The Impact of Real Exchange Rate Flexibility on East Asian Exports

Mizanur Rahman, University of Dhaka
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Asian Development Bank Institute (ADBI), Japan

1. INTRODUCTION

During the period from 1970 to 2005, East Asia has not only been the fastest growing region in the world, but their economic interdependency has grown even stronger in relation to the growth. The share of intra-regional trade in East Asia has far exceeded that of the North American Free Trade Area (NAFTA) and is approaching the level of the European Union (EU). However, unlike the EU and NAFTA, East Asia has attained such a high level of economic integration mainly through market mechanism, with little support from region-wide political and/or monetary institutions (see Kawai, 2005, 2007; Fujita, 2007). Ogawa and Yang (2008) showed that East Asian countries still conducted heterogeneous exchange rate and monetary policies and that their exchange rate regimes varied across the continuum of fixed to floating.1 The outcome is significant real misalignment within East Asia. The present study therefore examines the impact of intra-regional real exchange rate (RER) flexibility on exports from China and Japan.

The study focuses on China and Japan because these two countries have respectively de facto peg and independently floating exchange rate regimes, while their exporters are exacting fragmentation of production processes across...
borders in East Asia. In his Testimony before the US Senate Committee on Finance, Alan Greenspan (2005) remarked:

The enhanced integration of China into the world trading system is having a notable effect on Asia's trade with the rest of the world and on trade within Asia. . . . This has occurred as production within Asia has evolved, with the final stages of assembly and exporting to the United States and elsewhere becoming increasingly concentrated in China.

This phenomenon is known as East Asian production networks, whereby production processes are fragmented across national borders in the region. This development is undeniably related to the global imbalance problem, particularly a rising current account deficit in the United States. A growing consensus is that the imbalance is unsustainable and requires an orderly adjustment of East Asian exchange rates. The present study shows that an appreciation of all East Asian exchange rates, if generalised and coordinated, would be virtuous and significantly correct the payment imbalance. Otherwise, the effect would be heterogeneous, causing a significant decline in East Asian exports regardless of how individual countries conduct their exchange rate policies. The findings further imply that a regional currency basket mechanism has the potential to both enhance intra-regional exchange rate stability and engineer a collective exchange rate adjustment for resolving global imbalances against East Asia.

The remainder of the paper is organised as follows. The next section briefly discusses previous research on the trade effect of exchange rate uncertainty/flexibility. Section 3 outlines concepts and estimation methods. In Section 4, the study discusses data and variables. Section 5 contains econometric results and interpretation. Section 6 concludes the paper, drawing policy implications for regional exchange rate management in East Asia.

2. PREVIOUS RESEARCH

Several studies have examined the impact of exchange rate uncertainty and/or flexibility on the volume of international trade. Ethier (1973) showed that uncertainty about how a firm’s profit depends on the future spot rate would reduce volume of imports by the firm. But the study indicated that its expected profit would be independent of exchange risk, if the forward rate accurately reflected expectations about the future spot rate. The model, however, assumed that the firm knew the forward exchange rate and that the price of its output would not be sensitive to variability in the forward exchange rate. Clark (1973) instead argued that the forward rate, while known with certainty on any given day, would vary from day to day in a stochastic fashion and that the exporting firm’s planning

2 Rahman (2007) showed that the deepening of regional production networks essentially required East Asian countries to stabilise their exchange rates with one another and to move jointly against the rest of the world currencies, particularly the US dollar.
horizon would be considerably longer than the usual forward contract period. The study showed that marginal revenue of a risk-averse exporter should exceed marginal cost in order to compensate for the exchange risk. In other words, the exports supply curve would shift up and to the left as the variance of the forward exchange rate increased. Even if the firm could perfectly hedge for any maturities, the study showed, the flexibility in the forward exchange rates would increase the variance of profits and reduce the volume of trade.

Several studies have tried to detect a systematic relationship between exchange rate volatility and the volume of international trade. Coes (1981) and Rana (1981) found that exchange rate volatility had negative effects on exports. Hooper and Kohlhagen (1978), using quarterly trade data from Germany and the United States vis-à-vis other industrial countries, found no significant effect of exchange risk on volume of trade. The above studies used several alternative volatility measures such as standard deviation of current spot rate, standard deviation of current forward exchange rate or average absolute difference between the previous forward and the current spot rate. Cushman (1983) studied the effects of volatility in real exchange rates and measured volatility by standard deviation of quarterly changes in real exchange rates. Examining 14 bilateral trade flows in 1965–77, he found both negative and positive effects of volatility on trade flows. Kenen and Rodrik (1986) found that short-run volatility in real exchange rates had significant negative effects on import volumes only in four cases out of 14 industrial countries included in their study.

The empirical literature thus delivers a mixed picture on the trade effect of exchange rate volatility. There are two major caveats in this literature. The first is that the short-run volatility as measured by either standard deviation or absolute changes in the spot rate or the forward rate does not capture persistent real misalignment that enters into firms’ longer-term decisions. The other is that when firms, located across national borders in a particular region, jointly organise a product value chain, they conduct substantial trade in intermediate goods before the value chain results in a finished product. In this case, exchange rate flexibility is not how a particular country’s nominal exchange rate varies with respect to the invoice currency, say, the US dollar. Instead, it is the flexibility in relative prices between countries within the region that matters in firms’ production and exporting decisions. This is particularly the case in East Asia in recent times.

