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# The Effect of Exchange Rate Volatility on International Trade: The Implication for Production Networks in East Asia

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**Keywords:** Exchange rate volatility; Trade; East Asia
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## 1. Introduction

Since the Asian currency crisis in 1997, the debate on the exchange rate regime has taken center stage in East Asia. Because the rigid dollar-pegged rate regime was alleged to be a direct cause of the crisis, East Asian countries began to fear an excessive dependency on the US dollar. At the same time, exchange rate stability came to be seen as a key issue. Particularly in East Asia, international production/distribution networks in machinery industries have developed vigorously and have established their significance in each economy with extensive country coverage and structural sophistication. This development of international networks has led to a rise in the share of intra-regional trade in East Asia and has necessitated a stable exchange rate environment. One of the natural consequences of this has been the commencement of vigorous discussion on the possibility of a basket currency among East Asian countries.

The academic literature neither theoretically nor empirically concludes whether the stability of the exchange market enhances international trade or not. There are a large number of theoretical and empirical studies that analyze the relationship between exchange rate volatility and international trade (see, for example, McKenzie, 1999; Clark et al., 2004). As presented in McKenzie (1999), there are theoretical models supporting both negative and positive relationships between them. Empirical studies do not give clear-cut results, either. Most of the empirical results show a negative relationship, but this relationship is not always robust. The studies often find insignificant negative or positive relationships when employing other estimation methods such as instrument variable estimation or the introduction of fixed country effects.

According to anecdotal evidence for Japanese firms, however, exchange instability appears to discourage firms, particularly from constructing and managing international production/distribution networks in East Asia (Ito et al., 2008).[1] Although firms often successfully manage exchange rate risks through various kinds of hedging instruments, they must prepare specialized operations, for example, by establishing a foreign exchange and trade finance division and employing specialists in foreign exchange management, before developing and/or expanding international production/distribution networks. In this sense, exchange rate volatility can be an important part of the fixed

[1] The Research Institute of Economy, Trade and Industry (RIETI) conducted hearings on strategies for exchange risk management with a number of Japanese machinery firms as a part of their project on "The Optimal Exchange Rate Regime for East Asia". Ito et al. (2008) summarizes their results.

costs of engaging in international trade. The well-known Melitz model stresses a possible negative impact of such fixed entry costs on international trade (Melitz, 2003); only firms with high productivity can afford to pay the fixed entry costs. Since the volatility of exchange rates raises the level of these fixed costs, exchange rate volatility is expected to be negatively associated with international trade by discouraging the development of international production/distribution networks.

Previous empirical studies have investigated various hypotheses and subjected them to robustness checks. Some of the studies perform long-time series analyses and employ samples involving a large number of countries. Various kinds of volatility measures are employed in the literature, and furthermore the volatility is sometimes decomposed into its anticipated part and unanticipated part by using a GARCH model. The endogeneity between exchange rate volatility and trade is addressed through the use of instruments. The studies also compare the impact of volatility on trade among developed countries with that among developing countries. These studies aim to examine the differences in the currency/exchange system, or the availability of hedging instruments across countries, through investigating the impact of exchange rate volatility on trade. Recently, however, Clark et al. (2004)[2] compared the impact of volatility on trade in differentiated goods with that in homogenous goods. Our study intends to contribute to the literature by clarifying differences in the impact of exchange rate volatility among traded products or across trade structures.

To further explore the relationship between exchange rate volatility and international trade, particularly in the context of East Asia, we conduct the following analysis: Firstly, we examine whether volatility has a greater discouraging impact on trade in East Asia than in other regions. Secondly, we try to quantify the degree to which volatility impedes international trade in East Asia compared with tariffs and distance-related costs (e.g., transportation costs). Thirdly, we construct an unanticipated volatility measure different from those used in previous literature and examine its impact on international trade. Fourthly, we examine whether machinery parts trade is more sensitive to volatility than finished machinery products.

The fourth element, though it has not been thoroughly explored by previous literature, is especially important in the context of East Asia. International production networks are by nature accompanied by massive international transactions of

[2] Their finding of a larger impact on differentiated goods trade indicates that exchange rate volatility occupies a significant fraction of fixed entry costs since, from the theoretical point of view, differentiated goods trade is more sensitive to such costs.

intermediate goods. On the one hand, trade in intermediate goods may be expected to be less sensitive to exchange rate volatility because such goods are more likely to be traded within production networks in a stable manner even if exchange rates fluctuate. On the other hand, because stable transactions of intermediate goods are indispensable for the functioning of such networks, exchange rate volatility may deter the construction of production networks and consequently discourage trade in intermediate goods. Indeed, some Japanese firms report that exchange rate stability is essential for back-and-forth transactions of intermediate goods in international production networks (Ito et al., 2008). As a result, if exchange rate volatility significantly raises the fixed costs for entering into production networks, the latter effect becomes dominant, and trade in intermediate goods would be penalized by exchange rate volatility more seriously than trade in finished products. An investigation into the veracity of this matter would contribute to better understanding of differences in the impact of exchange rate volatility among trade structures.

The reminder of this paper is organized as follows: Section 2 explains our empirical methodology and an overview of our volatility measure. Section 3 reports on our regression results, and Section 4 concludes our argument.

## 2. Empirical Issues

This section offers an outline of our empirical methodology for testing the relationship between trade and exchange volatility. Data issues and their overview follow.

### 2.1. Empirical Methodology

It is well known that gravity equations can be supported by various kinds of theoretical models. Taking advantage of this property, a large number of researchers have performed a gravity analysis in order to carry out empirical investigations on correlations between international trade and the variables concerned. Following the recent literature on exchange volatility, this paper also employs a gravity equation approach.

