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Reliability of Structural Shocks Estimates from a Bivariate SVAR Model: The Case of Southeast Asian Countries

In order to assess the symmetry in the nature of structural shocks for a bloc of countries to form a currency union, long-run identifying restrictions to simple bivariate models are often used. This study attempts to assess the reliability of the estimated structural shocks produced from applications of these kinds of models by looking at their consistency in representing the designated shocks. The case examined covers some countries in the Southeast Asian bloc. The finding suggests that the commingling shocks problems exist. Exercise using larger models and higher frequency data is then advisable.

1. Introduction

The issue of financial integration in East Asia has received growing attention in past decades. The 1997 Asian financial crisis intensified the issue, and led to calls a common currency and coordinated exchange rate system in the region. These developments have revived the question of whether or not the East Asian region satisfies the requirements set out in the theory of optimum currency areas (OCA).

According to this theory, countries that seek a common monetary arrangement should meet some necessary level of political preconditions as well as standard economic criteria. The necessary political preconditions include a readiness to establish a trans-national institution capable of lending credibility to the commitment to jointly defend the currency pegs of the participating countries. The general standard economic criteria for OCA are as follows: (i) greater intra-regional trade; (ii) symmetry in the nature of economic/structural shocks; and, (iii) similarities in terms of past macroeconomic policies, stage of development and financial systems.

As far as the standard economic criteria for an OCA are concerned, considerable work has been done to assess the symmetry of structural shocks. Since structural shocks are generally not observable in published data sets, they are usually estimated using long-run identification restrictions such as those suggested by Blanchard and Quah (1989). The objective of this study is to assess the reliability of these estimated structural shocks (supply shock in particular)[1] produced by the long-run identifying restrictions for some Southeast

Asian countries as identified in earlier work by Bayoumi and Eichengreen (1994).[2] If the estimated structural shocks were not reliable, then some corrections would need to be in order to get a better measure for assessing the criteria. The findings of this study will then assess the reliability of those estimates for some Southeast Asian countries and suggest some potential corrections for estimation strategies.

The structure of this study is as follows. Section 2 presents a brief literature review concerning the issue. In section 3 the methodology used for assessing the issue is discussed. Section 4 presents a description of the data. Section 5 provides the empirical results and analysis; and section 6 summarises the main conclusions.

2. Literature review

In their seminal paper, Bayoumi and Eichengreen (1994) apply the Blanchard and Quah (1989) long-run identifying restriction to a bivariate vector auto-regression (VAR) system to uncover the structural shocks for a number of countries in the Americas, Western Europe and East Asia regions. Based on the positive correlation of their estimated supply shocks, the authors identify three potential regional groupings of economies to form a currency area that face similar underlying disturbances. In their Southeast Asian bloc, they include Hong Kong, Indonesia, Malaysia, Singapore and possibly Thailand.

In support of the earlier findings, Bayoumi, Eichengreen and Mauro (1999) and Bayoumi and Mauro (1999) extend the analysis by focusing on broader indicators for the possibility of the five largest members of ASEAN (Association of Southeast Asian Nations), namely Indonesia, Malaysia, Singapore, Thailand and the Philippines, forming a currency union. They conclude that in terms of economic pre-requisites, these ASEAN countries are not in a significantly worse position than the EU before the signing of Maastricht Treaty in 1992.

On the issue of the symmetry in the nature of economic shocks, these papers all rely on the estimated structural shocks produced by a bivariate structural VAR (SVAR) system. This approach was put forward initially by Blanchard and Quah (1989), where they assign a long-run identifying restriction to a bivariate VAR system containing output and unemployment using U.S. data. Bayoumi and Eichengreen (1994) estimated the same system with output and inflation instead of unemployment, for their sample countries. Blanchard and Quah (1989) cautioned about aggregating many types of shocks into a single demand and supply shock specification. The authors, therefore, suggested at least two possible extensions: examining the co-movements of the estimated structural shocks with larger sets of macroeconomic variables; and enlarging the system by incorporating more variables.[3]

These extensions, besides identifying more specific types of shocks in the case of enlarging the VAR system, are also valuable for checking the reliability of the estimated structural shocks produced by imposing long-run identifying restrictions on such a small system. The estimated structural shocks from a bivariate VAR system could potentially involve a commingling of supply and demand shocks due to the aggregation process. For example, the estimated supply shock may potentially be carrying some types of demand shocks due to the problems emanating from shock aggregation and/or time aggregation issues. Faust and Leeper (1997) set out some propositions for valid shock aggregations and also some empirical strategies to assess the issue.

In their paper, Faust and Leeper (1997) confront their set-up conditions to the findings from estimating different specifications of a small model. In their case, they estimate two sets of structural shocks using the Blanchard and Quah model (the income-unemployment or the YU-model) and the Bayoumi and Eichengreen model (the income-prices or the YP-model) for the U.S. data set. They find that the coefficient of correlation between the YP-supply shock and the YU-demand shock (0.56) is higher than its correlation with the YU-supply shock (0.20). Hence, there is an indication of a probable commingling of the underlying supply and demand shocks. Gottschalk and Zandweghe (2001) also come to a similar conclusion when applying the methodology to a German data set. In terms of the time aggregation issue, Faust and Leeper find that the identified supply shock estimated from the YU-model involves substantial commingling with the demand shock, while this is not the case for the estimated structural shocks from the YP-model.

3. Methodology

As mentioned earlier, the aim of this project is to conduct an evaluation of the reliability of the estimated structural shocks for the Southeast Asian bloc of countries that are identified by Bayoumi and Eichengreen (1994) as a potential group to form a currency area. In order to evaluate the reliability of the estimated underlying structural shocks for those specified countries, we employ the YP-model from Bayoumi and Eichengreen (1994). Bayoumi and Eichengreen identified their bivariate SVAR model based on the aggregate demand (AD) – aggregate supply (AS) framework. They assume that the AD shock has no long-run effect on output but has a permanent effect on price, while the AS shock has a permanent effect on both variables. This section consists of two subsections covering the methodology to estimate the structural shocks and to assess its reliability.

3.1 Estimating structural shocks

Following the YP-model, the specification of interest is set up as follows:

$$\begin{bmatrix} \Delta y_t \\ \Delta p_t \end{bmatrix} = \begin{bmatrix} c_{y1}(L) & c_{y2}(L) \\ c_{p1}(L) & c_{p2}(L) \end{bmatrix} \begin{bmatrix} u_{dt} \\ u_{st} \end{bmatrix} \quad (1)$$

or, $$X_t = C(L)u_t$$

where, Δy_t is the first difference of the log of real gross domestic product (GDP) measure (hence measuring economic growth) and Δp_t is the difference of the log of the real GDP deflator (hence measuring inflation). $c_{ij}(L)$; i=(y,p) and j=(1=demand shock, 2=supply shock). u_{dt} is the demand shock at time t and u_{st} is the supply shock at time t.