3. CONCEPTS AND METHODS

The standard two-country trade model, as suggested by Cushman (1987) and Rose and Yellen (1989), assumes that the observed exports from country i to
country $k$ exhibit an equilibrium behaviour of both supply and demand schedules. The following equations describe the basic set-up:

\[
Q^x_{ik} = A(p^x_{ik})^b(y_i)^c, \quad b > 0, c \neq 0,
\]

(1)

\[
Q^m_{ki} = B(p^m_{ki})^d(y_k)^e, \quad d < 0, e > 0,
\]

(2)

\[
p^m_{ki} = \left( \frac{P^m_{ki}}{P_k} \right) = \left( \frac{P^x_{ik}}{P_i} \cdot \frac{P_i}{E_{ik}P_k} \right) = p^x_{ik} \varepsilon_{ik},
\]

(3)

\[
Q^x_{ik} = Q^m_{ki} = Q_{ik},
\]

(4)

where $Q^x_{ik}$ is the quantity of exports supplied from $i$ to $k$, $Q^m_{ki}$ is the quantity of imports demanded by $k$ from $i$, $p^x_{ik}$ is $i$’s bilateral export price relative to the domestic price level, $y_i$ is exporter’s real income, $p^m_{ki}$ is $k$’s bilateral import price relative to its domestic price level, $E_{ik}$ is the nominal exchange rate between $i$ and $k$ (in units of $i$’s currency), $\varepsilon_{ik}$ is the bilateral real exchange rate (an increase denotes a real appreciation for country $i$), and $y_k$ is the importer’s real income.

Equation (4) is the equilibrium condition for the export market. It can be solved for $p^x_{ik}$ and $Q_{ik}$. Their product gives the following reduced-form equation for the observed exports from $i$ to $k$:

\[
\tilde{Q}_{ik} = (Q_{ik} \cdot p^x_{ik}) = [A^{-(1+d)}B^{(1+b)}y_i^{-(1+d)}y_k^{(1+b)}E_{ik}^{d(1+b)}]^{1/(b-d)} = G(y_i, y_k, \varepsilon_{ik}).
\]

(5)

In the context of East Asian exports, equation (5) does not recognise the important point that $\tilde{Q}_{ik}$ is the gross real value of exports that are produced along the cross-border production blocks in the region and that the domestic value-added by exporting country $i$ is only a part of the gross value. The present study thus takes a value-added approach, as outlined below.

Let $v_{ik}$ represent the incremental value-added by country $i$ and $\sum v_{jk}$ be the value of imported intermediate goods from the rest of East Asia. The subscript $j = 1, \ldots, N$ indicates other East Asian countries that supply the intermediate goods to country $i$. The subscript $k$ indicates the importing country that purchases the finished product. The study thus formulates $(N+1)$ structural equations of supply and corresponding $(N+1)$ structural equations of demand. Each equation is for the incremental value-added, which occurs across East Asian countries $j$ and the final exporting country $i$. At equilibrium, it gives the following $(N+1)$ reduced-form solutions:

\[
\tilde{v}_{jk} = v_{jk} \cdot p^x_{jk} = g_j[y_j, y_k, \varepsilon_{jk}], \quad j = 1, \ldots, N,
\]

(6)

\[
\tilde{v}_{ik} = v_{ik} \cdot p^x_{ik} = g_i[y_i, y_k, \varepsilon_{ik}].
\]
Since bilateral exports from \( i \) to \( k \) are recorded on a gross basis rather than as value added, individual \( v \)'s are unobserved but the gross value (\( \Sigma v \)) is observed. The present study therefore conducts an Armington aggregation of the equilibrium conditions (6). Note that \( v_{ik} \) represents values of intermediate inputs imported from \( j \) to \( i \) and hence called \( v_{ji} \) and that the variable \( \varepsilon_{ik} \), which is the real exchange rate between the supplier of intermediate inputs and the importer of finished exports, can be factored as follows: \( \varepsilon_{ik} = (\varepsilon_{ji} \cdot \varepsilon_{ik}) \). Thus the Armington aggregation results in the following reduced-form equation for the gross real value of final exports \( \hat{Q}_{ik} \):\(^4\)

\[
\hat{Q}_{ik} = \left[ \left( \sum_j \omega_{ji} \hat{\varepsilon}_{ji} \right) + \left( 1 - \sum_j \omega_{ji} \right) \hat{\varepsilon}_{ik} \right]^{\alpha/\alpha} = G'(\hat{y}_j, y_i, y_k, \hat{\varepsilon}_{ji}, \varepsilon_{ik}),
\]

where \( \omega_{ji} \) is the weight of country \( j \) in the gross value, \( \hat{y}_j = (\sum_j \omega_{ji} y_j)^{1/\alpha} \) and \( \hat{\varepsilon}_{ji} = (\sum_j \omega_{ji} \cdot \varepsilon_{ji})^{1/\alpha} \) are respectively the weighted incomes of East Asian countries that supply intermediate goods to \( i \) and the weighted real exchange rate between \( i \) and those countries.

