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The Effect of a Collective Exchange Rate Adjustment on East Asian Exports[*]

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Abstract

This paper estimates long-run effects of a collective exchange rate adjustment on multilateral exports from China, Japan, South Korea, and Taiwan. The findings show that a 1 percent generalized appreciation of all East Asian exchange rates would reduce East Asian exports by about 3 percent.

Keywords: Global imbalance; exchange rate appreciation; collective adjustment; production networks; East Asia.

JEL classification: F12, F14, F32, F36, F42

1. Introduction

The issue of global payment imbalance against East Asia including China, in particular, is one central debate in international macroeconomics. There are two competing views on the issue. The dominant view as borne by the U.S. Congress is that the global imbalance is largely because of *the undervalued Chinese Renminbi (RMB)*. The other view as shared by Alan Greenspan, Joseph Stiglitz, and many others is that a generalized exchange appreciation by all East Asian countries will be required to correct the imbalance against China as well as East Asia. Kawai (2007) too indicated that a collective exchange appreciation would bring about an orderly adjustment. The present study formulates a theoretical model for observed exports from East Asia and empirically tests the hypothesis that a generalized appreciation of all East Asian exchange rates would reduce East Asian exports to the world. The study conducts the analyses for China, Japan, South Korea, and Taiwan.

2. The Model

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 is an equilibrium behavior of both supply and demand schedules. The following equations describe the basic set-up.

$$Q_{ik}^x = A\left(p_{ik}^x\right)^b \left(y_i\right)^c \qquad\qquad b > 0, \quad c \neq 0 \qquad\qquad (1)$$

$$Q_{ki}^m = B\left(p_{ki}^m\right)^d \left(y_k\right)^e \qquad\qquad d < 0, \quad e > 0 \qquad\qquad (2)$$

$$p_{ki}^m = \left(\frac{P_{ki}^m}{P_k}\right) = \left(\frac{P_{ik}^x}{P_i} \cdot \frac{P_i}{E_{ik}P_k}\right) = p_{ik}^x \varepsilon_{ik} \qquad\qquad (3)$$

$$Q_{ik}^x = Q_{ki}^m = Q_{ik} \qquad\qquad (4)$$

where Q_{ik}^x is the quantity of exports supplied from i to k, Q_{ki}^m is the quantity of imports

demanded by k from i, p_{ik}^x is $i's$ bilateral export price relative to the domestic price level,

y_i is exporter's real income, p_{ki}^m 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), ε_{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.

Eq. (4) is the equilibrium condition for the export market. It can be solved for p_{ik}^x and Q_{ik}.

Their product gives a reduced-form for the real value of observed exports from i to k:

$$\tilde{Q}_{ik} = (Q_{ik} \cdot p_{ik}^x) = \left[A^{-(1+d)} B^{(1+b)} y_i^{-c(1+d)} y_k^{e(1+b)} \varepsilon_{ik}^{d(1+b)}\right]^{1/(b-d)} = G(y_i, y_k, \varepsilon_{ik}) \qquad (5)$$

In the context of East Asian exports, Eq. (5) does not recognize the important point that $\tilde{Q}_{ik}$ is

the gross real value of exports that are produced across fragmented production blocks in the

region and that the domestic value-added by the final exporter is only a part of it.

Greenspan (2005) in his Testimony on China remarked, "...production within Asia has

evolved, with the final stages of assembly and exporting ... becoming increasingly

concentrated in China." Its implication is that the share of local value added in the gross

value of final exports from any East Asian country is relatively small[1]. Greenspan argued that

a unilateral appreciation would affect only the local content of the gross value, not the larger

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[1] Lau and Stiglitz (2005) and Rahman and Thorbecke (2007) showed that the dollar value of intermediate goods imported into China from the rest of East Asia represented about 70 percent of the gross value of Chinese exports that are produced under the contractual arrangements with foreign multinationals. This should also be true for exports from South Korea and Taiwan to the extent that these countries organize some middle segments of the regional supply chain.

dollar cost of intermediate goods that are imported from the rest of East Asia. A generalized appreciation of all East Asian exchange rates would rather affect the gross value of East Asian exports. Its effect on global trade imbalance against China as well as East Asia would be significant.

