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REVISITING THE SHOCKING ASPECTS OF ASIAN MONETARY UNIFICATION

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Revisiting the Shocking Aspects of Asian Monetary Unification

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1. Introduction

The ongoing international financial crisis has rekindled interest in closer monetary and financial integration in Asia. Official actions include the multilateralisation and expansion of the Chiang Mai Initiative and the establishment of swap arrangements between some central banks in the region. The idea of creating an Asian Monetary Fund which was floated after the 1997-98 crises has been resuscitated if only informally. These developments may potentially revive discussions about co-ordination of central banks' exchange rate policies and possibly greater monetary cooperation.[1]

In view in these developments it is opportune to revisit the question whether economies in Asia are likely to be good candidates for pursuing similar exchange rate policies and ultimately joining together in a monetary union. This question encompasses many issues of a political and institutional nature, but here we shall focus uniquely on a specific economic perspective, namely the similarity of aggregate demand and supply shocks across economies. One of the criteria for the success of a monetary union is that member countries experience shocks whose incidence is distributed symmetrically among the prospective participants.

A number of authors have investigated this question before typically using some variant of the methodology originally used by Bayoumi and Eichengreen to study the same question for countries that were potential candidates to form common currency area in Europe.[2] It is the contention of this paper that this methodology is flawed because it fails to identify properly the aggregate demand and aggregate supply shocks in each economy and hence cannot adequately address one of the central issues in determining the suitability of two or more countries joining a monetary union. To remedy this deficiency in the existing literature we propose an alternative methodology to identify structural shocks. We will therefore be able to revisit the debate about monetary integration in Asia based on more solid empirical foundations.

The rest of the paper is structured as follows. The next section briefly overviews some of the contributions to the empirics of the prospects for monetary union is East Asia.[3] Section 3 then outlines why ignoring a role for foreign output (and monetary policy) can impact the innovation accounting approach used by Bayoumi and Eichengreen and others. We next provide a brief description of the data, outline the

[1] The view that exchange rate management should play a prominent part of macroeconomic policy is common in the region. A number of authors have suggested that pegging exchange rate to a basket (common or country-specific) may be useful in the transition to some form of monetary unification. See, for example, Kawai(2007), Rajan (2002), and Williamson(2005). For a contrary view, see Genberg and He (2009). See also Kenen and Meade (2007, Ch. 6) and Shanmugaratnam (2006) on monetary integration in the region more generally.

[2] Eichengreen and Bayoumi (1977).

[3] For the purposes of this study East Asia includes: China, Taiwan, Japan, Singapore, Hong Kong, Malaysia, Thailand, Indonesia, and the Philippines.

identification procedure used to estimate aggregate demand and supply shocks prior to discussing our main findings in Section 4. The paper concludes with a summary and suggestions for extensions.

2. The Literature: The Empirics of Asian Monetary Union

In what follows we focus on select papers that explore the prospect of monetary integration within Asia from the perspective of statistical models that are used to estimate shocks to a potential member's economy.

By far the most common approach to investigate the relevant issues relies on the well-known, and widely used, statistical framework first adopted by Blanchard and Quah (1989) to identify aggregate demand and supply disturbances in a small macro model of the U.S. economy. The basic intuition is that aggregate supply shocks have permanent effects on output while aggregate demand shocks are assumed to have only a transitory impact on output. The resulting dichotomy permits the investigator to identify the relevant shocks in a statistical fashion using the widely used vector autoregressive approach (VARs). This methodology was used by Bayoumi and Eichengreen (1997) to investigate the prospects for monetary unification in Europe. Not surprisingly, several authors (e.g., Bayoumi, Eichengreen, and Mauro 2000, Bayoumi and Eichengreen 1994, Ling 2001, Zhang, Sato, and McAleer 2005, and Saxena 2002) have relied on the same approach, or variants thereof, to investigate the correlation among shocks for different groupings of Asian economies. Also unsurprising perhaps is the absence of any consensus on the prospects of greater monetary integration with some studies finding a considerable amount of correlation or coherence among aggregate shocks (e.g., Bayoumi, Eichengreen, Mauro 2000) while others report different results (e.g., Sánchez 2005). Part of the disagreement stems, of course, from differences in the samples or countries over which the empirical studies are undertaken. Some discrepancies also arise because some studies (e.g., Zhang, Sato and McAleer 2005) specify a model with three sources of disturbances, namely aggregate demand, supply and monetary policy shocks, as opposed to the standard two variable model that was considered by Blanchard and Quah (1989).

Two conclusions from the empirical evidence are, however, common across the literature on the prospects of monetary integration in Asia. First, successful monetary integration is more likely to take place among a small subset of similar Asian economies (e.g., Thailand, Malaysia) than among the group as a whole consisting of 10 or more Asian economies, including China and Japan. Second, any serious advance in the likelihood of a monetary union in Asia will depend crucially on the respective roles and influence of Japan and China. These two countries likely have the same roles as do Germany and France in the European context.[4] Significantly, however, the political motive for greater economic integration may not parallel that of Europe's two dominant economies (e.g., see Kenen 2006, Munchau 2007).

[4] An appendix to this paper presents some data from selected studies that permits additional comparisons with the results reported below as space limitations preclude further discussion here.

It is only comparatively recently that various techniques that perform some kind of innovation accounting have begun to explicitly deal with the role of shocks that originate from the US or the role of global shocks more generally and how they influence estimates of domestic aggregate demand and supply shocks. For example, Moneta and Rüffer (2006) rely on a dynamic factor model to capture the potentially complex links that exist between Asia and economies outside the region, notably the US economy. They find that economic growth in East Asian economies, essentially the same ones examined in this paper, share a significant common trend but they ascribe the rising coherence in business cycle co-movements in the region to the bursting of the 2000 tech bubble in the US. In addition, their empirical results suggest that Taiwan's and Singapore's economies tend to diverge from the others in the region and that there is some evidence of decoupling between East Asia and the rest of the world. Dées and Vansteenkiste (2007) use a Global VAR[5] to show empirically that while US business cycle are correlated with those elsewhere in the world, Asian economies do show signs of moving independently. Their study also makes the point that business cycle correlations are asymmetric and that economies in Asia, and elsewhere, react differently to negative shocks relative to positive ones.

