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the Robustness of Recent Results**

by

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Is Asia an Optimal Currency Area? Testing the Robustness of Recent Results¹

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Abstract

Recent debate over the existence of an optimal currency area (OCA) in Asia has spurred an increasing number of authors to conduct research on the theme. One OCA criterion that has been the subject of recent research is whether shocks to Asian economies are symmetrical (or similar). Using a newly-developed approach to examine the symmetry of global (US), regional (Japan) and idiosyncratic country-specific shocks affecting Asian output, a recent paper by Chow and Kim (2003) investigates whether a common currency peg in Asia is feasible. Their findings suggest that a Japanese Yen bloc is not feasible in the region due to the dominance of country-specific shocks affecting output in most Asian countries. This study, however, tests the robustness of their outcome. The initial results suggest that when sample periods are changed and other countries (China and Thailand) are added to the analysis, regional (Japan) shocks explain a large part of forecast error variance of output in several Asian countries. Moreover, the Asian crisis seems to have intensified the dominance of regional (Japan) shocks in some Asian countries and weakened them in others. Additional analysis attempts to refine the results.

Key words: optimal currency area, Yen bloc, common currency peg

¹ Hwee Kwan Chow and Yoonbai Kim, (2003) "A Common Currency Peg in East Asia? Perspectives from Western Europe" *Journal of Macroeconomics* 25, 331-350.

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I. Introduction

Using a novel scheme in the identification of structural vector autoregressions (VARs), Chow and Kim (2003) argue against the existence and feasibility of an optimal currency area in the East Asia region. Using sample data from 1971 to 1997, their scheme allows them to estimate reduced form output shocks in several East Asian countries and then identify structural global, regional and country-specific shocks to real national output. They interpret structural global shocks as emanating from the US economy, while regional shocks emanate from Japan. Chow and Kim argue that adopting a common currency peg (to either the dollar or the yen) is not feasible because for most countries in the sample, the variance decompositions of forecast errors of real output reveal relatively low contributions from the US (global) and Japan (regional) shocks. They thus argue that idiosyncratic (i.e., country-specific) shocks account for much of the forecast error variance, so adopting a common currency peg in the region would be costly for stabilization purposes.

This study uses the same VAR techniques as Chow and Kim and demonstrates that their conclusions are not robust to changes in the sample period, as well as to expanding the number of countries in the sample set (China and Thailand were excluded from the original sample of Chow and Kim). Specifically, it is found that when the sample period is changed from 1971 - 1997 to 1980 - 2003, regional shocks dominate global and country-specific shocks over a short horizon (4 quarters) in Malaysia and dominate over short and long horizons global and country specific shocks in Thailand. Moreover, when the sample is split into pre-Asian and post-Asian crisis, differences emerge in terms of the countries dominated by regional shocks. Regional shocks tend to dominate in more East Asian countries during the latter period. All of these findings weaken the assertion by Chow and Kim that a currency peg to the yen entails potentially large stabilization costs for several countries in the region.

II. The Study by Chow and Kim

The identifying restrictions for VARs used in this study are of the type developed by Blanchard and Quah (1989), where zero restrictions are imposed on a matrix of long-run responses of endogenous variables to exogenous structural shocks. Structural shocks are interpreted as global, regional and national or domestic shocks to national output.

Domestic shocks are defined as those shocks that are idiosyncratic and not correlated across countries. Regional shocks are defined as those shocks that are common and symmetric across the countries in the region. Global shocks affect countries both in and out of a region. This type of interpretation of shocks is useful insofar as the analysis involves determining whether an optimal currency area (OCA) exists, with one (dominant) country serving as its anchor. To implement their tests, Chow and Kim first estimate recursive VARs with the following ordering (US (global) real output, Japan (regional) real output and real national output of an East Asian country being analyzed). Then, they impose recursive long run restrictions on the resulting reduced form shocks, such that global shocks have nonzero long-run effects on all global, regional and national

outputs, regional shocks have nonzero long run effects on national shocks but zero effects on global output, and finally, national shocks have zero long run effects on global and regional output.