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

$$\tilde{v}_{jk} = v_{jk} \cdot p_{jk}^v = g_j[y_j, y_k, \varepsilon_{jk}], \qquad j = 1, \cdots, N$$
$$\tilde{v}_{ik} = v_{ik} \cdot p_{ik}^v = g_i[y_i, y_k, \varepsilon_{ik}] \qquad\qquad (6)$$

Since exports from i to k are recorded on a gross basis rather than as value added, $v's$ are unobserved but the gross value is observed. The present study therefore conducts an Armington aggregation of the equilibrium conditions (6). Since v_{jk} is v_{ji} and $\varepsilon_{jk} \equiv (\varepsilon_{ji} \cdot \varepsilon_{ik})$, we obtain the following reduced-form equation for the gross real value of final exports $\tilde{Q}_{ik}^2$:

$$\tilde{Q}_{ik} = [(\Sigma_j \omega_{ji} \tilde{v}_{ji}^\alpha) + (1 - \Sigma_j \omega_{ji}) \tilde{v}_{ik}^\alpha]^{1/\alpha} = G'(\bar{y}_j, y_i, y_k, \bar{\varepsilon}_{ji}, \varepsilon_{ik}), \qquad (7)$$

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[2] An assumption that $\alpha = 0$ will imply unitary elasticity of substitution between domestic and foreign inputs and the aggregation is $\prod v_{jk}^{\omega_{jk}}$ due to $L'H\hat{o}pital's\ Rule$.

where ω_{ji} is the weight of country j in the gross value, $\bar{y}_j = \left(\Sigma \omega_{ji} y_j^\alpha\right)^{1/\alpha}$ and

$\bar{\varepsilon}_{ji} = \left(\Sigma \omega_{ji} \cdot \varepsilon_{ji}^\alpha\right)^{1/\alpha}$ 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.

An increase in $\bar{\varepsilon}_{ji}$ denotes a real appreciation of the rest of East Asia against i.

The long-run coefficient of ε_{ik} in Eq. (7) will measure the effect of a unilateral appreciation

of exporter's exchange rate, while that of $\bar{\varepsilon}_{ji}$ will measure the effect of joint appreciation of

exchange rates of other East Asian countries that supply intermediate goods to country i. A

linear combination of them will measure the effect of a generalized appreciation of all East

Asian exchange rates.

3. Data and variables

The study uses annual data on multilateral exports from China, Japan, South Korea, and

Taiwan over the 1992-2005 period. Data on trade, exchange rates, and real incomes of

exporters and importers are taken from the CEPII CHELEM database. The variable $\bar{\varepsilon}_{ji}$ is

defined as $\Sigma_j \omega_{ji} \, ln(\varepsilon_{ji})$, where ω_{ji} indicates the share of supplier of j in the total

intermediate goods imported into i from the rest of East Asia. Both the weighting matrix

ω and $\bar{\varepsilon}_{ji}$ are updated annually for each exporting country. The set of gravity variables

include the distance and dummy variables indicating whether the two countries are

contiguous, share a common language, have a colonial link, etc.

4. Estimation methods

This study estimates stochastic form of Eq. (7) in an autoregressive and distributed lag (ADL) framework[3]:

$$\tilde{Q}_{ikt} = \sum_{p=1}^{P} \alpha_{ip}\tilde{Q}_{ik(t-p)} + \boldsymbol{\beta}'_i(\mathbf{L})\mathbf{X}_{ikt} + \boldsymbol{\gamma}'_i\mathbf{Z}_{ik} + \eta_{ik} + \boldsymbol{\delta}'_i\mathbf{d}_t + u_{ikt},$$

$$t = p+1, \cdots, T; \quad i = \text{China, Japan, South Korea, and Taiwan}; \quad k = 1, \cdots, N. \quad (8)$$

Here $\tilde{Q}_{ik}$ represents bilateral real exports from country i to country k, the vector

$\mathbf{X}_{ik} = [\varepsilon_{ik} \ \bar{\varepsilon}_{ji} \ y_i \ y_k]'$ are the respective sets of right-hand side variables, $\boldsymbol{\beta}'_i(\mathbf{L})$ is the

corresponding coefficient vector of polynomials in the lag operator, The vector $\mathbf{Z}_{ik}$ is the set

of gravity variables. All the variables excepting the dummies are measured in natural logs.