Since u_{dt} and u_{st} are unobservable, they are estimated by first estimating the following unrestricted VAR model:

$$X_t = A(L)X_{t-1} + e_t \quad (2)$$

Where, $X_t^{\mathrm{T}} = [\Delta y_t, \Delta p_t]$; $A(L)$ is the 2x2 matrix with elements equal to $a_{ik}(L)$; k represents column; and $e_t^{\mathrm{T}} = [e_{yt}, e_{pt}]$, the vector of error terms from the two equation in the bivariate system. The next step is to convert the VAR model in (2) into its vector moving average (VMA) representation as follows:

$$X_t = (I - A(L))^{-1} e_t \quad (3)$$

Except for being expressed in different variables, (1) and (3) are exactly the same. Therefore: $(I - A(L))^{-1} e_t = C(L)u_t$. By assuming that u_{dt} and u_{st} follow a white noise process and normalising their variance to be equal to 1, and by imposing the long-run identifying restriction for the demand shock effects on output ($\Sigma c_{y1}(L)$=0), we have enough information to estimate the contemporaneous parameters u_{dt} and u_{st} ($c_{ij}(0)$).

Using the estimated $c_{ij}(0)$ above, we can then calculate the estimated values for the structural shocks. From (2), e_{it} is the one step ahead forecast error of Δy_t and Δp_t; while from (1), we know that those one step ahead forecast errors are $\Sigma_j c_{ij}(0)u_{jt}$. Therefore, $u_t = C(0)^{-1} e_t$.

An additional consistency check on the estimated structural shocks comes from the theoretical behaviour of the underlying model used to estimate the shocks. According to the theory, a supply shock should initially raise output and reduce price level. On the other hand, a demand shock should initially raise both output and price level. Given this feature of the underlying model, one can check the suitability of the estimated structural shocks by looking at the impulse response function produced by each shock to output and prices.

3.2 Assessing reliability

Unlike the methodology proposed by Faust and Leeper (1997) and reproduced by Gottschalk and Zandweghe (2001) for the case of Germany, this paper evaluates the shock aggregation problem by asking the question whether or not the estimated supply shock can be explained by some demand-specific policy variables. As suggested by the theory, an unanticipated policy would act as a shock to the demand side of an economy. The policy shifts the AD curve and changes the level of output and aggregate prices to a new equilibrium level.

In relation to the case of estimated structural shocks discussed previously, the policy should not be contained in the estimated supply shock. Furthermore, the estimated supply shock should also not systematically be led by those demand specific policies. In order to test this, the correlation between demand-specific policy variables and the estimated supply shock is examined. Since the correlation coefficient does not imply 'causation' (in the sense of precedence), we also use the Granger causality test to check whether or not the demand-specific policy variable helps in predicting the supply shock:

$$H_t = b + G(L)H_t + v_t \quad (4)$$

where $H_t = [u_{st}$, a demand-specific variable]; $b = [b_1, b_2]$, a vector of constant terms; $G(L)$ is a 2x2 matrix which elements are the sum of coefficients for lagged elements of H_t; $L = 1,\ldots,p$[4]; and v_t is a 2x1 vector of contemporaneous error terms.

To test the hypothesis, we basically conduct an F-test for the null hypothesis, H_0: all the parameters for lagged demand-specific variable in the supply shock equation = 0. If H_0 is rejected, then the estimated supply shock is Granger caused by the demand-specific variable. In other words, the demand-specific variable helps to predict the supply shock within a relatively short period (shortly leading the u_{st}).[5] Therefore, we have an indication that the estimated supply shock is commingled with some types of demand shocks. In other words, the estimated supply shock could not be regarded as an entirely reliable measure for the actual supply shock.

The Faust and Leeper (1997) approach is used to assess for the potential time aggregation problem. In order to characterise the similarity between the estimated structural shocks from quarterly and annual data, we need to assume that the estimates from quarterly data are correct and to assess how the estimates from annual data aggregate them. To be able to conduct the test, the annual estimated shock (supply and demand) is set as a function of four lagged quarterly shocks at the same year, that is:

$$e_{st} = V(L^4)\, u_{st} + W(L^4) u_{dt} + \eta_t \tag{5}$$

and,

$$e_{dt} = M(L^4)\, u_{st} + N(L^4) u_{dt} + \mu_t \tag{6}$$

where e and u are the estimated annual and quarterly shocks respectively. In order for the annual shocks to be consistently aggregating the quarterly ones, $W(L^4)$ in (5) and $M(L^4)$ in (6) must not be different from zero (0). Therefore, we conduct an F-test for the two hypotheses above. If the hypothesis is rejected, then there is an indication of shock commingling when annual data are used.

4. Data description and issues

This study uses both annual and quarterly data for the five countries identified earlier, namely, Hong Kong, Malaysia, Singapore, Indonesia and Thailand. To estimate the bivariate SVAR, data on real GDP (as a measure of real output) and the GDP deflator (as a measure of aggregate prices) for these countries were collected and the tests were conducted using the software program EVIEWS 4.1.

The annual data for output and prices come from the World Bank World Table (WBWT)[6] starting from 1960–2002.[7] All of the quarterly data comes from the CEIC database with different length of observation depending on availability. To avoid estimating effects caused by seasonality, all the quarterly real GDP data are seasonally adjusted.[8] Hong Kong data were collected for the period of 1973 (Q1)–2002 (Q4), Malaysia for 1991 (Q1)–2003 (Q2), Singapore for 1985 (Q1)–2003 (Q2), and Indonesia and Thailand from 1993 (Q1) to 2003 (Q2).

For the demand-specific policy variables, this study considers growth of reserve money (*RMG*) and changes in the level of short-run discount rate (*di*) as proxies of monetary policy; growth of government expenditure (*FPG*) as a proxy of fiscal policy; and change in the level of domestic currency exchange rate to the US dollar (*dER*) as a proxy for internationally induced demand effects. Both annual and quarterly data for those variables were collected for different length of observation, according to its availability, for each country.

The monetary policy data were taken from the international financial statistics (IFS) and CEIC database except for Malaysia (taken from WBWT). Hong Kong's annual interest rates were collected for the period of 1982–2002, while the quarterly data is for the period of 1982 (Q1)–2002 (Q4). Malaysia's annual *RMG* were taken from WBWT for 1960–2000, while the quarterly *RMG* and *di* were taken from CEIC database for 1991 (Q1)–2002 (Q4) and 1991 (Q1)–2003 (Q2) respectively. Singapore's annual and quarterly data *RMG* were collected for 1963–2002 and 1985Q1–2003Q2 respectively, while *di* was for 1985 (Q1)–2003 (Q2). Indonesia's and Thailand's annual and quarterly data for *RMG* and *di* were collected IFS for 1960–2002 and 1993 (Q1)–2003 (Q2) respectively.