3. Ignore Foreign Shocks at Your Peril

As we have already noted, most previous studies using the SVAR methodology have followed Blanchard and Quah to estimate a two-equation system of the form

$$y_t^i = A(L)y_{t-1}^i + B(L)\pi_{t-1}^i + \varepsilon_t^{1,i} \quad (1)$$

$$\pi_t^i = C(L)y_{t-1}^i + D(L)\pi_{t-1}^i + \varepsilon_t^{2,i} \quad (2)$$

where y stands for the output gap, π for inflation, and the superscript i refers to different economies.

Some restrictions are imposed on the system to transform the VAR residuals (the ε:s) into aggregate demand and aggregate supply shocks. Denoting the latter u^d and u^s, respectively, the restrictions typically take the form given in (3).

$$\begin{pmatrix} \varepsilon_t^{1,i} \\ \varepsilon_t^{2,i} \end{pmatrix} = R \begin{pmatrix} u_t^{d,i} \\ u_t^{s,i} \end{pmatrix} \quad (3)$$

where R is a 2x2 matrix of coefficients that reflects the restrictions imposed to transform equations (1) and (2) into aggregate demand and aggregate supply equations. The analysis then proceeds to investigate

[5] The approach consists in combining shocks estimated from country-specific VARs so that 'foreign' variables are permitted to play a role in each country's VAR estimates via an aggregation of 'rest of the world' effects.

the cross-country correlation of aggregate demand and aggregate supply shocks. Clearly the validity of this procedure is conditional on (1) and (2) being correctly specified. For open economies one of the possible sources of mis-specification is the omission of any role of foreign variables in either of the two equations. To investigate the consequences of this omission consider the following aggregate demand and aggregate supply equations.[6]

$$y_t^i = a_1^i r_{t-1}^i + a_2^i y_{t-1}^* + u_t^{d,i} \tag{4}$$

$$\pi_t^i = b_1^i y_{t-1}^i + b_2^i \pi_{t-1}^* + u_t^{s,i} \tag{5}$$

Aggregate demand, equation (4), depends on the real rate of interest and a measure of world demand y^* in addition to the structural demand disturbance. In equation (5) domestic inflation depends on the output gap, on world price inflation and an aggregate supply disturbance.

The nominal rate of interest is assumed to depend on the foreign nominal rate of interest as a result of integration of financial markets.

$$i_t^i = c_1^i i_t^* + u_t^{p,i}$$

One interpretation of this equation is that it represents an interest parity relationship where the exchange rate is either held fixed by the central bank or where exchange rate expectations are static.[7] On this interpretation the disturbance term $u_t^{p,i}$ represents shocks to interest rate parity which could be the result of time-varying risk premia.

Making the simplifying assumptions that expected inflation is equal to last period's inflation rate, and that the foreign interest rate, output gap, and inflation rates are simply equal to random disturbances, v^{i^*}, v^{y^*} and v^{π^*} respectively, we can rewrite the aggregate demand and aggregate supply equation in terms of y and π alone as in (4') and (5').

---

6 This specification is simplified in many dimensions to make the point as transparently as possible. In particular, it is assumed that there is no simultaneous relationship between inflation and output growth, which implies that the residuals can be interpreted as structural. The lag structure and the influence of foreign variables are also simplified. Expected inflation, which may be important in the Phillips curve (the aggregate supply equation) is omitted and in the calculation of real interest rate in the aggregate demand equation it is assumed to be backward looking. None of these simplifications should invalidate the main point that is established.

7 Among the economies we are considering only Hong Kong operates a fixed exchange rate regime. For those which have chosen a flexible exchange rate, the assumption of static expectations is arguably plausible in view of the (approximate) random-walk nature of floating exchange rates. For Singapore a term would have to be added to the right-hand-side of the equation to capture the policy-determined rate of appreciation of the Singapore dollar. Similar adjustments would be needed for Malaysia and Mainland China. None of these adjustments will alter the main thrust of the argument that follows.

$$y_t^j = -a_1^j \pi_{t-1}^j + u_t^{d,i} + a_1^j u_t^{p,i} + a_2^j v_{t-1}^{y^*} + a_1^j c_1^j v_{t-1}^{j^*} \quad (4')$$

$$\pi_t^j = b_1^j y_{t-1}^j + u_t^{s,i} + b_2^j v_{t-1}^{\pi^*} \quad (5')$$

or more compactly as (4'') and (5'').

$$y_t^i = -a_1^i \pi_{t-1}^i + \tilde{u}_t^{d,i} \quad (4'')$$

$$\pi_t^i = b_1^i y_{t-1}^i + \tilde{u}_t^{s,i} \quad (5'')$$

where the aggregate demand disturbance is now defined as in (6) and (7).