The model also includes fixed effect η_{ik} capturing unobserved factors. The vector $\mathbf{d}_t$ includes

the deterministics and $\boldsymbol{\delta}_i$ 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 panel specification (8) will capture the long-run equilibrium relations,

regardless of whether the vector $\mathbf{X}_{ikt}$ includes either trend stationary series or difference

stationary series or a mixture of them. Since the dynamic model includes the unobserved

fixed effects and one or more of the right-hand side variables may be either endogenous or

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[3] Rahman and Thorbecke (2007) estimated a different dynamic specification for China's exports. Their

specification included ε_{ik} and $\bar{\varepsilon}_{jk}$ as two variables of interest, which represented respectively China's bilateral

RMB real exchange rate and a weighted real exchange rate between countries that supply intermediate goods to

China and the countries that purchase final exports from China. Their study obtained inconsistent dynamic

estimates that a 10 percent RMB appreciation would increase China's exports by about 20 percent. The reason

of inconsistency was that the study ignored the identity ($\bar{\varepsilon}_{jk} \equiv \bar{\varepsilon}_{ji} \cdot \varepsilon_{ik}$) and included both ε_{ik} and $\bar{\varepsilon}_{jk}$ in the

same equation, which was econometrically implausible. They also did not report the long-run coefficients.

predetermined, the standard methods such as pooled OLS or fixed effect (FE) estimators are generally inconsistent (Nickell, 1981). Thus the present study also obtains two Generalized Method of Moments (GMM) estimators–the first-differenced GMM estimator and the system GMM estimator. The first-differenced GMM estimator, suggested by Arellano and Bond (1991), is based on a set of moment conditions 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. However, if the autoregressive parameter approaches to unity and/or the relative variance of fixed effect η_{ik} increases to infinity, the first-differenced GMM estimator can be further biased than the within estimates. This is due to the weak instrument problem. Based on the stationary properties that $E\left(\tilde{Q}_{ik(t+p)}\eta_{ik}\right) = E\left(\tilde{Q}_{ik(t+q)}\eta_{ik}\right)$ and $E\left(x_{ik(t+p)}\eta_{ik}\right) = E\left(x_{ik(t+q)}\eta_{ik}\right)$ for all p and q, Blundell and Bond (1998) argued that one could use additional moment conditions related to the levels equations. In this case, the lagged differences or the differences will be the valid instruments, depending on whether the included variable is either endogenous or predetermined. A stacked system combining both the differenced equations and levels equations is then estimated and the resultant estimator is called the system GMM estimator. Their Monte Carlo simulations showed that the system GMM estimator could be considerably more efficient when the model included highly persistent series.

5. Results and Interpretation

Table 1 presents the long-run estimation results of two variables of interest[4]. They are the bilateral real exchange rate between exporter and importer, and the weighted real exchange rate between exporter and the rest of East Asia. The table shows that long-run estimates across specifications are well within one standard error of the smallest estimate. However, for reasons explained in methodologies, we focus on system GMM estimates (Col. 4-5). The findings indicate that the effect of a joint appreciation of exchange rates of other East Asian countries is negative and significant on the multilateral exports of each country. For China and South Korea, the magnitude of the effect is largely comparable to that of a unilateral appreciation of their respective exchange rates. But for Japan, it is more than double the corresponding effect of a unilateral Yen appreciation. In the case of Taiwan, it is only the appreciation of exchange rates of other East Asian countries that matters for its multilateral exports. The findings therefore validate the hypothesis that a unilateral appreciation would only affect the domestic content of the exports but not the larger share of the gross value that arises across the regional production networks. A relatively larger effect of a joint appreciation of other East Asian exchange rates signifies this point.

