CITS WP 2005-01

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* An earlier version of the paper was presented at the 9th International Convention of the East Asian Economic Association in Hong Kong and the CITS Research Workshop at Yokohama National University, Japan. The authors wish to thank Rasmus Rüffer, Masahito Kobayashi, Hiroyasu Uemura, Craig Parsons, Masaru Inaba, and participants in the conference and seminar for their helpful comments and suggestions. The authors wish to acknowledge the financial support of Japan Society for the Promotion of Science through the Grant-in-Aid for Scientific Research (B), 116330059.

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Whither Currency Union in Greater China?

Abstract

The paper attempts to evaluate the prospect of creating a currency union in the "Greater China" economic area including Mainland China, Hong Kong and Taiwan. Despite of the political deadlock and military confrontation in the Taiwan Strait, the Greater China area has experienced rapid and spontaneous regional integration in the past decades as a result of increasingly cross-border trade, foreign direct investment (FDI), technology contracts, and other arrangements in accordance with changes in comparative advantage and industrial upgrading in these economies. In this study, we focus on the symmetry in shocks that is perceived as one of the major preconditions of a currency union. In contrast to the previous studies, we investigate the time-varying correlation of supply and demand shocks by using the Kalman filter technique in order to reveal whether the Greater China economies show a convergence trend. We also examine the costs of forming a currency union in the area that are caused by the loss of monetary autonomy in each economy. Our results emphasize an increasing symmetry in demand shocks and, to a lesser extent, in supply shocks, implying that these economies would not suffer too much from abandoning their monetary policy as an instrument of absorbing shocks.

JEL Classification: E32, F33, F41

Keywords: optimum currency area, structural shocks, vector autoregression, Kalman filter, output losses, Greater China

1. Introduction

Despite the political deadlock and military confrontation in the Taiwan Strait, the Greater China area including Mainland China, Hong Kong and Taiwan[1] has undoubtedly experienced rapid and spontaneous economic integration in the past decades. Hong Kong has been an important intermediary linking up Mainland China with the rest of the world for foreign trade and investment, and had achieved a high degree of integration with the Mainland well before its handover in 1997. On the other hand, Mainland China is also the largest source of inward investment in Hong Kong. In contrast to this integration pattern, the economic integration process of Taiwan with the Mainland is very different. On the one hand, the bifurcation of low and high politics across the Taiwan Strait has been the dominant feature of cross-strait relations since the end of the Cold War. On the other hand, economic forces in the form of increasing trade and investment tend to bridge the strait, to integrate the two societies, and to dilute political control. However, since the "full three links", i.e., direct trade, transportation, and communications links between Mainland China and Taiwan have been "frozen" for the past half century, cross-strait trade and investment have to be conducted indirectly via a third territory, mostly through Hong Kong, and also other parties such as Japan and Singapore. Complementary factor endowment and mutual economic interests, geographical proximity and cultural affinity also meant possible low transactional costs and have enabled both economies to develop a rather intense trade and investment linkages in the past decades. This process is also accompanied by a rapid labor mobility, even though mostly a one-way flow. It was

[1] Macau is not included in this study due to the lack of data.

estimated that the presence of Taiwanese in Shanghai has grown from tens of thousands in the early 1990s to as many as 250,000-350,000 by 2001. To many Taiwanese, Shanghai has become their "second home" after Taiwan.

It is believed that high degree of integration in the Greater China area would greatly shape their own economic structure and has direct implications for the effectiveness of domestic stabilization policy and policy coordination. Consider the recent proposals for exchange rate management or coordination in East Asia, it remains an interesting question to ask if it is feasible for the "Greater China" economic area to create a currency union from purely economic perspective.

This paper attempts to evaluate the prospect of creating a currency union in the Greater China economic area by focusing on the (a)symmetric issues of the structural shocks between the concerned economies. Early studies[2] in addressing the (a)symmetry in shocks typically employ the structural vector autoregression (VAR) technique developed by Blanchard and Quah (1989). However, this approach does not necessarily reveal how the (a)symmetry in shocks has evolved over time especially when economic interdependence between the economies concerned has deepened substantially. In this paper, we employ the time-varying parameter estimation technique developed by Haldane and Hall (1991), Boone (1997) and Babetskii et al. (2004) to measure the time-varying correlation of the identified shocks and the convergence trend. Following Ghosh and Wolf (1994), we also apply the output loss function analysis to assessing the costs of renouncing autonomous monetary policy instruments in forming a currency union in this region.

[2] See, for example, Bayoumi and Eichengreen (1994), Bayoumi, Eichengreen and Mauro (2000), Chow and Kim (2003), and Zhang, Sato and McAleer (2004).

The remaining of the paper is organized as follows. Section 2 reviews the changing dynamics of foreign trade and business linkages in the Greater China economic area during the past decades. The theoretical framework and methodology of this study are presented in Section 3. Section 4 conducts an empirical assessment of convergence in shocks, with a dynamic approach, between China and the rest of the Greater China as well as the other regional economies. We then conduct a sensitivity analysis of forming a currency union between the Greater China economies to determine the costs of the union due to the loss of monetary autonomy in each economy. Finally, Section 5 draws concluding remarks towards the feasibility of forming a currency union in the Greater China region.

2. Dynamic Linkages of Trade and Business Between Greater China Economies

2.1 Trade linkage Between Greater China Economies:

Contrasting to the enduring political deadlock and military confrontation in the Strait, to tie Taiwan to Mainland China through "economic rope" has been very effective. Two factors might have contributed to this integration process: the emergence of the Mainland economy as a trading nation and manufacturing center since its adoption of the open-door policy in the late 1970s (see Lardy, 1992; Naughton, 1996), and the rapid and spontaneous regional integration in East Asia in the past decades (Dobson and Chia, 1997; Zhang, 2001). Figure 1 shows the evolution of the cross-strait trade since the late

1980s. It can be seen that Taiwan's exports to the Mainland rose rapidly from less than US$1 billion in the middle of the 1980s to the peak of US$26.14 billion by 2000. Since 1993 China has become Taiwan's second largest export market, next only to the United States. However, due to Taiwan's "relaxing indirect exports control and restricting imports" trade policy implemented in the 1980s[3], cross-strait trade has been developed highly unbalanced, continuously in favor of Taiwan's trade balance. The accumulative trade surplus in 1987-2001 for Taiwan reached US$163.3 billion, which is 3.5 times of its trade surplus with the rest of the world during the period [4]. It has become evident that the cross-strait trade helped Taiwan's trade balance and also enhanced the economic interdependence across the Taiwan Strait.

Hong Kong had achieved a high degree of integration with the mainland well before its handover to Mainland China. It served as an important intermediary to develop the trade and investment linkages between Mainland China and Taiwan as well as the rest of the world.[5] Since 1985 the Mainland has been Hong Kong's largest trading partner. Share of the Mainland in Hong Kong's global trade rose from 9.3% in 1978 to 43.1% in 2003. The Mainland was Hong Kong's largest import source, accounting for 43.5% of

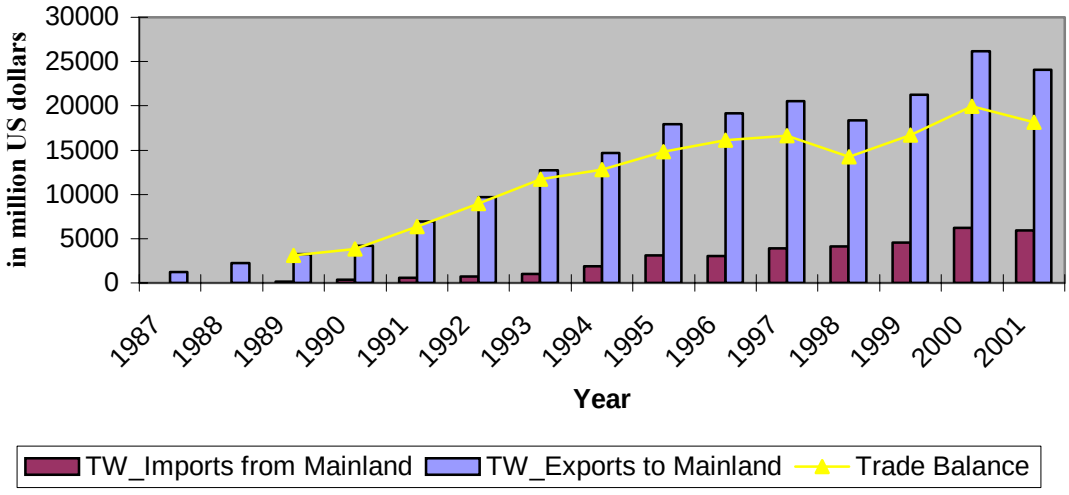
[3] Taiwan limited the number of items permitted for indirect imports from the Mainland to 29 in 1987 and 2,155 by the end of 1994. In recent years, especially since its entry of WTO, Taiwan has gradually relaxed indirect imports control. By 2001, the number of items open for imports increased to 5,350 for industrial products and 484 for agricultural products, accounting for 64.8% and 23.2% of their respective total. On average, Taiwan has opened up 56.4% of its total number of agricultural and industrial products for imports from Mainland China.

[4] Taiwan had a trade deficit with the world for three consecutive years from 1998 to 2000, totaling over US$2.3 billion. The trade surplus with the Mainland exceeds Taiwan's total trade balance in any single year from 1987 to 2001, the lowest by one time in 1997 and the highest by 97 times in 2000 (see Zhang, Xu and Zhang, 2003).

[5] Data used in this section were adopted from ADB: Key indicators 2003 and MOFTEC: Almanac of China's Foreign Economic Relation and Trade, various issues, with authors' calculation.