$$\tilde{u}_t^{d,i} = u_t^{d,i} + a_1^i u_t^{p,i} + a_2^i v_{t-1}^{y^*} + a_1^i c_1^i v_{t-1}^{i^*} \quad (6)$$

$$\tilde{u}_t^{s,i} = u_t^{s,i} + b_2^i v_{t-1}^{\pi^*} \quad (7)$$

The Blanchard and Quah procedure calls for estimating (4'') and (5''), and calculating the cross-country correlation between the aggregate demand and aggregate supply disturbances. Given the structure of our simplified model the results we would get would correspond to the theoretical values

$$\mathrm{cov}(\tilde{u}_t^{d,i}, \tilde{u}_t^{d,j}) = \mathrm{cov}(u_t^{d,i}, u_t^{d,j}) + a_2^i a_2^j \ \mathrm{var}(v_t^{y^*}) + a_1^i a_1^j c_1^i c_1^j \ \mathrm{var}(v_t^{i^*})$$

and

$$\mathrm{cov}(\tilde{u}_t^{s,i}, \tilde{u}_t^{s,j}) = \mathrm{cov}(u_t^{s,i}, u_t^{s,j}) + a_2^i a_2^j \ \mathrm{var}(v_t^{\pi^*})$$

assuming that $u_t^{d.i}, u_t^{p,i}, v_{t-1}^{y^*}, and\ v_{t-1}^{j^*}$ are uncorrelated with each other, that $u_t^{p,i}$ and $u_t^{p,j}$ are uncorrelated, and that $u_t^{s.i}$ *and* $v_{t-1}^{\pi^*}$ are uncorrelated.

In order to assess whether two economies are good candidates for a monetary union, we are interested in whether demand (supply) disturbances are similar or not, in other words whether $u^{d,i}$ and $u^{d,j}$, on the one hand, and $u^{s,i}$ and $u^{s,j}$, on the other, are positively or negatively correlated. But the specification will give

us an estimate of $\mathrm{cov}(\tilde{u}_t^{d,i}, \tilde{u}_t^{d,j})$ which is an overestimate of $\mathrm{cov}(u_t^{d,i}, u_t^{d,j})$, provided $a_2^i a_2^j$, $a_1^i a_1^j d_1^i d_1^j$, *and* $b_2^i b_2^j$ are positive.

In order to get appropriate measures of the structural disturbances and hence of their cross-country correlation, it suffices to include the foreign interest rate and the foreign output gap in the VAR system to be estimated. In our example we would estimate equation (4''') and (5''')

$$y_t^i = -a_1^i \pi_{t-1}^i + a_{1i}^{i*} i_{t-1}^* + a_2^i y_{t-1}^* + \hat{u}_t^{d,i} \tag{4'''}$$

$$\pi_t^i = b_1^i y_{t-1}^i + b_2^i \pi_{t-1}^* + u_t^{s,i} \tag{5'''}$$

where $\hat{u}_t^{d,i} = u_t^{d,i} + a_1^i u_t^{p,i}$.

The true correlation between the countries' demand and supply shocks could then be estimated correctly based on the estimated residuals from (4''') and (5''').

Taking explicit account of the impact of external shocks also allows us to investigate how similar the reactions to such shocks are across economies. This is an important consideration for the formation of a monetary union among open economies which has not received much empirical analysis in the literature using the Bayoumi-Eichengreen methodology. Consider two economies being hit by the same external shock. Whether or not the optimal monetary response to this shock is the same in both economies, i.e. whether a monetary union would be able to deliver the appropriate policy responses, depends on how each economy reacts to the common shock. If one economy reacts more strongly than the other, a common monetary policy would not be appropriate, and a monetary union would lead to sub-optimal outcomes.

To investigate this aspect of the creation of a monetary union we rely on the decomposition of the forecast error variance (FEV) of output and inflation in each economy. Specifically, we calculate the proportion of the FEV attributable to the foreign shocks and infer that country pairs for which this proportion is similar would be better candidates for a monetary union.

4. Data and Estimation Methodology

4.1 Data

All data are quarterly from 1990Q1. For some countries (e.g., Indonesia (1993Q1), Malaysia (1991Q1), and Thailand (1993Q1)) the required data were only available for a sample that begins slightly later (shown in parenthesis). Sources of data vary across countries but include the respective national central bank, the national statistical authority, and the *International Financial Statistics* CD-ROM (Washington, D.C.: International Monetary Fund). More details about the data and their sources are available on request.

Figure 1 and Figure 2 plot real GDP growth and the inflation rate, respectively, for the 10 Asian economies, as well as for the US since 1991. Growth rates are evaluated as the annual log difference in the levels of real GDP and the Consumer Price Index. The shaded area highlights the Asian crisis which is dated as having taken place between 1997Q3 and 1998Q4. In the empirical work that follows we adopted two strategies to deal with the crisis. In the first instance it was assumed that the impact on the model is temporary and is accounted for by adding a dummy variable active only during the period highlighted in the Figures. Alternatively, we assumed that the impact on the respective economies is permanent so that the Asian crisis dummy was set to be active from 1997Q3 to the end of the sample. Space limitations prevent showing all the results but, in brief, the results seemed more plausible when the crisis is assumed to have led to a permanent shift than the alternative of assuming a transitory effect in the region. Hence, only these results are discussed below.

Figure 1 suggests that real GDP growth rates across the economies considered do not show obvious signs of being highly correlated. What is more noticeable, however, is that the Asian crisis led to a short spell of negative growth in all economies shown with the exception of China and Taiwan (and the US of course). As regards inflation rates depicted in Figure 2, there again appears to be a relatively wide diversity across the region.

4.2 Econometric Methodology

The principal drawback of the structural VAR approach, and the variants used in the relevant literature on examining the likely success of monetary unification, is that they are all based on the assumption that aggregate demand and supply disturbances for an individual economy are uncorrelated and that they can be estimated in isolation of global economic conditions. Moreover, as shown by Cover, Enders and Hueng (2006), Blanchard-Quah type decompositions critically assume but do not test the independence of aggregate demand and supply disturbances. There is now a small but growing literature that points out that this assumption is not supported by the empirical evidence in both large and small open economies

(e.g., Enders and Hurn 2006, Souki 2008, Siklos and Yang 2009). Therefore, the proper estimation of the correlation of shocks from a model used to examine the extent to which they are idiosyncratic across a group of countries requires not only that the investigator test the independence of aggregate demand and supply shocks but also that any such model recognize that domestic shocks are not likely to be independent of shocks emanating from a dominant trading partner or the global economy more generally. Consequently, instead of specifying a model where only domestic aggregate demand and supply factors matter alone, we specify a model where foreign disturbances also play a role. In what follows, we assume that the source of global shocks is the US. It should be kept in mind, however, that this assumption can be replaced with a case wherein either shocks from Japan, China, or, in principle, both, can interact with domestic factors.