As pointed out earlier, the sum of these two long-run coefficients is the combined effect of a generalized appreciation of all East Asian exchange rates. The findings show that the estimates are −3.2, −2.9, −3.6, and −2.7 for China, Japan, South Korea, and Taiwan respectively. The results indicate that a one-percent generalized appreciation of all East Asian

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[4] The long-run coefficients and their standard errors are based on the dynamic estimates, which are not reported. The sum of the long-run coefficients of two exchange rate variables is a non-linear combination of their respective dynamic estimates. The test statistics are computed by using the delta method. Footnotes to Table 1 describe specification differences of the estimated model.

exchange rates would reduce regional exports by about 3 percent. To the contrary, the effect of a unilateral appreciation is mixed and asymmetric across countries.

6. Concluding remarks

The findings imply that a collective exchange rate adjustment would significantly correct global payment imbalance against China as well as East Asia. It would also enhance intra-regional exchange rate stability and the deepening of East Asian production networks.

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Table 1
Long-run coefficients based on dynamic estimates of autoregressive and distributed lag model–China, Japan, South Korea, and Taiwan
(Dependent variable: Real exports to 33 major trading partners, 1992-2005)

Independent Variables	1 Pooled OLS	2 Fixed Effect	3 GMM1	4 GMM2	5 GMM3
Panel A: China					
Bilateral RER (ε_{ik})	-1.232***	-0.860**	-2.969***	-1.836***	-1.448**
	(0.451)	(0.385)	(1.027)	(0.716)	(0.625)
Weighted RER ($\bar{\varepsilon}_{ji}$)	-0.81	-2.658**	-2.447**	-1.366**	-1.792**
	(0.682)	(1.069)	(1.105)	(0.769)	(0.938)
Sum of the effects	-2.042**	-3.518**	-5.416**	-3.203**	-3.240**
	(0.993)	(0.385)	(2.073)	(1.359)	(1.429)
Panel B: Japan					
Bilateral RER (ε_{ik})	-0.526**	-0.526**	-0.725***	-0.950*	-0.889
	(0.213)	(0.204)	(0.245)	(0.607)	(0.607)
Weighted RER ($\bar{\varepsilon}_{ji}$)	-1.391‡	-1.391‡	-1.684**	-1.962**	-1.929**
	(0.929)	(0.889)	(0.861)	(1.146)	(1.076)
Sum of the effects	-1.917**	-1.917**	-2.419**	-2.913**	-2.817**
	(0.936)	(0.896)	(0.983)	(1.460)	(1.197)
Panel C: South Korea					
Bilateral RER (ε_{ik})	-1.107***	-1.113***	-1.332***	-1.748***	-1.195***
	(0.316)	(0.296)	(0.358)	(0.318)	(0.287)
Weighted RER ($\bar{\varepsilon}_{ji}$)	-2.226***	-1.839**	-2.488**	-1.816**	-2.389***
	(1.206)	(0.793)	(1.222)	(0.940)	(1.231)
Sum of the effects	-3.333***	-2.952***	-3.821***	-3.565***	-3.585***
	(1.156)	(0.769)	(1.175)	(0.933)	(1.235)
Panel D: Taiwan					
Bilateral RER (ε_{ik})	0.129	0.286	0.153	-0.495	-0.526
	(0.406)	(0403)	(0.342)	(0.497)	(0.197)
Weighted RER ($\bar{\varepsilon}_{ji}$)	-2.065**	-2.985***	-1.684**	-2.247**	-1.972**
	(1.011)	(0.863)	(0.778)	(1.024)	(0.983)
Sum of the effects	-1.936**	-2.699***	-1.531**	-2.742***	-2.498***
	(0.841)	(0.810)	(0.685)	(0.845)	(0.895)

The selection of ADL order in the estimated model is based on observed minimum of AIC/BIC information criteria. The GMM estimates are obtained under the assumption that exporter's income is endogenous and both the exchange rate variables are predetermined. GMM1 is the first-difference GMM estimator. GMM2 and GMM3 are the system GMM estimators. They differ only in the treatment of importer's income variable, with GMM2 assuming it as exogenous, and GMM3 assuming it as endogenous. For the GMM estimates, the Hansen J-test and the tests of first-order and second-order serial correlation in the first-differenced residuals are respectively consistent with the maintained assumptions of instrument validity and no serial correlation.

Significance tests: *** $p<0.01$, ** $p<0.05$, * $p<0.1$, ‡$p<0.15$.