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ABSTRACT

Debate continues over whether a monetary or currency union will be a viable alternative to the current exchange arrangements in East Asia. The present paper adds to the literature by assessing the level of business cycle synchronization among 10 major East Asian countries, which is considered a key precondition for a regional currency union. Unlike previous studies, this paper employs a factor-augmented VAR model that characterizes a large set of 62 foreign and domestic variables simultaneously. Five common shocks are identified, and we examine how and to what extent these shocks affect each economy in the region. Empirical results indicate that the majority of East Asian countries exhibit similar responses to world and regional shocks. Of particular importance is the finding that individual GDPs are well synchronized in response to the two major determinants of world and regional GDP shocks. Overall, the evidence presents positively for consideration of a regional currency union in East Asia. Some suggestions are offered concerning steps to build a foundation towards the establishment of an East Asian currency union.

Keywords: Business Cycle Synchronization, Asian Currency Union, Factor-augmented VAR
JEL Classification: E32, F33, F44

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1. Introduction

East Asia has been among the fastest growing and most dynamic regions in the world for nearly the past half century. In the 1980s and 1990s, leading up to the Asian financial crisis of 1997-98, economies in the region kept stable exchange rates, especially vis-à-vis the U.S. dollar, to support exports, a key driver of growth for many of them. However, “de facto” currency pegs against the U.S. dollar, which allowed a build-up of macro-imbalances, led to the crisis. In its aftermath, East Asian countries were forced to transition towards more flexible exchange rate regimes. However, freely floating exchange rates imply too much bilateral volatility in the region given the extent of its trade integration; this fact prompted a number of research and policy debates over alternative exchange rate arrangements to promote stability and credibility in exchange rates. The launch of the euro in 1999 also simulated great interest in regional monetary integration or even a currency union for many economies, including those in East Asia.

Along with these developments, East Asian countries stepped up efforts to enhance their financial stability through financial and monetary cooperation in the region. In 1999, ASEAN expanded to include the region’s larger neighbours: China, Japan, and Korea (ASEAN+3). In 2000, ASEAN+3 announced the establishment of the Chiang Mai Initiative (CMI), a network of bilateral swap arrangements, in an effort to prevent another crisis. In 2010, in part driven by the desire to fend off panic from the global financial crisis of 2008-09, the CMI was expanded and transformed into a multilateral arrangement, the Chiang Mai Initiative Multilateralization (CMIM). In 2011, ASEAN+3 also established the ASEAN+3 Macroeconomic Research Office (AMRO) in association with CMIM to strengthen regional surveillance. In parallel, economic integration has accelerated in the region through increasing trade and business linkages. ASEAN envisions the creation of the ASEAN Economic Community (AEC) by 2015.

This paper aims to assess the feasibility of a currency union in East Asia. A regional currency union presents an economic trade-off between the potential costs and benefits of joining. The main expected advantages are exchange rate stability, a reduction in transaction costs, price convergence and stability, and the consolidation of regional markets. A currency union also helps enhance national economic policy discipline due to the regional surveillance and monitoring arrangements that go along with it. The problems associated with a currency union arise from the diversity of the economies joining it. When economies with different economic fundamentals, levels of efficiency, and levels of productivity are joined under a single currency, a single form of monetary control may not be suitable to address the disparate domestic economic conditions. A loss of national monetary control implies that the national monetary authorities can no longer undertake measures to address country-specific macroeconomic conditions, such as combating inflation or reducing unemployment. The member countries will also lose nominal exchange rates as an adjustment mechanism in response to country-specific external shocks such as swings in foreign demand or sudden interruptions in capital inflows.

Despite the progress of regional economic integration, there is substantial heterogeneity across East Asian countries in the level of economic and financial development. The skepticism has been further fuelled by recent economic turmoil in the euro zone, which provides key lessons for countries contemplating various forms of regional monetary cooperation and/or currency unions. Indeed, the feasibility of a common currency for East Asia has been a topic of continued debate. The theory of optimal currency area (OCA), introduced by Mundell (1961) and McKinnon (1963), provides a list of important criteria for a common currency in a region. According to traditional OCA theory, countries may consider adopting a common currency when their economies have (i) similar shocks and business cycles, (ii) high trade integration, (iii) internal labor mobility, and (iv) internal fiscal transfers.