The baseline equation is shown by:

$$\ln T_{ij} = \beta_0 + \beta_1 \ln GDP_i + \beta_2 \ln GDP_j + \beta_3 \ln distance_{ij} + \beta_4 volatility_{ij} + \beta_5 language_{ij} + \beta_6 contingency_{ij} + \varepsilon_{ij.}$$

The time subscript $t$ is omitted in this equation. $T_{ij}$ represents real export values of country $i$ to country $j$. $GDP_i$ denotes real gross domestic product in country $i$. $distance_{ij}$ is the geographical distance between countries $i$ and $j$. $language_{ij}$ is an indicator variable taking the value unity if a common language is spoken by at least 9% of the population in both countries $i$ and $j$, and zero otherwise. $contingency_{ij}$ takes the value of one if the two countries are contiguous and zero otherwise. $\varepsilon_{ij}$ is a disturbance term.

The literature has applied various kinds of variables for exchange rate volatility, $volatility_{ij}$. In this paper, following Rose (2000), we primarily use a widely-used indicator, the real exchange rate volatility, which is constructed as the standard deviation of the first-difference of the monthly natural logarithm of bilateral real exchange rates in the five years preceding period $t$. A number of other indicators are also introduced in our robustness checks.

We first estimate the above gravity equation for bilateral trade values in the world by the ordinary least squares (OLS) method. Then, by introducing an East Asia dummy interacting with the real exchange rate volatility, we examine the impact of exchange rate volatility on trade in East Asia relative to that in the other regions. The East Asia dummy takes the value unity if both countries $i$ and $j$ are East Asian countries and zero otherwise. Next, by restricting our sample to intra-East Asian trade, we investigate more closely the impact of exchange rate volatility on trade. By introducing tariffs as an independent variable, we quantify the degree of significance of the effect of exchange rate volatility on East Asian trade compared with that of tariffs. In addition, we decompose the real exchange rate volatility into an anticipated volatility that is predicted from economic and social conditions and an unanticipated volatility as the residual, both of these being introduced as explanatory variables. Finally, to verify the importance of stable transactions of intermediate goods in the formation of production networks, we regress the gravity equation for trade in finished machinery goods and trade in machinery parts separately.

## 2.2. Data Overview

Our sample includes bilateral trade between 60 countries (see Appendix) from 1992 to 2005. Data on international trade values are obtained from UN Comtrade. The HS code list of parts and components is drawn from Ando and Kimura (2005). Data on *GDP* come from the World Development Indicator (World Bank). GDP is deflated by the U.S. wholesale price index, which is also from the World Development Indicator. The source of $distance_{ij}$, $language_{ij}$, and $contingency_{ij}$ is the CEPII website. The

nominal exchange rate (monthly) is drawn from IFS (af) and is deflated by the monthly consumer price index, which is also from IFS.

Figure 1 depicts changes in the real exchange rate volatilities among countries in each region. Large volatility is apparent in Latin America in the first half of the 1990s. While the volatility there subsequently declined rapidly, volatility in East Asia began to rise in 1998. As a result, by around 2000, East Asia had the largest degree of volatility in the world. Volatility in Africa has been relatively large since the first half of the 1990s, while that in Europe has been relatively small.

== Figure 1 ==

In Figure 1, "unanticipated" indicates unanticipated exchange volatility in East Asia. The unanticipated exchange volatility is constructed as follows: Firstly, we regress the following equation by the OLS method:

$$volatility_{ij,t} = \alpha_0 + \alpha_1 \ln Risk_{i,t-5} + \alpha_2 \ln Risk_{j,t-5} + \varsigma_{ij,} \qquad (1)$$

where $Risk_i$ denotes country risk in country $i$. Secondly, by using estimates of $\alpha_0$, $\alpha_1$, and $\alpha_2$, we can obtain the residual of each observation. Finally, we define the unanticipated volatility as the absolute value of the residual. That is, the unanticipated volatility is defined as the mass of exchange volatility not predicted by the country risk for each of the countries. As a proxy for the country risk, we use the country risk index, which is drawn from *Institutional Investor* (*Institutional Investor*, various issues). This index is the aggregate of bankers' evaluations on the risk of default, and a larger index indicates that the country has a smaller risk of default. As shown in Figure 1, together with the "total" volatility, the unanticipated volatility in East Asia rose from 1998. This rise seems to reflect the currency crisis.

## 3. Empirical Results

In the following, we first present baseline results regarding the several hypotheses listed in section 2.1. Following this, the results of various kinds of robustness checks are reported.

### 3.1. Baseline Results

#### 3.1.1. East Asia versus the World Countries

Table 1 reports the regression results obtained using our full sample. Columns

two and three show the values for all manufactured goods and machinery products, respectively. Almost all coefficients are estimated to be significant with the expected signs. Large GDP of importers and exporters, and short distances between trading countries encourage international trade. Our main interest in this paper lies in the results concerning the exchange rate volatility, for which coefficients are significantly negative in both columns. The negative coefficients imply that large volatility discourages international trade in both manufactured goods and machinery products in the world. This result may reflect the fact that exchange rate volatility generates a significant fraction of the fixed costs for trading activities.

== Table 1 ==

The East Asian slope dummy is introduced into our equation, as shown in columns four and five of Table 1. The results for most of the usual coefficients are unchanged from the previous results. The slope coefficients are significantly negative, implying that intra-East Asian trade is more seriously discouraged by exchange rate volatility than trade in other regions. The immaturity of the international exchange market and of hedging instruments may account for the creation of this more serious impact on East Asia. We will observe later that, in addition to the immaturity of the financial sector, the mechanics of machinery trade contribute to this result.

### 3.1.2. The Impact of Unanticipated Volatility on East Asian Trade

In Table 2, we narrow down our sample to intra-East Asian trade. Looking at the results in columns two and three, tariffs are introduced as an independent variable, ln (1+tariffs(%)/100), and their coefficients are estimated to be negative. The coefficient for contingency turns out to be positive and significant. The coefficients for exchange rate volatility are significantly negatively, and their magnitude is at almost the same level as that of the results in Table 1. The results in the other variables are qualitatively unchanged from the previous ones in Table 1, though the magnitude of the coefficients is slightly decreased.

