Monetary Coordination in Northeast Asia: An Option for China-Japan-Korea

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I. Introduction

What monetary and exchange-rate arrangements are appropriate for Northeast Asia? This question has recently been given increasing importance mainly by two factors. The 1997-98 Asian currency crisis is one of them. It caused huge output losses and thus significant declines in living standards in the region. The Asian crisis gave impetus to the view that softly pegged regime is not viable in a world of high capital mobility and that the only sustainable exchange rate regimes are purely flexible rates and hard peg (Eichengreen 1999). According to this view, we are to choose one of the two corner solutions – a purely floating rate regime with monetary policy independence and a firmly fixed rate regime with no monetary policy independence.

The other factor is the recent trend of growing economic integration in the region. This trend has popularized the idea that growing economic cooperation and integration should require a fixed exchange rate system or even a common currency.

This paper attempts to make a contribution to a recent search triggered by the two

factors above for better monetary and exchange-rate arrangements in Northeast Asia. It does so by assessing the feasibility of optimum currency area in the region and by putting forward a viable option for the monetary cooperation in the region.

The plan of paper is as follows. In Section II, we use a structural VAR model to see if any group(s) of countries in the region may form an optimal currency area (OCA) in terms of macroeconomic shocks. A further probe into this issue is given in Section III, where we construct a generalized PPP model. The main empirical findings in Sections II and III are:

- China, Japan, and Korea, as a group, do not constitute an OCA. (Sections II and III)
- Six economies including Korea, Singapore, Hong Kong, Thailand, Malaysia, and Indonesia, have good reason to form an OCA altogether. (Section II)
- China, Japan, and Korea, if joined together with Indonesia, Malaysia, Singapore, and Thailand, are shown to share common trends. Therefore, ASEAN+3 can be a good candidate for a future common currency area. (Section III)

These findings seem to suggest, if anything, that setting up an OCA in Northeast Asia may not be feasible at present. Thus in Section IV, we finally come up with a regional system of inflation targeting with floating rates as a viable option in the short-run.

II. A Common Currency for Northeast Asia?: A Structural VAR Approach

The theory of optimal currency area (OCA) suggests that there are three major criteria in terms of which a group of countries may consider forming a currency union. They are the patterns of trade, the size and correlations of macroeconomic shocks, and

the similarity of economic development and financial systems, among those countries concerned (Bayoumi and Mauro, 2001). This chapter focuses on the size and correlations of macroeconomic shocks in particular. In order to "recover aggregate supply and demand shocks from time-series data," we closely follow the procedure that Bayoumi and Eichengreen (1994) developed on the basis of Blanchard and Quah (1989).

1. Methodology

A brief description of Bayoumi and Eichengreen(1994)'s methodology is in order. First, they assume a standard AD-AS framework. The aggregate demand curve (AD) is downward-sloping, whereas the short-run aggregate supply curve (SRAS) and the long-run aggregate supply curve (LRAS) are upward-sloping and vertical, respectively. In this framework, it is straightforward to show that a permanent outward shift in AD (i.e., a permanent positive AD shock, such as a shift in the demand management policy) brings about a temporary rise in output, followed by a permanent return to the initial level of output and a permanent rise in prices, whereas a permanent outward shift in AS (i.e., a permanent positive AS shock, such as a technological innovation) leads to a permanent rise in output and a permanent fall in prices. This feature that obtains in the standard AD-AS framework that Bayoumi and Eichengreen(1994) assume, is to be used to identify between the underlying AD and AS shocks.

Next, Bayoumi and Eichengreen(1994) consider a system in which the true model can be represented by an infinite moving average of a vector of X_t and an equal number of shocks ε_t. Using the lag operator L, X_t can be shown as a linear combination of current and past structural shocks by the following moving average

process

$$X_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + A_3\varepsilon_{t-3} + \cdots = \sum_{i=0}^{\infty} L^i A_i \varepsilon_t \tag{1}$$

where the matrices A_i represent impulse response functions of the shocks to the elements of X.

If we let X_t be the vector of a change in the logarithm of output and a change in the logarithm of prices, and let ε_t be the vector of demand and supply shocks, the model becomes

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \sum_{i=0}^{\infty} L^i \begin{bmatrix} a_{11i} & a_{12i} \\ a_{21i} & a_{22i} \end{bmatrix} \begin{bmatrix} \varepsilon_{dt} \\ \varepsilon_{st} \end{bmatrix} \tag{2}$$

where Δy_t and Δp_t show the changes in the logarithm of output and prices, a_{11i} represents element a_{11} in matrix A_i, and ε_{dt} and ε_{st} are independent demand and supply shocks with respective variances normalized so that $E(\varepsilon_t \varepsilon_t^{'}) = I$ holds.

The feature we have assumed in the standard AD-AS framework is that supply shocks permanently affect the level of output while demand shocks do not. However, both shocks permanently affect the level of prices. This assumption imposes the following restriction which requires that the permanent effect of demand shocks on Δy_t must be zero.

$$\sum_{i=0}^{\infty} a_{11i} = 0 . \tag{3}$$

We now proceed to estimate the model. Each element of X_t is regressed on lagged values of all the elements of X by using a vector autoregression(VAR). Representing B to be the estimated coefficients, the VAR can be shown in matrix form as

$$\begin{aligned} X_t &= B_1 X_{t-1} + B_2 X_{t-2} + \cdots + B_n X_{t-n} + e_t \\ &= [I - B(L)]^{-1} e_t \\ &= [I + B(L) + B(L)^2 + \cdots] e_t \\ &= e_t + D_1 e_{t-1} + D_2 e_{t-2} + D_3 e_{t-3} + \cdots \end{aligned} \tag{4}$$

where e_t represents the residuals from the equations in the VAR. Since X_t is composed of Δy_t and Δp_t, e_t comprises e_{yt} and e_{pt} that are the residuals of a regression of lagged values of Δy_t and Δp_t on current values of each in turn.