The annual fiscal policy data were mostly came from the WBWT except for Malaysia (1971–2002) and Indonesia (1973–1999) – from CEIC database – and Thailand (1960–2002) – from the IFS. Data for Hong Kong (1977–2002) and Singapore (1964–2002) were de-trended due to the significant trend effects on the series. The trend is assumed to be largely anticipated, hence is left out in order to capture the unanticipated effect of this policy.

All the quarterly fiscal policy data were taken from CEIC database except for Indonesia where the series of quarterly data are not available. Hong Kong data are available for 1984 (Q1)–2002 (Q4), Malaysia for 1991 (Q1)–2003 (Q2), Singapore data for 1985 (Q1)–2003 (Q2) and are seasonally adjusted due to remarkable seasonality feature present in the data, and Thailand for 1993 (Q1)–2003 (Q4).

Finally, the annual *dER* data were collected from the WBWT except for Hong Kong, which is taken from the CEIC database. Hong Kong data were collected for 1980–2002, Malaysia, Singapore and Thailand for 1960–2002, and Indonesia for 1967–2002. The quarterly data were all taken from CEIC database. Hong Kong data were collected for 1980 (Q1)–2002 (Q4), Malaysia for 1991 (Q1)–2003 (Q2), Singapore for 1985 (Q1)–2003 (Q2), and Indonesia and Thailand for 1993 (Q1)–2003 (Q2).

The growth of each variable previously explained is measured by the first difference of its log value. Exception applies for the interest rate and exchange rate variables, which is measured by their first difference in levels. All the obvious seasonality and trends were corrected from the data in order to get a better measure of unanticipated shocks for each economy. The following table shows the results for the augmented Dickey Fuller (ADF) tests for each variable under consideration.

As seen in the Table 1 below, it is quite clear that all the variables of interest are stationary in the form for which they are used for the analysis. Therefore, we can proceed to the estimation of our model and the results and analysis are presented in the following section. Some variables have been stationary in levels, like the annual log of reserve money in Malaysia, and both annual and quarterly interest rates in Hong Kong. However, since

Table 1 ADF unit root test

Variable		Hong Kong Annual	Hong Kong Quarterly	Malaysia Annual	Malaysia Quarterly	Singapore Annual	Singapore Quarterly	Indonesia Annual	Indonesia Quarterly	Thailand Annual	Thailand Quarterly
y	Level	0.41	6.78	–.048	2.86	–0.65 (detrended)	4.86	3.27	1.22	–0.39 (detrended)	1.43
	First differences	–2.51**	–3.01***	–5.38***	–3.54***	–4.69***	–2.99***	–2.39**	3.91***	–3.63***	–3.71***
p	Level	–0.93 (detrended)	1.38	3.74	2.77	1.66	3.60	–0.81	1.82	2.38	2.67
	First differences	–2.42**	–2.50**	–4.30***	–5.29***	–2.37**	–3.55***	–2.64***	–3.11***	–2.64***	–4.95***
rm	Level			–1.85* (detrended)	1.65	–0.69 (detrended)	5.57	3.65	3.78	–1.01 (detrended)	3.38
	First differences			–3.86***	–5.81***	–3.28***	–2.91***	–12.42***	–2.69***	–8.72***	–6.80***
i	Level	–1.92*	–2.07**		–1.15		–1.54		–1.25		–1.46
	First differences	–3.53***	–10.35***		–7.20***		–10.08***		–6.10***		–4.76***
fp	Level	–0.99 (detrended)	0.91	–1.22 (detrended)	0.94	–0.50 (detrended)	3.29 (SA)	3.95		2.02	1.23
	First differences	–3.74***	–2.26**	–2.33**	–6.62***	–7.14***	–12.09***	–1.81*		–1.83*	–9.82***
ER	Level	0.19	1.24	0.45	0.30	–1.56	–1.25	0.38	0.12	1.76	0.82
	First differences	–2.44**	–5.93***	–5.29***	–3.74***	–3.66***	–9.92***	–6.94***	–4.56***	–5.54***	–4.88***

Note: SA means seasonally adjusted.
Lag length for the ADF regression is selected on the basis of AIC or SIC.
*,**,*** significant at the 10%, 5% and 1% level respectively.

we are interested in the (relative) change of those variables in conducting our analysis, we still use the first difference form of those variables.

5. Empirical results and analyses

5.1 The structural shocks estimation

Using the data set discussed in the previous section, we proceed to estimate the bivariate SVAR model for each country. The lag lengths are determined using the Akaike information criteria (AIC) and/or the Schwarz information criteria (SIC).

By applying the methodology outlined in sub-section 3.1 to uncover the aggregate supply and demand shocks, the model produces sensible results for each economy under consideration. The imposed long-run identifying restriction produced stable impulse response functions (as seen in Appendixes 1 and 2). Another way to check the sensibility of the SVAR results is by checking the "over identifying" restriction as set out in 3.1. All the impulse responses produced are consistent with what suggested by the theory, that is supply shock initially raises output and reduces the price level, and demand shock initially raises both output and the price level (see Appendixes 1 and 2).

As discussed earlier in sub-section 3.1, the implied supply and demand shocks faced by each economy under consideration are estimated from the model for each country. The series of those structural shocks for both the annual and quarterly data set can be seen in the figures in Appendix 5. By decomposing the forecasted variance errors for output growth and inflation, it can be seen that in general, the variance of output growth is dominated by the supply shocks, while the variance of inflation is dominated by the demand shocks. The findings apply generally for almost all of the countries under observation and for both annual and quarterly data sets. The main exception is Indonesia's and Thailand's inflation for the quarterly data set (See Appendixes 3 and 4).

5.2 Reliability assessment

Shock aggregation issue

The coefficient of correlation between the estimated supply shock and some demand-specific policy variables for the countries under consideration is examined in order to get an insight of whether or not the estimated supply shock is closely and significantly correlated with those supposedly demand shock components. Table 2 below shows the correlation coefficients by country and by time frequency. The correlation coefficient is tested for H_0: the correlation coefficient is not different than zero (0) using t-statistics.