== Table 2 ==

How large is the trade impediment caused by exchange rate volatility, compared with other trade impediments such as tariffs? Our volatility measure is a form of standard deviation, and thus direct interpretation of the magnitude of its coefficients is

difficult. In order to estimate its magnitude intuitively, we quantify the seriousness of the effect of exchange rate volatility on East Asian trade, compared with the effects of distance-related costs and tariffs, by calculating the following measures (**Disc**ouragement):

$$Disc(i) = \frac{\widehat{\beta}_{volatility} \cdot mean(Volatility)}{\widehat{\beta}_i \cdot mean(i)} \quad \text{for} \quad i \in \{\text{distance, tariffs}\},$$

where *mean* (*i*) denotes the mean value of variable *i*. The results are reported in the rows, *Disc* (distance) and *Disc* (tariff). We can conclude here that exchange rate volatility *on average* discourages international trade by a factor of 0.2 and has twice the impact of distance-related costs and tariffs, respectively. The finding that exchange rate volatility penalizes East Asian trade more seriously than one of the most well-known impediments, tariffs, is important, even though tariffs have already been lowered substantially in East Asia.

Columns four and five in Table 2 report regression results obtained using the unanticipated volatility measure. The equations in the columns also include importer and exporter risk indices. The coefficients for both risk indices are significantly positive, implying that the lower the risk of default in trading countries, the more international trade occurs between them. The coefficients for unanticipated volatility are also estimated to be significant in both columns. The negative coefficients here indicate that, in addition to country risk, the existence of exogenous factors creating exchange rate volatility reduces manufacturing and machinery trade. Furthermore, unanticipated volatility on average has a slightly larger discouraging impact on trade than tariffs. Comparing with the results in columns two and three, we conclude that a large portion of the negative impact of exchange rate volatility is induced by its unanticipated part.

### 3.1.3. Finished Goods Trade versus Intermediate Goods Trade

Here we regress the gravity equation for trade in finished machinery goods and trade in machinery parts and components separately in East Asia. To formally test whether exchange rate volatility has a different impact on finished products and parts, we conduct the Wald test using the null hypothesis, which states that the coefficients are identical in both equations. These results are reported in columns six to nine in Table 2.

There are three points to note. First, as above, standard gravity variables such as GDPs are estimated with the expected signs, though the fit of both gravity models is not as good. Second, coefficients for total volatility and unanticipated volatility are again significantly negative. Exchange rate volatility is a significant impediment to trade in both finished machinery goods and machinery parts. Third, and most interestingly, the

Wald tests reject the null hypothesis at the 1% level of significance. This implies that trade in machinery parts is more sensitive to exchange rate volatility than trade in finished machinery goods, which indicates that stable transactions of parts are crucial to the formation of production networks.

#### 3.1.4. Simulation Analyses

Here we perform simple simulation analyses by using the results in Table 2. We simulate the average growth of exports by an East Asian country by reducing its sample mean level of real exchange rate volatility (0.037) to the ECU level and the EURO level. The mean level in the ECU countries during the period 1992-1998 (0.019) is used as the ECU level, and that in the EURO countries during the period 1999-2005 (0.010) as the EURO level. Although those levels are not necessarily achieved only by the introduction of the ECU and EURO, we simply apply those levels for East Asia, which can possibly be interpreted as the effect of introducing an East Asian basket currency or an East Asian common currency, respectively. The case of complete elimination of mean volatility in East Asia (0.037) is also simulated. These hypothetical scenarios are compared with the case of a complete reduction of the sample means for tariffs (0.066 for manufacture; 0.060 for machinery).

The simulation results are reported in Table 3. For example, the simulation result of "ECU" in "Manu" is derived from the following calculation: (0.019 – 0.037) * (-17.697). "-17.697" is the estimate of volatility shown in column two of Table 2. In all scenarios, machinery parts trade experiences the largest increase. Of course, this is due to the fact that the largest absolute value of the volatility coefficient is found in machinery parts. The magnitude of the effects is not huge; the increase in parts exports would be less than one percentage point in the ECU and EURO scenarios. Even in the case of complete elimination of exchange rate volatility, which would be impossible in the real world, parts exports would increase by only one percentage point. However, these scenarios have a larger impact than the achievement of free trade (zero tariffs). We can thus conclude that the introduction of a basket currency or a common currency may contribute to enhancing the magnitude of international trade in East Asia to some extent.

== Table 3 ==

## 3.2. Robustness Checks

In almost all previous studies, the negative effect of exchange rate volatility on trade is not found to be robust, which is quite contrary to our results. Thus, we perform

various kinds of robustness checks. The results are reported in Tables 4 to 10, which confirm that the negative impact is truly robust *at least* in the case of East Asian trade.

Firstly, in Table 4, we examine the impact of more purely random shocks in exchange rates, i.e., an unanticipated volatility measure which excludes volatility due to time-invariant country-specific characteristics such as capital regulations. Such a measure can be constructed by introducing fixed importer and exporter effects and year dummies into equation (1). The results obtained using this new unanticipated volatility measure are reported in Table 4, and are qualitatively unchanged from those in Table 2. All coefficients are estimated to be significant with the expected signs. The coefficients for unanticipated volatility are significantly negative in all sectors of East Asian trade. In particular, unforeseeable changes in exchange rates produce a more serious effect on machinery parts trade. The remarkable rise of the absolute magnitude of the unanticipated volatility coefficient in all sectors infers that such pure random shocks in exchange rates are one of the most serious elements in the negative impact of exchange rate volatility on trade.

== Table 4 ==

Secondly, Tables 5 and 6 attempt to address to some extent an omitted-variables problem.[3] In particular, in addition to variables related to colonial ties, importer and exporter remoteness indices are also incorporated. These newly added variables are estimated to be significant with the expected sign in both tables. More interestingly, in Table 5, while volatility coefficients are not estimated to be significant, East Asia slope coefficients are still significantly negative. This means that volatility punishes trade in East Asia more seriously than in other regions. The results in Table 6 are qualitatively unchanged with the results in Table 2. In particular, exchange rate volatility has a more discouraging impact on trade in machinery parts than on trade in finished machinery products.