Literally, an increase in \( \hat{\varepsilon}_{ji} \) denotes a real appreciation of the rest of East Asia against \( i \). The present study argues that the variable rather represents the intra-regional real exchange rate (RER) flexibility between country \( i \) and the rest of East Asia. The term ‘flexibility’ refers to wider variability of \( \hat{\varepsilon}_{ji} \) around its trend line and any deviation of it from the trend line indicates the unintended misalignment in relative prices along the country’s supply chain in the region. The question arises whether the use of the level \( \hat{\varepsilon}_{ji} \) in a dynamic panel model captures the effect of changes in the level (i.e. a real appreciation or a real depreciation) or the effect of deviations from its trend. As far as the estimated model includes deterministics and appropriate order of dynamics for reasons to be explained later, the coefficient of \( \hat{\varepsilon}_{ji} \) should reflect the effect of deviations from its trend, which is otherwise the unintended misalignment within the region. In the present context, given that production processes are vertically fragmented across borders in East Asia and that the countries conduct heterogeneous exchange rate policies, the effect would be negative, asymmetric and destabilising regardless of how a particular East Asian country conducts its exchange rate and monetary policy. By contrast, a regional exchange rate mechanism whereby East Asian countries stabilise their intra-regional relative prices would cause the effect to be symmetric but less in magnitude across East Asia. The mechanism itself would be an instrument to bring about a generalised appreciation of East Asian exchange rates.

In order to estimate the effect of exchange rate flexibility reliably, the present study estimates a stochastic formulation of equation (7) in an autoregressive and distributed lag (ADL) framework. The following dynamic panel specification is

\(^4\) An assumption that \( \alpha = 0 \) will imply unitary elasticity of substitution between domestic and foreign inputs and the aggregation is \( \Pi v_{ji}^{\omega} \) due to l’Hôpital’s rule.
separately estimated for bilateral exports of China and Japan over the period 1992–2005:

\[
\dot{Q}_{ikt} = \sum_{p=1}^{p} \alpha_{ip} \dot{Q}_{ik(t-p)} + \beta'(L)X_{ikt} + \gamma'Z_{ik} + \eta_{ik} + \delta_{i} + u_{ikt},
\]

\( t = p + 1, \ldots, T; i = \text{China, and Japan}; k = 1, \ldots, N, \)

where \( \dot{Q}_{ikt} \) represents bilateral real exports from country \( i \) to country \( k \), the vector \( X_{ikt} = [\epsilon_{ikt} \; \dot{e}_{ji} \; y_{it} \; y_{kt}]' \) is the set of right-hand-side variables that can be either endogenous, predetermined and/or strictly exogenous, \( \beta'(L) \) is the coefficient vector of polynomials in the lag operator, \( \dot{e}_{ji} \) is the intra-regional RER flexibility as defined earlier, \( \epsilon_{ikt} \) is the bilateral real exchange rate between country \( i \) and its trading partners \( k \) (an increase indicates a real appreciation of the exporting country \( i \)), \( y_{kt} \) is the real income of the importing country \( k \), and \( y_{it} \) is the exporter’s GDP. The variable \( y_{it} \) is included as a proxy to control for exporters’ increased capacity to supply new varieties (see Bayoumi, 1999; Chinn, 2005). The vector \( Z_{ik} \) is a set of gravity variables, such as the distance between country \( i \) and country \( k \), and dummy variables indicating whether the two countries are contiguous, share a common language, and have a colonial link. All the variables except the dummies are measured in natural logs. The model also includes fixed effect \( \eta_{ik} \) capturing unobserved factors that are not explicitly included as explanatory variables but affect the cross-sectional units of the sample and the values of the dependent variable observed for them. The vector \( d_{i} \) indicates the deterministic variables (intercept and/or trend terms) and \( \delta_{i} \) indicates the corresponding vector of coefficients. The error terms \( u_{ikt} \) are assumed to be serially uncorrelated and distributed independently across cross-sectional units.

The dynamic specification (8) does not presuppose that the variables (\( \dot{Q}_{ikt}, X_{ikt} \)) are unit-root processes and that there exist cointegration relations. The model is flexible and captures both the short-run dynamics and the long-run equilibrium relations, regardless of whether the vector \( X_{ikt} \) includes either trend stationary series or difference stationary series or a mixture thereof. Rahman (2007) showed that the (\( \dot{Q}_{ikt}, X_{ikt} \)) variables were often trend stationary series with higher-order autoregressive terms and that the conditional distribution of the regression would likely be trend stationary, particularly when the sample size was moderate. The study further showed that the variables (\( \dot{Q}_{ikt}, X_{ikt} \)) would not be cointegrated and the constrained long-run specifications such as dynamic ordinary least squares (DOLS) or the semi-parametric fully modified OLS approach of Phillips and Hansen (1990) would likely produce spurious estimates for the long-run parameters. Furthermore, since the dynamic panel model includes the unobserved fixed effects and one or more of the right-hand-side variables may be either endogenous or predetermined, the standard methods such as pooled OLS (POLS) or fixed effect (FE) estimators are also generally inconsistent (see

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Nickell, 1981). The present study therefore estimates the model by using the generalised method of moments (GMM) approach as developed by Holtz-Eakin et al. (1988), Arellano and Bond (1991) and Blundell and Bond (1998).

Arellano and Bond (1991) suggested that lagged values of the dependent/endogenous variable itself and past, present and future values of the strictly exogenous variables would be valid instruments for the lagged dependent variable and other non-exogenous variables in the differenced equations of later period. For example, in a first-order autoregressive model $y_{it} = \alpha y_{i(t-1)} + \beta' x_{it} + \eta_i + u_{it}$ that includes an endogenous vector $x_{it}$ in the sense that $E(x_{it}'u_{it}) \neq 0$ for $s \leq t$ but zero otherwise, then the vector $x_{it}$ would be treated symmetrically with the dependent variable $y_{it}$. In this case the complete set of moment conditions available has the form of $E(Z_i'\Delta u_i) = 0$ for $i = 1, \ldots, N$, where $\Delta u_i = (\Delta u_{i1}, \ldots, \Delta u_{iT})'$ and the optimal matrix of the instruments $Z_i = \text{diag}(y_{i1}, \ldots, y_{iT}, x_{i1}, \ldots, x_{iT})$ ($s = 1, \ldots, T - 2$) are the valid instruments in the differenced equations. GMM estimators that are based on the above moment conditions are referred to as the first-differenced GMM estimators.