Hong Kong's total imports, and the largest export market, accounting for 42.6 % of Hong Kong's total exports in 2003. Hong Kong's trade with the Mainland is to a large extent related to outward processing activities. More than 80% of Hong Kong manufacturers have established production facilities in the Mainland, which have substantially boosted outward processing activities and Hong Kong's re-export growth. In 2003, 43.9% of Hong Kong's total exports (of which 68% of Hong Kong's domestic exports and 42.7% of re-exports) to the Chinese Mainland were related to outward processing activities. Meanwhile, 71.7% of Hong Kong's imports from the Mainland and 79.4% of Hong Kong's re-exports of the Mainland origin to all countries other than China were related to outward processing.

Figure 1: Taiwan Trade and Trade Balance with Mainland China



Sources: Taiwan Ministry of Economic Affairs, and Almanac of China's Foreign Economic Relation and Trade (Beijing).

2.2 Trade Interdependence

Although cross-strait trade has to be conducted indirectly, their trade relationship has become increasingly interdependent. As indicated in Table 1, the Mainland is much more important as an outlet for Taiwan's exports rather than as a source of supply for Taiwan's imports even though the latter's share has been growing since the middle of the 1990s. Taiwan's dependence on the Mainland market as an outlet for its exports grew rapidly from about 2.3 percent in 1987 to about 20 percent by 2001. In contrast, imports from Mainland China accounted for less than 1 percent of Taiwan's total imports before 1992 and rose gradually to 5.5 percent by 2001. Mainland China's trade dependence on Taiwan as a source of imports supply rose rapidly to 14.4 percent in 1997 and declined since then to less than 10 percent by 2001. Taiwan as an outlet for the Mainland's exports remained insignificant during the period, accounting for a share of smaller than 1% before 1992 and only 2.2% by 2001. Moreover, it is interesting to note the significant change in the commodity composition of cross-strait exports and imports. During the early stage of the cross-strait trade, Taiwan's exports to the Mainland consisted mainly of consumer goods, while imports from the Mainland mainly raw materials. In recent years, Taiwan's imports from the Mainland were mainly composed of mechanics and electronics, clothes and textiles, coals, steels and containers, and exports to the Mainland were dominated by raw materials of plastics, raw materials of textile, machine equipment and parts and steels (Zhang, Xu and Zhang, 2003). These significant changes in the commodity composition reflect the "dynamic" nature of their trade relationship despite of the political constraint, a result of which has been the shifting and relocating, at least partially, of certain

industries in which Taiwan has been losing or lacking comparative advantage relative to Mainland China.

Table 1: Trade Interdependence between the Greater China Economies (in percentage)

	Of the Mainland's Total Imports (%)		Of Taiwan's Total Exports (%)		Of the Mainland's Total Exports (%)		Of Taiwan's Total Imports (%)	
Year:	TW's Exports to Mainland	HK's Exports to Mainland	TW's Exports to Mainland	HK's Exports to Mainland	TW's Imports from Mainland	HK's Imports from Mainland	TW's Imports from Mainland	HK's Imports from Mainland
1986	-	17.46	-	21.31	-	33.35	-	29.59
1987	2.84	26.12	2.29	23.29	0.00	38.13	0.00	31.05
1988	4.02	30.76	3.67	26.95	0.00	41.83	0.00	31.20
1989	5.49	31.82	4.89	25.74	0.28	47.65	0.28	34.95
1990	7.82	37.78	6.21	24.75	0.55	48.30	0.62	36.75
1991	10.86	41.86	9.10	27.12	0.83	52.47	0.95	37.65
1992	12.03	43.25	11.90	29.63	0.88	53.47	1.04	37.09
1993	12.35	42.16	14.96	32.36	1.12	56.70	1.32	37.51
1994	12.67	42.93	15.75	32.81	1.54	50.36	2.18	37.62
1995	13.86	43.78	16.03	33.34	2.08	46.82	2.99	36.18
1996	13.78	44.61	16.52	34.33	2.02	48.79	2.99	37.15
1997	14.41	46.13	16.81	34.91	2.14	42.96	3.42	37.67
1998	13.11	42.63	16.62	34.45	2.24	40.80	3.93	40.61
1999	12.81	35.00	17.45	33.37	2.32	40.19	4.09	43.61
2000	11.62	30.98	17.63	34.53	2.50	36.84	4.45	43.04
2001	9.88	28.77	19.58	36.92	2.22	32.89	5.50	43.44
2002	-	22.72	25.10	44.69	-	23.25	-	41.14

Sources: ADB: Key indicators 2003; Taiwan Ministry of Economic Affairs: indirect trade across the Taiwan Straits; and MOFTEC: Almanac of China's Foreign Economic Relation and Trade, with authors' calculation.

With a different pattern, Hong Kong and the Mainland have become increasingly mutually interdependent in trade. As an outlet for China's exports and imports, Hong Kong has been playing an important intermediary role to link China with the rest of the world. The share of its exports in China's total exports reached the peak of over 46 percent in 1997 and the imports share at about 57 percent in 1993. Since then both shares

show a declining trend, down to about 23 percent by 2002, thanks to Mainland China's direct trade with the rest of the world. On the other hand, the Mainland has become increasingly important as an outlet for Hong Kong's both exports and imports, accounting for a share of about 45 percent and 41 percent of its total in 2002, respectively. Bear in mind of Hong Kong's huge capital flows to the mainland, the dependence of Hong Kong on the mainland economy will be enhanced further.

2.3 Intra-Industry Trade

Regional integration has also important adjustment implications for the concerned economies. One widely used empirical method to assess possible adjustment pressures is to look at intra-industry trade (IIT) patterns. A high share of IIT in overall trade is considered to reflect relatively less labour market disruption, with workers tending to move more within rather than between industries, a result of which would be low adjustment costs. We use 5-digit SITC bilateral export and import data to calculate the IIT shares in the manufacturing (SITC categories 5 to 8) between China and Hong Kong and Taiwan. As it can be seen in Table 2, the bilateral trade in Chemicals and related products (Category 5) between China and Hong Kong contains the highest share of intra-industry trade, followed by machinery and transport equipment (Category 7) and manufactured goods (category 6). The results are in support to our casual observation that most of Hong Kong's manufacturing has been relocated to the mainland since the late 1980s due to its less competitive operation costs. The cross-strait trade contains less IIT, but it shows an increasing sign especially in the recent years. The low intensity of IIT

between the Mainland and Taiwan is largely explained by Taiwan's export restriction policy guiding trade with the Mainland.

Table 2: IIT Shares in the Manufacturing between China and Hong Kong and Taiwan (in Percentage)

ISIC		1992	1994	1996	1997	1998	1999	2000
Hong Kong	5	0.214	0.461	0.475	0.446	0.448	0.483	0.503
	6	0.482	0.454	0.389	0.330	0.327	0.326	0.315
	7	0.287	0.428	0.424	0.422	0.411	0.371	0.383
	8	0.195	0.201	0.177	0.107	0.121	0.150	0.177
Taiwan	5	0.068	0.054	0.052	0.066	0.076	0.070	0.070
	6	0.086	0.080	0.086	0.090	0.087	0.089	0.090
	7	0.078	0.145	0.191	0.261	0.292	0.264	0.229
	8	0.188	0.245	0.230	0.248	0.264	0.261	0.281

Source: OECD: International Trade by Commodity REV3.

2.4 Business linkages

Similar to its trade pattern with the Mainland, Taiwan's investments in the Mainland were essentially carried out indirectly through a third party, which first appeared in the early 1980s, but remained small and also was not captured in official statistics until the end of the 1980s. According to the Taiwan Ministry of Economic Affairs, by 2002 Taiwan has approved investment applications in the Mainland totalling 27,276. The total investment value amounted to US$26.61 billion, and more than 48 percent of Taiwan's total outward direct investment was directed to the mainland (Wang, 2003). The figures would make Mainland China the largest recipient of Taiwan's outward direct investment. One estimate by Taiwan's Central Bank indicates Taiwanese firms have invested more

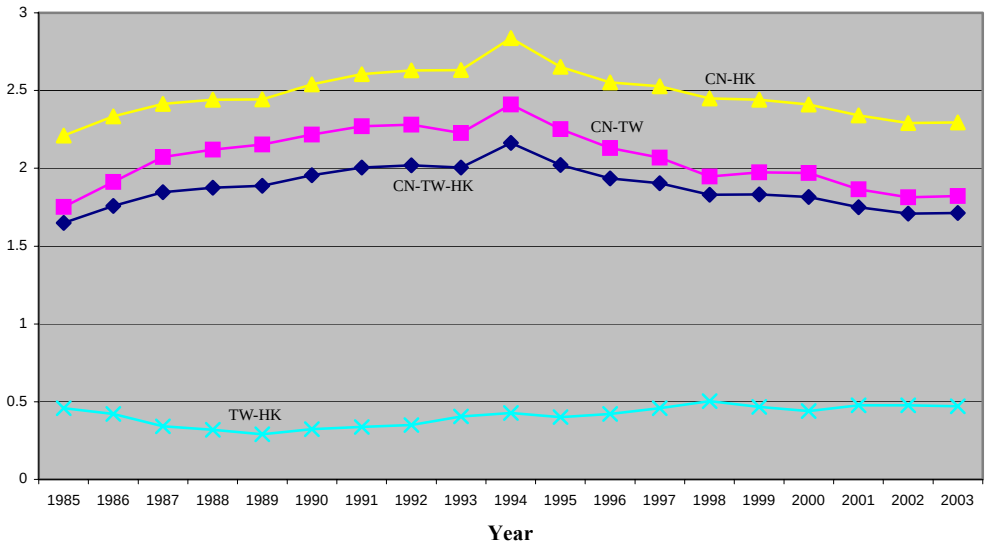
than US$66.8 billion during the period in 1990-2002 (Wang, 2003). According to the sources from Mainland China, the total number of approved Taiwanese investment projects reached 55,700, the total contracted investment amounted to US$61.47 billion, with realized investment reaching US$33.1 billion. Taiwan would be listed as the second-largest source of investment after Hong Kong should investment via the third party be counted. Another interesting feature for Taiwanese investment is its change in sectoral distribution and geographical location. Since the middle of the 1990s, especially in the most recent years, there was a clear shift of investment interests towards electronic and electric appliances, information and high technology, capital-intensive industries (Zhang, Xu and Zhang, 2003). Concerning the geographical distribution, Taiwanese investments in Mainland China are largely committed into the coastal provinces and municipalities, accounting for over 80% of Taiwan's total FDI in the Mainland in 1992-2001. In particular, Jiangsu and Shanghai experienced a rapid expansion of their shares in attracting direct investment from Taiwan, increasing from about 14% in 1992 to 51% by 2001, thanks to the establishment of the Pudong New Zone (a super special economic zone (SEZ)) in Shanghai in 1990, while Fujian and Guangdong, on the other hand, experienced a sharp drop, down respectively from 12% and 45% in 1992 to 4% and 28% by 2001. Finally, in recent years there have been increasingly more and more Taiwanese living, working and studying in the Mainland, although the mobility of people to Taiwan from the Mainland is still restricted. Most of Taiwanese live in Shanghai and Shenzhen. With its tradition of liberal business and international atmosphere, Shanghai has become the "second home" of most Taiwanese after Taiwan. It was estimated that the presence of