== Tables 5 & 6 ==

Thirdly, to further explore volatility measures, we also attempt to employ nominal exchange rates rather than real exchange rates; the standard deviation of the

[3] The measure of "unanticipated volatility" in the following tables is that used in Table 2, not Table 4. However, using the measure in Table 4 does not result in qualitatively different values.

first-difference of the monthly natural logarithm of bilateral nominal exchange rates in the five years preceding period *t*. The results are reported in Tables 7 and 8, which are similar to the baseline results. Although some of the volatility coefficients in Table 7 are not estimated to be significant, East Asia slope coefficients are still significantly negative. Thus, we can say that, although the results for the world sample are somewhat influenced, the use of nominal or real exchange rates is not crucial to the results for East Asian trade.

== Tables 7 & 8 ==

Finally, here we regress the first-difference logarithmic form of the gravity equation. In this paper, as in almost all gravity studies, we have completely disregarded potential stationarity issues. If our variables are integrated of order one, such a first-difference logarithmic form of the gravity equation would be appropriate. In the equation, to control effects of exchange rate changes *per se* on trade, we introduce the first-difference logarithm of real exchange rates between trading countries: the larger this variable is, the more rapidly the exporter's currency is devaluated. The results are reported in Tables 9 and 10. Firstly, and disappointingly, the coefficients for real exchange rates are not estimated to be significant. Secondly, in Table 9, although volatility coefficients are estimated to be positive, East Asian slope coefficients still have a large negative magnitude, indicating the serious negative impact of exchange rate volatility on East Asian trade. Thirdly, in Table 10, all of the volatility coefficients are estimated to be negative, though some of them are not significant and the Wald test is not rejected.

== Tables 9 & 10 ==

## 4. Concluding Remarks

In this paper, we empirically investigated the relationship between exchange rate volatility and trade, focusing on East Asia. Our findings are summarized as follows: intra-East Asian trade is discouraged by exchange rate volatility more seriously than trade in other regions. One important source for the discouragement is that intermediate goods trade in international production networks, which is quite sensitive to exchange rate volatility compared with other types of trade, occupies a significant fraction of East Asian trade. In addition, such a negative effect of the volatility in East Asia is mainly

induced by its unanticipated part. Furthermore, the negative effect of the volatility is greater than that of tariffs and smaller than that of distance-related costs in East Asia. Our simulation analysis shows that introduction of a basket currency or a common currency may have a larger positive impact on international trade than free trade.

In interpreting our results, we may need to consider a link between the reduction of exchange rate volatility and foreign direct investment (FDI). Kiyota and Urata (2004) show a significant negative relationship between exchange rate volatility and Japanese FDI to East Asian countries, though they do not quantify this negative impact in a rigorous manner. FDI is certainly an important element in constructing international production networks. The introduction of an East Asian basket currency or an East Asian common currency may induce a substantial increase in international goods trade, together with a further encouragement of FDI in East Asia.

## Appendix. Sample Countries

| Region | Country |
|---|---|
| Africa | Algeria, Ghana, Kenya, Madagascar, Mauritius, Morocco, Senegal, Seychelles |
| East Asia | China, Hong Kong, Indonesia, Japan, Korea, Malaysia, Philippines, Singapore, Thailand |
| Europe | Austria, Denmark, Finland, France, Greece, Hungary, Iceland, Italy, Malta, Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, United Kingdom |
| Latin America | Argentina, Barbados, Bolivia, Brazil, Chile, Colombia, Costa Rica, El Salvador, Guatemala, Honduras, Jamaica, Mexico, Panama, Paraguay, St.Lucia, Trinidad and |
| Others | Canada, United States, Fiji, Cyprus, India, Israel, Jordan, Nepal, Pakistan, Saudi Arabia, Sri Lanka |

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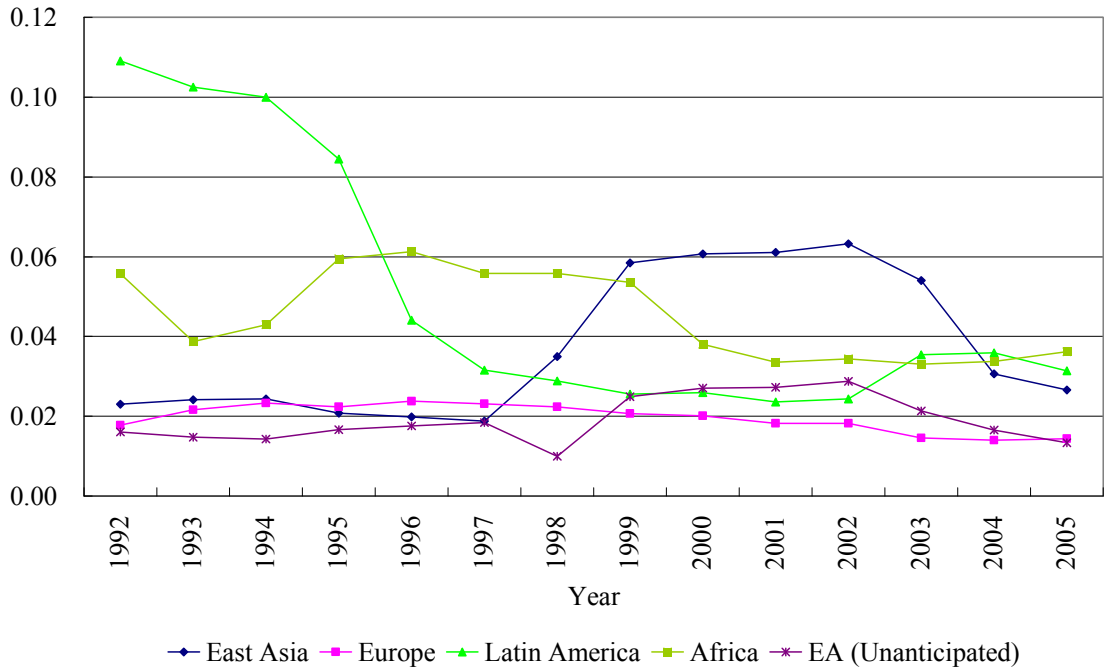
Figure 1. Changes in Real Exchange Rate Volatility by Region