In order to convert equation (4) into the model defined by equations (2) and (3), the residuals from the VAR (e_t) must be transformed into the demand and supply shocks (ε_t). A comparison of the VAR and the model defined by equations (2) and (3) implies the existence of a conversion formula $e_t = C\varepsilon_t$ which can be used to recover the underlying demand and supply shocks (ε_t) from the estimated VAR residuals (e_t). Since the two-by-two case is being dealt with, the C matrix has four elements in it so that four restrictions are needed to solve for them. In fact, all those four restrictions have already been given. The condition $E(\varepsilon_t \varepsilon_t^{'}) = I$, which assumes the orthogonality

of demand and supply shocks as well as the respective normalizations to unity of the variances of the serially uncorrelated demand and supply shocks, defines the three restrictions. Finally, equation (3) that the permanent effect of demand shocks on Δy_t should be zero implies the fourth restriction as follows:

$$\sum_{i=0}^{\infty}\begin{bmatrix} d_{11i} & d_{12i} \\ d_{21i} & d_{22i} \end{bmatrix}\begin{bmatrix} c_{11} & c_{12} \\ c_{21} & c_{22} \end{bmatrix}=\begin{bmatrix} 0 & \cdot \\ \cdot & \cdot \end{bmatrix}. \tag{5}$$

This procedure uniquely defines the C matrix, which is used in turn to identify the structural demand and supply shocks ($\varepsilon_t = [\varepsilon_{dt}, \varepsilon_{st}]'$), respectively.

2. Data, Estimation, and Results

We use the annual data for the eleven East Asian economies (or countries) – China, Japan, Korea, Indonesia, Malaysia, Philippines, Hong Kong, Singapore, Thailand, Australia, and New Zealand. This sample set includes nine Northeast/Southeast Asian economies and two Asia-Pacific economies of Australia and New Zealand.

We estimate the structural VAR model, following the procedure represented by equations (4) and (5) for each economy in the sample. Taking an average of the three lags each of which is computed by application of the Akaike Information Criterion, the Hannan and Quinn Criterion, and the Schwarz Bayesian Criterion, respectively, we have set the optimal order of lags to 6 years for Japan and to 1 year for each of the other ten countries. The estimation is done mostly for the period of 1960-2002. Due to the lack of relevant data, the sample periods for China, Malaysia, and for Hong Kong, are

1979-2002, 1970-2002, and 1961-2002, respectively. From the estimation of the structural VAR, we can obtain series of supply and demand shocks, size of shocks, and adjustment speed made in response to those shocks for each of the eleven economies in our sample (See Table 3).

Correlations of Shocks

The pairwise correlation of aggregate supply shocks is estimated by way of Bayoumi and Eichengreen(1994)'s structural VAR procedure and presented in Table 1. Supply shocks are "generally more relevant" than demand shocks, since supply shocks are "more related to underlying private sector behavior"(Bayoumi and Mauro, 2001), and "unaffected by changes in demand-management policies and are more likely to be invariant with respect to alternative international monetary arrangements."(Bayoumi and Eichengreen, 1994). Although we obtain series of supply and demand shocks, size of shocks and adjustment speed mostly for the period of 1960-2002, Table 1 lists the results of pairwise correlations of aggregate supply shocks for the period of 1972-2002. This is due to the fact that we lack the relevant data for China and Malaysia during 1960s.

Before our discussion of the correlation coefficients, we have to address two assessment criteria. First, it is not sufficient to look at the signs of the correlations. We must also examine their statistical significance.[1] The figures with statistical significance

[1] To test the significance of correlations, the following formula is used with the null hypothesis $H_0 : \rho = 0$ The formula is $Z = 0.5\sqrt{N-3}(\ln[(1+r)(1-\rho)/(1-r)(1+\rho)])$, where r is the estimated correlation coefficient and ρ is the null value of the correlation coefficient (Romano, 1970:

of 5 percent are shaded in Table 1. Second, we also assume that if the correlation is positive(negative or not statistically different from zero), the shocks are categorized as symmetric(asymmetric) as in Yuen(2001) and Horvath and Grabowski(1997).

Note that the results in Table 1 present a very neat picture. They clearly suggest that, viewed at least in terms of size of the pairwise correlations of supply shocks, six economies including Korea, Singapore, Hong Kong, Thailand, Malaysia, and Indonesia, have good reason to form a currency union altogether. Our results confirm some of the previous research findings, and in some sense widens the horizon for forming a currency union that may consist of more economies. Bayoumi and Eichengreen(1994) report, using annual data for 1969-1989, that supply shocks are significantly correlated for Japan, Korea, and Taiwan, on one hand, and for Hong Kong, Indonesia, Malaysia, and Singapore, on the other. As for Bayoumi and Eichengreen(1994)'s former grouping, which is also suggested by Yuen(2001) that uses annual data for 1967-1997, Taiwan is not covered in our sample, and in contrast our results do not yield significant correlations of supply shocks between Japan and Korea. This is also in contrast to the high, positive correlations of supply shocks that are reported in Kwack, *et al*.(2003) to exist respectively for the three different sample periods, 1975-2001, 1975-1989, and 1990-2001. As for Bayoumi and Eichengreen(1994)'s latter grouping, however, our results not only

Table 1: Correlation Matrix of Supply Shocks, 1972-2002 [1)]

	CN	**JP**	**KR**	ID	MY	PH	HK	SG	TH	AU	NZ

pp.156-160). The rejection region is $Z = \left|0.5\sqrt{N-3}(\ln[(1+r)/(1-r)])\right|$ >1.96 at the 5 percent level of significance. This corresponds to a coefficient of correlation of 0.355 for the period of 1972-2002.