Taiwanese in Shanghai has grown from tens of thousands in the early 1990s to as many as 250,000-350,000 by 2001.

As a financial centre in the region, Hong Kong is the largest source of overseas direct investment in Mainland China. According to MOFTEC, by the end of 2003, among the 465,277 foreign investment projects registered in Mainland China, 48.3% were tied to Hong Kong interests. Contracted and utilized capital inflow from Hong Kong amounted to US$414.5 billion and US$222.6 billion, accounting for 44% and 44.4% of the national total. The increasing use of outward processing facilities in the Mainland has enhanced production flexibility and helped maintain the price competitiveness of Hong Kong products in the world market. According to a survey conducted by the Federation of Hong Kong Industries in December 2002, 11 million Chinese workers were employed either directly or indirectly in the Mainland by industrial ventures with Hong Kong interests, of which 10 million were in Guangdong. This, in effect, provides Hong Kong with a substantial production base across the border. On the other hand, Mainland China is also the largest source of inward investment in Hong Kong. Based on the Hong Kong statistics, the Mainland's cumulative direct investment in Hong Kong were HK$594.6 billion at end-2002, accounting for 22.6% of the stock of inward direct investment. According to market estimation, there are over 2,000 mainland-backed enterprises registered in Hong Kong, with total asset exceeding US$220 billion. Over 100 mainland and state-owned enterprises were listed on the Stock Exchange of Hong Kong and the Growth Enterprise Market (GEM). Although there are no official statistics available, it is generally believed that the mobility of labour between Hong Kong and the Mainland is the highest in the Greater China area. With China's accession to the World Trade

Organisation (WTO) in late 2001 and the signing of the Closer Economic Partnership Arrangement (CEPA) between the Mainland and Hong Kong in 2003 as well as the various policy initiatives to enhance economic cooperation between Guangdong and Hong Kong, economic integration between Hong Kong and the Mainland is expected to be further strengthened.

Figure 2: Dispersion of Per Capita GDP for Greater China



Source: ADB: Key Indicator 2003 and IMF: IFS, various issues, with authors' calculation.

2.5 Economic Convergence among the Greater China economies

We group the Greater China economies and calculate a time-series of the coefficient of variation using GDP per capita data for each year for the period in 1985-2003. Figure 2 presents the results. It is interesting to note that for all samples including the mainland economy a growing divergence in GDP per capita is the major phenomenon

up to 1994, and since then there is a clear tendency for these economies to approach each other. Even if we control for the effect of China's dual exchange rates reunification in 1994, there is a sign of declining coefficient of variation during the period, indicating the trend of economic convergence in the Greater China area in the long run.

3. Analytical Framework

The early literature in addressing the desirability of forming monetary union suggests that similarity in terms of disturbances and economic structure between the candidates would be an important criterion (Mundell, 1961; McKinnon, 1964). A large literature in the recent years attempts to evaluate empirically the degree of business cycle synchronization and the correlation in structural shocks by employing the structural vector autoregression (VAR) technique developed by Blanchard and Quah (1989).[6] However, this approach does not necessarily consider how the symmetry in shocks has evolved over time, especially when the situations concerning the economic interdependence between the candidates economies have been changed. This study attempts to examine the changes in structural shocks among the economies by employing the Kalman filter technique. More specifically, we identify the supply and demand shocks for each economy by the structural VAR technique, and then employ the time-varying

[6] Among others, Bayoumi and Eichengreen (1994), Bayoumi, Eichengreen and Mauro (2000), Chow and Kim (2003), and Zhang, Sato and McAleer (2004) apply the structural VAR technique to the East Asian region and found that some sub-groups of the East Asian economies, such as Asian NIEs and/or ASEAN, would be a potential candidate for a currency union.

parameter methodology developed by Haldane and Hall (1991) and Boone (1997) to examine the dynamics of the (a)symmetry in shocks.

3.1 Estimation of Structural Shocks

We first employ the conventional 2-variable VAR with the log of home output (*y*) and home price level (*p*) to identify the fundamental supply and demand shocks. Let $\Delta x_t \equiv [\Delta y_t, \Delta p_t]'$ and $\varepsilon_t = [\varepsilon_{st}, \varepsilon_{dt}]'$ where Δ represents the first-difference operator and ε_{st} and ε_{dt} denote supply and demand shocks, respectively. The structural model can be compactly written,

$$\Delta x_t = A_0\varepsilon_t + A_1\varepsilon_{t-1} + A_2\varepsilon_{t-2} + \cdots = A(L)\varepsilon_t, \qquad (1)$$

or

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} A_{11}(L) & A_{12}(L) \\ A_{21}(L) & A_{22}(L) \end{bmatrix} \begin{bmatrix} \varepsilon_{st} \\ \varepsilon_{dt} \end{bmatrix}, \qquad (2)$$

where $A_{ij}(L) = a_{ij}^0 + a_{ij}^1 L + a_{ij}^2 L + \cdots,$ is a polynomial function of the lag operator, *L*. We assume that the structural shocks are serially uncorrelated and have a covariance matrix normalized to the identity matrix.

In order to identify the structural A_i matrices, we follow the method developed by Blanchard and Quah (1989). We impose the following long-run restrictions based on

standard macroeconomic theory: only supply shocks affect output in the long-run, but both supply and demand shocks have a long-run impact on prices. Thus, the restrictions require $A_{12}(1) = 0$ which is sufficient to identify the structural A_i matrices and, hence, the time series of structural shocks.

We estimate a reduced-form VAR as:

$$\Delta x_t = B(L)\Delta x_{t-1} + u_t, \qquad (3)$$

where u_t is a vector reduced form disturbance and $B(L)$ is a 2×2 matrix of lag polynomials. An MA representation of equation (3) is given as:

$$\Delta x_t = C(L)u_t, \qquad (4)$$

where $C(L) = (1 - B(L)L)^{-1}$ and the lead matrix of $C(L)$ is, by construction, $C_0 = I$. By comparing equations (1) and (4), we obtain the relationship between the structural and reduced form disturbances: $u_t = A_0\varepsilon_t$. As the shocks are mutually orthogonal and each shock has unit variance, $C(1)\Sigma C(1)' = A(1)A(1)'$ where $\Sigma = Eu_t u_t' = EA_0\varepsilon_t\varepsilon_t' A_0' = A_0 A_0'$. Letting H denote the lower triangular Choleski decomposition of $C(1)\Sigma C(1)'$, we obtain $A(1) = H$ since our long-run restrictions imply that $A(1)$ is also lower triangular. Consequently, we obtain $A_0 = C(1)^{-1}A(1) = C(1)^{-1}H$. Given an estimate of A_0, we can recover the time series of structural shocks.

3.2 The Convergence Test

To address the dynamic issue of convergence in structural shocks, we apply the time-varying parameter convergence approach developed by Haldane and Hall (1991), Boone (1997) and Babetskii et al. (2004) to analyzing the feasibility of a currency union in the Greater China area. We set the following observation equation:

$$(\varepsilon_t^i - \varepsilon_t^j) = \alpha_t + \beta_t(\varepsilon_t^i - \varepsilon_t^k) + \omega_t, \qquad (5)$$

where ε represents the structural shocks and superscripts *i, j, k* denote the regional key economy, regional economies and the rest of the world, respectively, and ω_t is an independently and normally distributed error term with zero mean and a constant variance, σ_ω^2. α and β are time-varying coefficients and characterized by the following state equations:

$$\alpha_t = \alpha_{t-1} + \eta_t, \qquad (6)$$

$$\beta_t = \beta_{t-1} + \nu_t, \qquad (7)$$

where η_t and ν_t are random error terms with zero mean and variances, σ_η^2 and σ_ν^2, respectively.

The time-varying parameter β coefficients in equation (5) measures the temporal relationship in shocks among three countries (*i*, *j* and *k*), for the purpose of distinguishing

a global trend of convergence from a more specific convergence between two economies.[7] If β approaches to one, the spread on shocks between country *i* and *j* is explained by the spread between country *i* and *k*, showing that the country *j* converges toward the country *k*. If β tends toward zero, shocks for country *j* are explained by those for country *i*, implying that the country *j* converges toward the country *i*.