*Source*: Authors' calculation

Table 1. Results of Full Sample Regressions

| | Manu | Machine | Manu | Machine |
|---|---|---|---|---|
| importer's GDP | 1.376*** | 1.220*** | 1.376*** | 1.220*** |
| | [0.011] | [0.010] | [0.011] | [0.010] |
| exporter's GDP | 2.228*** | 2.202*** | 2.228*** | 2.202*** |
| | [0.010] | [0.009] | [0.010] | [0.009] |
| distance | -1.272*** | -1.107*** | -1.273*** | -1.107*** |
| | [0.045] | [0.041] | [0.045] | [0.041] |
| volatility | -1.831*** | -1.479** | -1.623** | -1.255** |
| | [0.670] | [0.613] | [0.678] | [0.620] |
| * East Asia | | | -17.570*** | -18.934*** |
| | | | [2.302] | [2.215] |
| language | 1.634*** | 1.463*** | 1.631*** | 1.460*** |
| | [0.061] | [0.056] | [0.061] | [0.056] |
| contingency | -0.267* | -0.186 | -0.285** | -0.206 |
| | [0.139] | [0.129] | [0.139] | [0.129] |
| East Asia | 2.547*** | 3.503*** | 3.200*** | 4.208*** |
| | [0.091] | [0.091] | [0.127] | [0.129] |
| Europe | 1.616*** | 2.139*** | 1.621*** | 2.144*** |
| | [0.095] | [0.088] | [0.095] | [0.088] |
| Latin America | 2.124*** | 1.797*** | 2.125*** | 1.798*** |
| | [0.104] | [0.093] | [0.104] | [0.093] |
| Africa | -0.638*** | -0.625*** | -0.636*** | -0.624*** |
| | [0.237] | [0.207] | [0.237] | [0.207] |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 49,549 | 49,549 | 49,549 | 49,549 |
| R-sq | 0.5810 | 0.6060 | 0.5811 | 0.6061 |

*Notes*: Heteroskedasticity-consistent standard errors (White) are in parentheses. ***, **, and * show 1%, 5%, and 10% significance, respectively.

Table 2. Regression Results for Intra-East Asian Trade

| | Manu | Machine | Manu | Machine | Final | Parts | Final | Parts |
|---|---|---|---|---|---|---|---|---|
| importer's GDP | 0.499*** | 0.419*** | 0.260*** | 0.142*** | 0.551*** | 0.397*** | 0.254*** | 0.085*** |
| | [0.020] | [0.027] | [0.022] | [0.027] | [0.031] | [0.031] | [0.028] | [0.030] |
| exporter's GDP | 0.796*** | 0.782*** | 0.593*** | 0.505*** | 0.914*** | 0.770*** | 0.604*** | 0.491*** |
| | [0.021] | [0.027] | [0.021] | [0.024] | [0.031] | [0.031] | [0.029] | [0.031] |
| distance | -0.424*** | -0.486*** | -0.402*** | -0.442*** | -0.422*** | -0.607*** | -0.359*** | -0.537*** |
| | [0.044] | [0.059] | [0.040] | [0.050] | [0.072] | [0.072] | [0.059] | [0.063] |
| tariffs | -5.064*** | -5.700*** | -2.777*** | -3.339*** | | | | |
| | [0.518] | [0.724] | [0.455] | [0.685] | | | | |
| volatility | -17.697*** | -22.261*** | | | -18.474*** | -26.541*** | | |
| | [1.379] | [1.586] | | | [1.936] | [1.944] | | |
| unanticipated volatility | | | -12.331*** | -18.090*** | | | -10.357*** | -20.634*** |
| | | | [1.432] | [1.754] | | | [1.841] | [1.979] |
| importer's risk | | | 1.538*** | 1.732*** | | | 2.159*** | 2.134*** |
| | | | [0.094] | [0.120] | | | [0.126] | [0.135] |
| exporter's risk | | | 1.238*** | 1.703*** | | | 2.034*** | 1.620*** |
| | | | [0.088] | [0.115] | | | [0.110] | [0.118] |
| language | 0.545*** | 0.703*** | 0.446*** | 0.554*** | 0.878*** | 0.810*** | 0.594*** | 0.604*** |
| | [0.064] | [0.078] | [0.054] | [0.064] | [0.088] | [0.088] | [0.072] | [0.078] |
| contingency | 0.577*** | 0.417*** | 0.540*** | 0.402*** | 0.397*** | 0.164 | 0.426*** | 0.298** |
| | [0.125] | [0.137] | [0.119] | [0.119] | [0.141] | [0.141] | [0.115] | [0.123] |
| Year dummy | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Disc (distance) | 20% | 22% | 7% | 10% | | | | |
| Disc (tariff) | 195% | 240% | 127% | 171% | | | | |
| Wald test (p-value) | | | | | 0.0000 | | 0.0000 | |
| Obs. | 997 | 997 | 997 | 997 | 957 | 957 | 957 | 957 |
| R-sq | 0.6830 | 0.6029 | 0.7635 | 0.7083 | 0.5777 | 0.5615 | 0.7223 | 0.6697 |

*Notes*: See notes to Table 1. The null hypothesis in the Wald test states that the coefficient for volatility/unanticipated volatility between the final goods and parts equations is identical.

Table 3. Simulation: Rise of Exports in Each East Asian Country (% point)

| | Manu | Machine | Final | Parts |
|---|---|---|---|---|
| ECU | 0.3% | 0.4% | 0.3% | 0.5% |
| EURO | 0.5% | 0.6% | 0.5% | 0.7% |
| ALL | 0.7% | 0.8% | 0.7% | 1.0% |
| Tariffs | 0.3% | 0.3% | | |

*Notes*: The simulation scenario involves the reduction of exchange rate volatility to its level in ECU countries and in EURO countries respectively. In addition, the simulation result of complete elimination of mean volatility in East Asia is also reported (ALL). The mean of volatility in ECU countries (92-98) and EURO countries (99-05) is 0.0194559 and 0.0101294, respectively. The mean of volatility in East Asia (92-05) is 0.037187.

