1		
<i>CMB</i>	0.4370	-0.1271	0.8649	1	
<i>LQ</i>	0.2024	-0.2962	0.6769	0.5489	1
<i>FSDI</i>	0.3605	-0.0683	0.7026	0.7296	0.5214

**Table 2.** *IPS* panel-unit root test (Im, Pesaran, and Shin, 2003)

<i>Variables</i>	<i>t-bar Statistics</i>	<i>P-value</i>
Real Exports	-3.7324**	0.0001
Foreign Income	-10.8120**	0.0000
Relative Prices	-1.3089^	0.0953
Volatility	-4.5749**	0.0000
FSDI	-3.4948**	0.0002
Volatility*FSDI	-3.7744**	0.0001

*Notes:* \*\* and ^ indicates significant at 1 percent level and 10% level respectively. Values in the parentheses are P-value. Null hypothesis of *IPS* test is that each series in the panel is integrated of order one.

**Table 3.** The impact of exchange rate volatility on exports

	GLS-panel	GMM-IV	G2SLS-IV
Importing country income ( $Y^*$ )	1.1243** (0.0605)	1.3277** (0.0657)	1.1249** (0.0627)
Relative Price ( $RP$ )	0.0237** (0.0062)	0.0211** (0.0062)	0.0237** (0.0063)
Exchange rate volatility ( $V$ )	-1.4211** (0.1587)	-3.5388** (1.2250)	-3.4482** (0.7844)
Distance	-0.7749** (0.1774)	-	-0.7536** (0.1822)
Sharing a common border	0.8271 (0.5388)	-	0.8052 (0.5527)
Membership of AFTA	0.3657** (0.0516)	0.4143** (0.0552)	0.4423** (0.0586)
<i>R</i> -square	0.4872	0.4580	0.4600
Anderson canon. corr. LR statistic	-	121.747	-
Chi-sq(2) <i>P</i> -value		(0.000)	
Cragg-Donald F-statistic	-	63.930	-
Hansen J statistic	-	0.015	-
Chi-sq(1) <i>P</i> -value		(0.6359)	

*Notes:* Numbers in the parentheses are standard errors. \*\* and \* in the table denote statistical significant coefficients in 1% and 5% respectively. The null hypothesis of Anderson Canon test is underidentification. Cragg-Donald F-statistics tests for weak identification. 10% critical value of Stock-Yogo weak ID test is 19.93.

**Table 4.****Exchange rate volatility and exports: The role of financial sector development**

	<b>1</b>	<b>2</b>	<b>3</b>	<b>4</b>
	<b>G2SLS-IV</b>	<b>GMM-IV</b>	<b>G2SLS-IV</b>	<b>GMM-IV</b>
Importing country income ( $Y^*$ )	1.1140** (0.0572)	1.3701** (0.0621)	1.1204** (0.0570)	1.3845** (0.0615)
Relative Price ( $RP$ )	0.0203** (0.0062)	0.0182** (0.0058)	0.0197** (0.0062)	0.0177** (0.0059)
Exchange rate volatility ( $V$ )	-3.2846** (0.7811)	-3.3646** (1.2696)	-4.5670** (0.8179)	-4.7655** (2.0292)
$FSDI$	0.5467** (0.0573)	0.5284** (0.0966)	0.4274** (0.0978)	0.3989* (0.1646)
Exchange rate volatility * $FSDI$	-	-	2.2694** (0.8691)	2.4031* (1.2978)
Distance	-0.7673** (0.1529)	-	-0.7748** (0.1519)	
Sharing a common border	0.7141 (0.4609)	-	0.7194 (0.4582)	
Membership of AFTA	0.4966** (0.0558)	0.4561** (0.0539)	0.4827** (0.0544)	0.4801** (0.0501)
$R$ -square	0.4838	0.4818	0.4823	0.4805
$WALD$ Tests				9.87**
$H_0$ =Total effect of exchange rate volatility = 0				$p=0.001$
Anderson canon. corr. LR statistic	-	139.963	-	147.818
Chi-sq(2) $P$ -value		0.000		0.000
Cragg-Donald F-statistic	-	74.492	-	86.876
Hansen J statistic	-	0.018	-	0.017
Chi-sq(1) $P$ -value		0.8924		0.8975

*Notes:* Numbers in the parentheses are standard errors. \*\* and \* in the table denote statistical significant coefficients in 1% and 5% respectively. The null hypothesis of Anderson Canon test is underidentification. Cragg-Donald F-statistics tests for weak identification. 10% critical value of Stock-Yogo weak ID test is 19.93.