Arellano–Bond first-differenced GMM estimators can, however, be more biased than the within estimators under certain conditions. Alonso-Borrego and Arellano (1996) showed that the first-differenced GMM estimators would be weakly identified when the instruments were weak in the sense that they had a low correlation with the included endogenous variables. Blundell and Bond (1998) argued that GMM-diff. estimators could be seriously downward biased in two important cases. First, as the value of the autoregressive parameter ($\bar{\alpha}$) approaches unity, and second, as the relative variance of the fixed effects $\eta_i$, i.e. $(\sigma^2_\eta/\sigma^2_\varepsilon)$ increases to infinity. To solve the problem, Arellano and Bover (1995) and Blundell and Bond (1998) proposed a new GMM estimator that would combine in a stacked system the regression in differences with the regression in levels. They called it the system GMM estimator.

The system GMM estimator is based on a set of moment conditions that are related to both the differenced equations and the levels equations of the model. The moment conditions imply that if a right-hand-side variable is potentially endogenous, its lags dated $(t - 2)$ or earlier can be instruments in the differenced equations and the lagged differences can be instruments in the levels equations. By contrast, if a right-hand-side variable is predetermined, its lags dated $(t - 1)$ or earlier will be instruments in the differenced equations and the first differences can be used as instruments for the levels equations. For the set of strictly exogenous variables, their past, present and future values will be valid instruments in the differenced equations, while the differences of these variables will be valid instruments in the levels equations. The latter is based on the stationary property that $E(x_{it+p}\eta_k) = E(x_{it+q}\eta_k)$ for all $p$ and $q$. Since the model is estimated as a stacked system of the differenced equations and the levels equations, the resultant system GMM estimators are derived by exploiting an extended instrument matrix. The term ‘extended’ comes from the use of additional moment conditions related to the
levels equations, in addition to those defined by Arellano and Bond (1991) for the differenced equations. Rahman (2007) provides a detailed formulation of orthogonality conditions for a general autoregressive and distributed-lag (ADL) model.

The present study uses both the first-differenced GMM and the system GMM estimators, in addition to the pooled OLS and within estimators in order to draw valid inference on the long-run parameters of the model. In so doing, the study follows a two-step strategy, similar to that suggested by Pesaran and Shin (1998). The first step involves the selection of the order of the ADL model using either the Akaike information criterion (AIC) or the Schwarz Bayesian criterion (BIC). Then the long-run coefficients and their standard errors are estimated by using dynamic estimates of the ADL model selected in the first step. The test statistics are computed using the delta (Δ) method. Pesaran and Shin (1998) showed that in small samples, albeit in the context of time series, these test statistics generally performed much better than those computed using asymptotic results.

4. DESCRIPTION OF DATA AND VARIABLES

The study uses panel data on bilateral exports and imports statistics of China and Japan over the period 1992–2005. The dataset is created from the CHELEM database developed by the Centre d’Études Prospectives et d’Informations Internationales (CEPII, 2007). It includes 33 major trading partners for each of China and Japan. The respective sample accounts for more than 90 per cent of total exports of each country. Figure 1 shows trends of exports from China and Japan to major destinations including the United States, Europe and East Asia.

The study uses the export price index (line 74d of IMF, International Financial Statistics) to deflate the nominal dollar value of Japan’s bilateral exports. The index is not available for China over the sample period and so the Hong Kong export price index is instead applied to deflate China’s nominal exports. Liang and Fung (2005) and Rahman and Thorbecke (2007) did the same arguing that the Hong Kong export price index traced the price movement of China’s exports better than others. The study also uses the US Bureau of Labor Statistics (BLS) import price index of manufactured imports from non-industrial countries as an alternative deflator, as suggested by Cheung et al. (2006).

The data for bilateral real exchange rates between exporting country \( i \) and importing country \( k \) (\( \varepsilon_{ik} \)) are also defined alternatively. The first two definitions differ in the use of price indices, i.e. the consumer price index (line 64 of IMF’s IFS) or the producer price index (line 63). The third definition is the PPP-based bilateral real exchange rates taken from the CHELEM database. An increase indicates a real appreciation of the exporting country \( i \).

The intra-regional RER flexibility variable, \( \tilde{e}_{ji} \), is a time series variable. Since the variable is defined as \( \sum \omega_{ji} \ln(\varepsilon_{ji}) \), the study first organises information on both
and ε_{ji}, which represent trade intensity and price-adjusted real exchange rate, respectively, between exporting country i and another East Asian country j. For instance, in the case of Japan, the subscript j represents China, Hong Kong, South Korea, Taiwan and ASEAN-5, including Indonesia, Malaysia, Philippines, Singapore and Thailand. By contrast, in the case of China, j represents Japan, Hong Kong, South Korea, Taiwan and ASEAN-5. The term ω_{ij} is defined as (x_{ij} + m_{ij})/(X_i + M_i), where x_{ij} and m_{ij} represent bilateral exports and imports respectively between i and j, and X_i and M_i represent the overall exports and imports respectively of country i. Therefore, both the weighting matrix ω and ε_{ji} are updated annually and for each exporting country under analysis.