Table 4. Robustness Checks on East Asian Sample Regressions: Another Unanticipated Volatility Measure

| | Manu | Machine | Final | Parts |
|---|---|---|---|---|
| importer's GDP | 0.288*** | 0.192*** | 0.286*** | 0.148*** |
| | [0.022] | [0.027] | [0.028] | [0.030] |
| exporter's GDP | 0.622*** | 0.555*** | 0.632*** | 0.546*** |
| | [0.022] | [0.026] | [0.028] | [0.030] |
| distance | -0.376*** | -0.365*** | -0.318*** | -0.460*** |
| | [0.039] | [0.048] | [0.059] | [0.062] |
| tariffs | -2.644*** | -2.975*** | | |
| | [0.431] | [0.639] | | |
| unanticipated volatility | -19.762*** | -39.562*** | -23.120*** | -45.142*** |
| | [2.606] | [3.332] | [3.330] | [3.518] |
| importer's risk | 1.513*** | 1.645*** | 2.074*** | 1.972*** |
| | [0.092] | [0.113] | [0.126] | [0.133] |
| exporter's risk | 1.202*** | 1.600*** | 1.975*** | 1.506*** |
| | [0.086] | [0.112] | [0.110] | [0.116] |
| language | 0.487*** | 0.627*** | 0.642*** | 0.697*** |
| | [0.055] | [0.064] | [0.072] | [0.076] |
| contingency | 0.627*** | 0.622*** | 0.544*** | 0.526*** |
| | [0.122] | [0.124] | [0.117] | [0.123] |
| Year dummy | Yes | Yes | Yes | Yes |
| Wald test (p-value) | | | 0.0000 | |
| Obs. | 997 | 997 | 957 | 957 |
| R-sq | 0.7598 | 0.7224 | 0.7269 | 0.6862 |

*Notes*: See notes to Table 2. "Unanticipated volatility" in this table is constructed by introducing fixed importer and exporter effects and year dummies into equation (1).

Table 5. Robustness Checks on Full Sample Regressions: Omitted Variables

| | Manu | Machine | Manu | Machine |
|---|---|---|---|---|
| importer's GDP | 1.372*** | 1.233*** | 1.372*** | 1.233*** |
| | [0.011] | [0.010] | [0.011] | [0.010] |
| exporter's GDP | 2.226*** | 2.169*** | 2.226*** | 2.169*** |
| | [0.011] | [0.010] | [0.011] | [0.010] |
| distance | -0.882*** | -0.661*** | -0.883*** | -0.662*** |
| | [0.050] | [0.046] | [0.050] | [0.046] |
| volatility | -0.202 | 0.457 | -0.002 | 0.672 |
| | [0.673] | [0.614] | [0.681] | [0.621] |
| * East Asia | | | -16.939*** | -18.250*** |
| | | | [2.392] | [2.395] |
| language | 0.880*** | 0.703*** | 0.877*** | 0.699*** |
| | [0.075] | [0.069] | [0.075] | [0.069] |
| contingency | 0.477*** | 0.656*** | 0.459*** | 0.638*** |
| | [0.145] | [0.135] | [0.145] | [0.135] |
| Colony | 1.234*** | 1.215*** | 1.240*** | 1.220*** |
| | [0.126] | [0.117] | [0.126] | [0.117] |
| Comcol | 1.898*** | 1.947*** | 1.896*** | 1.945*** |
| | [0.105] | [0.096] | [0.105] | [0.096] |
| importer's Remoteness | -0.938*** | -0.778*** | -0.937*** | -0.778*** |
| | [0.059] | [0.054] | [0.059] | [0.054] |
| exporter's Remoteness | -0.902*** | -1.380*** | -0.901*** | -1.380*** |
| | [0.056] | [0.052] | [0.056] | [0.052] |
| East Asia | 3.544*** | 4.652*** | 4.174*** | 5.331*** |
| | [0.109] | [0.105] | [0.141] | [0.141] |
| Europe | 1.356*** | 1.817*** | 1.360*** | 1.822*** |
| | [0.093] | [0.086] | [0.093] | [0.086] |
| Latin America | 3.198*** | 2.967*** | 3.199*** | 2.968*** |
| | [0.116] | [0.104] | [0.116] | [0.104] |
| Africa | -0.064 | 0.029 | -0.062 | 0.031 |
| | [0.248] | [0.221] | [0.248] | [0.221] |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 49549 | 49549 | 49549 | 49549 |
| R-sq | 0.5872 | 0.6149 | 0.5872 | 0.6149 |

*Note*: See notes to Table 1.