In this paper we define China as a reference country *i* and the United States or Japan as another reference country (i.e., alternative attractor) *k*. Taiwan, Hong Kong and other East Asian economies are treated as country *j*. Accordingly, equation (5) indicates that if the shocks of an East Asian country are correlated more with those of China than the U.S. or Japanese shocks (or the shocks of the East Asian country is independent of the U.S. or Japanese shocks), the parameter β tends to be zero. Conversely, if the shocks of the East Asian country are correlated more with those of the U.S. or Japan (or the former is independent of the Chinese shocks), we expect the parameter β to approach to one.

We estimate the time-varying α and β coefficients in equation (5) by using the Kalman filter technique.[8] In employing the Kalman filter technique, the specifications of the state equations must be carefully considered. Among others, starting values of the state coefficients may substantially affect the results in small samples. Following McNelis and Neftçi (1982), we first perform the constant parameter estimation by OLS, and then use the OLS estimates as the starting values of the state coefficients, which will minimize any possible variation in the parameters. For the specification of the variance-

[7] Testing the convergence of the variables just between two countries is not sufficient if the convergence of the variables happens to be a global trend. See Boon (1997) for a detailed discussion of this issue.

[8] See Hamilton (1994) for the Kalman filter estimation.

covariance matrix of the state equations, we employ the estimated variance-covariance matrix obtained by OLS.

4. Empirical Analysis

4.1 Data Description

We use real GDP and consumer price index (CPI) as proxies for real output and prices, respectively. All data are quarterly, expressed in natural logarithms and seasonally adjusted.[9] The sample period covers 1986Q1-2003Q4 for all economies except Korea.[10]

The data for real GDP are obtained from the web sites of the statistic authorities in respective economies and the NUS ESU databank[11]. The data for CPI are collected from IMF, *International Financial Statistics*, Online Version, and the web sites of the statistics authorities in China, Taiwan and Hong Kong.

4.2 Shock Convergence

Following Blanchard and Quah (1989), we first estimate a structural VAR with 2-variables of real output and prices to identify respectively the supply and demand shocks

[9] We use *EViews 5* for empirical analysis. Seasonality is adjusted using Census X-12.

[10] The sample period for Korea is from 1986Q1 to 2003Q3.

[11] We are grateful to Tilak Abeysinghe for providing us with the real GDP series for some East Asian economies.

using the whole sample period from 1986Q1 to 2003Q4[12]. Then, we conduct the correlation analysis of the identified shocks for both the whole sample period and the sub-sample periods.

Table 3: Correlation of Structural Shocks between China, Taiwan and Hong Kong

		Supply Shocks			***Demand Shocks***	
		Taiwan	HK		Taiwan	HK
1986Q2-2003Q4	China	0.23	0.26	*	0.04	0.10
1986Q2-1993Q4	China	0.17	0.20		-0.21	0.08
1994Q1-2003Q4	China	0.27	0.33	*	0.22	0.09
1986Q2-1990Q4	China	0.20	0.26		-0.07	-0.10
1991Q1-1996Q4	China	0.15	-0.14		0.11	0.06
1997Q1-2003Q4	China	0.33	0.42	*	0.11	0.29

Notes: Shaded figures and a single asterisk denote positive and significant at the 5 percent and the 2.5 percent level (one-tailed test), respectively, under the null hypothesis that correlation coefficient is zero. Significance levels for correlation coefficients are assessed using the Fisher's variance-stabilizing transformation (see Rodriguez, 1982).

The results of the correlation analysis (reported in Table 3) indicate that demand and supply shocks between China, Hong Kong and Taiwan have become increasingly correlated over time, especially since the 1990s. The correlation coefficients of supply shocks between China and Taiwan rose from 0.17 in 1986-1993 to 0.27 in 1994-2003, and from 0.20 to 0.33 for Hong Kong during the respective sample periods. For demand shocks, the correlation coefficient changed from negative 0.21 in 1986-1993 to 0.22 in 1994-2003 for the case of Taiwan, an indication of increasing symmetry in shocks; and a

[12] Specifically, we took the first-difference of real GDP and CPI, and then estimated the 2-variable VAR specified in Equation (3). Before conducting the VAR estimation, we first checked the stationarity of the real GDP and CPI by performing the augmented Dickey-Fuller (ADF) test and the Phillips-Perron test, and found that all series are non-stationary in level but stationary in the first-difference. Because our main interest is to identify structural shocks, we do not conduct the cointegration estimation, instead the structural VAR in first-difference.

little change in shocks correlation for Hong Kong during the respective periods. It is interesting to note that the regional financial crisis has improved the significance of shock correlations between these economies. However, these results may not be able to reflect the on-going process and to reveal the dynamics of convergence in shocks. We then estimate the time-varying coefficients specified in equation (5) by using the Kalman filter technique.

Convergence toward China is defined to be evident if the estimated time-varying coefficients trend downwards, approaching to zero; and weak if constant but not necessarily zero or declines over the latest part of the sample (see also Boone, 1997; Babetskii et al., 2004). As α-coefficient represents "autonomous" convergence and should have an expected value of zero over the long-run, we focus on β-coefficient only.[13] Figures 3 and 4 present the shock convergence of Hong Kong and Taiwan to Mainland China against respectively the U.S. and Japan as an alternative attractor.[14] The results show that the convergence patterns in both cases are similar. With the U.S. as an alternative attractor, Taiwan's supply shocks seem to remain stable and converge to Mainland China only in recent years; while Hong Kong appears to have converged toward China, especially since the 1990s, although this convergence process is not completed. When using Japan as the alternative attractor, both Taiwan and Hong Kong show a diverging trend from China during the 1990s and exhibit weak convergence toward China after 2000. This finding is in line with our early discussion that the increasing trade and business linkages among the Greater China economies have shaped

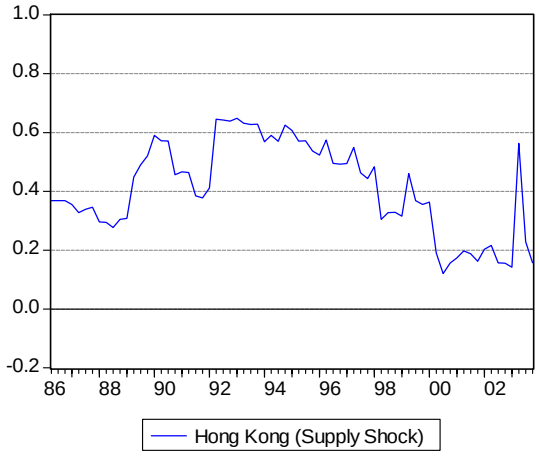
[13] We conducted the unit-root test (the ADF test) without constant and trend for the estimated time-varying α-coefficients and found that they are stationary in level.

[14] We have also conducted estimations of equation (5) with the US or Japan as a leading country and China an alternative attractor, and the results are very similar to the reported.

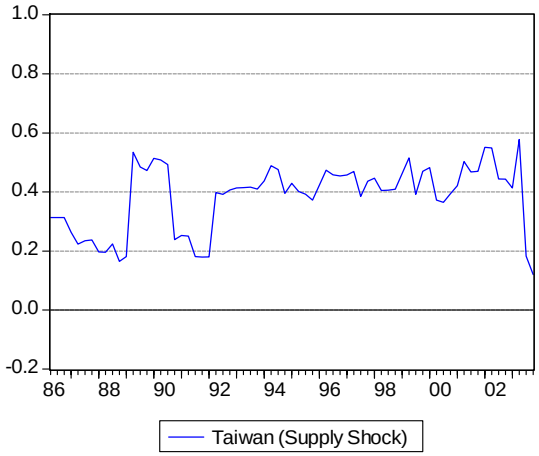
these economies structurally. Given the transition status of the Chinese economy toward market, it is not surprising to note the existence of structural difference and the incompleteness of the convergence process. However, it is important to see the trend of convergence in recent years. In favor of a dynamic process, we may conclude that there is a rising structural symmetry between those economies.