Table 2 Coefficient of correlation between supply shock and demand-specific policy variables

Country		Relative change in RM	Change in interest rate	Relative change in FP	Change in exchange rate
HonHong Kong	Q	–	0.05	–0.027	–0.168
	A	–	0.069	–0.109	–0.003
MalMalaysia	Q	0.21	–0.045	0.31**	0.467***
	A	0.305*	–	–0.176	–0.175
SingSingapore	Q	–0.036	0.13	–0.061	–0.099
	A	0.135	–	–0.03	–0.404***
IndoIndonesia	Q	–0.065	0.302*	–	0.29*
	A	0.40**	–	0.223	0.098
ThaiThailand	Q	0.204	0.417***	–0.24	0.409***
	A	–0.029	–	–0.154	0.044

Notes: Q and A stands for quarterly and annual respectively;
*,**,*** significant at the 10%, 5% and 1% level respectively.

From Table 2, one can see that the correlation coefficients between the measure of supply shock and all of the demand-specific policy proxies are not significantly different from zero in the case of Hong Kong. This indicates that the estimated supply shock for Hong Kong is relatively uncorrelated with the proxies of demand shock components in the model. In the case of the other countries, however, there are some indications that the estimated supply shocks are correlated with some demand shock components. In the case of Malaysia, there is an indication that the quarterly supply shock correlates with relative changes in the fiscal policy and exchange rate changes, while its annual underlying supply shock is significantly correlated with the growth of reserve money. For Singapore, the annual estimated supply shock shows significant correlation with changes in the exchange rate. For Indonesia, changes in interest rates and the exchange rate correlate significantly with the quarterly estimate of the supply shock, while the annual supply shock also significantly correlated with the growth of reserve money. In Thailand's case, the estimated quarterly supply shock is also significantly correlated with changes in interest and exchange rates.

Although some correlation coefficients are found to be significant, they do not necessarily imply causation. The policy changes could be part of a response to a supply shock rather than otherwise, or they may just appear to move together coincidentally. In this case, then, the estimated supply shocks need not necessarily contain some elements of the demand shocks.

To check for this possibility, we proceed by conducting the Granger causality test as discussed in subsection 3.2. The results of the test are as follows:

Table 3 Granger causality test results

		Hong Kong		Malaysia		Singapore		Indonesia		Thailand	
		q (lag 1)	A (lag 1)	q (lag 1)	A (lag 1)	q (lag 2)	A (lag 2)	q (lag 1)	A (lag 2)	q (lag 1)	A (lag 1)
Relative	F-stat			0.63	0.99	4.66[b]	9.60	2.02	0.18	1.54[c]	2.62
Change in	p-value			0.43	0.33	0.03	0.00	0.16	0.83	0.22	0.11
RM	Conclusion			H0 NR	H0 NR	**H0 R**	**H0 R**	H0 NR	H0 NR	H0 NR	H0 NR
Change in	F-stat	1.68	1.38	2.11[a]		0.2		0.005		2.79[a]	
interest	p-value	0.198	0.26	0.13		0.82		0.94		0.07	
rate	Conclusion	H0 NR	H0 NR	H0 NR		H0 NR		H0 NR		H0 NR	
Relative	F-stat	1.64	0.001	5.27	0.29	0.70	0.14[b]		8.85	4.3	0.03[a]
Change in	p-value	0.204	0.97	0.03	0.59	0.48	0.71		0.002	0.04	0.76
FP	Conclusion	H0 NR	H0 NR	**H0 R**	H0 NR	H0 NR	H0 NR		**H0 R**	**H0 R**	H0 NR
Change in	F-stat	0.01	0.74	2.66	1.49	3.43	13.49	0.01	35.88[b]	2.31	1.34
exchange	p-value	0.91	0.40	0.11	0.23	0.003	0.00	0.90	0.00	0.14	0.25
rate	Conclusion	H0 NR	H0 NR	H0 NR	H0 NR	**H0 R**	**H0 R**	H0 NR	**H0 R**	H0 NR	H0 NR
[a] (lag 2)											
[b] (lag 1)											
[c] (lag 4)											

Notes: H0: Demand-Specific Policy Variable does not Granger Cause Supply Shock; H0 R denotes H0 is rejected; H0 NR denotes failure to reject H0; and the rejection criteria is made for α =5%. Lag lengths are chosen based on AIC or SIC.

Table 3 shows that the estimated supply shock for Hong Kong could be regarded as relatively consistent, or reliable, since neither of the demand specific policy proxies led the supply shock within the necessary short period (four quarters). In the other cases, however, there is an indication that the estimated supply shocks are commingled with some types of demand shocks. In the case of Malaysia and Thailand, while the annual supply shock may not seem to be capturing any of the elements of demand shock considered in this study, the quarterly estimate of supply shocks are led by the relative changes in fiscal policy within the necessary short period. Therefore, there is an indication that the estimated quarterly supply shock commingled with some type of real demand shock to the economy. Singapore's case indicates that both annual and quarterly estimated supply shocks are commingled with some types of nominal and internationally induced demand shocks. In the case of Indonesia, the annual supply shocks seem to be commingled with the real and internationally induced demand shocks.

Except for evaluating the relative reliability of the structural shocks aggregation in a bivariate system, the approach employed also points to some possible sources for the type of commingling shocks. This feature may be regarded as information on a directive indication for enlarging the VAR system in order to get a better measure of the underlying structural shocks. For example, in the case of Singapore, estimating a system that explicitly separates the nominal and internationally induced demand shocks may produce a more reliable estimate of the underlying structural shocks.

Time aggregation issue

To see whether the broad features of the quarterly models are being carried over to the annual models, one can compare the forecast-error variance produced by each of the model (as reported in Appendixes 3 and 4). For the case of Hong Kong, Malaysia and Singapore, the broad features of the quarterly models are carried over to their annual models. The forecast error variances for output growth in those countries are dominated by the supply shocks, while the forecast error variances for inflation are mostly accounted for by the demand shocks. However, the role of the annual supply shocks in explaining output growth and inflation tend to be under represented relative to the role they play in the quarterly models. This resemblance in the role of the structural shocks in explaining output growth and inflation for both the quarterly and the annual models suggests that the underlying structural shocks in both models may be identified in similar ways.

The indications in the cases of Indonesia and Thailand, however, are less promising. Although features for the forecast error variance of output growth in the quarterly models are carried over to the annual models, that is not the case for the forecast error variances of inflation. In the case of Indonesia, inflation variances are mostly accounted for by supply shocks in the quarterly model, but are the other way around in the annual model. In the case of Thailand, the quarterly model shows an equally important role of the two structural shocks in explaining inflation variances. This feature also failed to be carried over into the annual model. In other words, for these last two country cases, the issue of time aggregation problems may be more pronounced, where the aggregated annual estimated supply shocks may capture some of the quarterly demand shocks.