Among these factors, synchronization of business cycles is the most well understood and is considered a key precondition. Once a currency union is instituted, member countries will follow a common monetary policy established by a super-national central bank. If they are less synchronized in their business cycles, the costs of surrendering monetary policy autonomy are bound to be significant, as they cannot adopt independent policies suited to their domestic conditions. If the business cycles are assimilated, the costs tend to be low or negligible and can be outweighed by the benefits of forming a currency union.

In this context, the present paper empirically investigates the degree and economic nature of business cycle synchronization among the 10 most economically significant countries in East Asia with the aim of uncovering ‘hard’ evidence concerning the viability of a currency union in the region. The selected countries are the ASEAN5 (Indonesia, Malaysia, Singapore, Thailand, and the Philippines) as well as China, Hong Kong, Japan, Korea, and Taiwan. For each country, six key macroeconomic variables are employed to characterize business cycle movements: GDP, the real exchange rate, inflation, money growth, exports, and imports. Oil prices and world GDP are also included to reflect changes in the world market; thus, the model comprises a total of 62 variables. The paper models this large dataset and evaluates the dynamic interactions among variables using the factor-augmented VAR (FAVAR) approach developed by Forni *et al.* (2000), Bernanke *et al.* (2005), and Stock and Watson (2005). FAVAR provides a parsimonious and effective framework of analysis by extracting common factors from a large set of data and utilizing the benefits of VAR models in characterizing the dynamics. This approach is also useful when the time span of the data is rather short, as in this case. The structural shocks underlying the model are classified as global, regional, and idiosyncratic shocks, as economies can respond differently to shocks depending on their origin. By construction, each country is subject to common world and regional shocks. This allows us to compare the responses of the variables to these shocks

across countries, which in turn facilitates a straightforward interpretation of business cycle synchronization.

Our study is closely related to those of Eickmeier (2009) and Bagliano and Morana (2009) in terms of its objectives and methodology. Using FAVAR models, they documented the co-movements of key macro-variables in the core eurozone countries and in the U.S., U.K., Canada, Japan, and the euro area. Most of other studies have used small-scale VAR or factor models to assess the degree of business cycle synchronization as a means of determining the suitability of a currency union. While there is a large body of literature on the European business cycle, the parallel literature on the Asian business cycle has been modest. Bayoumi and Eichengreen (1994) undertook a benchmarking study of Asian business cycle synchronization. They estimated a bivariate VAR of GDP and inflation to identify supply and demand shocks using a long-run restriction approach of the type proposed by Blanchard and Quah (1989). Taking the correlation of identified shocks between each pair of countries as a measure of business cycle synchronization, they suggested which group of East Asian countries was suitable for forming a currency union in the region. Subsequently, a number of studies followed suit, including Bayoumi *et al.* (2000), Yuen (2001), Kim (2007), Rana (2007), and Lee and Koh (2012). However, Lee *et al.* (2003) and Lee and Azali (2012) raised several issues concerning such studies. They argue that an examination of the region-wide synchronization, rather than bilateral data, is more appropriate because the net benefits of adopting a currency union need to be assessed across the entire set of economies in a region. Moreover, underlying shocks may be estimated differently in each country, making it difficult to compare the results across countries with the same base. Finally, a standard correlation analysis of shocks does not account for the sources of the shocks. A third factor, such as a world income shock, can induce a high correlation between countries.

To overcome these shortcomings, Lee *et al.* and Lee and Azali proposed to employ a dynamic factor model similar to that in Kose *et al.* (2003). This model examines the degree of business cycle synchronization among a group of countries in the presence of world, regional, and idiosyncratic shocks. They concluded that regional shocks suitably account for movements in the outputs of East Asian countries and that the region is well prepared for a currency union based on that criterion. Using similar models, Moneta and Ruffer (2009) reported that most East Asian countries share significant common growth dynamics, while He and Liao (2012) found strong evidence of Asian business cycles being independent of U.S. and European cycles. While these factor models simultaneously contain the outputs of countries in the region, the computational complexities associated with maximum likelihood estimations can hinder one from accounting for many different types of variables and thus accommodating richer dynamics. Even when this is possible, the factors identified can often lack structural interpretations.