The real income and population data of exporters and importers are taken from the CHELEM database. The set of gravity variables including the distance and dummy variables indicating whether the two countries are contiguous, share a common language, have a colonial link, etc., is taken from the CEPII website and Rose and van Wincoop (2001).
5. RESULTS AND INTERPRETATION

Table 1 presents dynamic estimates for the case of China. The first two columns report the pooled OLS and the within estimates, respectively, while the remaining columns (3–6) report four alternative GMM estimates of the ADL(1,1)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>1 Pooled OLS</th>
<th>2 Fixed Effect</th>
<th>3 GMM (1)</th>
<th>4 GMM (2)</th>
<th>5 GMM (3)</th>
<th>6 GMM (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lagged real exports&lt;sub&gt;ik(t−1)&lt;/sub&gt;</td>
<td>0.668*** (0.093)</td>
<td>0.677*** (0.082)</td>
<td>0.625*** (0.076)</td>
<td>0.692*** (0.067)</td>
<td>0.631*** (0.081)</td>
<td>0.704*** (0.100)</td>
</tr>
<tr>
<td>Bilateral RER&lt;sub&gt;ik&lt;/sub&gt;,t−1</td>
<td>−0.550*** (0.106)</td>
<td>−0.583*** (0.094)</td>
<td>−1.079*** (0.335)</td>
<td>−0.599*** (0.118)</td>
<td>−0.851*** (0.130)</td>
<td>−0.929*** (0.140)</td>
</tr>
<tr>
<td>Intra-regional RER flexibility&lt;sub&gt;EA,t−1&lt;/sub&gt;</td>
<td>0.352 (0.221)</td>
<td>0.091 (0.206)</td>
<td>0.174 (0.362)</td>
<td>0.240 (0.233)</td>
<td>0.188 (0.269)</td>
<td>0.239 (0.268)</td>
</tr>
<tr>
<td>GDP of importer&lt;sub&gt;k&lt;/sub&gt;,t</td>
<td>2.502*** (0.453)</td>
<td>2.371*** (0.349)</td>
<td>3.288*** (0.676)</td>
<td>2.672*** (0.541)</td>
<td>0.678*** (0.276)</td>
<td>0.181 (0.130)</td>
</tr>
<tr>
<td>GDP of exporter&lt;sub&gt;i&lt;/sub&gt;,t−1</td>
<td>−1.782*** (0.447)</td>
<td>−1.568*** (0.345)</td>
<td>−2.129*** (0.556)</td>
<td>−1.923*** (0.507)</td>
<td>0.022 (0.319)</td>
<td>0.696* (0.374)</td>
</tr>
<tr>
<td>GDP of exporter&lt;sub&gt;i&lt;/sub&gt;,t−(t−1)</td>
<td>1.021*** (0.380)</td>
<td>1.982*** (0.392)</td>
<td>0.022 (0.319)</td>
<td>0.696* (0.374)</td>
<td>−0.006 (0.457)</td>
<td>−0.246 (0.419)</td>
</tr>
<tr>
<td>GDP of exporter&lt;sub&gt;i&lt;/sub&gt;,t−(t−1)</td>
<td>−3.827*** (0.649)</td>
<td>−1.841*** (0.474)</td>
<td>−3.761*** (0.728)</td>
<td>−3.845*** (0.684)</td>
<td>−0.006 (0.457)</td>
<td>−0.246 (0.419)</td>
</tr>
</tbody>
</table>

Notes:
Subscript k represents China’s main trading partners that account for more than 90 per cent of its exports. GMM(1) is one-step difference GMM, GMM(2–4) are one-step system GMM estimates. All the GMM estimates are obtained under the assumption that $y_{kt}$, $y_{kt}$, and $y_{kt}$ are predetermined, but $y_{kt}$ is endogenous in the system. The pooled OLS and GMM(2–4) include country-specific dummies. Both GMM(3) and GMM(4) include only the contemporaneous terms of $y_{kt}$ and $y_{kt}$, not their distributed-lag terms. GMM(4) differs from the other GMM estimates in that it includes regional dummies for East Asia and EU-15, while country-specific dummies for other importers. m1 and m2 are tests for first-order and second-order serial correlation in the first-differenced residuals with the null of no serial correlation. Hansen J-statistic is the test for over-identifying restrictions with the null of instrument validity. Asymptotic standard errors, robust to cross-section and time-series heteroscedasticity, are reported in parentheses. Standard errors of OLS and FE estimates are clustered and therefore adjusted for intra-group correlations.
Significance tests: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. 

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Since the dynamic panel model includes lagged real exports, GDPs and exchange rate variables, which are weakly exogenous or potentially endogenous, the OLS and within estimates are inconsistent. We therefore focus on the GMM estimates. All the GMM estimates are one-step system GMM estimates, for which we believe inference based on the asymptotic variance matrix to be more reliable. All the GMM estimates are obtained under the assumption that importer’s GDP and both the RER variables are predetermined, whereas the exporter’s GDP and the lagged dependent variable are endogenous. Footnotes to the table describe the specification differences. The Hansen test of over-identifying restrictions indicates that the null of instrument validity is not rejected in three out of four cases. The tests of first-order and second-order serial correlation in the first-differenced residuals are in all cases consistent with the maintained assumption of no serial correlation.