CN	1.00										
JP	-0.13	1.00									
KR	0.02	0.06	1.00								
ID	-0.05	0.24	0.65	1.00							
MY	0.00	0.11	0.61	0.80	1.00						
PH	-0.44	0.11	0.09	0.22	0.11	1.00					
HK	0.06	0.11	0.52	0.63	0.65	0.17	1.00				
SG	-0.11	0.24	0.41	0.60	0.77	0.15	0.59	1.00			
TH	-0.07	0.30	0.74	0.73	0.65	0.25	0.48	0.56	1.00		
AU	-0.22	0.03	-0.13	-0.17	-0.28	0.14	-0.13	-0.18	-0.07	1.00	
NZ	0.03	-0.09	0.30	0.28	0.18	-0.10	0.28	0.32	0.21	-0.03	1.00

1) The sample period for China is 1981-2002. The shaded figures are positively significant at the 5 percent. The critical value at the 5 percent level is 1.96. The statistical significance requires a coefficient of correlation of 0.355 for the period of 1972-2002.
2) ISO country codes: CN=China, JP=Japan, KR=Korea, ID=Indonesia, MY=Malaysia, PH=Philippines, HK=Hong Kong, SG=Singapore, TH=Thailand, AU=Australia, NZ=New Zealand.

confirm their four-economy grouping, but also add two more economies, Korea and Thailand, further suggesting the six economies as a good candidate group to form a wider currency union. This is also in contrast to Yuen(2001) that reports three overlapping groupings of economies with significant correlations of supply shocks, such as Singapore and Malaysia, Malaysia and Indonesia, and finally Taiwan, Hong Kong, and Singapore.

Further, note that any significant correlations of supply shocks between any two pairs of China, Japan, and Korea, have not been found so far, except for those found, in Bayoumi and Eichengreen(1994), Kwack, *et al.*(2003), and in Yuen(2001), to exist between Japan and Korea. Our current results are in line with Bayoumi and Mauro(2001) that do not find any such significant correlations of supply shocks between Japan and Korea.

Now we turn our attention to the estimated pairwise correlations of demand shocks that are presented in Table 2. The six economies as a group that have emerged, based on

correlations of supply shocks, to be good candidates for forming a currency union, are not found to be so when viewed from the angle of correlations of demand shocks estimated for the period of 1972-2002 as shown in Table 2. Instead, there emerge this time three overlapping sub-groups such as Korea, Indonesia, Singapore, and Thailand (1st sub-group), Indonesia, Malaysia, Singapore, and Thailand (2nd sub-group), and Indonesia and Hong Kong(3rd sub-group). In addition, Table 2 also introduces five new groupings based on the correlations of demand shocks estimated for the period of 1972-2002: Japan, Malaysia, Singapore, and Thailand; Japan, Philippines, and Singapore; Malaysia, Thailand, and Australia; Philippines, Australia, and Hong Kong; and finally, Australia and New Zealand.

Table 2: Correlation Matrix of Demand Shocks, 1972-2002 1)

	CN	**JP**	**KR**	ID	MY	PH	HK	SG	TH	AU	NZ
CN	1.00										
JP	-0.05	1.00									
KR	0.12	0.20	1.00								
ID	0.10	0.07	0.54	1.00							
MY	-0.15	0.49	0.27	0.36	1.00						
PH	0.18	0.39	0.03	0.32	0.28	1.00					
HK	0.13	0.08	0.14	0.48	0.27	0.36	1.00				
SG	0.36	0.44	0.41	0.60	0.47	0.42	0.21	1.00			
TH	0.13	0.37	0.47	0.69	0.58	0.33	0.26	0.72	1.00		
AU	-0.15	0.32	0.06	0.33	0.48	0.54	0.40	0.19	0.44	1.00	
NZ	0.12	0.12	0.07	0.01	-0.21	0.33	0.14	-0.09	-0.09	0.38	1.00

1) The sample period for China is 1981-2002. The shaded figures are positively significant at the 5 percent. The critical value at the 5 percent level is 1.96. The statistical significance requires a coefficient of correlation of 0.355 for the period of 1972-2002.

Size of Shocks and Adjustment Speed

The more highly correlated and the smaller are aggregate shocks, the better candidacy is given to countries with these good attributes for forming a currency union. In this sense, the correlations and size of shocks matter. In addition, adjustment speed also matters. A rapid adjustment that an economy makes in response to shocks is certainly another good attribute for it to join a currency union, since it contributes to a reduction in costs incurred by being a member of a currency union and thus losing sovereign monetary policy.

Table 3 reports, for each of the eleven economies in our sample, size of shocks and adjustment speed made in response to those shocks estimated mostly for the period of 1960-2002. Again due to lack of relevant data, the sample periods for China, Malaysia, and for Hong Kong, are 1979-2002, 1970-2002, and 1961-2002, respectively. Table 3 also illustrates the case of the United States as a benchmark.

Following Bayoumi and Eichengreen(1994), we measure the size of supply shocks (i.e., the size of shift in potential supply) as the long-run output effect, whereas we compute the size of demand shocks (i.e., the size of the short-run change in nominal GDP) by summing the first-year impact on output and prices. Also following Bayoumi and Eichengreen(1994), the speed of adjustment is measured as the first two-year output and prices response as a share of the long-run effect.

Table 3: Size of Disturbances and Adjustment Speed, 1960-2002 [1)]

	Supply Shocks		Demand Shocks	
	Size	Adjustment Speed	Size	Adjustment Speed

CH	0.044	0.86	0.040	0.67
JP	0.229	0.12	0.011	0.70
KR	0.040	0.91	0.038	0.36
ID	0.058	0.89	0.493	0.96
ML	0.053	0.95	0.050	1.02
PH	0.049	0.83	0.043	1.02
HK	0.057	0.95	0.036	0.58
SN	0.055	0.93	0.039	1.03
TH	0.066	0.77	0.039	0.81
AU	0.019	0.78	0.022	0.54
NZ	0.030	0.98	0.037	0.52
US	0.022	0.28	0.016	0.30

1) The sample period for China is 1979-2002, 1970-2002 for Malaysia and 1961-2002 for Hong Kong.