The SVAR can be expressed as a reduced form (i.e., as a VAR), where all the variables are functions of their own lagged realizations and of the other country's lagged variables. This can be written as

$$
\begin{aligned}
\Delta y_t^* &= \sum_{j=1}^{k} \alpha_{11j} \Delta y_{t-j}^* + \sum_{j=1}^{k} \alpha_{12j} \Delta i_{t-j}^* + \varepsilon_t^{y^8} \\
\Delta i_t^* &= \sum_{j=1}^{k} \alpha_{21j} \Delta y_{t-j}^* + \sum_{j=1}^{k} \alpha_{22j} \Delta i_{t-j}^* + \varepsilon_t^{i^8} \\
\Delta y_t &= \sum_{j=0}^{k} \alpha_{31j} \Delta y_{t-j}^* + \sum_{j=0}^{k} \alpha_{32j} \Delta i_{t-j}^* + \sum_{j=1}^{k} \alpha_{33j} \Delta y_{t-j} + \sum_{j=1}^{k} \alpha_{34j} \Delta i_{t-j} + \alpha_{35} CRISIS_t + \varepsilon_t^y \\
\Delta \pi_t &= \sum_{j=0}^{k} \alpha_{41j} \Delta y_{t-j}^* + \sum_{j=0}^{k} \alpha_{42j} \Delta i_{t-j}^* + \sum_{j=1}^{k} \alpha_{43j} \Delta y_{t-j} + \sum_{j=1}^{k} \alpha_{44j} \Delta \pi_{t-j} + \alpha_{45} CRISIS_t + \varepsilon_t^i
\end{aligned}
\tag{8}
$$

where y^* and y are, respectively, the log of foreign and domestic output, i* is the foreign interest rate, π is the inflation rate, and CRISIS is the Asian crisis dummy described previously.[8] The foreign interest rate is proxied by the three month yield on U.S. Treasury bills and the series is differenced in the VAR.

The estimated and structural shocks are related in the following manner

$$
\begin{pmatrix} \varepsilon_t^{y^*} \\ \varepsilon_t^{i^*} \\ \varepsilon_t^{y} \\ \varepsilon_t^{\pi} \end{pmatrix} = \begin{pmatrix} f_{11} & f_{12} & f_{13} & f_{14} \\ f_{21} & f_{22} & f_{23} & f_{24} \\ f_{31} & f_{32} & f_{33} & f_{34} \\ f_{41} & f_{42} & f_{43} & f_{44} \end{pmatrix} \begin{pmatrix} u_t^{*1} \\ u_t^{*2} \\ u_t^{s} \\ u_t^{d} \end{pmatrix} \tag{9}
$$

[8] Unlike Enders and Hurn (2007), inflation is not differenced to induce stationarity in the series. A version of (6) that includes foreign inflation (see Souki 2008) was also considered but sample size restrictions led to the preference for a three variable model. In addition, while US output shocks are likely to have an impact on East Asian economies it is less clear whether US inflation shock would be as meaningful.

Identification then proceeds by assuming: (1) that f_{11} = f_{22} =1 which amounts to a normalization, (2) that f_{13} = f_{14} = f_{23} = f_{24} = 0 which follows from the assumption that the domestic economy is 'small' relative to the foreign economy, (3) that cov(u^{*1},u^{d})=cov(u^{*2},u^{d}) =cov(u^{*1},u^{s})=cov(u^{*1},u^{s}) =0, and (4) that demand shocks have no long-run impact on domestic output. The covariance between domestic AD and AS shocks is not restricted to zero and, again as normalizations, f_{33} =f_{44}.

The basis of the estimated model is an aggregate demand and supply model with a Lucas style aggregate supply function and an aggregate demand function that is partly determined by foreign output and interest rate developments as illustrated in (4''') and (5''') above. Hence, the basic two variables model is augmented by equations that define foreign output and interest rates as evolving independently of the rest of model. Finally, we let the Asian crisis have a permanent effect on all domestic variables.
The methodology proposed by Cover, Enders and Hueng (2006) relaxes the restriction that AD and AS shocks are uncorrelated. Instead, they specify short-run restrictions implied by an aggregate demand and supply model which, when combined with the BQ restrictions, permits the structural shocks to be correlated.

Two alternatives for the short-run restrictions involving the correlation between AD and AS shocks are possible. We can assume that an AS shock has an immediate impact on AD shocks in the following manner:

$$u_t^d = \beta u_t^s + \tilde{u}_t^d \tag{10}$$

where u_t^d is the linear combination of pure AD shocks $\tilde{u}_t^d$ and the induced change from the AS shocks is βu_t^s; β is the weight of temporary AS shocks that can result in a contemporary change in aggregate demand. Covers, Enders, and Hueng (2006), show that the BQ decomposition amounts to assuming that a shift in AS leads to a shift in AD. A plausible scenario is one where the monetary authorities believe there has been an aggregate supply shock, and they react to it within the same quarter. Hence, AD shocks are seen to be a response to shocks that originate from the AS side of the economy. The reaction need not, of course, be such that $\beta = 1$.

A second possibility is that the short-run link runs from AD shocks to AS shocks in which case the relationship is written:

$$u_t^s = \gamma u_t^d + \tilde{u}_t^s \tag{11}$$

For example, the parameter γ can depend on the degree of price rigidity in the economy. Firms do not fully adjust price in response to some unexpected demands shock and continue to oversupply the output demanded.