Figure 3. Convergence to Mainland China as opposed to the USA: β-coefficients

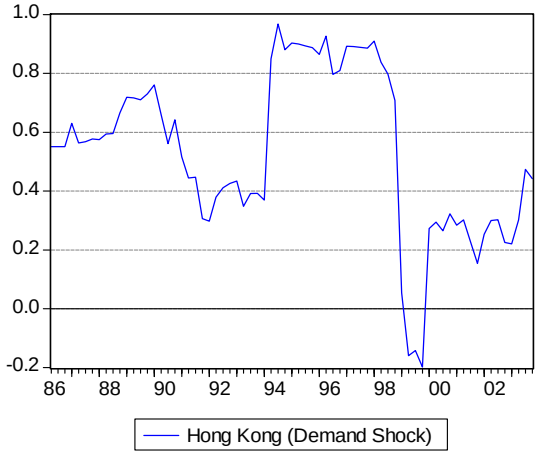
a) Supply Shock: Hong Kong



b) Supply Shock: Taiwan



c) Demand Shock: Hong Kong



d) Demand Shock: Taiwan

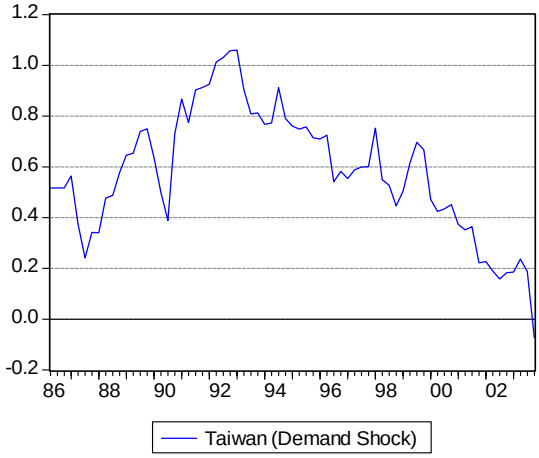
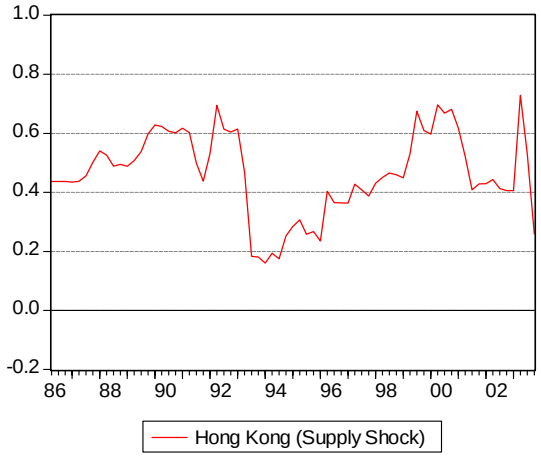
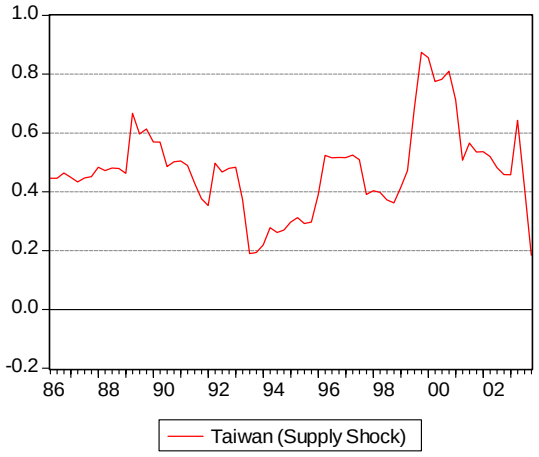


Figure 4. Convergence to Mainland China as opposed to Japan: β-coefficients

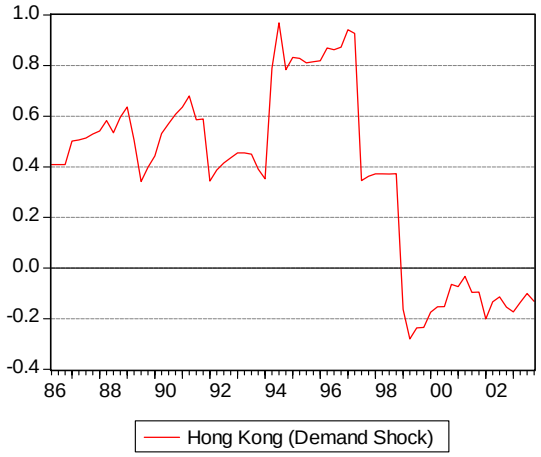
a) Supply Shock: Hong Kong



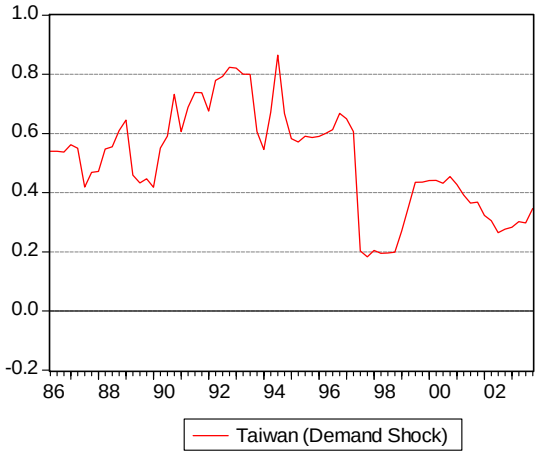
b) Supply Shock: Taiwan



c) Demand Shock: Hong Kong



d) Demand Shock: Taiwan



In contrast, convergence in demand shocks is much more evident than in supply shocks. Both Hong Kong and Taiwan show a clear convergence trend in demand shocks to Mainland China, especially since the early 1990s. As demand shocks are transitory and essentially policy induced/corrected, the results indicate that business cycles among these economies have become more synchronized. As a matter of fact, the deflationary pressure exerted by China on the Hong Kong price level is a manifestation of the close ties and

business cycles synchronization between the two economies (Cheung, Chinn and Fujii, 2003).

For comparison purposes, we have also estimated the shock convergence for the rest of East Asian economies (see Appendix Figures B1-B4). Concerning the supply shocks, it is interesting to note that with the U.S. as the alternative attractor, Korea, Singapore, Indonesia, Malaysia and Thailand converge with a clear trend to China, whereas the β coefficient shows a considerable increase in 2003. However, when using Japan as the alternative reference, the six economies diverge from the Chinese pattern of supply shocks or exhibit a weak convergence after 2000. For demand shocks, the convergence trend of these East Asian economies to the demand shocks pattern of China is very evident, especially since the middle of the 1990s, in both cases of using the U.S. and Japan as the alternative reference. This finding implies the increasing importance of China as an emerging economy in the region, and to certain context it also indicates that macroeconomic policies implemented in these economies have become more cooperative.

4.3 Sensitivity Analysis of Forming a Currency Union

If countries adopt a common currency, they typically relinquish the monetary policy autonomy and conduct a common stabilization policy in the union. However, if each economy faces idiosyncratic shocks, such common monetary policy cannot work well as stabilizing instruments and, hence, the cost of joining a currency union will be quite large. In this section, we conduct a sensitivity study by employing the output loss

function analysis approach to assess the costs of forming a currency union between the Greater China economies.

Following Ghosh and Wolf (1994) and Cheung and Yuen (2003), we employ the following output loss function to assess the country's output costs of joining a currency union and pursuing a common monetary policy:

$$L_t = 1 - \exp\left[(\varepsilon_t - \varepsilon_t^c)\alpha/(1-\alpha)\right] \text{ if } \varepsilon_t < \varepsilon_t^c, \qquad (8)$$

where ε_t denotes the productivity shock to the individual country, ε_t^c the shock to the currency union, and α the labor share.[15] Before joining a currency union, individual countries conduct their own monetary policy and react to shocks to maintain full employment under the assumption of nominal wage rigidity. After joining a currency union, however, member countries have no choice but to use a common monetary policy to accommodate a union-wise shock. Unless the individual shocks are equal to the union-wide ones, member countries will suffer from the output loss caused by joining a currency union and renouncing their own monetary policy autonomy. Whereas this is a highly simplified model, it enables us to assess empirically the costs of forming a currency union.

[15] See Appendix A for the details of the Ghosh and Wolf (1994) model.

Table 4. The Average Output Losses in Percentages: Group A (China, Taiwan and Hong Kong; Weighted Average)

	1986-2003	1986-1990	1991-1996	1997-2003
α=0.7				
China	0.144	0.204	0.111	0.135
Taiwan	0.230	0.118	0.186	0.336
Hong Kong	0.242	0.213	0.252	0.252
α=0.6				
China	0.106	0.152	0.081	0.099
Taiwan	0.193	0.105	0.146	0.287
Hong Kong	0.202	0.181	0.212	0.206
α=0.5				
China	0.077	0.112	0.058	0.072
Taiwan	0.157	0.088	0.112	0.237
Hong Kong	0.164	0.150	0.173	0.165
α=0.4				
China	0.055	0.080	0.041	0.051
Taiwan	0.122	0.070	0.083	0.186
Hong Kong	0.128	0.119	0.135	0.127
α=0.3				
China	0.037	0.054	0.027	0.035
Taiwan	0.088	0.051	0.057	0.137
Hong Kong	0.093	0.087	0.098	0.092

Note: The output losses in percentages are calculated based on supply shocks estimated from the Blanchard-Quah method. It is assumed that a currency union consists of China, Taiwan and Hong Kong, and also that the monetary authorities in the union accommodate the GDP-weighted average of the shocks to its member countries. α is a labor share that ranges from 0.3 to 0.7.

To calculate the output loss of joining a currency union, the identified supply shocks in the previous sub-section are used in equation (8). The shocks to the currency union, ε_t^c, is defined as the GDP-weighted average of individual member country's shocks.[16] The labor share parameter, α, ranges from 0.3 to 0.7 for our analysis. We also attempt to assign a specific value to the individual country's labor share in line with the

[16] The output losses of small economies (i.e., Hong Kong and Taiwan) in terms of GDP will be far greater than those of large countries, such as Japan and China, because the losses are computed by taking GDP weighted average.

existing studies. For cost comparison purposes, we estimate the output losses for each economy (Hong Kong and Taiwan) when joining a currency union with different leading country, i.e., China or Japan. Table 4 reports the results of average output losses with different labor shares caused by the union-wide shocks for a currency union consisting of the Greater China economies only, and Table 5 reports the results of output loss when Hong Kong and Taiwan form a currency union with Japan.[17] In Table 6, we calculate the average output losses by assigning a specific labor share for each economy adopted from Young (1995, 2000) and Cheung and Yuen (2003).

It is noted from Tables 4 and 5 that the estimated output losses for the member countries are positively correlated with the labor shares. The higher the labor share, the higher the output losses would be if a currency union were formed. In the case where a currency union consists of Mainland China, Taiwan and Hong Kong, the percentage of output losses increases over time for Taiwan and declines for Hong Kong during the 1990s. It is interesting to note that, when a currency union is formed with Japan, the average output costs decline over time for Hong Kong and increase for Taiwan during the 1990s. Moreover, the estimated output losses for each economy in this case would be larger than forming a currency union with Mainland China. The results suggest that it would be more costly for Hong Kong and Taiwan to form a currency union with Japan than with China.