Consider the six economies that we have identified earlier, based on significantly positive correlations of supply shocks, as being suitable for setting up a currency union. The size of supply shocks for the six economies and that for the other five, average 0.055 and 0.074 respectively, while speed of adjustment for the former and that for the latter average 0.90 and 0.71 respectively. That is, the six economies with high correlations face smaller supply shocks and show higher speed of adjustment on average than the other five economies in the sample. This evidence lends further support to the grouping of the six economies. In terms of demand shocks, however, these six economies turn out to face bigger shocks (0.12) and to show higher speed of adjustment (0.79) on average than the other five (0.03 and 0.69, respectively). Compared with the United States, the six economies show on average higher speed of adjustment in response to both types of shocks. Supply shocks that face those six economies are more than two times as big as those for the United States on average,

while demand shocks for the six economies are bigger than those for the United States.

Correlations of Cyclical Output Components

Table 4 reports pairwise correlations of cyclical output for the periods of 1972-2002. In order to detrend the output series of each country and to estimate its business cycle components, the Hodrick-Prescott filter with $\lambda = 7$ is applied to the real GDP data of each economy. Results yield various sub-groupings depending on the sample period, but the picture as a whole is not as clear as what we have found in Table 1. There are six sub-groups that emerge from estimated correlations for 1972-2002. They include: China, Australia, and New Zealand; Japan, Malaysia, Philippines, Thailand, and Singapore; Japan, Hong Kong, Singapore, and Thailand; Korea, Indonesia, Malaysia, Hong Kong, and Thailand; Indonesia, Singapore, Malaysia, Thailand; and lastly, Hong Kong and Australia.

Table 4: Correlation Matrix of Cyclical Output Components, 1972-2002 [1)]

	CN	**JP**	**KR**	ID	MY	PH	HK	SG	TH	AU	NZ
CN	1.00										
JP	-0.51	1.00									
KR	0.14	0.23	1.00								
ID	0.02	0.35	0.48	1.00							
MY	-0.15	0.45	0.51	0.71	1.00						
PH	-0.56	0.39	0.20	0.31	0.41	1.00					
HK	0.22	0.49	0.44	0.50	0.55	0.33	1.00				
SG	-0.25	0.46	0.22	0.43	0.81	0.51	0.49	1.00			
TH	-0.06	0.41	0.73	0.76	0.68	0.44	0.46	0.46	1.00		
AU	0.44	0.31	-0.09	-0.02	-0.05	-0.00	0.37	0.05	-0.03	1.00	
NZ	0.43	-0.17	0.19	0.31	0.19	0.14	0.34	0.30	0.18	0.46	1.00

1) The sample period for China is 1981-2002. The shaded figures are positively significant at the 5 percent. The critical value at the 5 percent level is 1.96. The statistical significance requires a coefficient of correlation of 0.355 for the period of 1972-2002. The cyclical output

components are the de-trended series of the real GDP through Hodrick-Prescott filter, using parameter $\lambda = 7$ for annual observations (See Pesaran and Pesaran, 1997).

III. Candidates for an OCA in Northeast Asia?: A Generalized-PPP Approach

Long-run purchasing power parity(PPP) implies that the real exchange rate ($e + p^* - p$) is stationary, if p and p^* denote the natural logarithms of domestic and foreign price levels and e is the log of the price of foreign exchange. A huge literature has shown, however, that real exchange rates are non-stationary casting doubt on the validity of PPP as a structural model of real exchange-rate behavior. In spite of the questionable evidence, Enders and Hurn(1994) have suggested that the multivariate cointegration test should confirm the existence of common trends among those non-stationary real exchange rates if they are driven by "similarly trending stochastic forcing variables." According to Enders and Hurn(1994), a system of non-stationary real exchange rates may have a long-run equilibrium path in common, "since the individual nations will experience a set of common real macroeconomic shocks." Their approach is termed the G-PPP (generalized-purchasing power parity hypothesis).

Recently, Liang(1999) construes the G-PPP as offering yet another explicit necessary criterion in terms of which some countries may consider forming a currency area together. If a group of countries face "symmetric rather than idiosyncratic" shocks so that economic fundamentals such as economic growth, productivity, and the real interest rate in each country in the group, are closely interrelated, the real exchange rates, being determined by those fundamentals, will be cointegrated in the long run. If this is the case, Liang(1999) argues, the group of countries may be considered a candidate to form

an OCA. Pursuing this line of thought further, Liang finds that Hong Kong SAR and China as a group, are not eligible for an OCA, whereas they are, only if joined together by Japan and the United States.

In an extended context of our focus presented in Section II on the size and correlations of macroeconomic shocks, we further examine if some Northeast Asian countries, being appropriately grouped, passes the G-PPP test. We begin by introducing a brief outline of the methodology as presented by Liang(1999).

1. Methodology

According to the long-run PPP, the bilateral real exchange rate series can be constructed using the United States as the base country as follows:

$$q_t = e_t + p_t^* - p_t \tag{6}$$

where e_t is the natural logarithm of the national currency price of the U.S. Dollar, p_t^* and p_t are the natural logarithms of the United States and domestic price levels, respectively. Therefore, an upward movement of q_t indicates real depreciation of the domestic currency.

The G-PPP theory suggests that although the individual real exchange rate series are non-stationary, certain groupings of them may be stationary if macroeconomic fundamentals behind the real rates are sufficiently interrelated. For each country j within a group of n countries, the long-run relationships between its real exchange rate

and its macroeconomic fundamentals is posited as follows:

$$q_{1jt} = x_{jt}^{'}\beta_j + \varepsilon_{jt} \qquad j = 1,2,\cdots,n \tag{7}$$

where q_{1jt} is the country $j's$ real exchange rate that is defined using the country 1 as the base country, x_{jt} is the vector of m economic fundamentals, β_j is the vector of m coefficients, and ε_{jt} is the error term. Unless every element that comprises x_{jt} is stationary, the real exchange rate will not be stationary, with the result that the purchasing power parity will never hold. If an element contained in x_{jt} does not prove to be stationary in fact, the long-run relationship given in equation (7) should hold only when q_{1jt} and thus x_{jt} are cointegrated. Stacking q_{1jt} together for $j = 1,2,\cdots,n$, we get the system of n equations as follows:

$$\begin{bmatrix} q_{11t} \\ q_{12t} \\ \cdot \\ \cdot \\ q_{1nt} \end{bmatrix} = \begin{bmatrix} \beta_{11} & \beta_{12} & \cdots & \beta_{1m} \\ \beta_{21} & \beta_{22} & \cdots & \beta_{2m} \\ \cdot & \cdot & \cdot & \cdot \\ \cdot & \cdot & \cdot & \cdot \\ \beta_{n1} & \beta_{n2} & \cdots & \beta_{nm} \end{bmatrix} \begin{bmatrix} x_{1t} \\ x_{2t} \\ \cdot \\ \cdot \\ x_{mt} \end{bmatrix} + \begin{bmatrix} \varepsilon_{1t} \\ \varepsilon_{2t} \\ \cdot \\ \cdot \\ \varepsilon_{nt} \end{bmatrix} \tag{8}$$

where we assume that all the m elements in x_{jt} are non-stationary. This is because omitting stationary variables from x_{jt} "should not statistically affect the cointegration relation …."(Liang, 1999). Here, the rank of the matrix β is important. For example, if β has the zero rank, the PPP holds for every bilateral real exchange rate within the

group of countries in question. In contrast, if β has full rank, it implies that no long-run underlying economic relationship can be found among the group of countries. The presence of common trends in a group of countries means that the real exchange rates of different countries have a long-run relationship with one another. When the G-PPP holds within the group of n countries in question, the real exchange rates are cointegrated with a unique cointegrating vector so that:

$$\alpha_2 q_{12t} + \alpha_3 q_{13t} + \alpha_4 q_{14t} + \cdots + \alpha_n q_{1nt} \sim I(0) \quad (9)$$

Note that the weights α_i are the functions of parameters in matrix β that represent macroeconomic linkages - such as trade linkages, technology transfers, labor and financial resource movements - among the countries.

2. Test of Common Trends and An OCA in Northeast Asia

With the United States being the base country, we compute the monthly bilateral real exchange rate data following equation (6). Prices and exchange rate series are monthly national currency prices of the U.S. Dollar(end of period) and consumer price indexes with 1995=100.

Unit Root Tests

As an initial step toward cointegration analysis, we have first examined the time

series properties of the bilateral real exchange rate series between each of the nine Asian countries and the United States (the base country).

Table 5: Time Series Properties of Δq_{1j} Series: Mar 1971- Sep 2003 [1)]

	Lags	ADF Test	PP Test	95% Critical Value
Δq_{CN}	0	-14.47*	-14.82*	-3.44
Δq_{JP}	0	-17.74*	-22.34*	-3.42
Δq_{KR}	0	-18.67*	-11.20*	-3.42
Δq_{ID}	4	-8.08*	-17.30*	-3.42
Δq_{MY}	0	-18.37*	-9.28*	-3.42
Δq_{PH}	0	-20.35*	-16.64*	-3.42
Δq_{HK}	0	-11.61*	-11.05*	-3.44
Δq_{SG}	0	-18.09*	-16.27*	-3.42
Δq_{TH}	1	-14.56*	-16.89*	-3.42

1) The sample period for China is Mar 1988-Feb 2003, and Mar 1991-Sep 2003 for Hong Kong.

Table 5 reports the test results for the first-differenced data (we do not report here the results for the level data). Both the Augmented Dickey-Fuller (ADF) test and the Phillips-Perron(PP) test show that each of the first-differenced data series in the the sample is stationary, whereas each of the level data is integrated of order one, that is $I(1)$. The optimal order of lags for each data series is determined with both the Akaike Information Criterion (AIC) and the Schwarz Bayesian Criterion (SBC) taken into account.

Do China-Japan-Korea Constitute an OCA?

Johansen's maximum likelihood approach is used to estimate and test cointegrating

relations in this research.

First, we have followed the Johansen procedure to see if US/China, US/Japan, and US/Korea, may be qualified to form an OCA, judging in terms of the presence of a well-defined cointegrating relationship among the three bilateral real exchange rate data series. The test results are reported in Table 6 for the sample period of February 1987 and February 2003.

The optimal order of lags is selected as usual by AIC and the SBC. According to Table 6, neither the $\lambda - \max$ statistics nor the $\lambda - trace$ statistics can reject the respective null hypothesis of no cointegration($r = 0$). Our conclusion here is that there is no cointegrating vector among US/China, US/Japan, and US/Korea real exchange rates and thus that the G-PPP fails to hold for the countries in question – China, Japan, Korea and the United States. They do not share common trends, and are not eligible as a group to becoming a potential OCA.

We have applied the Johansen's cointegration test to see further if the G-PPP holds for the respective three pairs (US/Japan-US/Korea, US/Japan-US/China, and US/Korea-US/China) of bilateral real exchange rates. Table 7 reports the results for the sample period of February 1987 and February 2003.

Table 6: Generalized PPP Tests for an OCA among China-Japan-Korea[1)] (VAR=1)

Hypotheses		$\lambda - \max$		$\lambda - trace$	
Null	Alternative	Statistic	95% Critical Value	Statistic	95% Critical Value
$r = 0$	$r = 1$	10.84	21.12	18.28	31.54
$r \leq 1$	$r = 2$	5.37	14.88	7.44	17.86
$r \leq 2$	$r = 3$	2.07	8.07	2.07	8.07

1) The sample period is Feb 1987-Feb 2003.

Table 7: Generalized PPP Tests for an OCA [1)] : Japan-Korea; Japan-China; Korea-China

Hypotheses		$\lambda - \max$		$\lambda - trace$	
Null	Alternative	Statistic	95% Critical Value	Statistic	95% Critical Value
Japan-Korea (Order of VAR = 12)					
$r = 0$	$r = 1$	5.62	14.88	8.27	17.86
$r \leq 1$	$r = 2$	2.65	8.07	2.65	8.07
Japan-China (Order of VAR = 1)					
$r = 0$	$r = 1$	5.40	14.88	9.31	17.86
$r \leq 1$	$r = 2$	3.92	8.07	3.92	8.07
Korea-China (Order of VAR = 1)					
$r = 0$	$r = 1$	5.35	14.88	7.26	17.86
$r \leq 1$	$r = 2$	1.91	8.07	1.91	8.07

1) The sample period is Feb 1987-Feb 2003.