5. Empirical Evidence

5.1 Blanchard-Quah Decomposition

In order to facilitate comparison with the existing literature, as well as to ascertain the impact of the proposed alternative identification strategy on the interpretation of the results, we begin by discussing the correlation matrix between aggregate demand and supply shocks relying on the traditional Blanchard-Quah decomposition. The results are displayed in Tables 1 and 2. To conserve space, Table 1 also displays the correlations between aggregate demand and supply shocks for the favoured alternative identification strategy.

Table 1 reveals that the BQ decomposition finds that aggregate demand shocks among the relatively smaller economies of Asia appear to be more highly correlated with the larger or more advanced economies in the regions such as Korea, Hong Kong, Singapore, and Japan, than they are amongst themselves. It is also notable that, with one exception (i.e., Malaysia) aggregate demand shocks in China are only very weakly correlated with shocks from any of the other countries in the regions. Only Indonesia's aggregate demand shocks are statistically significantly correlated with several other economies' aggregate demand shocks. Overall, only about a third of the correlations are statistically significant at the 10% level. These results differ rather significantly from those, for example, presented in Zhang *et al.* (2001) who, leaving out the period since the Asian crisis, found correlations significantly higher in the region. It is notable, as pointed out previously, that exchange rate regimes in the economies in the region were far more similar before than after 1998. Several of the countries in the region adopted a float, or a managed float, together with inflation targeting in some cases (e.g., Indonesia, Philippines, Korea, and Thailand).

Turning to the correlations among aggregate supply shocks displayed in Table 2 we find that, based on the Blanchard-Quah decomposition, all of the shocks are not only statistically significant but they are also highly correlated. These results stand in sharp contrast with those presented in Zhang *et al*. (2001), and Bayoumi *et al*. (2000), when the Asian financial crisis is excluded from the dataset. In spite of the fact that we have assumed that the Asian crisis has had a permanent effect in the estimated model it is clear that the underlying structural relationships have been significantly impacted by the financial crisis.

5.2 Alternative Identification Strategy

An important distinction between the BQ and the alternative identification strategy used in this paper concerns the correlation between aggregate demand and supply shocks. Table 3 shows the estimates of these correlations based on two proxies for controlling for the impact of the Asian financial crisis. The correlations are positive and statistically significant in four of the economies examined, namely Hong Kong, Taiwan, Singapore, and Korea, though the latter correlation is perhaps sensitive to the treatment of the financial crisis period. It should also be kept in mind that data limitations and constraints on the size of any estimated model for a group of 10 countries whose economies are no doubt inter-dependent means that these correlations possibly understate the effective amount of correlation between aggregate demand and supply shocks. In any event, it is likely that imposing the usual restriction that these shocks are uncorrelated, as in the BQ identification strategy, is likely to produce vastly different results.

As shown in Table 1, once we allow aggregate demand and supply shocks to be correlated, there are fewer statistically significant correlations. The most dramatic differences occur when we examine the correlations among aggregate supply shocks, as seen in Table 2. Only about a third of the correlations remain statistically significant. It is notable, however, that aggregate supply shocks remain most highly correlated between China, Hong Kong and the remainder of the economies in our sample while Japan and Singapore, most notably, seem more 'disconnected' with the rest of the region. The alternative correlation matrix now more closely resembles the one published by Bayoumi *et al*. (2000) than when the BQ decomposition is applied to an updated data set.

5.3 The Role of Foreign Shocks

As discussed previously, the extant literature has tended to leave out an explicit role for foreign shocks, proxied here by a U.S. nominal interest rate. Table 4 shows that domestic aggregate demand and supply shocks are not highly correlated with the foreign shock. Indeed, none of the correlations are statistically significant. However, tables 5 and 6, which give the variance decompositions for domestic inflation from U.S. interest rate changes reveals that these shocks have had a statistically significant impact on domestic inflation in 6 of the 10 economies considered under the alternative identification strategy and in 7 of the 10 economies considered when the BQ decomposition is used.[9] This shows the importance of controlling for the effects of foreign influences as argued in Section 3. If the foreign shock had not been included in the specification, its influence on domestic inflation and growth would have been erroneously ascribed to either domestic aggregate demand or aggregate supply shock. The cross-country correlation between these shocks would have been mis-calculated.

[9] It is interesting to note that four of six economies strongly affected by foreign monetary policy shocks considered (i.e., Indonesia, Korea, Philippines, and Thailand) adopted inflation targets in the last few years of the sample. Also notable is the fact that U.S. monetary policy has virtually no explanatory power for China's inflation rate.

6. Conclusions

We have implemented two modifications to the conventional VAR-based empirical methodology aimed at identifying likely candidates in Asia for monetary unification: by taking account of the role of foreign shocks, on the one hand, and by allowing for possible correlation between domestic aggregate demand and aggregate supply disturbances on the other. The results show that these modifications do matter for the cross-country correlation of these shocks. For example, when some degree of correlation is allowed between domestic AS and AD shocks the cross-country correlation of shocks declines substantially implying a weaker case for monetary unification than would be implied by the conventional empirical specification.

Taking explicit account of foreign shocks not only prevents them from erroneously being confounded with domestic shocks as in the conventional methodology, it also makes it possible to evaluate the desirability of a common monetary policy response to common external shocks. Our results show that this can have an important bearing on assessing the desirability of forming a monetary union among the economies in the region.

With respect to the implications for monetary unification our results do not clearly identify a group of countries for which shocks are unambiguously highly correlated and which therefore would be able to perform well with a common monetary policy. The correlation structure differs between aggregate demand shocks and aggregate supply shocks. Our results also show that previous findings in the literature do not always hold up when our modelling methodology is applied to the data.