[17] We chose not the U.S. but Japan as an alternative leading country, because our preliminary analysis of correlation in supply shocks shows that Taiwan and Hong Kong are far more correlated with Japan than the U.S.

Table 5. The Average Output Losses in Percentages: Group B (Japan, Taiwan and Hong Kong; Weighted Average)

	1986-2003	1986-1990	1991-1996	1997-2003
α=0.7				
Japan	0.054	0.023	0.082	0.049
Taiwan	0.273	0.266	0.164	0.369
Hong Kong	0.322	0.377	0.309	0.299
α=0.6				
Japan	0.037	0.015	0.056	0.032
Taiwan	0.234	0.240	0.129	0.320
Hong Kong	0.276	0.321	0.267	0.257
α=0.5				
Japan	0.025	0.010	0.039	0.022
Taiwan	0.195	0.208	0.099	0.269
Hong Kong	0.227	0.265	0.220	0.211
α=0.4				
Japan	0.017	0.007	0.027	0.015
Taiwan	0.155	0.170	0.073	0.216
Hong Kong	0.178	0.210	0.172	0.164
α=0.3				
Japan	0.011	0.004	0.018	0.010
Taiwan	0.115	0.129	0.050	0.162
Hong Kong	0.130	0.155	0.125	0.120

Note: The output losses in percentages are calculated based on supply shocks estimated from the Blanchard-Quah method. It is assumed that a currency union consists of Japan, Taiwan and Hong Kong, and also that the monetary authorities in the union accommodate the GDP-weighted average of the shocks to its member countries. α is a labor share that ranges from 0.3 to 0.7.

Table 6. The Average Output Losses in Percentages for Specific Labor Shares

	1986-2003	1986-1990	1991-1996	1997-2003
Group A: China, Taiwan and Hong Kong				
China	0.106	0.152	0.081	0.099
Taiwan	0.249	0.124	0.208	0.361
Hong Kong	0.210	0.188	0.220	0.215
Group B: Japan, Taiwan and Hong Kong				
Japan	0.035	0.015	0.054	0.031
Taiwan	0.291	0.276	0.182	0.392
Hong Kong	0.285	0.332	0.276	0.265

Note: Labor share: 0.60 for China, 0.59 for Japan, 0.749 for Taiwan, and 0.62 for Hong Kong (see Young 1995 and 2000).

When we assign a labor share estimated by Young (1995, 2000) to our estimations, the above argument does not change much (see Table 6). The results still indicate that the estimated output losses would be smaller for Hong Kong and Taiwan to form a currency union with Mainland China than with Japan.

4. Concluding Remarks

Despite of the political deadlock and military confrontation in the Taiwan Strait, the Greater China economies have experienced rapid integration in the past few decades, which is believed to have shaped their own economic structure and has direct implications for the effectiveness of domestic stabilization policy and policy coordination. In this study, we have used a dynamic measure of shock convergence to assess if there is an increasing symmetry in shocks among the Greater China economies, in particular, to assess whether there is a process of convergence at work during the sample period in 1986-2003. The results show that Hong Kong displays a pattern of supply shocks that looks increasingly similar to that of China, while there is little indication of convergence for Taiwan except during the recent years. Most importantly the results indicate an on-going process of convergence. The demand shocks of Hong Kong and Taiwan have become increasingly synchronized with the Mainland, which to certain extent may reflect the capacity of these two economies to mimic the policy mix of the mainland Central Banks.

We have conducted a sensitivity analysis of forming a currency union between the

Greater China economies versus the one consisted of Japan, Hong Kong and Taiwan. The results show that the estimated output losses of forming a currency union would be far greater in the latter case than with Mainland China. This finding provides additional evidence to our conclusion that there is an increasing trend of shocks symmetry among the Greater China economies and, hence, these economies would not suffer too much from abandoning their monetary policy as an instrument of absorbing shocks.

Appendix A: Analysis of Output Losses

Ghosh and Wolf (1994) set up a simple macroeconomic model and assume that nominal wage is only rigid downward. Let a country's output at time *t* be given by:

$$Q_t = e^{\theta_t} l_t^{\alpha}, \qquad \text{(A1)}$$

where θ_t is a productivity shock, l_t is labor employed in period *t*, and $0 < \alpha < 1$ is a labor share. The real wage is equal to the marginal product of labor. The nominal wage is assumed to be set based on information available at $t-1$ to reach labor market equilibrium:

$$\log(w_t) = \log(E_{t-1} p_t) + \log(\alpha) + E_{t-1}\theta_t + (\alpha - 1)\log(\bar{l}), \qquad \text{(A2)}$$

where p_t is the price level, E_{t-1} is the expectations operator based on information available at $t-1$, and $\bar{l}$ is the equilibrium employment level.

As nominal wages are downward sticky, the *ex post* labor demand is conditional on whether the unexpected productivity shock, ε_t ($\equiv \theta_t - E_{t-1}\theta_t$), is positive or negative. If the unexpected productivity shock is positive, nominal wages are assumed to adjust so that full-employment can prevail. If the unexpected productivity shock is negative, however, nominal wages do not go down and the *ex post* labor demand, l_t, is given by:

$$\log(p_t) + \log(\alpha) + \theta_t + (\alpha - 1)\log(l_t) = \log(w_t). \qquad \text{(A3)}$$

If the country is not a member of a currency union, it conducts discretionary monetary policy to offset an adverse shock and set the price at the following level to restore labor market equilibrium:

$$\log(p_t) - \log(E_{t-1} p_t) = -\varepsilon_t. \qquad \text{(A4)}$$

From equations (A2) and (A3),

$$\begin{aligned} \log(p_t) + \log(\alpha) + \theta_t + (\alpha - 1)\log(l_t) &= \log(w_t) \\ &= \log(E_{t-1} p_t) + \log(\alpha) + E_{t-1}\theta_t + (\alpha - 1)\log(\bar{l}). \end{aligned} \qquad \text{(A5)}$$

Suppose, instead, that the country forms a currency union with another country. Let the productivity shock to the currency union be ε_t^c, a weighted average shock to the two member countries. It is also assumed that the monetary authorities in the currency union pursue a stabilization policy similar to equation (A4) and, hence, the price level (p_t^c) in the currency union is set based on:

$$\log(p_t^c) - \log(E_{t-1} p_t^c) = -\varepsilon_t^c. \qquad \text{(A6)}$$

Then, the *ex post* labor demand when forming the currency union is given by:

$$l_t / \bar{l} = \exp[(\varepsilon_t - \varepsilon_t^c)/(1-\alpha)], \qquad \text{(A7)}$$

and output, Q_t^c, is given by:

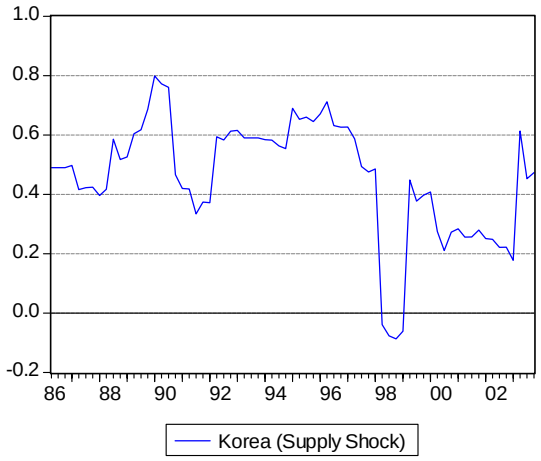
$$Q_t^c / Q_t = (e^{\theta_t} l_t^{\alpha})/(e^{\theta_t} \bar{l}^{\alpha}) = \exp[(\varepsilon_t - \varepsilon_t^c)\alpha/(1-\alpha)]. \qquad \text{(A8)}$$

Accordingly, when $\varepsilon_t < \varepsilon_t^c$, the stabilization policy (A6) does not lead to full employment for the member country concerned, and the country's output loss in percentage term is given by:

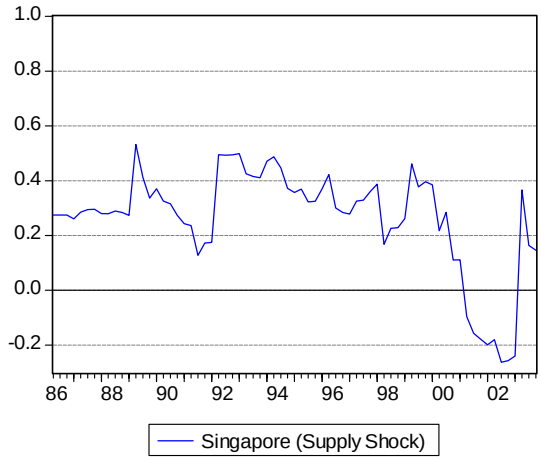
$$L_t = 1 - \exp\left[(\varepsilon_t - \varepsilon_t^c)\alpha/(1-\alpha)\right] \text{ if } \varepsilon_t < \varepsilon_t^c. \qquad \text{(A9)}$$

Appendix Figure B1: Convergence to Mainland China as opposed to the USA: β-coefficients for supply shocks