The order of optimal lags is set as usual. All the statistics show that we cannot reject the null hypotheses of no cointegration. Thus, the G-PPP fails to hold for any pair of two countries among US/China, US/Japan, and US/Korea.

Which Countries Constitute an OCA?

Next, we have turned to use the Johansen's test procedure to see which countries can constitute an OCA together with Korea. Table 8 shows the cointegration test results for a group of countries including US/Korea, US/Indonesia, US/Malaysia, US/Singapore, US/Thailand, US/Japan, and US/China for the sample period of February 1987 and February 2003. In fact, we have found that there are two cointegrating vectors among

the group of the seven real exchange rates. The implication is that the seven countries (including the US) do share common trends and are eligible as a group to becoming a potential OCA, although the long-run relationship cannot be uniquely identified among those seven real exchange rates.

It is quite interesting to note that China, Japan, and Korea, have not been found to share common trends within the three-country group, whereas these three countries have just been found to do so within a larger group, i.e., ASEAN+3 countries, provided they are joined by Indonesia, Malaysia, Singapore, and Thailand.[2]

Table 8: Generalized PPP Tests for an OCA: Korea, Indonesia, Malaysia, Singapore, Thailand, Japan, and China (VAR=1)

Hypotheses		$\lambda - \max$		$\lambda - trace$	
Null	Alternative	Statistic	95% Critical Value	Statistic	95% Critical Value
$r = 0$	$r = 1$	86.10*	45.63	189.48*	124.62
$r \leq 1$	$r = 2$	46.66*	39.83	103.38*	95.87
$r \leq 2$	$r = 3$	24.88	33.64	56.72	70.49
$r \leq 3$	$r = 4$	13.83	27.42	31.85	48.88
$r \leq 4$	$r = 5$	11.07	21.12	18.02	31.54
$r \leq 5$	$r = 6$	6.35	14.88	6.95	17.86
$r \leq 6$	$r = 7$	0.59	8.07	0.59	8.07

1) The sample period is Feb 1987-Feb 2003.

Table 8 shows that both the $\lambda - \max$ and the $\lambda - trace$ statistics indicate the existence of two cointerating vectors at the 5 percent significance level. The real exchange rates of these countries are tied together by two cointegrating long-run equilibrium relationshisps, and the G-PPP holds for them. These countries as a group

[2] We excluded Hong Kong in our test procedure, since the real exchange rate data for Hong Kong were

are found to be eligible for an OCA.

Table 9: Cointegrating Vectors and the Adjustment Coefficients (VAR=1, $r = 2$)

	Cointegrating Vectors		$H_0 : \alpha_i = 0$ in both vector	
	Vector 1	Vector 2	$\chi^2(2)$	Probability
q_{KR}	0.62*	0.81*	43.9	0.00
q_{ID}	-0.74*	-0.20*	92.8	0.00
q_{MY}	0.68*	0.75*	19.5	0.00
q_{SG}	-0.84*	0.54*	64.3	0.00
q_{TH}	0.43*	-1.37*	33.0	0.00
q_{JP}	0.14*	0.03*	24.2	0.00
q_{CN}	-0.29*	0.28*	36.8	0.00
VECM for each Δq_i				
	Constant	$ecm1(-1)$	$ecm2(-1)$	
Δq_{KR}	0.16* (0.04)	0.08* (0.04)	-0.16* (0.04)	
Δq_{ID}	-0.17* (0.08)	0.65* (0.07)	0.06 (0.07)	
Δq_{MY}	-0.01 (0.03)	0.14* (0.03)	-0.01 (0.03)	
Δq_{SG}	-0.00 (0.02)	0.05* (0.02)	-0.01 (0.02)	
Δq_{TH}	-0.06 (0.04)	0.16* (0.03)	0.03 (0.03)	
Δq_{JP}	0.14* (0.04)	-0.03 (0.03)	-0.12* (0.03)	
Δq_{CN}	0.01 (0.04)	0.05 (0.04)	-0.02 (0.03)	

1) The sample period is Feb 1987-Feb 2003. Numbers in the brackets are standard errors.

Finally, we are ready to discuss Table 9. The upper part of it presents the two estimated cointegrating relationships. The seven estimated coefficients that appear in the cointegrating equations are all significant at the 5 % level, as indicated by the corresponding log-likelihood ratio(LR) test statistics that are distributed with $\chi^2(2)$.

not available until 1990s.

The null hypothesis for the LR-test is a zero restriction($H_0 : \alpha_i = 0$) in both cointegrating vectors.

The lower part of Table 9 reports the estimated error correction relations. The signs of coefficient of error correction terms are mixed, but the size is rather big, suggesting that it should take five to ten months for the system to settle to its new long-run equilibrium if it were shocked.

IV. A Viable Option for Northeast Asia - China, Japan and Korea?

In the previous chapters, we have seen that China, Japan and Korea, as a group, are not easy to form an optimal currency area or other type of monetary arrangement in the near future. Then a question that naturally arises is: what is a feasible way to enhance the cooperation in terms of pre-existed Chiang Mai Initiative Swap Arrangement or the coordination in terms of monetary policy among three countries? In this chapter we will investigate these issues in turn.

1. Regional Inflation Targeting with Floating Exchange Rate Regime

Dewatripont, et al. (1995) argues in a report on European integration that a system of inflation targeting is a preferred option for monetary coordination. According to them, the system of inflation targeting has many potential virtues that would help reduce real exchange rate volatility. For example, it is symmetric and the countries within the system are less tempted to get involved in competitive devaluations. The credibility of monetary policy will be enhanced in the system. Further, all the countries within the

system, would have to automatically respond, in their efforts to meet the inflation target, to a depreciation of their currency in a way that would tend to stabilize the exchange rate itself. This view is further supported by Persson and Tabellini (1996) that use a simple theoretical model.