To formally test for the time aggregation problem, we used the method suggested by Faust and Leeper (1997) as discussed in sub-section 3.2. Except for Hong Kong, the available data for most of the countries under consideration are not large enough. For that reason, only the test for Hong Kong is presented.

Table 4 shows the result of the Wald test conducted on equations (5) and (6). The results suggest that for equation (5), H_0 is rejected at 5 percent level of significance.

Table 4 Testing for time aggregation problem

Equation (5)	H_0: $W(L^4)=0$	*F*-statistics	Probability
	df:(4,21)	2.93	0.045
Equation(6)	H_0: $M(L^4)=0$	*F*-statistics	Probability
	df:(4,21)	1.996	0.132

Therefore, there is an indication that in its aggregation process, the estimated annual supply shock picked up some quarterly demand shock components. In equation (6), however, the test fails to reject H_0 at 5 percent level of confidence. One can conclude that the estimated annual demand shock for Hong Kong is purely aggregating its respective quarterly ones.

5.3 Some notes on interpretation

This section has estimated the underlying structural shocks to the economies under consideration and has investigated simple statistical correlations between the estimated supply shocks with some demand-specific policy proxies. It is demonstrated that except for the case of Hong Kong, the estimated supply shocks tend to be significantly correlated to some of the demand-specific policy proxies. A Granger causality test is performed to confirm that the correlation does not imply the containment of some demand shock components in the estimated supply shock.

Except for Hong Kong, the Granger causality tests suggested an existence of commingling shocks problems in the estimated supply shock. Therefore, the estimated structural shocks from a simple bivariate VAR system may, in this case, not be reliable. The feature of the approach used in this study enables one to obtain an indication of the possible direction of further improvement that can be made to the VAR system in order to obtain more reliable estimates of the structural shocks.[9] In the case of the quarterly model of Malaysia, and both the quarterly and the annual models of Thailand, enlarging the VAR system to explicitly separate the real demand shock may be a good direction, in terms of giving better estimates of the underlying structural shocks. In the case of the annual model of Indonesia, estimating a system that explicitly separates the real and the internationally induced demand shocks may be preferable.

One may argue that the omitted information problem in performing the Granger causality test – as suggested by Hamilton (1983) – may also be present in this case. However, since the demand-specific policy proxies used are supposedly demand shocks in theory, then even if there was an interfering variable omitted from the Granger causality test, this points to the possibility of a commingling shocks problem, but will not alter the conclusions of the test. However, it may alter the directive indication on a possible further improvement of the model.

Another point worth noting here is that even if the shock aggregation problem may not be apparent, its reliability may still be questionable due to the time aggregation problem. The estimated supply shock for Hong Kong, for example, does not appear to suffer from a shock aggregation problem. However, when confronted by the higher frequency data, the estimated quarterly demand shock seems to be picked up by the estimated annual supply shock. Hence, there is also an indication of shock commingling problem. Although the formal test could not be conducted for the case of the other countries, due to data inadequacy, a failure to carry over the broad feature of a model with higher frequency data to the one with a lower frequency data (as in the cases of Indonesia and Thailand) may also be interpreted as an indication of the presence of the commingling shocks problem.

6. Conclusion

The objective of this study is to assess the reliability of the estimated structural shocks produced by applying the Blanchard and Quah (1989) long-run identifying restrictions to a simple bivariate VAR model. The cases of interest in this study are some countries in the Southeast Asian bloc as identified by Bayoumi and Eichengreen (1994), namely Hong Kong, Malaysia, Singapore, Indonesia and Thailand.

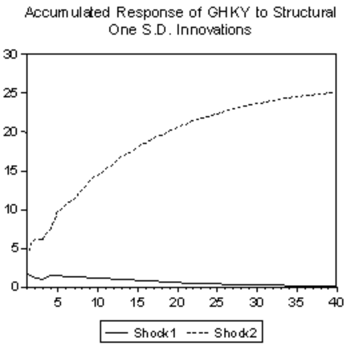
The finding from this study indicates that the commingling shocks problems appear in the identified underlying structural shocks. This result suggests the disadvantages of the low dimension of bivariate models in uncovering the structural shocks to the economy. In relation to assessing the symmetry of structural shocks for a bloc of countries, the commingling shocks problems will have important implication for the reliability of any inferences drawn from employing the models.

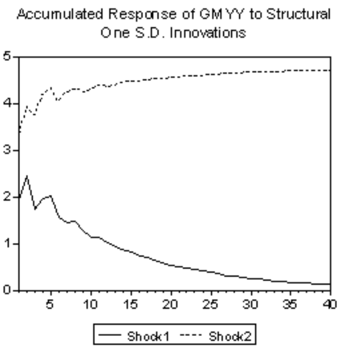
For the above reason, to improve reliability, it seems advisable to use larger models in estimating structural shocks. These larger models will help to disentangle structural shocks in a more detailed manner, thereby separating the unwanted effects in each of the estimates. However, estimating larger models would cost the convenience and all the advantages of smaller models. To this end, the methodology applied in this study could provide a simple directive indication on a possible further enlargement of the model, if needed.

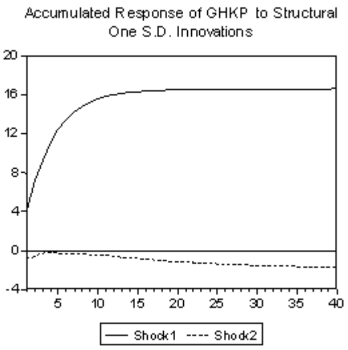
From an exercise using the Hong Kong data, there is also an indication that using higher frequency data in estimating the structural shocks could produce more desirable results by avoiding time aggregation problems. Additionally, these higher frequency data would also capture more dynamics in the data development processes, which may fail to be captured by the lower frequency ones.

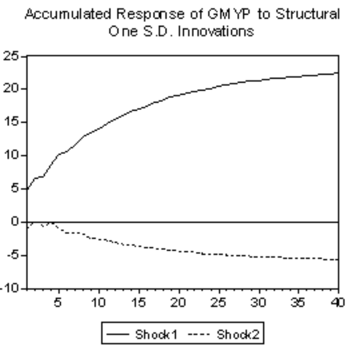
As for the issue of assessing the symmetry in the nature of structural shocks for a bloc of countries to form a currency union, in order to get a more reliable result, an exercise using models that may produce more reliable estimates of structural shocks should be preferable. This study does not provide an answer to that problem??, but indicates the need for further investigations??? in the future research agenda.