Table 2 shows the long-run estimates of the key variables of the model and they are based on the dynamic estimates reported in Table 1. The finding shows that the long-run coefficient of $\hat{e}_{ji}$, which is the intra-regional RER flexibility between China and the rest of East Asia, is negative and statistically significant in all the GMM estimations. The range of the estimates is $-2.45$ to $-1.37$, which includes one particular estimate ($-2.45$) along with its precision level being the same in two cases. It is interesting to note that the range of the long-run parameter implied by four different GMM estimates is well within the range implied by the OLS and within estimates, which are respectively upward biased and downward biased. The findings indicate that the intra-regional RER flexibility between China and the rest of East Asia significantly reduces the volume of China’s exports in general. When considered against the long-run coefficient of China’s own bilateral

<table>
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<tr>
<th>Specifications and Estimation Methods</th>
<th>Income of Importing Country GDP$_{kt}$</th>
<th>Bilateral Real Exchange Rate ($\varepsilon_{ik}$)</th>
<th>Intra-regional RER Flexibility ($\hat{e}_{ji}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pooled OLS</td>
<td>2.169*** (0.482)</td>
<td>$-1.232*** (0.451)$</td>
<td>$-0.810 (0.682)$</td>
</tr>
<tr>
<td>2. Fixed effect</td>
<td>2.484*** (0.561)</td>
<td>$-0.860** (0.385)$</td>
<td>$-2.658** (1.069)$</td>
</tr>
<tr>
<td>3. GMM(1)</td>
<td>3.092*** (1.051)</td>
<td>$-2.969*** (1.027)$</td>
<td>$-2.447** (1.105)$</td>
</tr>
<tr>
<td>4. GMM(2)</td>
<td>2.434*** (0.882)</td>
<td>$-1.836*** (0.716)$</td>
<td>$-1.366** (0.769)$</td>
</tr>
<tr>
<td>5. GMM(3)</td>
<td>1.839*** (0.679)</td>
<td>$-1.448** (0.625)$</td>
<td>$-1.792** (0.938)$</td>
</tr>
<tr>
<td>6. GMM(4)</td>
<td>0.610** (0.274)</td>
<td>$-1.895*** (0.685)$</td>
<td>$-2.447** (1.206)$</td>
</tr>
</tbody>
</table>

Notes:
The long-run coefficients are based on dynamic estimates of the ADL model (Table 1) and the corresponding test statistics are computed using the delta method.
Significance tests: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. 

5 Arellano and Bond (1991) suggested that caution would be advisable in making inference based on the two-step estimators.
real exchange rate ($\varepsilon_{ik}$), the coefficient of $\varepsilon_{ji}$ is largely comparable in terms of both statistical and economic significance. This indicates that real exchange rate flexibility between China and its regional partners in East Asia would affect the price competitiveness of its exports as much as would do a real appreciation of renminbi against the rest of the world. This is because the intra-regional RER flexibility would affect the dollar cost of intermediate goods imported into China from the rest of East Asia, which represents a significant share of the gross value of Chinese exports.

Now we focus on the case of Japan, which has a freely floating exchange regime as opposed to China’s *de facto* pegged regime. The argument of floating rates implies that such rates would be likely to cause the forward exchange rate to more closely approximate the expected spot rate, thus raising efficiency, and that exchange risk would not likely rise. In other words, the long-run effect of $\varepsilon_{ji}$ on Japan’s exports should be statistically zero.

Tables 3 and 4 present short-run dynamics and long-run estimates, respectively, of the model for Japan. Footnotes to Table 3 describe how the alternative estimates are different from one another. The interesting finding is that the dynamic estimates under both the pooled OLS and within estimations are identical, though the within estimates have some gain in precision. According to these estimates, as Table 4 shows, the long-run effect of $\varepsilon_{ji}$ is $-1.39$ (the $p$-value of the within estimate is 0.128). The corresponding four GMM estimates lie in the range between $-1.46$ and $-1.96$, all being statistically significant at around the 5 per cent level. All the six estimates of the long-run coefficient of the intra-regional RER flexibility between Japan and the rest of East Asia are well within a half of the standard error of the smallest estimate. This finding is in contrast with what is implied by the argument of floating rates. The findings show that a 10 per cent real appreciation of Japanese yen would probably reduce Japanese exports by 5 per cent, but a corresponding 10 per cent real misalignment between Japan and the rest of East Asia would reduce Japanese exports by about 15 per cent. This is a factor of three of the effect of a yen appreciation. Another noticeable finding is that partner’s GDP is statistically insignificant in five out of six estimations, with the exception of a unity coefficient in the case of GMM(4), which treated the variable to be strictly exogenous. A contrasting observation that the income effect is very high and significant for Chinese exports but not for Japanese exports indeed reflects China’s status as the platform of final stages of assembly and exporting to the United States and elsewhere.

6. SUMMARY AND CONCLUDING REMARKS

The study bears significant policy implications for East Asian countries in general and for a regional exchange rate management in particular. The deepening
of East Asian production networks has caused increasing trade integration of East Asian countries with one another. However, except Japan, other East Asian countries directly or indirectly peg their currencies to the US dollar. McKinnon and Schnabl (2006) argued that the policy reflected the invoicing preference of East Asian traders and that these countries were strong competitors, particularly

TABLE 3
Estimation of Autoregressive and Distributed Lag (ADL) Model
(Dependent Variable: Japan’s Exports to 33 Countries, 1992–2005)