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Table 1. Correlations: Aggregate Demand Shocks

Economy	CN	HK	ID	JP	KR	MY	PH	SG	TH	TW
CN	1									
HK	0.03	1								
	0.02									
ID	-0.02	0.05	1							
	-0.03	*0.05*								
JP	0.03	-0.11	0.12	1						
	0.04	*-0.10*	*-0.27**							
KR	0.18	0.15	0.06	0.02	1					
	0.17	*0.14*	*0.41**	*0.01*						
MY	**0.22***	0.05	-0.09	-0.02	**0.44***	1				
	*0.28**	*0.03*	*0.52**	*-0.04*	*0.44**					
PH	**0.24***	0.00	-0.04	0.10	**0.38***	**0.56***	1			
	-0.08	*0.09*	*-0.16*	*0.07*	*0.03*	*-0.08*				
SG	0.10	0.19	0.20	0.17	0.06	0.01	0.01	1		
	0.21	*0.16*	*0.32**	*0.10*	*-0.17*	-0.21	*0.35**			
TH	0.04	**0.36***	-0.01	-0.03	**0.22***	0.16	**0.25***	-0.11	1	
	0.08	*0.36**	*-0.08*	*-0.03*	*0.22**	*0.16*	*0.01*	*0.26**		
TW	-0.11	-0.08	**0.25***	-0.03	**-0.23***	-0.04	0.13	0.12	0.07	1
	0.21	*0.30**	*0.08*	*-0.01*	*0.29**	*0.22**	*0.19*	0.16	*0.30**	

Note: The top figure is based on the alternative identification strategy; bottom figure is based on the BQ decomposition. * indicates statistically significant at least at the 10% level.

Table 2. Correlations: Aggregate Supply Shocks

Economy	CN	HK	ID	JP	KR	MY	PH	SG	TH	TW
CN	1									
HK	**0.93***	1								
	*0.81**									
ID	-0.11	-0.08	1							
	*0.87**	*0.89**								
JP	**0.88***	**0.90***	-0.13	1						
	*0.80**	*0.90**	*0.92**							
KR	**0.84***	**0.86***	-0.06	**0.89***	1					
	*0.77**	*0.86**	*0.92**	*0.89**						
MY	**0.96***	**0.97***	-0.11	**0.91***	**0.87***	1				
	*0.85**	*0.97**	*0.92**	*0.91**	*0.87**					
PH	-0.02	-0.02	**0.95***	-0.03	-0.06	-0.03	1			
	0.84	*0.90**	*0.97**	*0.94**	*0.93**	*0.93**				
SG	0.05	0.07	0.03	0.01	0.01	0.06	0.02	1		
	*0.85**	*0.87**	*0.94**	*0.92**	*0.91**	*0.92**	*0.96**			
TH	**0.85***	**0.87***	-0.10	**0.88***	**0.90***	**0.88***	-0.09	0.04	1	
	*0.90**	*0.93**	*0.99**	*0.99**	*0.96**	*0.93**	*0.94**	*0.96**	*0.94**	
TW	0.03	0.03	-0.06	0.00	-0.04	0.02	-0.05	**0.95***	0.01	1
	*0.82**	*0.84**	*0.90**	*0.90**	*0.86**	*0.89**	*0.91**	*0.91**	*0.91**	

Note: The top figure is based on the alternative identification strategy; bottom figure is based on the BQ decomposition. * indicates statistically significant at least at the 10% level.

Table 3. Correlations Between Aggregate Demand and Supply Shocks

Economy	(1)	(2)
China (CN)	0.07 (.57)	0.06 (.65)
Hong Kong (HK)	**0.27 (.03)***	**0.22 (.07)***
Indonesia (ID)	0.00 (.99)	-0.11 (.43)
Japan (JP)	0.08 (.53)	0.05 (.70)
Korea (KR)	**0.21 (.10)***	0.08 (.54)
Malaysia (MY)	0.00 (.97)	-0.09 (.49)
Philippines (PH)	-0.04 (.75)	-0.07 (.58)
Singapore (SG)	**0.34 (.01)***	**0.38 (.00)***
Thailand (TH)	0.07 (.60)	0.02 (.88)
Taiwan (TW)	**0.22 (.08)***	**0.23 (.07)***

Notes: (1) 100 times log difference of nominal effective exchange rates used as control; (2) Asia dummy variable used as control (=1 1997:3-2007:4).

Table 4. Correlations Between Domestic and Foreign Shocks

Economy	Aggregate Supply	Aggregate Demand
China (CN)	0.05	0.02
	0.04	-0.00
Hong Kong (HK)	-0.13	0.14
	-0.15	0.15
Indonesia (ID)	0.04	-0.11
	-0.11	0.07
Japan (JP)	-0.08	-0.11
	-0.10	-0.17
Korea (KR)	-0.12	-0.18
	-0.12	-0.17
Malaysia (MY)	-0.16	-0.02
	-0.18	-0.04
Philippines (PH)	-0.09	-0.02
	-0.10	0.01
Singapore (SG)	-0.11	-0.16
	-0.15	-0.21
Thailand (TH)	-0.04	-0.05
	-0.04	-0.05
Taiwan (TW)	-0.11	0.06
	-0.10	-0.01

Note: The top figure relies on the alternative identification strategy while the bottom figure is based on the BQ decomposition.