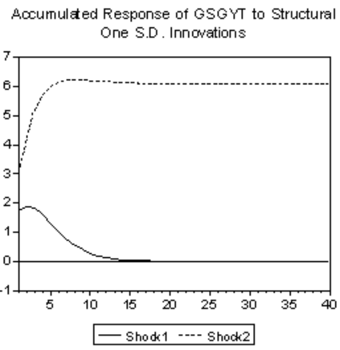
Appendix 1 Cumulative impulse responses for the annual data set

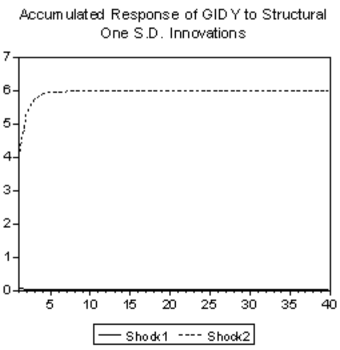


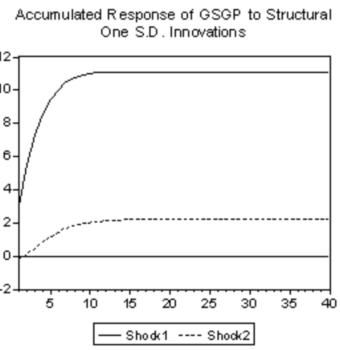


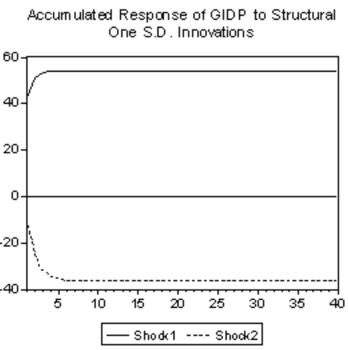


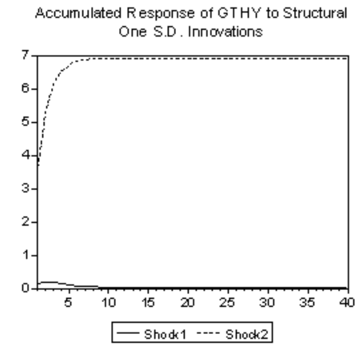


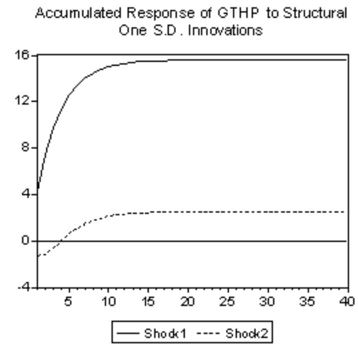






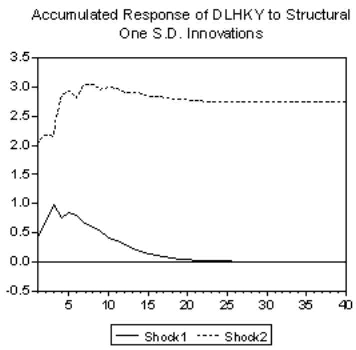


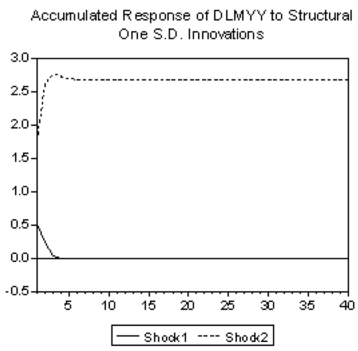


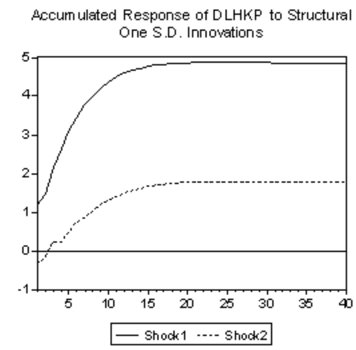


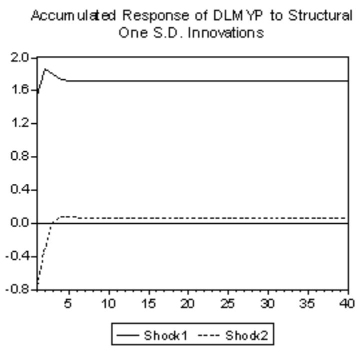
Note: Shocks 1 and 2 represent the underlying demand and supply shocks respectively; Gij (i {HK(Hong Kong), MY (Malaysia), SG (Singapore), ID (Indonesia), TH (Thailand)} and j {Y(output), P(prices)}) represents annual growth of Y and P (inflation) for country i.

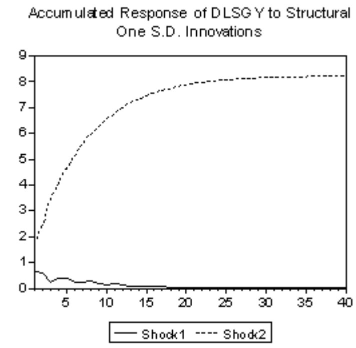
Appendix 2 Cumulative impulse responses for the quarterly data set

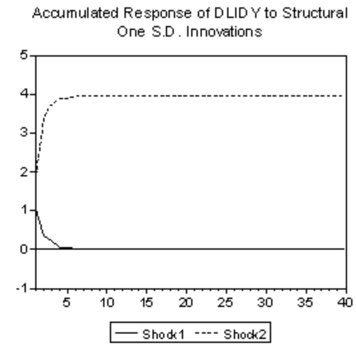


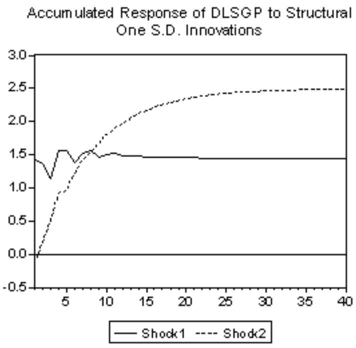


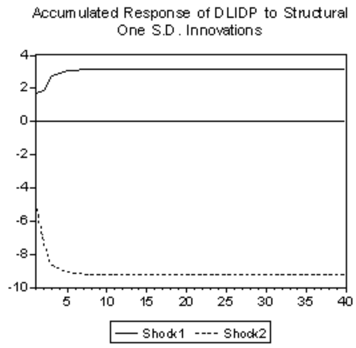


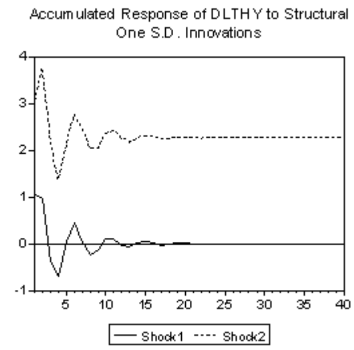


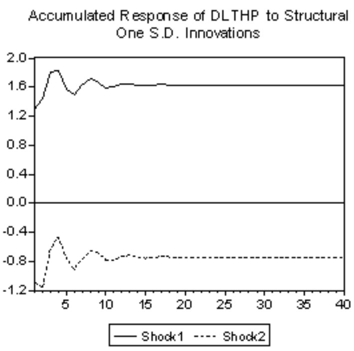












Note: Shocks 1 and 2 represent the underlying demand and supply shocks respectively; DLij (i {HK (Hong Kong), MY (Malaysia), SG (Singapore), ID (Indonesia), TH (Thailand)} and j {Y (output), P (prices)}) represents quarterly growth of Y and P (inflation) for country i.