In a similar vein, Kwack *et al.*(2003) recently argue that flexible inflation targeting and floating rate system with foreign exchange market intervention is a plausible framework for monetary policy for East Asia. China, Japan, and Korea could be coordinated, in terms of monetary policy, to adopt an inflation targeting framework with a flexible exchange regime. Inflation targeting can be flexible or strict. In strict targeting, the monetary authority only considers achieving a given inflation target. In flexible targeting, the monetary authority can to some extent focus on other matters, for instance, the stability of growth or exchange rates. As East Asian countries are highly open, flexible inflation targeting may be proper. A change in exchange rates would affect the economy through its effect on output and inflation.

Under the inflation targeting framework, the monetary authority uses interest rates to attain an inflation target while an adjustment of the interest rate depends on the deviation of output and inflation as well as exchange rate fluctuations. In this regard, Japan and China need to adopt the inflation targeting framework to enhance the monetary policy coordination in the region, as Korea has already adopted the inflation targeting system.

Since the currency crisis in 1997, many East Asian economies have adopted flexible exchange regime. Under a flexible exchange rate system, exchange rate is the external balance equilibrator and permits monetary policy to aim independently at internal balance. Over the last decade, industrial economies with flexible exchange rates have

held a smaller stock of foreign reserves. On the other hand, developing and emerging economies with flexible exchange rate system recorded less volatility in their exchange rates and kept a large stock of reserves. This behavior implies that they heavily intervened to smooth out their exchange rate fluctuations, while retaining their monetary policy autonomy.

By using both a random walk model and an index of exchange rate flexibility, which combines exchange rates and foreign reserves, Chang and Choi(2002) showed that the non-Japan East Asian countries with flexible rate systems tended to stabilize their exchange rates. The intervention can be explained by the fact that under-developed and shallow financial systems in East Asian economies are more vulnerable to external shocks. Greater exchange rate flexibility can play as a safeguard against external shocks and helps to manage financial shocks coming from abroad.

If China chooses flexible exchange regime with intervention, and therefore all three economies including Japan and Korea maintain floating exchange rate system, the system allows individual economy to handle its exchange rate fluctuations. The ensuing decline in exchange rate volatility lowers the welfare cost of exchange rate volatility in terms of output foregone.[3] The floating rate system together with an inflation target as a nominal anchor achieves the objectives of lowering the costs of external shocks and maintaining inflation rate low and stable. Calvo and Reinhart(2002) argue that greater commitment to an inflation target ensues to smaller variance in the nominal interest rate and in the exchange rate changes. In general, strict and credible pursuit of a flexible inflation target can contain its exchange rate volatility to a small amount. Table 10 corroborates these arguments.

[3] Obstfeld and Rogoff (1999) argue that the welfare cost is as much as 1 % of GDP.

Table 10: Rates of Currency Depreciation and Inflation, 1972-2002 [1)]

	Depreciation Rate		Inflation Rate	
	Mean	Coeff of Variation [2)]	Mean	Coeff of Variation [2)]
CN	5.00	2.15	7.61	1.09
JP	-3.11	4.04	3.44	1.34
KR	3.73	4.35	8.22	0.81
ID	9.90	1.89	12.35	0.72
MY	0.89	10.35	4.04	0.77
PH	6.81	1.90	10.67	0.73
HK	-0.00	n.a.	3.85	1.45
SG	-1.65	3.60	3.25	1.46
TH	2.33	5.47	5.87	0.83
AU	2.40	4.18	6.46	0.62
NZ	2.64	4.80	7.51	0.72
Average	2.63	4.27	6.66	0.96

1) The sample period for China is 1987-2002, and 1991-2002 for Hong Kong. 2) Coefficient of variation = standard deviation/mean

The records of the depreciation rates against the US Dollar and the inflation rates for these eleven economies, mostly for the period of 1972-2002, are shown in Table 10. A look at the Table 10 clearly reveals that there are significant differences among the sample economies in terms of their depreciation and inflation performances. Most economies are shown to have experienced depreciation on an average during the sample period, while Japan and Singapore, appreciation. The averages depreciation rates and of the inflation rates of the eleven countries are 2.63% and 6.66%, respectively. It is interesting to note that all the five countries with higher-than-average inflation rates - China, Korea, Indonesia, the Philippines, and New Zealand - exactly coincide with those with higher-than-average depreciation rates.

To look at the role of exchange rates in the inflation targeting regime in the open economy, let's consider the standard objective function for monetary policy used in inflation targeting literature. The objective function generally consists of squared deviations of inflation from its target level **(** π^* **)** and output from potential level **(** y_t^* **).** The exchange rate implicitly appears in the formulation of the objective function indirectly through its effect on output and inflation. Therefore, in a highly open economy so that the impact of exchange rate on output and inflation is large, the standard form may not adequately capture the full effect of exchange rate changes on output and inflation. Consequently, it may be appropriate to extend the objective function to explicitly take account of the exchange rate from its target **(** e_t^* **)** (Deblle 2001).

$$L_t = E_t \sum_{s=t}^{\infty} \delta^{s-t} [(1-\lambda)(\pi_s - \pi^*)^2 + \lambda(y_s - y_s^*)^2 + \kappa(e_s - e_s^*)^2]$$

This equation of the objective function is a sort of extended version of Taylor rule, which consists of a trade-off between output variability and inflation variability. The extended version comprises a trade-off among variability of exchange rate, inflation and output. When we focus on the trade-off between the variations of exchange rate and inflation, the trade-off can be illustrated by considering an economy where exchange rate channel of monetary policy is the most effective in the short-term because the pass-through of changes in exchange rate to consumer prices is rapid. In a circumstance where inflation is expected to rise temporarily, interest rates can be increased to induce an exchange rate appreciation and a decrease in the prices of tradable goods. When the

inflationary pressure reduces, interest rates can be cut down again and the exchange rate is allowed to depreciate. In this situation, the variations of inflation can be lowered at the expense of increased fluctuations in the exchange rate.