Table 6. Robustness Checks on East Asian Sample Regressions: Omitted Variables

| | Manu | Machine | Manu | Machine | Final | Parts | Final | Parts |
|---|---|---|---|---|---|---|---|---|
| importer's GDP | 0.535*** | 0.456*** | 0.305*** | 0.179*** | 0.613*** | 0.422*** | 0.328*** | 0.116*** |
| | [0.021] | [0.029] | [0.022] | [0.030] | [0.031] | [0.032] | [0.030] | [0.033] |
| exporter's GDP | 0.837*** | 0.821*** | 0.640*** | 0.544*** | 0.970*** | 0.794*** | 0.674*** | 0.524*** |
| | [0.021] | [0.028] | [0.020] | [0.025] | [0.031] | [0.032] | [0.030] | [0.033] |
| distance | -0.401*** | -0.449*** | -0.426*** | -0.467*** | -0.373*** | -0.513*** | -0.413*** | -0.520*** |
| | [0.049] | [0.066] | [0.044] | [0.060] | [0.076] | [0.079] | [0.065] | [0.071] |
| tariffs | -4.615*** | -4.931*** | -2.997*** | -3.348*** | | | | |
| | [0.536] | [0.753] | [0.479] | [0.712] | | | | |
| volatility | -15.845*** | -21.022*** | | | -17.207*** | -25.365*** | | |
| | [1.363] | [1.607] | | | [1.860] | [1.931] | | |
| unanticipated volatility | | | -11.896*** | -17.813*** | | | -10.140*** | -20.541*** |
| | | | [1.375] | [1.730] | | | [1.802] | [1.973] |
| importer's risk | | | 1.435*** | 1.656*** | | | 1.995*** | 2.028*** |
| | | | [0.098] | [0.124] | | | [0.128] | [0.140] |
| exporter's risk | | | 1.153*** | 1.624*** | | | 1.886*** | 1.521*** |
| | | | [0.092] | [0.122] | | | [0.112] | [0.122] |
| language | 0.399*** | 0.615*** | 0.323*** | 0.493*** | 0.764*** | 0.689*** | 0.573*** | 0.524*** |
| | [0.065] | [0.083] | [0.059] | [0.074] | [0.091] | [0.094] | [0.077] | [0.084] |
| contingency | 0.552*** | 0.337** | 0.547*** | 0.373*** | 0.245* | 0.131 | 0.295** | 0.310** |
| | [0.128] | [0.142] | [0.119] | [0.123] | [0.139] | [0.145] | [0.118] | [0.129] |
| Colony | -0.459*** | -0.199 | -0.671*** | -0.469*** | -0.248 | 0.155 | -0.661*** | -0.23 |
| | [0.097] | [0.133] | [0.093] | [0.128] | [0.242] | [0.252] | [0.205] | [0.225] |
| Comcol | 0.924*** | 0.928*** | 0.493*** | 0.374*** | 1.319*** | 1.031*** | 0.582*** | 0.456*** |
| | [0.090] | [0.113] | [0.086] | [0.110] | [0.147] | [0.153] | [0.130] | [0.143] |
| importer's Remoteness | -0.194* | 0.095 | -0.334*** | -0.106 | 0.593*** | 0.185 | 0.339*** | -0.13 |
| | [0.111] | [0.149] | [0.098] | [0.127] | [0.135] | [0.140] | [0.113] | [0.124] |
| exporter's Remoteness | 0.139 | 0.302** | -0.038 | 0.048 | 0.428*** | 0.324** | 0.16 | 0.015 |
| | [0.095] | [0.130] | [0.077] | [0.104] | [0.140] | [0.145] | [0.117] | [0.129] |
| Year dummy | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Disc (distance) | 19% | 22% | 7% | 9% | | | | |
| Disc (tariff) | 191% | 262% | 114% | 168% | | | | |
| Wald test (p-value) | | | | | 0.0000 | | 0.0000 | |
| Obs. | 997 | 997 | 997 | 997 | 957 | 957 | 957 | 957 |
| R-sq | 0.6830 | 0.6029 | 0.7754 | 0.7127 | 0.6282 | 0.5875 | 0.7522 | 0.7247 |

*Note*: See notes to Table 2.

Table 7. Robustness Checks on Full Sample Regressions: Nominal Volatility

| | Manu | Machine | Manu | Machine |
|---|---|---|---|---|
| importer's GDP | 1.377*** | 1.220*** | 1.377*** | 1.220*** |
| | [0.011] | [0.010] | [0.011] | [0.010] |
| exporter's GDP | 2.229*** | 2.202*** | 2.229*** | 2.202*** |
| | [0.010] | [0.009] | [0.010] | [0.009] |
| distance | -1.273*** | -1.110*** | -1.274*** | -1.111*** |
| | [0.045] | [0.042] | [0.045] | [0.042] |
| volatility | -1.296** | -0.814 | -1.138* | -0.647 |
| | [0.578] | [0.532] | [0.584] | [0.537] |
| * East Asia | | | -17.183*** | -18.116*** |
| | | | [2.264] | [2.208] |
| language | 1.637*** | 1.468*** | 1.634*** | 1.465*** |
| | [0.061] | [0.056] | [0.062] | [0.056] |
| contingency | -0.267* | -0.19 | -0.287** | -0.211 |
| | [0.139] | [0.129] | [0.139] | [0.129] |
| East Asia | 2.545*** | 3.501*** | 3.159*** | 4.149*** |
| | [0.091] | [0.091] | [0.123] | [0.126] |
| Europe | 1.625*** | 2.149*** | 1.628*** | 2.152*** |
| | [0.095] | [0.088] | [0.095] | [0.088] |
| Latin America | 2.124*** | 1.790*** | 2.124*** | 1.791*** |
| | [0.104] | [0.094] | [0.104] | [0.094] |
| Africa | -0.645*** | -0.635*** | -0.643*** | -0.632*** |
| | [0.237] | [0.207] | [0.237] | [0.207] |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 49549 | 49549 | 49549 | 49549 |
| R-sq | 0.5810 | 0.6059 | 0.5811 | 0.6060 |

*Note*: See notes to Table 1.