Appendix 3 Variance decomposition from structural factorisation (annual data set)

Variance decomposition of GHKY:				Variance decomposition of GMYY:				Variance decomposition of GSGYT:			
Year	S.E.	Shock1	Shock2	Year	S.E.	Shock1	Shock2	Year	S.E.	Shock1	Shock2
1	4.40	14.97	85.03	1	3.86	25.04	74.96	1	3.51	24.16	75.84
2	4.94	12.76	87.24	2	3.94	25.74	74.26	2	3.70	21.77	78.23
4	5.19	12.60	87.40	4	4.04	27.96	72.04	4	3.86	20.46	79.54
6	5.72	10.47	89.53	6	4.08	28.78	71.22	6	3.90	21.18	78.82
10	6.05	9.41	90.59	10	4.10	29.01	70.99	10	3.92	21.90	78.10

Variance decomposition of GHKP:				Variance decomposition of GMYP:				Variance decomposition of GSGP:			
Year	S.E.	Shock 1	Shock 2	Year	S.E.	Shock1	Shock2	Year	S.E.	Shock1	Shock2
1	4.32	96.42	3.58	1	4.88	95.18	4.82	1	3.06	99.80	0.20
2	5.26	97.54	2.46	2	5.36	92.02	7.98	2	3.92	99.43	0.57
4	5.98	97.64	2.36	4	5.68	91.56	8.44	4	4.53	98.33	1.67
6	6.19	97.69	2.31	6	6.05	89.46	10.54	6	4.67	97.59	2.41
10	6.29	97.64	2.36	10	6.33	89.22	10.78	10	4.71	97.19	2.81

Variance decomposition of GIDY:				Variance decomposition of GTHY:			
Y ear	S.E.	Shock 1	Shock 2	Year	S.E.	Shock 1	Shock 2
1	3.99	0.03	99.97	1	3.46	0.16	99.84
2	4.20	0.03	99.97	2	3.88	0.13	99.87
4	4.23	0.03	99.97	4	4.00	0.13	99.87
6	4.23	0.03	99.97	6	4.01	0.14	99.86
10	4.23	0.03	99.97	10	4.01	0.14	99.86

Variance decomposition of GIDP:				Variance decomposition of GTHP:			
Year	S.E.	Shock1	Shock2	Year	S.E.	Shock1	Shock2
1	43.45	94.73	5.27	1	4.44	92.39	7.61
2	46.66	85.78	14.22	2	5.44	94.91	5.09
4	47.34	83.51	16.49	4	6.18	94.26	5.74
6	47.35	83.46	16.54	6	6.40	93.26	6.74
10	47.35	83.46	16.54	10	6.48	92.72	7.28

Note: Shocks 1 and 2 represent the underlying demand and supply shocks respectively; Gij (i∈ {HK (Hong Kong), MY(Malaysia), SG (Singapore), ID (Indonesia), TH (Thailand)} and j{Y (output),P (prices)}) represents annual growth of Y and P (inflation) for country i.

Appendix 4 Variance decomposition from structural factorisation (quarterly data set)

Variance decomposition of DLHKY:				Variance decomposition of DLMYY:				Variance decomposition of DLSGY:			
Quarter	S.E.	Shock 1	Shock 2	Quarter	S.E.	Shock 1	Shock 2	Quarter	S.E.	Shock 1	Shock 2
1	2.06	3.65	96.35	1	1.84	7.86	92.14	1	1.84	11.23	88.77
4	2.23	7.66	92.34	4	2.06	9.13	90.87	4	2.32	9.52	90.48
8	2.26	8.30	91.70	8	2.06	9.13	90.87	8	2.52	8.61	91.39
24	2.27	8.89	91.11	24	2.06	9.13	90.87	24	2.60	8.26	91.74
40	2.27	8.90	91.11	40	2.06	9.13	90.87	40	2.60	8.25	91.75

Variance decomposition of DLHKP:				Variance decomposition of DLMYP:				Variance decomposition of DLSGP:			
Quarter	S.E.	Shock 1	Shock 2	Quarter	S.E.	Shock 1	Shock 2	Quarter	S.E.	Shock 1	Shock 2
1	1.23	92.32	7.68	1	1.72	80.79	19.21	1	1.43	99.17	0.8
4	1.58	87.95	12.05	4	1.84	73.99	26.01	4	1.63	85.38	14.62
8	1.77	84.72	15.28	8	1.84	73.99	26.01	8	1.69	82.07	17.93
24	1.82	83.37	16.63	24	1.84	73.99	26.01	24	1.71	80.20	19.80
40	1.82	83.37	16.63	40	1.84	73.99	26.01	40	1.71	80.18	19.82

Variance decomposition of DLIDY:				Variance decomposition of DLTHY:			
Quarter	S.E.	Shock 1	Shock 2	Quarter	S.E.	Shock 1	Shock 2
1	2.07	25.83	74.17	1	3.23	10.39	89.61
4	2.75	21.73	78.27	4	4.01	19.06	80.94
8	2.75	21.74	78.26	8	4.28	21.97	78.03
24	2.75	21.74	78.26	24	4.31	22.22	77.78
40	2.75	21.74	78.26	40	4.31	22.22	77.78

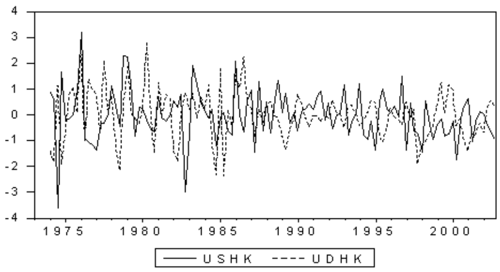
Variance decomposition of DLIDP:				Variance decomposition of DLTHP:			
Quarter	S.E.	Shock 1	Shock 2	Quarter	S.E.	Shock 1	Shock 2
1	5.15	10.65	89.35	1	1.70	58.42	41.58
4	5.92	10.60	89.40	4	1.83	54.83	45.17
8	5.92	10.68	89.32	8	1.89	53.97	46.03
24	5.92	10.68	89.32	24	1.90	53.90	46.10
40	5.92	10.68	89.32	40	1.90	53.90	46.10

Note: Shocks 1 and 2 represent the underlying demand and supply shocks respectively; DLij (i∈ {HK (Hong Kong), MY (Malaysia), SG (Singapore), ID (Indonesia), TH (Thailand)} and j{Y (output),P (prices)}) represents quarterly growth of Y and P (inflation) for country i.