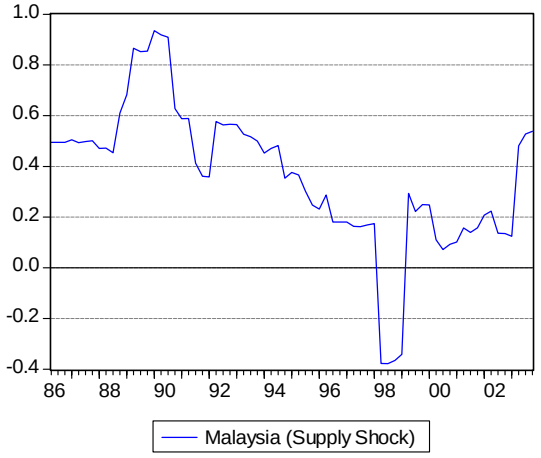
a) Supply Shock: Korea



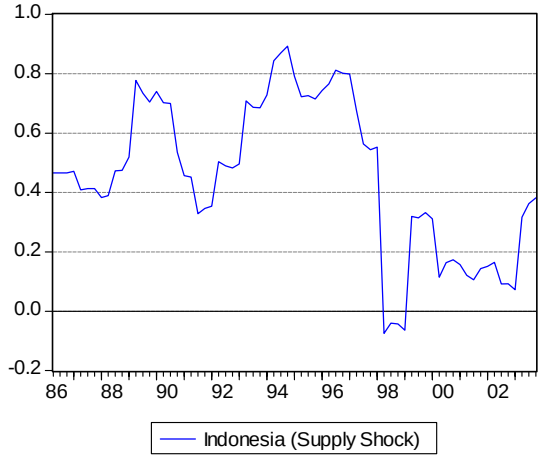
b) Supply Shock: Singapore



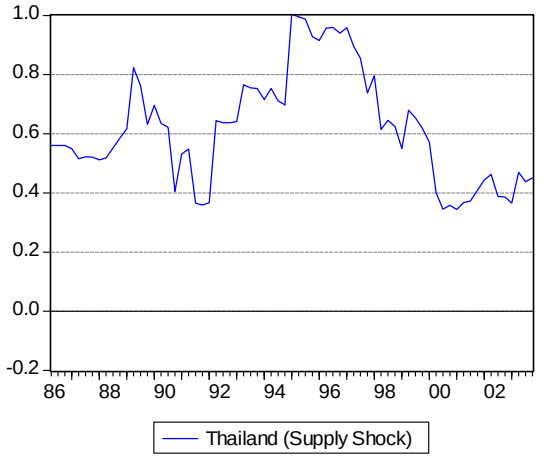
c) Supply Shock: Malaysia



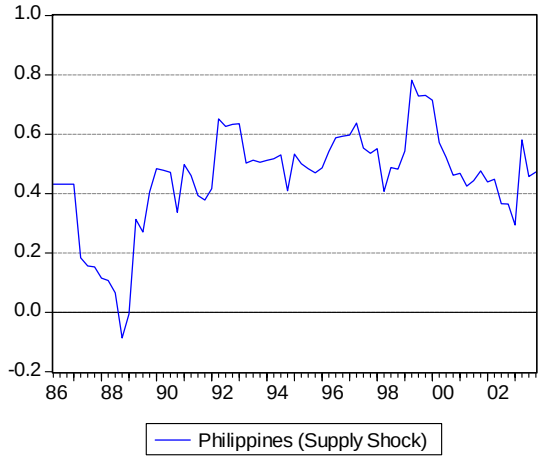
d) Supply Shock: Indonesia



e) Supply Shock: Thailand

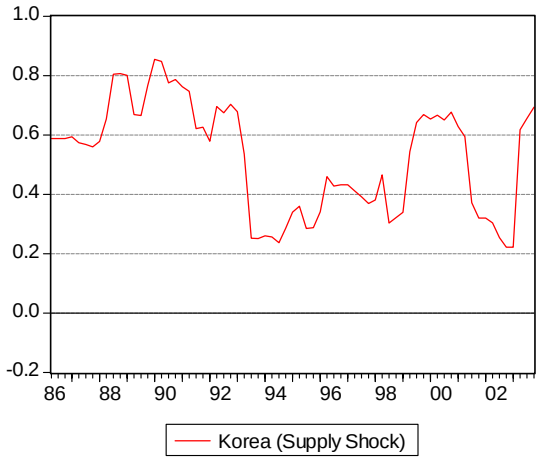


f) Supply Shock: The Philippines

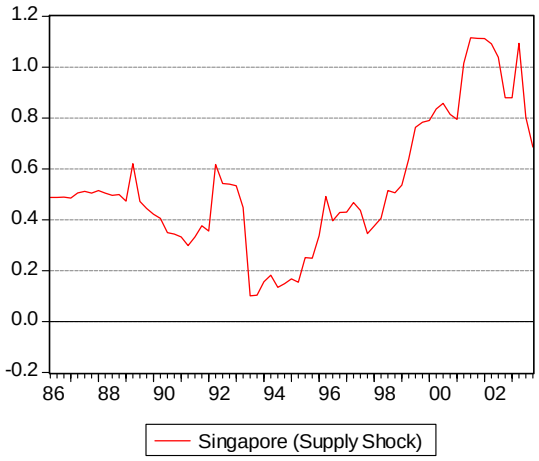


Appendix Figure B2: Convergence to Mainland China as opposed to Japan: β-coefficients for supply shocks

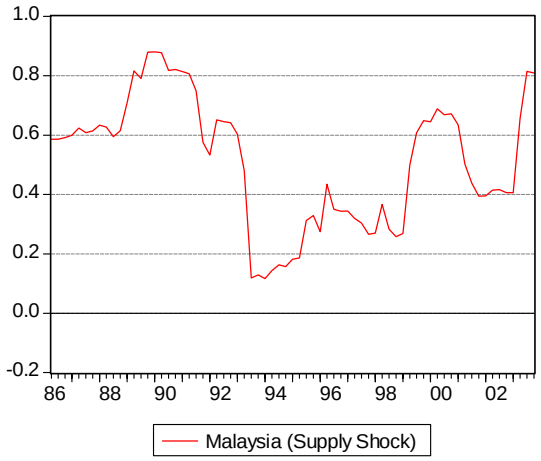
a) Supply Shock: Korea



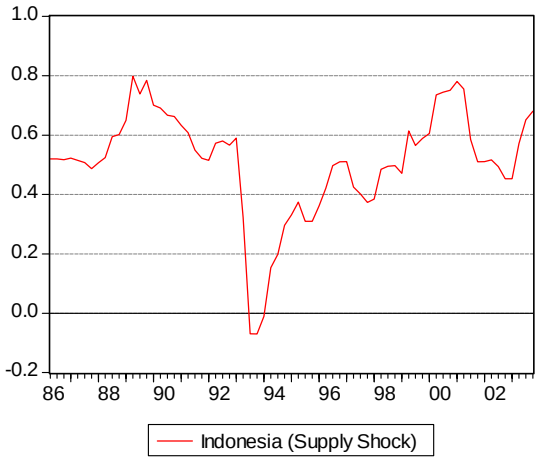
b) Supply Shock: Singapore



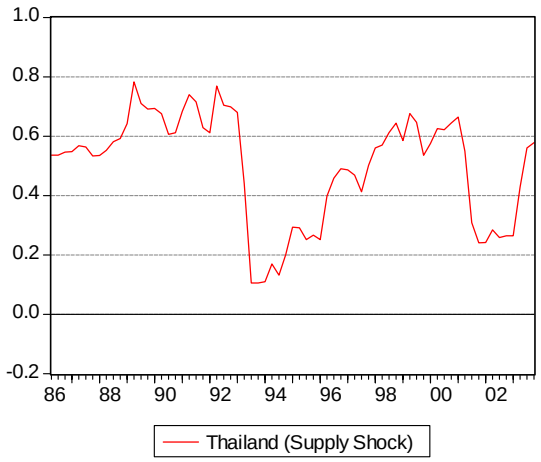
c) Supply Shock: Malaysia



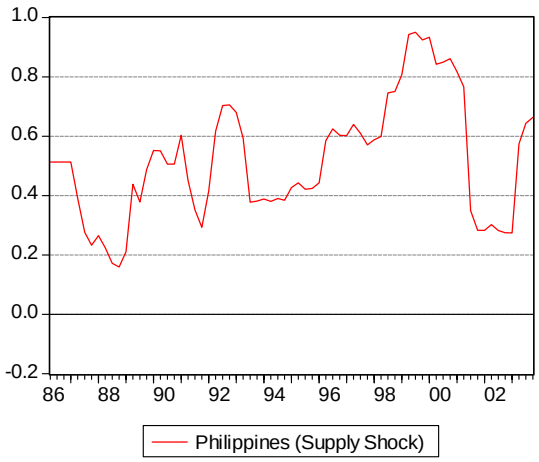
d) Supply Shock: Indonesia



e) Supply Shock: Thailand

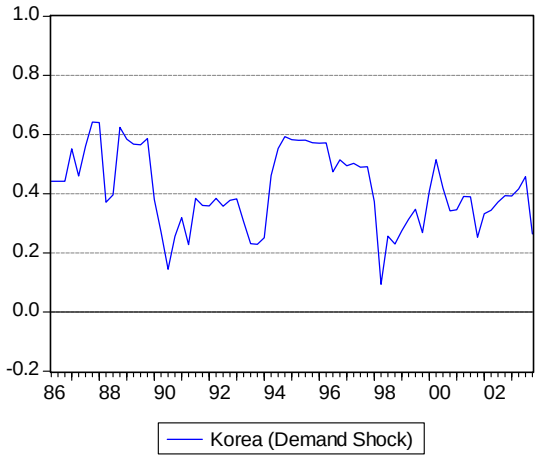


f) Supply Shock: The Philippines

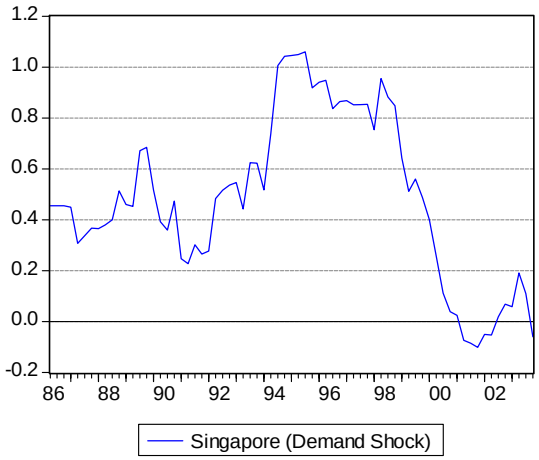


Appendix Figure B3: Convergence to Mainland China as opposed to the USA: β-coefficients for demand shocks