Chow and Kim then examine the resulting variance decompositions in order to determine how the three structural shocks account for forecast error variances of real output. If the forecast error variance decomposition for a particular country indicates that idiosyncratic national shocks dominate output, this suggests that the cost of joining a currency area is potentially high. On the other hand, if output is dominated by regional shocks, the costs of joining a currency area with a dominant country in the region may be lower. The potential geographic scope for a currency area will be even larger if global shocks tend to dominate national output. Whenever shocks are symmetric within a region or within a larger level of aggregation, the costs of joining a monetary union: loss of independence of monetary policy for stabilization purposes may be mitigated.

On the basis of their variance decompositions, Chow and Kim find that all East Asian countries tend to have country outputs dominated by national or idiosyncratic shocks. Their findings therefore support the view that forming a currency area would be costly for countries in the region.

This study extends the earlier of Chow and Kim in three ways:

- 1) there are results for Thailand and China;
- 2) the sample period for all countries begins in 1980 (instead of in 1971 as in Chow and Kim), and quarterly data is used; and
- 3) the full sample is broken down into two sub-periods for analysis: pre- and post-Asian crisis.

The source of most of the data is *International Financial Statistics*.³

III. Identification Method: Identification via Imposing Long-Run Restrictions

The identification method used in this study is patterned after Blanchard and Quah (1989). Let y_t be a column vector of n variables in the model. A reduced form VAR(p) would then be:

$$y_t = A(L)y_{t-1} + \varepsilon_t \quad \text{where} \quad A(L) = A_0 + A_1L + A_2L^2 + \dots + A_pL^p \quad (1)$$

(1) implies that

$$[I - A(L)L]y_t = \varepsilon_t = H(L)\varepsilon_t$$

$$y_t = [I - A(L)L]^{-1} \varepsilon_t = H(L)^{-1} \varepsilon_t \quad (2)$$

where it is clear that the last equation above is the impulse-response function (IRF) of the VAR, relating the vector of endogenous variables to the reduced-form shocks.

$$y_t = H(L)^{-1} \varepsilon_t = C(L) \varepsilon_t$$

$$y_t = \varepsilon_t + C_1 \varepsilon_{t-1} + C_2 \varepsilon_{t-2} + C_3 \varepsilon_{t-3} + \dots \quad \text{where } H(L)^{-1} = C(L) \quad (3)$$

The forecast error variance decomposition indicates the proportion of the movements in a time series due to its own shocks versus shocks to other variables. Analysis of the variance decomposition consists of examining it at various forecast horizons, to determine if one or more variables are important in explaining forecast error variances in others. The error forecast of the s-periods ahead forecast is

$$y_{t+s} - E_t y_{t+s} = \varepsilon_{t+s} + C_1 \varepsilon_{t+s-1} + C_2 \varepsilon_{t+s-2} + \dots + C_{s-1} \varepsilon_{t+1} \quad (4)$$

Therefore, the covariance matrix of the (s-periods ahead) forecast errors is:

$$E(y_{t+s} - E_t y_{t+s})(y_{t+s} - E_t y_{t+s})' = \Omega + C_1 \Omega C_1' + \dots + C_{s-1} \Omega C_{s-1}' \quad (5)$$

Suppose we index the shocks by $j = 1, \dots, n$ (there are n shocks because we have n variables in the VAR). If $i = 1, \dots, n$ denotes an index for the number of variables in the VAR, then we are looking at i variances of forecast errors due to j shocks.