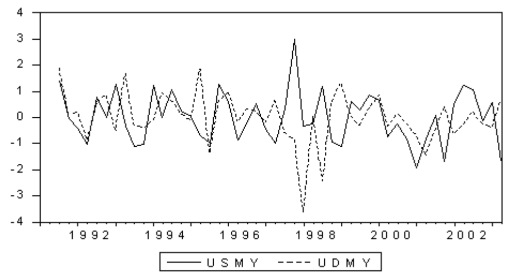
Appendix 5 The estimated structural shocks

Estimation results for shocks from quarterly data

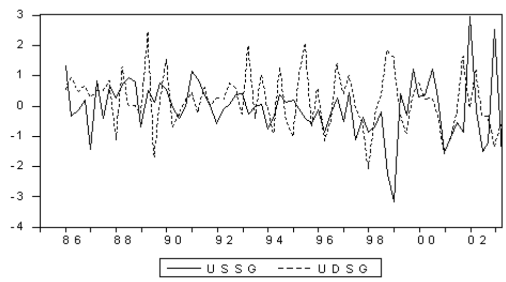
1. Hong Kong case (1973:1-2003:4); VAR lag length: 3



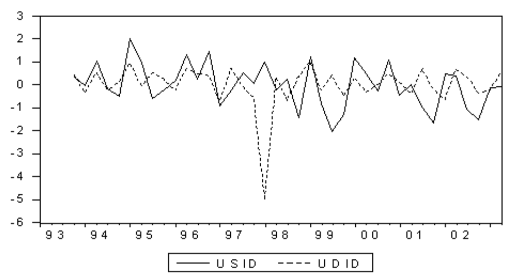
2. Malaysia case (1991:1–2003:2); VAR lag length: 1



3. Singapore case (1985:1–2003:2); VAR lag length: 4

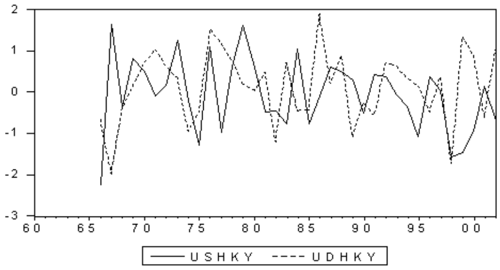


4. Indonesia case (1993:1–2003:2); VAR lag length: 2

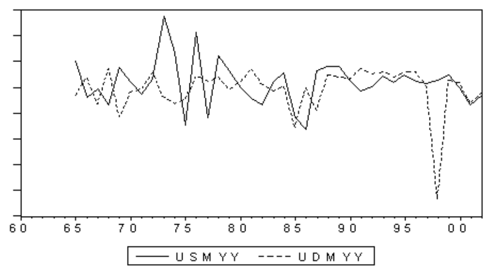


Estimation results for shocks from annual data

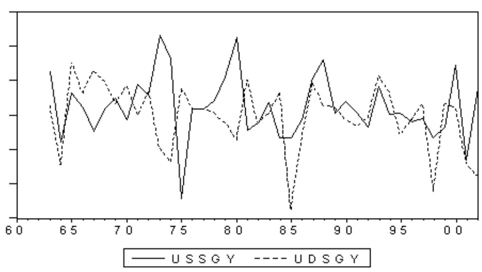
1. Hong Kong case (1960–2002); VAR lag length: 4



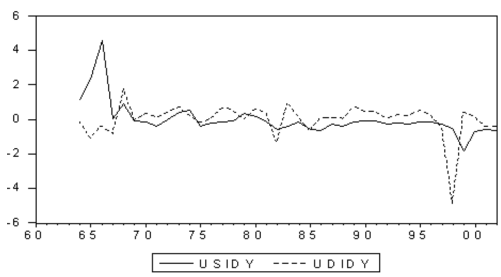
2. Malaysia case (1960–2002); VAR lag length: 4



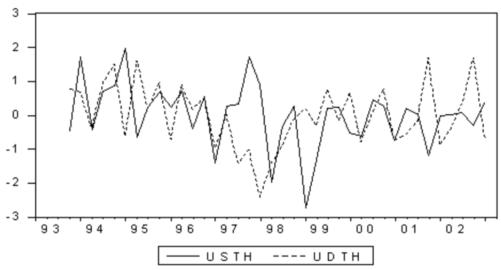
3. Singapore case (1960–2002); VAR lag length: 2



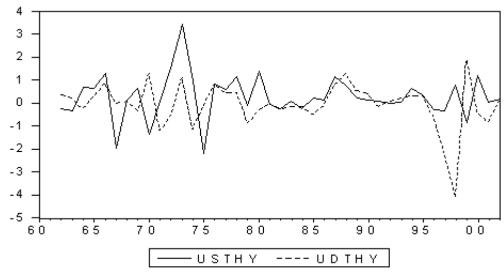
4. Indonesia case (1960–2002); VAR lag length: 1



5. Thailand case (1993:1–2003:2); VAR lag length: 2



5. Thailand case (1960–2002); VAR lag length:



Note: USi and UDi; (i ∈ {HK (Hong Kong), MY (Malaysia), SG (Singapore), ID (Indonesia), TH (Thailand)} represents supply and demand shocks for country i respectively. Y represents the annual data.

Notes

* I thank Professor Gordon de Brouwer for helpful comments and suggestions. The author remains solely responsible for the content of this paper.

1 The particular focus on the supply shock component is its relative importance in analysing the symmetry of the economic disturbances (see Bayoumi and Eichengreen 1994, p. 23).

2 The countries under consideration will be explained in the next section.

3 This last extension was also advocated earlier by Sims (1980).

4 Since we want to test for only a set of short-lagged policy variable, then p must not be too high.

5 Since we only consider a relatively small value of p (see footnote 4).

6 Except for Hong Kong, which is not available in WBWT. Taken from the CEIC database.

7 Data from WBWT available up to 2000, the data for 2001–2002 for all countries were taken from CEIC data base.

8 Seasonally adjusted data are available for all countries under consideration except for Indonesia and Malaysia, which are adjusted further using census X11-additive method available in EVIEWS 4.1.

9 This was also suggested for the case of Singapore earlier in this section.

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