Table 5. Variance Decompositions: U.S. Monetary Policy Shocks and Domestic Inflation: BQ Identification Strategy

Period	CHINA	HONG KONG	INDONESIA	JAPAN	KOREA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	TAIWAN
1	0.00	**4.39**	**98.98**	**58.72**	**99.40**	2.75	**10.68**	0.14	**67.50**	4.13
2	0.00	**2.82**	**97.54**	**58.00**	**99.34**	2.45	**10.48**	2.14	**54.83**	4.02
3	0.00	**2.57**	**94.51**	**58.67**	**99.36**	2.46	**11.45**	2.19	**49.41**	3.68
4	0.00	**3.27**	**92.27**	**58.60**	**99.36**	2.46	**10.64**	2.14	**49.30**	3.66
5	0.00	**4.27**	**91.72**	**58.68**	**99.38**	2.46	**10.96**	2.06	**48.52**	3.50
6	0.00	**5.12**	**91.79**	**58.67**	**99.37**	2.46	**10.53**	2.01	**49.26**	3.50
7	0.00	**5.74**	**91.81**	**58.57**	**99.37**	2.46	**11.12**	2.02	**49.42**	3.50
8	0.00	**6.15**	**91.80**	**58.57**	**99.37**	2.46	**11.11**	2.07	**49.47**	3.48
9	0.00	**6.40**	**91.82**	**58.58**	**99.36**	2.46	**11.26**	2.12	**49.36**	3.48
10	0.00	**6.56**	**91.85**	**58.58**	**99.36**	2.46	**11.26**	2.15	**49.30**	3.47
11	0.00	**6.65**	**91.88**	**58.59**	**99.36**	2.46	**11.30**	2.15	**49.21**	3.47
12	0.00	**6.70**	**91.88**	**58.58**	**99.36**	2.46	**11.29**	2.15	**49.15**	3.47

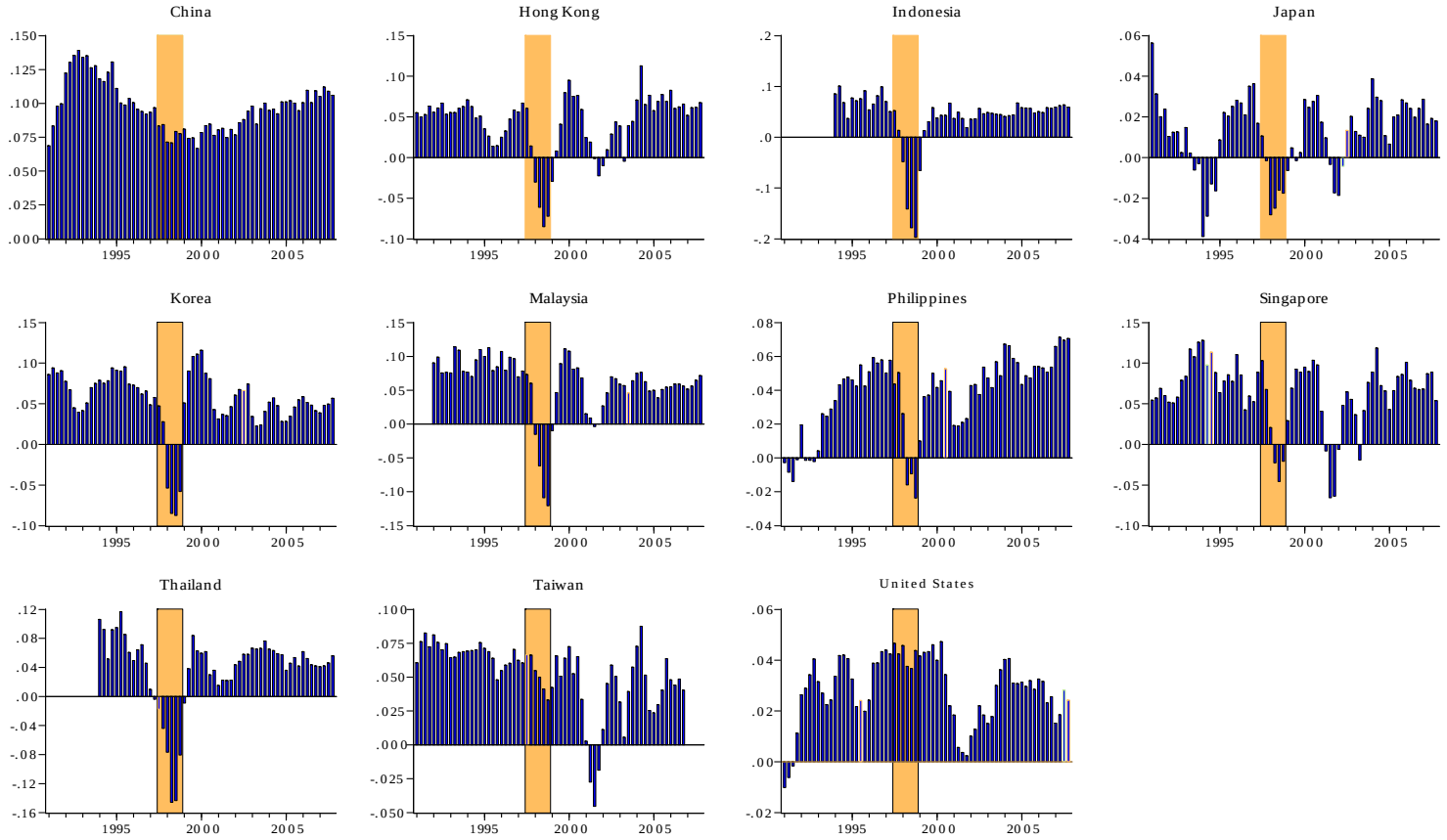
Note: Bold numbers are statistically significant at the 10% level. U.S. monetary policy is proxied by the 3 month U.S. Treasury bill rate.