<table>
<thead>
<tr>
<th>Independent Variables</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pooled OLS</td>
<td>Fixed Effect</td>
<td>GMM (1)</td>
<td>GMM (2)</td>
<td>GMM (3)</td>
<td>GMM (4)</td>
</tr>
<tr>
<td>Lagged real exports(_{it-1})</td>
<td>0.735***</td>
<td>0.735**</td>
<td>0.747***</td>
<td>0.771***</td>
<td>0.761***</td>
<td>0.724***</td>
</tr>
<tr>
<td>(0.057)</td>
<td>(0.054)</td>
<td>(0.060)</td>
<td>(0.076)</td>
<td>(0.177)</td>
<td>(0.069)</td>
<td></td>
</tr>
<tr>
<td>Bilateral RER(_{ik,t})</td>
<td>-0.594***</td>
<td>-0.594***</td>
<td>-0.637***</td>
<td>-0.634***</td>
<td>-0.464***</td>
<td>-0.593***</td>
</tr>
<tr>
<td>(0.102)</td>
<td>(0.097)</td>
<td>(0.106)</td>
<td>(0.145)</td>
<td>(0.145)</td>
<td>(0.099)</td>
<td></td>
</tr>
<tr>
<td>Bilateral RER(_{ik,t-1})</td>
<td>0.247***</td>
<td>0.247***</td>
<td>0.252***</td>
<td>0.214***</td>
<td>-0.061</td>
<td>0.189***</td>
</tr>
<tr>
<td>(0.052)</td>
<td>(0.050)</td>
<td>(0.057)</td>
<td>(0.071)</td>
<td>(0.188)</td>
<td>(0.049)</td>
<td></td>
</tr>
<tr>
<td>Intra-regional RER flexibility (_{iEA,t-1})</td>
<td>-1.084***</td>
<td>-1.084***</td>
<td>-1.112***</td>
<td>-1.108***</td>
<td>-0.054***</td>
<td>-1.066***</td>
</tr>
<tr>
<td>(0.216)</td>
<td>(0.207)</td>
<td>(0.201)</td>
<td>(0.209)</td>
<td>(0.243)</td>
<td>(0.203)</td>
<td></td>
</tr>
<tr>
<td>Intra-regional RER flexibility (_{iEA,t})</td>
<td>0.695***</td>
<td>0.695***</td>
<td>0.704***</td>
<td>0.716***</td>
<td>0.544***</td>
<td>0.660***</td>
</tr>
<tr>
<td>(0.139)</td>
<td>(0.133)</td>
<td>(0.129)</td>
<td>(0.145)</td>
<td>(0.210)</td>
<td>(0.131)</td>
<td></td>
</tr>
<tr>
<td>GDP of importer(_k)</td>
<td>2.961***</td>
<td>2.961***</td>
<td>2.956***</td>
<td>2.981***</td>
<td>4.526***</td>
<td>3.105***</td>
</tr>
<tr>
<td>(0.358)</td>
<td>(0.342)</td>
<td>(0.335)</td>
<td>(0.448)</td>
<td>(0.626)</td>
<td>(0.332)</td>
<td></td>
</tr>
<tr>
<td>GDP of importer(_{kt})</td>
<td>-2.885***</td>
<td>-2.885***</td>
<td>-2.959***</td>
<td>-3.084***</td>
<td>-5.104***</td>
<td>-2.988***</td>
</tr>
<tr>
<td>(0.543)</td>
<td>(0.519)</td>
<td>(0.447)</td>
<td>(0.585)</td>
<td>(0.842)</td>
<td>(0.532)</td>
<td></td>
</tr>
<tr>
<td>GDP of exporter(_i)</td>
<td>4.917***</td>
<td>4.917***</td>
<td>4.941***</td>
<td>4.831***</td>
<td>2.591</td>
<td>4.612***</td>
</tr>
<tr>
<td>(0.883)</td>
<td>(0.845)</td>
<td>(0.785)</td>
<td>(0.969)</td>
<td>(1.557)</td>
<td>(0.883)</td>
<td></td>
</tr>
<tr>
<td>GDP of exporter(_{it})</td>
<td>-5.623***</td>
<td>-5.623***</td>
<td>-5.730***</td>
<td>-5.716***</td>
<td>-2.704*</td>
<td>-5.341***</td>
</tr>
<tr>
<td>(0.835)</td>
<td>(0.799)</td>
<td>(0.851)</td>
<td>(0.914)</td>
<td>(1.374)</td>
<td>(0.793)</td>
<td></td>
</tr>
<tr>
<td>m1</td>
<td>2.89***</td>
<td>2.88***</td>
<td>2.49***</td>
<td>2.71***</td>
<td>2.88***</td>
<td></td>
</tr>
<tr>
<td>(0.835)</td>
<td>(0.845)</td>
<td>(0.785)</td>
<td>(0.969)</td>
<td>(1.557)</td>
<td>(0.883)</td>
<td></td>
</tr>
<tr>
<td>Hansen J-statistic</td>
<td>1.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>(p-value (d.f.))</td>
<td>1.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td>0.000</td>
<td></td>
</tr>
<tr>
<td>No. of groups</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td>33</td>
<td></td>
</tr>
<tr>
<td>No. of obs.</td>
<td>396</td>
<td>396</td>
<td>363</td>
<td>396</td>
<td>396</td>
<td>396</td>
</tr>
</tbody>
</table>