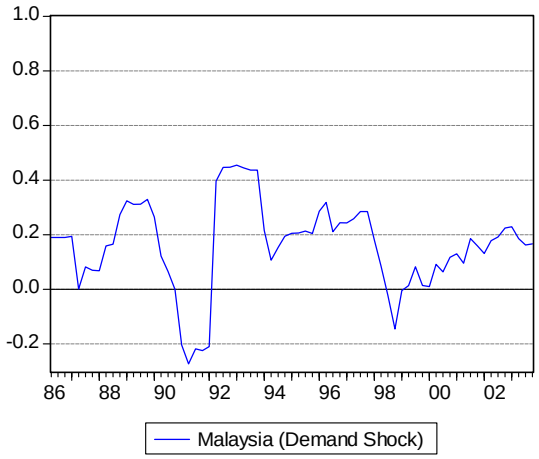
a) Demand Shock: Korea



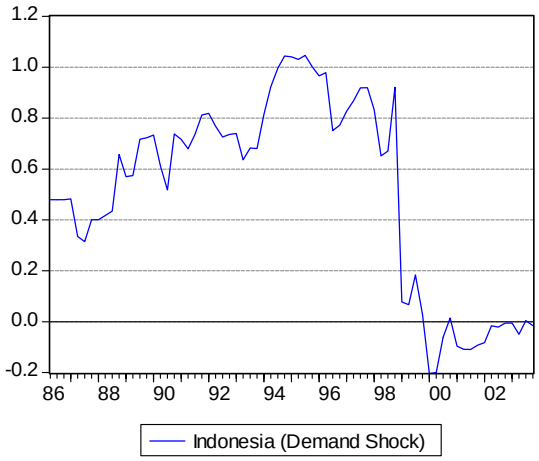
b) Demand Shock: Singapore



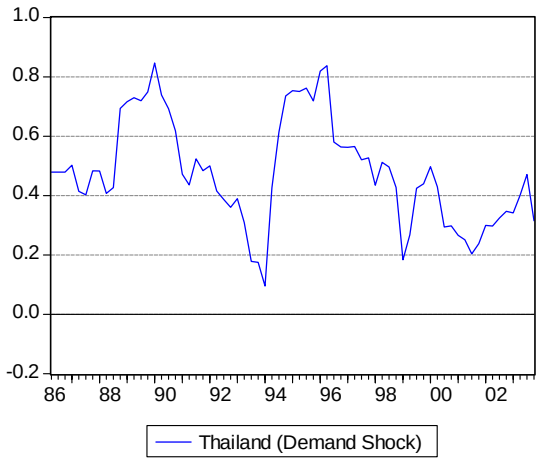
c) Demand Shock: Malaysia



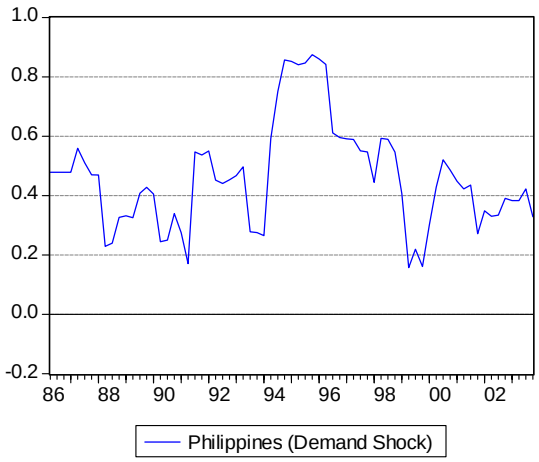
d) Demand Shock: Indonesia



e) Demand Shock: Thailand

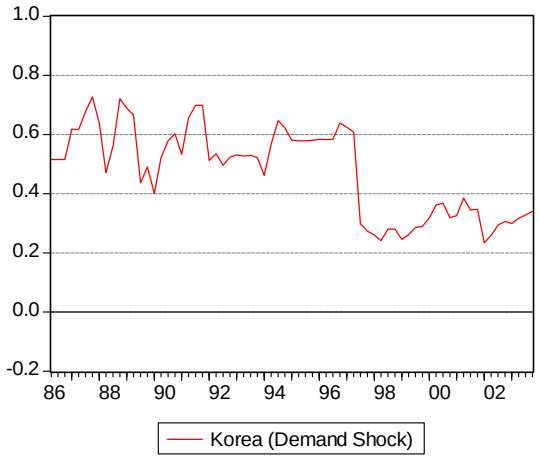


f) Demand Shock: The Philippines

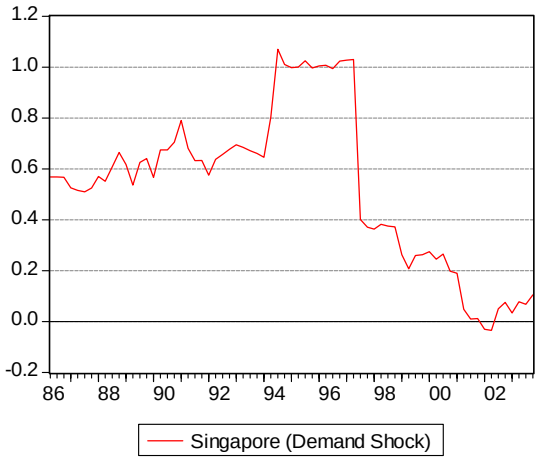


Appendix Figure B4: Convergence to Mainland China as opposed to Japan: β-coefficients for demand shocks

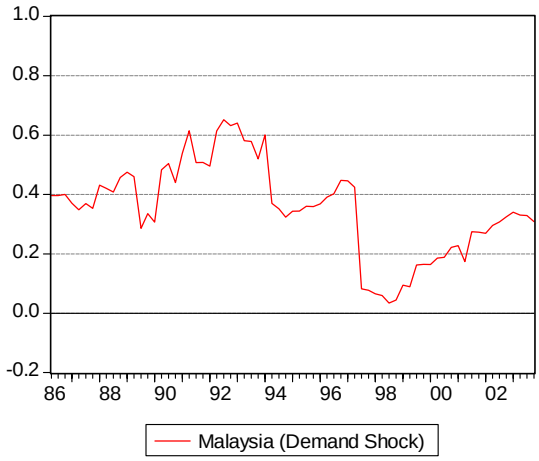
a) Demand Shock: Korea



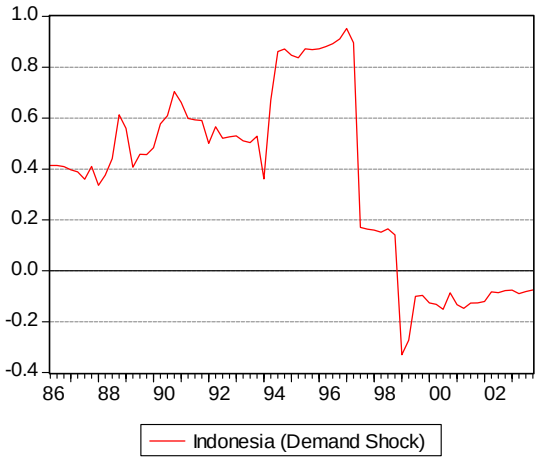
b) Demand Shock: Singapore



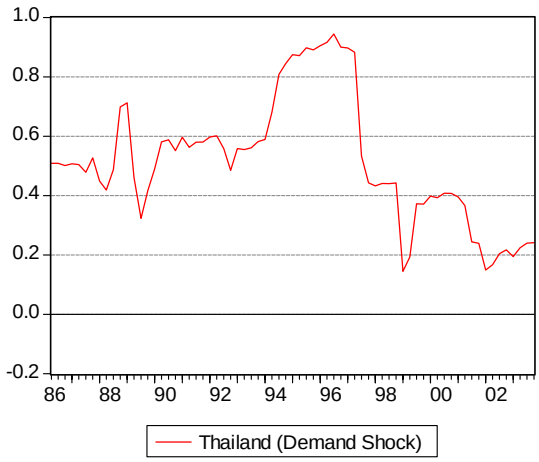
c) Demand Shock: Malaysia



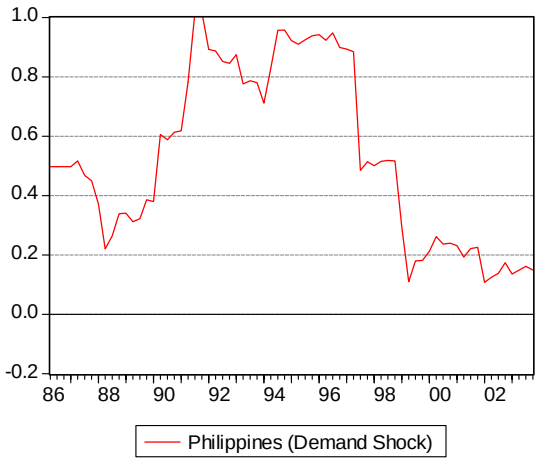
d) Demand Shock: Indonesia



e) Demand Shock: Thailand



f) Demand Shock: The Philippines



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