If the shocks are uncorrelated, it is possible to calculate the fraction of the variance of the i th forecast error for time $t + s$, $\text{var}(y_{i,t+s} - E_t y_{i,t+s})$, due to the j th shock, and examine the forecast error variance decomposition. To get these fractions, simply divide each element in the RHS of (5) by the total forecast error variance for the entire horizon on the LHS of (5). **This fraction tells us what proportion of the forecast error in one variable (or a vector of variables) in time $t + s$ is caused by lagged shocks to one or all of the variables in the system.**

Since (1) is a reduced form, it follows that the IRF is a series of responses of y_t to the reduced form shocks to x_t and z_t . However, economists are usually more interested in determining the IRF and variance decomposition with respect to structural shocks, which we assume to be a linear function of the reduced form shocks:

$$u_t = F \varepsilon_t, \quad \text{with } \text{var}(u_t) = D \quad (6)$$

³ I thank James Cargill for the Chinese data, as well as Academia Sinica for the Taiwan data.

where F is an invertible $n \times n$ matrix containing the coefficients of ε_t . The variance of the structural shocks is D . Usually, D is assumed to be diagonal.

Note from (3) that the impulse response function for the structural shocks u , is:

$$y_t = F^{-1}u_t + C_1F^{-1}u_{t-1} + C_2F^{-1}u_{t-2} + C_3F^{-1}u_{t-3} + \dots = C(L)F^{-1}u_t \quad (7)$$

From (7), the long-run response of y to u is captured by the sum of the coefficients of u :

$$\lim_{s \rightarrow \infty} \frac{\partial y_{t+s}}{\partial u_t} = \lim_{s \rightarrow \infty} C_s F^{-1} = C(1)F^{-1} \quad (8)$$

where $C(1) = \sum_{j=0}^{\infty} C_s$.

There must be $(n(n-1)/2)$ restrictions imposed on these long-run responses (to get the needed n^2 restrictions for exact-identification of all elements in F). In order to do this, we note that since

$$\varepsilon_t = F^{-1}u_t$$

It follows that

$$EC(1)F^{-1}u_t u_t' (F^{-1})' C(1)' = EC(1)\varepsilon_t \varepsilon_t' C(1)' \quad (9)$$

$$C(1)F^{-1}D(F^{-1})C(1)' = C(1)\Omega C(1)$$

$$C(1)F^{-1}(F^{-1})C(1)' = C(1)\Omega C(1) \quad (10)$$

We can thus apply the Cholesky decomposition to the RHS of (10) (which is known from the estimation of the VAR) to obtain the lower triangular matrix Λ , the matrix containing the long-run responses of y to the structural shocks:

$$\Lambda = C(1)F^{-1} \quad (11)$$

We can solve for F^{-1} and thus, F , by using (11) (since $C(1)$ is known from estimation of the RF)). In the study by Chow and Kim, (11) is equal to

$$\begin{bmatrix} \text{unrestricted} & 0 & 0 \\ \text{unrestricted} & \text{unrestricted} & 0 \\ \text{unrestricted} & \text{unrestricted} & \text{unrestricted} \end{bmatrix} = C(1)F^{-1} \quad (12)$$

Thus, Chow and Kim's structural model is

$$\begin{bmatrix} \Delta y_t^{global} \\ \Delta y_t^{regional} \\ \Delta y_t^{national} \end{bmatrix} = \begin{bmatrix} \text{unrestricted} & 0 & 0 \\ \text{unrestricted} & \text{unrestricted} & 0 \\ \text{unrestricted} & \text{unrestricted} & \text{unrestricted} \end{bmatrix} \begin{bmatrix} u_t^{global} \\ u_t^{regional} \\ u_t^{national} \end{bmatrix} = C(1)F^{-1}u_t \quad (13)$$

where

y_t^{global} = log of US GDP

$y_t^{regional}$ = log of Japanese GDP

$y_t^{national}$ = log of GDP of country of interest

The upper (1,1) element in the left hand side of (13) is the long-run response of global (US) output to global shocks. It is assumed that regional and national shocks have no long-run effect on global output. The second equation in the structural VAR assumes that regional (Japanese) GDP is a linear function of global and regional shocks. It is assumed that national shocks have no long-run effect on regional shocks. The last equation in the VAR has national output being a linear function of all of the shocks in the long-run.