Notes:
Subscript \(k\) represents Japan’s main trading partners that account for more than 90 per cent of the exports. GMM(1) is one-step difference GMM, GMM(2–4) are one-step system GMM estimates. The pooled OLS and GMM(2–4) include country-specific dummies. The maintained assumption is that \(\varepsilon_{ikt}\) and \(\varepsilon_{jik}\) are predetermined. GMM(2) and GMM(3) differ in that the former assumes \(y_{kt}\) as predetermined but \(y_{it}\) to be strictly exogenous, and the latter treats both \(y_{kt}\) and \(y_{it}\) as endogenous. GMM(4) treats \(y_{kt}\) as strictly exogenous but \(y_{it}\) as endogenous. m1 and m2 are tests for first-order and second-order serial correlation in the first-differenced residuals with the null of no serial correlation. Hansen J-statistic is the test for over-identifying restrictions with the null of instrument validity. The test statistics rejects the null for GMM(2–4) for the reason that importer dummies were included as instruments for the levels equations. Key parameter estimates are, however, comparable to the first-differenced GMM estimates. Asymptotic standard errors, robust to cross-section and time-series heteroscedasticity, are reported in parentheses. Standard errors of OLS and FE estimates are clustered and adjusted for intra-group correlations. Significance tests: *** \(p < 0.01\), ** \(p < 0.05\), * \(p < 0.1\).
in manufactures, in each other’s markets as well as in the Americas and Europe. They viewed that no one East Asian country would want its currency suddenly to appreciate, which would lead to a sharp loss in its price competitiveness in export markets. Therefore, McKinnon and Schnabl (2006) called East Asia a natural dollar area and further argued that unilateral pegs to the dollar might well be preferred to the currency basket approach. However, the findings of this present study contradict their argument. Neither the unilateral dollar pegging by China nor a freely floating regime by Japan stabilised movements of their currencies against other regional exchange rates. The long-run effect of the intra-region RER flexibility is invariably negative in both cases. The implication is that neither a unilateral dollar pegging nor a freely floating regime is an optimal choice for East Asian exchange rates.

A regional currency basket mechanism will likely increase intra-regional exchange rate stability. The mechanism also has the potential to engineer a collective exchange rate adjustment for resolving global payment imbalance against East Asia. However, such a collective adjustment will not happen as long as

<table>
<thead>
<tr>
<th>Specifications and Estimation Methods</th>
<th>Income of Importing Country GDP$_{kt}$</th>
<th>Bilateral Real Exchange Rate ($\varepsilon_{ik}$)</th>
<th>Intra-regional RER Flexibility ($\bar{e}_{ji}$)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. Pooled OLS</td>
<td>1.048 (0.734)</td>
<td>-0.526** (0.213)</td>
<td>-1.391‡ (0.929)</td>
</tr>
<tr>
<td>2. Fixed effect</td>
<td>1.048 (0.703)</td>
<td>-0.526** (0.204)</td>
<td>-1.391‡ (0.889)</td>
</tr>
<tr>
<td>3. GMM(1)</td>
<td>0.880 (0.711)</td>
<td>-0.725*** (0.245)</td>
<td>-1.684** (0.861)</td>
</tr>
<tr>
<td>4. GMM(2)</td>
<td>0.610 (1.395)</td>
<td>-0.950* (0.607)</td>
<td>-1.962** (1.146)</td>
</tr>
<tr>
<td>5. GMM(3)</td>
<td>1.023 (0.673)</td>
<td>-0.889 (0.607)</td>
<td>-1.929** (1.076)</td>
</tr>
<tr>
<td>6. GMM(4)</td>
<td>1.030** (0.479)</td>
<td>-0.675** (0.268)</td>
<td>-1.455** (0.846)</td>
</tr>
</tbody>
</table>

Notes:
The long-run coefficients are based on dynamic estimates of the ADL model (Table 3) and the corresponding test statistics are computed by using the delta method. Significance tests: *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$, ‡ $p < 0.15$.

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6 Kawai (2007, pp. 14–16) discussed several options for a regional currency basket arrangement that included (a) a G3 currency basket comprising the US dollar, the euro and the yen; (b) a G3-plus currency basket that would additionally include emerging East Asian economies, and (c) an Asian currency unit (ACU), which is an appropriately weighted basket of East Asian currencies. It seems that a major problem in the construction of a regional currency basket will be the choice of optimal weights for the basket. The question is rather more empirical than theoretical given that the production networks/supply chains are rapidly evolving in East Asia and hence the parameter estimates are most likely susceptible to regime shifts. Though the present study does not evaluate these specific options, the empirical specification implicitly incorporates a limiting case of trend flexibility in intra-regional real exchange rates. The coefficient of the intra-regional RER flexibility indeed captures the effect of its variations from the trend line. Since a regional currency basket mechanism should minimise those variations, its effect would diminish and be symmetric across East Asian countries.
as major currencies such as the Chinese renminbi and the Malaysian ringgit continue to be significantly pegged to the US dollar. This is more unlikely as relative prices are now leading the adjustment process through the impact of a substantial terms-of-trade shock led by the surge in oil and food prices. And this is unfolding when East Asian countries have little or no coordination in their international macroeconomic policies.

The study concludes that the deepening of economic interdependency of East Asian countries has called for greater symmetry in their intra-regional relative price relationships. A regional currency basket, if properly defined, would lessen the adverse effect of intra-regional RER flexibility. It would bring about an orderly adjustment to global payment imbalance against East Asia or, at least, minimise the unintended consequence of a discrete adjustment. Given the fact that East Asian countries continue to conduct heterogeneous exchange rate and monetary policies, a discrete appreciation of their exchange rate(s) and/or a bout of protectionism in major export markets have the potential to destabilise the production networks. The goal of coordination and shared responsibility is therefore overriding, if not mandatory, for the deepening of economic integration in East Asia.

REFERENCES