**Table 5.****Robustness Check: Alternative measures of exchange rate volatility**

	MASD		GARCH	
	G2SLS-IV	GMM-IV	G2SLS-IV	GMM-IV
Importing country income ( $Y^*$ )	1.1282** (0.0568)	1.4070** (0.0625)	1.3123** (0.0775)	1.3893** (0.0656)
Relative Price ( $RP$ )	0.0161** (0.0062)	0.0139* (0.0064)	0.0128^ (0.0067)	0.0132^ (0.0076)
Exchange rate volatility ( $V$ )	-3.1837** (0.8511)	-3.1997** (1.3229)	-91.5456** (28.268)	-90.7452^ (47.2167)
$FSDI$	0.4351** (0.0905)	0.4223* (0.1484)	0.5119** (0.0774)	0.5126** (0.1346)
Exchange rate volatility * $FSDI$	1.6511** (0.5671)	1.6534* (0.8464)	67.3045** (21.8062)	66.6889^ (37.9356)
Distance	-0.7754** (0.1509)		-0.9173** (0.3663)	
Sharing a common border	0.7313^ (0.4551)		0.8193 (1.1282)	
Membership of AFTA	0.4476** (0.0534)	0.4014** (0.0466)	0.4249** (0.0569)	0.4147** (0.0516)
$R$ -square	0.4807	0.4809	0.4318	0.4194
Anderson canon. corr. LR statistic	-	181.091 (0.000)	-	16.159 (0.0003)
Cragg-Donald F-statistic	-	113.190	-	8.122
Hansen J statistic	-	0.017	-	1.503
Chi-sq(1) $P$ -value		(0.8948)		(0.2202)

*Notes:* Numbers in the parentheses are standard errors. \*\*, \* and ^ in the table denote statistical significant coefficients in 1%, 5% and 10% respectively. The null hypothesis of Anderson Canon test is underidentification. Cragg-Donald F-statistics tests for weak identification. 10% critical value of Stock-Yogo weak ID test is 19.93.

**Table 6.****Robustness Check: Alternative measures of financial sector development**

	<i>PCR</i>		<i>LQ</i>		<i>CMB</i>	
	<i>G2SLS-IV</i>	<i>GMM-IV</i>	<i>G2SLS-IV</i>	<i>GMM-IV</i>	<i>G2SLS-IV</i>	<i>GMM-IV</i>
Importing country	1.1229**	1.3746**	1.1468**	1.4603**	1.1073**	1.3673**
income ( <i>Y</i> *)	(0.0588)	(0.0635)	(0.0567)	(0.0684)	(0.0598)	(0.0664)
Relative Price ( <i>RP</i> )	0.0204**	0.0186**	0.0164**	0.0171*	0.0231**	0.0208**
	(0.0062)	(0.0062)	(0.0062)	(0.0061)	(0.0064)	(0.0063)
Exchange rate	-3.852**	-3.919*	-9.502**	-9.514**	-15.265*	-14.241^
volatility ( <i>V</i> )	(0.9795)	(1.561)	(2.117)	(3.317)	(6.3583)	(9.036)
<i>FSDI</i>	0.3788*	0.3553^	0.7414**	0.7362**	-0.6899	-0.5611
	(0.1291)	(0.2084)	(0.1588)	(0.2595)	(0.7647)	(1.1631)
Exchange rate	1.9118*	2.0030	9.438**	9.4667**	15.696*	14.5867
volatility * <i>FSDI</i>	(0.8981)	(1.3549)	(2.2348)	(3.5746)	(7.068)	(9.859)
Distance	-0.7793*		-0.769**		0.7677**	-
	(0.1607)		(0.1455)		(0.1598)	
Sharing a common	0.6691		0.5511		0.8052^	-
border	(0.4858)		(0.4382)		(0.4832)	
Membership of	0.4518**	0.4119	0.6108**	0.5563**	0.3716	0.333**
AFTA	(0.0547)	(0.0489)	(0.0588)	(0.0590)	(0.0567)	(0.0515)
<i>R</i> -square	0.4739	0.4731	0.4733	0.4681	0.4382	0.4417
Anderson-Canon.	-	142.170	-	68.828	-	43.357
Chi-sq(2) <i>P</i> -value		(0.000)		(0.000)		(0.000)
Cragg-Donald	-	80.079	-	35.043	-	22.188
F-statistic						
Hansen J statistic	-	0.000	-	0.043	-	0.194
Chi-sq(1) <i>P</i> -value		(0.9980)		(0.8361)		(0.6600)

*Notes:* Numbers in the parentheses are standard errors. \*\*, \* and ^ in the table denote statistical significant coefficients in 1%, 5% and 10% respectively. The null hypothesis of Anderson Canon test is underidentification. Cragg-Donald F-statistics tests for weak identification. 10% critical value of Stock-Yogo weak ID test is 19.93.

## Appendix A

Table A1. List of countries

<i>emerging East Asian countries</i>	<i>Importing countries</i>
China	Australia
Indonesia	Austria
Malaysia	Belgium
Philippines	Canada
Thailand	China
	Denmark
	France
	Germany
	Indonesia
	Italy
	Japan
	Malaysia
	Netherland
	Philippines
	Spain
	Thailand
	United Kingdom
	United States

Table A2. Exports to the sample countries (% of total exports)

<i>Exporters</i>	<i>2000</i>	<i>2006</i>
China	55	50
Indonesia	60	58
Malaysia	55	56
Philippines	68	72
Thailand	61	58
<b>Regional Total</b>	58	53

Source: Direction of Trade Statistics