Table 8. Robustness Checks on East Asian Sample Regressions: Nominal Volatility

| | Manu | Machine | Manu | Machine | Final | Parts | Final | Parts |
|---|---|---|---|---|---|---|---|---|
| importer's GDP | 0.497*** | 0.416*** | 0.262*** | 0.144*** | 0.549*** | 0.393*** | 0.257*** | 0.090*** |
| | [0.020] | [0.027] | [0.022] | [0.028] | [0.031] | [0.031] | [0.028] | [0.030] |
| exporter's GDP | 0.794*** | 0.779*** | 0.596*** | 0.509*** | 0.912*** | 0.766*** | 0.606*** | 0.495*** |
| | [0.021] | [0.027] | [0.021] | [0.024] | [0.031] | [0.031] | [0.029] | [0.031] |
| distance | -0.442*** | -0.510*** | -0.402*** | -0.440*** | -0.442*** | -0.637*** | -0.358*** | -0.534*** |
| | [0.044] | [0.060] | [0.040] | [0.050] | [0.072] | [0.073] | [0.059] | [0.063] |
| tariffs | -5.148*** | -5.821*** | -2.716*** | -3.249*** | | | | |
| | [0.521] | [0.730] | [0.453] | [0.682] | | | | |
| volatility | -17.192*** | -20.984*** | | | -17.585*** | -24.764*** | | |
| | [1.401] | [1.652] | | | [1.948] | [1.972] | | |
| unanticipated volatility | | | -12.107*** | -18.364*** | | | -10.459*** | -21.128*** |
| | | | [1.452] | [1.781] | | | [1.862] | [1.998] |
| importer's risk | | | 1.546*** | 1.739*** | | | 2.156*** | 2.126*** |
| | | | [0.093] | [0.119] | | | [0.126] | [0.135] |
| exporter's risk | | | 1.238*** | 1.700*** | | | 2.033*** | 1.616*** |
| | | | [0.088] | [0.115] | | | [0.110] | [0.118] |
| language | 0.542*** | 0.705*** | 0.453*** | 0.564*** | 0.880*** | 0.817*** | 0.600*** | 0.614*** |
| | [0.064] | [0.079] | [0.054] | [0.064] | [0.088] | [0.090] | [0.072] | [0.077] |
| contingency | 0.546*** | 0.381*** | 0.546*** | 0.416*** | 0.364** | 0.12 | 0.435*** | 0.318*** |
| | [0.125] | [0.138] | [0.120] | [0.121] | [0.142] | [0.143] | [0.115] | [0.123] |
| Year dummy | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Disc (distance) | 18% | 19% | 7% | 10% | | | | |
| Disc (tariff) | 179% | 213% | 130% | 182% | | | | |
| Wald test (p-value) | | | | | 0.0000 | | 0.0000 | |
| Obs. | 997 | 997 | 997 | 997 | 957 | 957 | 957 | 957 |
| R-sq | 0.6801 | 0.5961 | 0.7625 | 0.7086 | 0.5738 | 0.5502 | 0.7223 | 0.6707 |

*Note*: See notes to Table 2.

Table 9. Robustness Checks on Full Sample Log-difference Regression: Exchange Rate

| | Manu | Machine | Manu | Machine |
|---|---|---|---|---|
| importer's GDP | 1.271*** | 1.125*** | 1.271*** | 1.125*** |
| | [0.175] | [0.156] | [0.175] | [0.156] |
| exporter's GDP | 0.03 | 0.142 | 0.03 | 0.142 |
| | [0.177] | [0.158] | [0.177] | [0.158] |
| exchange rate | -0.027 | -0.022 | -0.027 | -0.022 |
| | [0.023] | [0.021] | [0.023] | [0.021] |
| volatility | 3.611*** | 3.365*** | 3.722*** | 3.462*** |
| | [1.344] | [1.204] | [1.360] | [1.218] |
| * East Asia | | | -9.466*** | -8.299*** |
| | | | [1.824] | [1.758] |
| East Asia | -0.021 | 0.024 | -0.02 | 0.025 |
| | [0.024] | [0.022] | [0.023] | [0.021] |
| Europe | -0.075*** | -0.049** | -0.075*** | -0.050** |
| | [0.024] | [0.023] | [0.024] | [0.023] |
| Latin America | 0.05 | 0.017 | 0.05 | 0.017 |
| | [0.078] | [0.069] | [0.078] | [0.069] |
| Africa | -0.019 | -0.058 | -0.019 | -0.058 |
| | [0.192] | [0.169] | [0.192] | [0.169] |
| Year dummy | Yes | Yes | Yes | Yes |
| Obs. | 46,009 | 46,009 | 46,009 | 46,009 |
| R-sq | 0.0029 | 0.0033 | 0.0029 | 0.0034 |

*Note*: See notes to Table 1.

Table 10. Robustness Checks on East Asian Sample Log-difference Regression: Exchange Rate

| | Manu | Machine | Manu | Machine | Final | Parts | Final | Parts |
|---|---|---|---|---|---|---|---|---|
| importer's GDP | 0.416*** | 0.535*** | 0.375** | 0.486** | 0.765*** | 0.636*** | 0.821*** | 0.671*** |
| | [0.127] | [0.155] | [0.183] | [0.205] | [0.163] | [0.137] | [0.165] | [0.138] |
| exporter's GDP | 0.415** | 0.501** | 0.476** | 0.546** | 0.274* | 0.316** | 0.317* | 0.346** |
| | [0.201] | [0.215] | [0.196] | [0.213] | [0.165] | [0.138] | [0.168] | [0.140] |
| tariffs | -1.059 | -0.933 | -0.838 | -0.822 | | | | |
| | [0.806] | [0.752] | [1.081] | [0.983] | | | | |
| exchange rate | 0.024 | 0.031 | 0.18 | 0.174 | -0.176 | 0.163 | -0.198 | 0.154 |
| | [0.128] | [0.154] | [0.140] | [0.169] | [0.148] | [0.124] | [0.149] | [0.125] |
| volatility | -1.419 | -0.775 | | | -3.390*** | -1.880* | | |
| | [1.531] | [1.752] | | | [1.188] | [0.996] | | |
| unanticipated volatility | | | -2.269** | -1.801 | | | -2.342** | -1.111 |
| | | | [0.933] | [1.188] | | | [1.061] | [0.888] |
| importer's risk | | | 0.535 | 0.368 | | | -0.13 | 0.147 |
| | | | [0.397] | [0.394] | | | [0.168] | [0.140] |
| exporter's risk | | | -2.339 | -2.249 | | | 0.308* | 0.334** |
| | | | [2.500] | [2.465] | | | [0.173] | [0.145] |
| Year dummy | Yes | Yes | Yes | Yes | Yes | Yes | Yes | Yes |
| Wald test (p-value) | | | | | 0.2354 | | 0.2784 | |
| Obs. | 936 | 936 | 936 | 936 | 936 | 957 | 957 | 957 |
| R-sq | 0.0394 | 0.0458 | 0.0814 | 0.0824 | 0.2506 | 0.2676 | 0.2513 | 0.2706 |

*Note*: See notes to Table 2.