Table 6. Variance Decompositions: U.S. Monetary Policy Shocks and Domestic Inflation: Alternative Identification Strategy

Periods	CHINA	HONG KONG	INDONESIA	JAPAN	KOREA	MALAYSIA	PHILIPPINES	SINGAPORE	THAILAND	TAIWAN
1	0.00	**3.59**	**92.51**	**61.84**	**99.37**	**96.94**	**74.17**	0.67	**95.33**	4.47
2	0.00	**14.70**	**90.83**	**61.12**	**99.32**	**97.24**	**74.44**	0.80	**93.89**	4.36
3	0.00	**14.49**	**87.26**	**61.67**	**99.33**	**97.24**	**73.33**	0.77	**91.53**	4.00
4	0.00	**13.77**	**85.52**	**61.59**	**99.33**	**97.24**	**74.77**	2.41	**90.86**	3.98
5	0.00	**13.19**	**85.30**	**61.66**	**99.36**	**97.24**	**74.41**	3.17	**90.67**	3.81
6	0.00	**12.86**	**85.65**	**61.65**	**99.35**	**97.24**	**75.17**	3.31	**90.57**	3.81
7	0.00	**12.69**	**85.71**	**61.55**	**99.35**	**97.24**	**74.25**	3.35	**90.53**	3.81
8	0.00	**12.59**	**85.69**	**61.55**	**99.34**	**97.24**	**74.27**	3.35	**90.51**	3.78
9	0.00	**12.54**	**85.75**	**61.56**	**99.34**	**97.24**	**74.05**	3.33	**90.51**	3.78
10	0.00	**12.51**	**85.85**	**61.56**	**99.34**	**97.24**	**74.04**	3.33	**90.50**	3.78
11	0.00	**12.48**	**85.92**	**61.56**	**99.34**	**97.24**	**74.00**	3.34	**90.50**	3.78
12	0.00	**12.47**	**85.94**	**61.55**	**99.34**	**97.24**	**74.01**	3.34	**90.50**	3.78

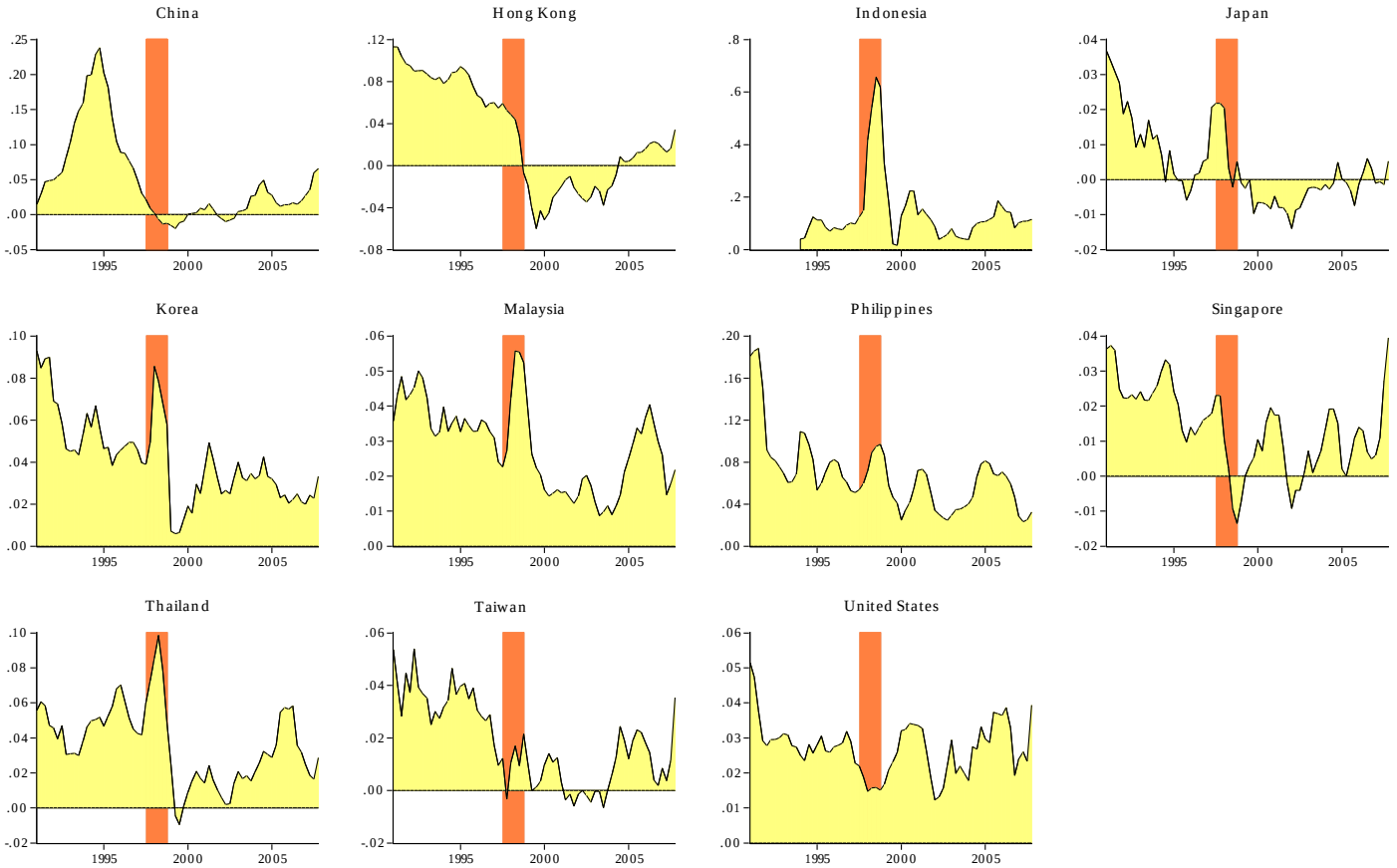
Note: Bold numbers are statistically significant at the 10% level. U.S. monetary policy is proxied by the 3 month U.S. Treasury bill rate.

Figure 1. Real GDP Growth



Note: Real GDP growth is 100 times $\Delta_4$log of the level of real GDP. Sources of data are listed in the Appendix. The vertical shaded area identifies the 1997-98 Asian financial crisis (1997Q3-1998Q4).

Figure 2. CPI Inflation



Note: Inflation is 100 times $\Delta_4$log of the level of the CPI level. Sources of data are listed in the Appendix. The vertical shaded area identifies the 1997-98 Asian financial crisis.