Note that the long-run restriction that the upper right hand element of Λ equals zero imposes one restriction on the elements of F (i.e., that the sum of the terms in the upper right hand element of the right hand side of (13) equals zero). Remember that this restriction is just one equation that will help pin down one of the elements of F . The other three restrictions (equations) are provided by the fact that $F^{-1}(F^{-1})' = \Omega$ (since Ω is symmetric). This yields three equations, so that the system to be solved has four equations in four unknowns (again, exactly identified).

IV. Results of Estimation

The quarterly data used for the study comes from several sources.⁴ The tables below indicate for each country the percentage of the 4 and 20 quarters ahead forecast error variance of real output that can be attributed to global, regional and domestic (country-specific) shocks. The shaded rows indicate that the country's output is dominated by regional (Japan) shocks for a particular horizon:

Table 1: Chow and Kim, 2003 (sample period: 1971-1997)

Country	Quarters	Global	Regional	National
Hong Kong	4	16.7	6.1	77.2
	20	15.3	7.4	77.4

⁴ Taiwan data comes from Academia Sinica. Chinese data comes from James Cargill. Other data comes from International Financial Statistics of the International Monetary Fund and the ARIC website of the Asian Development Bank.

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$$\begin{bmatrix} \Delta y_t^{global} \\ \Delta y_t^{regional} \\ \Delta y_t^{national} \end{bmatrix} = \begin{bmatrix} \text{unrestricted} & 0 & 0 \\ \text{unrestricted} & \text{unrestricted} & 0 \\ \text{unrestricted} & \text{unrestricted} & \text{unrestricted} \end{bmatrix} \begin{bmatrix} u_t^{global} \\ u_t^{regional} \\ u_t^{national} \end{bmatrix} = C(1)F^{-1}u_t \quad (13)$$

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Indonesia	4	10.1	15.0	74.9
	20	6.1	10.6	83.3
Korea	4	33.9	2.0	64.2
	20	18.5	1.8	79.6
Malaysia	4	11.2	1.2	87.6
	20	35.9	1.4	62.8
Philippines	4	5.7	17.6	76.7
	20	15.2	13.3	71.5
Singapore	4	9.2	12.3	78.5
	20	13.3	3.7	83.0
Taiwan	4	26.3	27.3	46.4
	20	28.1	10.1	61.7

Table 2: This study, full sample (1980-2003)

Country	Quarters	Global	Regional	National
Hong Kong	4	21.03	24.63	54.34
	20	24.46	25.91	49.63
Indonesia	4	6.39	20.90	72.71
	20	8.43	20.62	70.95
Korea	4	5.30	26.67	68.04
	20	4.52	23.29	72.19
Malaysia	4	20.98	46.26	32.76
	20	12.66	30.46	56.88
Philippines	4	11.77	4.18	84.05
	20	17.29	2.53	80.17
Singapore	4	29.88	1.46	68.65
	20	29.74	3.93	66.33
Taiwan	4	58.04	6.51	35.46
	20	49.25	16.46	34.29
Thailand	4	2.19	79.32	18.48
	20	5.06	81.55	13.39

Table 3: This study, split sample (1980-1996, 1997-2003)

Country	Quarters	Pre-crisis sample (1980-1996)			Post-crisis sample (1997-2003)		
		Global	Regional	National	Global	Regional	National
China	4	No data available			12.66	38.68	48.65
	20				19.20	41.51	38.53
Hong Kong	4	4.92	8.87	86.21	17.49	39.81	42.70
	20	2.04	12.12	85.84	13.99	27.85	58.16