Based on the above discussion, it would be better for China to adopt inflation targeting as an anchor of its monetary policy to promote the cooperation in the region when China moves from a fixed exchange regime to a flexible one.

2. A Further Move beyond the Chiang Mai Initiative

The Chiang Mai Initiative can be considered as a starting point of East Asian financial cooperation. Since the currency crisis in 1997, Asian countries have discussed monetary and financial cooperation in the region. With various endeavors, the CMI swap agreement was introduced by ASEAN+3 (China, Japan and Korea) Finance Ministers meeting in May 2000 as a regional liquidity facility. The basic idea of the CMI framework is that by contributing a certain amount out of the total foreign reserve of each economy to improve financial stabilization, these economies can mobilize more resources than the resources provided by the multilateral international financial institutions such as the IMF, World Bank.

Until present, ASEAN's multilateral swap arrangement has been expanded to US$ 1 billion. Japan added US$ 2 billion to original US$ 5 billion swap amount to Korea provided by Miyazawa Plan, and signed the agreement of swap of US$ 3 billion with Indonesia, the Philippines and Thailand, respectively. Japan also agreed to provide US$ 3.5 billion swap credit to Malaysia including the amount provided by the New Miyazawa Initiative. China singed a standby credit of US$ 2 billion with Thailand.

Most recently, China and Indonesia reached an agreement on US$ 1 billion swap. To date, a total of sixteen the bilateral swap arrangements (BSAs) under the CMI have been concluded with a combined size of US$ 34.5 billion and it is expected that more economies are participating in them (see Table 11).

Table 11: The Bilateral Swap Arrangement under the Chiang Mai Initiative in East Asia, June 2004

(in billion of U.S. dollars)

	Korea	Japan	China
Indonesia	1*	3	1
Malaysia	1*	1	1.5
Philippines	1*	3	1
Singapore		1	
Thailand	1*	3	2
China	2*	3*	
Taiwan			
Korea		2**	2*
Japan	2**		3*
Total	8	16	10.5

Note: * indicates a two-way arrangement where each party can request the other party to enter into the swap transaction.
** indicates a one-way arrangement of Japan to Korea.
Source: The Bank of Korea

However, the CMI swap agreement is bilateral in nature and lacks multilateralism that the Asian Monetary Fund (AMF) originally pursued. The AMF was proposed by the Japanese government in response to the Asian currency crisis as an alternative to the IMF. In September 1997, the Japanese government suggested a proposal of the AMF to provide the liquidity for the countries in currency crisis at the annual meeting of the Asian Development Bank and the IMF. The main idea of the AMF is to seek regional

monetary stability through regional cooperation. As the US government and the IMF were opposite to the idea because the function of the framework would be similar to that of the IMF, the CMI has emerged as an alternative.

Another problem of the CMI is, as Wyplosz (2001) pointed out, that CMI carefully eschews institution building, thus failing to plant seeds for an eventual next step and, for the point of view of regional integration, the risk is that the initiative will be both a beginning and an end.

Then, how to enhance the CMI framework of bilateralism to the AMF of multilateralism? Let's investigate the crucial points for a feasible AMF based on Kwack (2004) and Xu(2004).

First, there is a need of political wisdom of the countries, particularly China and Japan to improve their mutual understanding and trust. Because of the historical and political reasons, economies in the region remain skeptic each other and always disbelieve other countries' motivations of certain proposals. This is very unfruitful for the regional cooperation and sometimes it ruins the potentiality of cooperation. What we really need is some sort of sincere initiatives of the big players in the region to consult and share opinions with each other. If China, Japan, and Korea together with ASEAN really make common efforts under ASEAN+3 framework and work out a plan under the condition not to harm the multilateralism while improving the regional cooperation, East Asia would really become a promising economic development region and East Asian Monetary Union would not be impossible in the future.

Second, it is important to start with an applicable goal and concrete policy cooperation. Any impractical suggestion and aim would delay the regional cooperation process. It is suggested to go a bit further from the Chiang Mai Initiative and make this

swap arrangement more comprehensive in a multilateral manner. For example, make the standby credit a common credit pool. Then the credit quota in each bilateral agreement can be pooled together as the one member's overall credit quota. This multilateral reserve pooling arrangement can be based on the disposition of new foreign exchange reserves accumulated from short-term portfolio capital inflows (Chaipravat, Supapol and Sangsubhan 2003). The quota then can be transformed into the Asian Monetary Fund or the Asian Bond Fund (ABF). The ABF can be used for intra-regional investment in securitized debt instruments in the region. The character of the policy cooperation and coordination in terms of the both Fund will have the effect of promoting East Asian self-help and support beyond the CMI and toward greater financial stability in the region.

V. Conclusion

This paper is an attempt to explore what kind of monetary cooperation is desirable and feasible for Northeast Asia. Pursuing this issue rigorously in the structural VAR model and in the generalized PPP model, we have first tried to see if China, Japan, and Korea, may constitute an OCA by themselves. The proposition has failed to survive both tests. However, we have found in the G-PPP framework that the three countries may form part of an OCA, provided they are joined by four ASEAN countries including Indonesia, Malaysia, Singapore, and Thailand. This finding raises quite an interesting possibility that ASEAN+3 can be a good candidate for a future common currency area. In addition, we have shown in the structural VAR framework that six economies including Korea, Singapore, Hong Kong, Thailand, Malaysia, and Indonesia, together are eligible to an

OCA membership.

We consider these empirical findings of the model have important policy implications regarding the future directions of monetary and foreign exchange arrangements in Northeast Asia. The concept of an OCA in this region does not, however, seem to be favorably received for many reasons, political or whatever. Thus from the short-run perspective, we have suggested a regional system of inflation targeting with floating as a preferred option for now.

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