Indonesia	4	65.33	27.28	7.39	13.38	55.00	31.62
	20	53.36	27.79	18.85	17.42	50.50	32.08
Korea	4	25.75	12.04	62.21	3.55	8.57	87.88
	20	27.84	10.54	61.62	3.24	3.79	92.97
Malaysia	4	16.90	65.59	27.51	20.16	52.17	26.66
	20	17.08	65.94	16.98	11.81	34.30	53.88
Philippines	4	13.39	8.09	78.52	44.80	23.27	31.95
	20	17.08	6.47	76.45	25.58	35.82	38.61
Singapore	4	26.46	36.92	36.62	44.26	10.58	45.16
	20	28.60	39.18	32.22	38.34	15.72	45.94
Taiwan	4	38.78	10.46	50.76	24.59	38.74	36.67
	20	26.81	28.79	44.40	11.42	14.90	73.68
Thailand	4	No data available			9.50	63.56	26.95
	20				14.53	57.87	27.60

The results show that:

- 1) In contrast to the results of Chow and Kim, who use older data, the proportion of forecast error variances attributable to the three shocks generally displays a much greater balance among the three structural shocks.
- 2) For the sample starting in 1980 and ending in 2003, regional shocks dominate the short-run (4 quarter) forecast error variance of output in Malaysia and Thailand, and the long-run forecast error variance in Thailand.
- 3) From 1980 to 1996, the forecast error variance of output in Malaysia and Singapore are dominated by regional shocks at short and long horizons. All other countries except Indonesia are dominated by country-specific national shocks. Indonesia is dominated by global shocks.
- 4) After 1996, the forecast error variance of output in Indonesia and Thailand are dominated by regional shocks at short and long horizons. Malaysia and Taiwan are dominated by regional shocks at short horizons. China is dominated by regional shocks over a long horizon, while Singapore is dominated by country-specific national shocks. The Philippines is dominated by global shocks over a short horizon during the latter sample.
- 5) Korea and Hong Kong remain consistent with Chow and Kim. They are dominated by country-specific shocks in all samples over all forecast horizons.

With respect to pre- and post-crisis shock patterns:

- 6) The forecast error variance decomposition of output in Hong Kong and the Philippines suggests that after the Asian crisis, the intensity of country-specific shocks weakened and global and regional shocks strengthened. The opposite occurred in Indonesia, where the intensity of global and country-specific shocks weakened and regional shocks strengthened after 1997.
- 7) The forecast error variance decomposition of output in Korea suggests that after the Asian crisis, the intensity of global and regional shocks weakened and country-specific shocks strengthened. This also occurs in Malaysia and Taiwan over a long horizon (20 quarters). In Singapore, regional shocks weakened after the crisis, but global and country-specific shocks strengthened over all horizons.

What accounts for these results? Two results are immediately striking. The first is that using a more recent sample, several countries are dominated by regional shocks (compared to none in the Chow and Kim study). Perhaps inclusion of 1970's data biases the sample towards observations prior to increased openness in the macroeconomy for East Asian countries. Another possible explanation is Japanese investment fragmentation, a phenomenon where Japanese firms shift production for different product components to different countries. This type of investment pattern could enhance the dominance of regional shocks insofar as it may increase the correlation of both demand and supply shocks between Japan and other countries. The other striking result is that Singapore and Malaysia are no longer dominated by regional shocks over long horizons in the post-crisis sample. Instead, countries dominated by regional shocks after 1996 include China, Indonesia and Thailand. Even results for Hong Kong and the Philippines suggest that regional shocks have increased their intensity during the post-crisis period. Perhaps these countries are becoming increasingly popular investment destinations for Japanese firms willing to outsource production. For some of these countries, the relatively large real depreciations they experienced after the Asian crisis may have made it more profitable for Japanese firms to locate investments there.

V. Conclusions

The results of the exercise suggest that the results of Chow and Kim (2003) are not robust to changes in the sample period, as well as expanding the number of countries in the sample. They also offer some evidence that the costs of forming a regional currency area may not be as high as previously thought, as output in some countries in the region is already dominated by regional shocks. Perhaps earlier results dismissing the feasibility of a currency area in the region (based on the symmetry of shocks criteria) might be premature. Further study may need to confirm the contribution of investment fragmentation to the results in this paper.

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