The rest of this paper is organized as follows. Section 2 briefly presents the FAVAR model used for the application at hand. The data are described in Section 3, and Section 4 presents the extraction of common factors that summarize co-movements in the model. Section 5 explains how East Asian countries respond to underlying common shocks with a view to assessing the synchronization of business cycles in the region. Finally, Section 6 discusses the implications of our findings with regard to the feasibility of a currency union in East Asia and concludes the paper.

2. Econometric model and estimation

2.1. A FAVAR model

It is assumed that the joint dynamics of n variables are specified by the following dynamic factor model (Stock and Watson, 2005; Bagliano and Morana, 2009),¹

$$X_t = \Lambda F_t + D(L)X_{t-1} + \nu_t \quad (1)$$

$$F_t = \Phi(L)F_{t-1} + \eta_t \quad (2)$$

where X_t is an $(n \times 1)$ vector of stationary variables, F_t is an $(r \times 1)$ vector of unobserved common factors with $r < n$, Λ is an $(n \times r)$ matrix of the loading coefficients, $D(L)$ is an $(n \times n)$ lag polynomial of order p , and $\Phi(L)$ is an $(r \times r)$ matrix lag polynomial of order q . ν_t is an $(n \times 1)$ vector of idiosyncratic disturbances, and η_t is an $(r \times 1)$ vector of the disturbances driving the common factors. Following convention, F_t and ν_t are taken to be mutually orthogonal due to their different natures; hence, $E(F_t \nu_{is}) = 0$ and $E(\eta_{jt} \nu_{is}) = 0$ for all i, j, t , and s . Further assumptions are that ν_t are mutually orthogonal (i.e., $E(\nu_{jt} \nu_{is}) = 0$ for all $i, j, t, s, i \neq j$) and that $D(L)$ is a diagonal matrix. With these two assumptions, each variable in X_t is affected only by its own idiosyncratic shock, and all other idiosyncratic shocks will not have any effect across horizons.²

Substituting (2) into (1) and collecting terms, the dynamic factor model is written in VAR form. This is henceforth referred to as FAVAR:

$$\begin{bmatrix} F_t \\ X_t \end{bmatrix} = \begin{bmatrix} \Phi(L) & 0 \\ \Lambda\Phi(L) & D(L) \end{bmatrix} \begin{bmatrix} F_{t-1} \\ X_{t-1} \end{bmatrix} + \begin{bmatrix} \mathcal{E}_t^F \\ \mathcal{E}_t^X \end{bmatrix} \quad (3)$$

where

¹ (1) and (2) correspond to the static form representation of the dynamic factor model of Stock and Watson. In general, the static factor F_t can contain lags of the underlying dynamic factors. We assume for the applications at hand that the numbers of static and dynamic factors coincide. In this case, the static and dynamic factors are identical and there is no difference between the static and dynamic forms. See Stock and Watson for details.

² The diagonality of $D(L)$ can be relaxed by introducing the lags of other variables to each equation in (1). The benefit is that the variable is allowed to be affected by other idiosyncratic shocks at horizons other than the contemporaneous term. However, this comes at the cost of consuming degrees of freedom. The cost will be particularly severe when the model has a large set of variables with a short span of time series data, such as that in our study. The degree of freedom saved from the diagonality assumption of $D(L)$ would also help accommodate enough lags of common factors (q) to take into full account the common interactions among variables, which is our main focus in this study.

$$\begin{bmatrix} \varepsilon_t^F \\ \varepsilon_t^X \end{bmatrix} = \begin{bmatrix} I \\ \Lambda \end{bmatrix} \eta_t + \begin{bmatrix} 0 \\ v_t \end{bmatrix} \quad (4)$$

with the covariance matrix

$$E(\varepsilon_t \varepsilon_t') = \begin{bmatrix} \Sigma_\eta & \Sigma_\eta \Lambda' \\ \Lambda \Sigma_\eta & \Lambda \Sigma_\eta \Lambda' + \Sigma_v \end{bmatrix} \quad (5)$$

where $\Sigma_\eta = E(\eta_t \eta_t')$ and $\Sigma_v = E(v_t v_t')$. Inverting the FAVAR representation in (3) and (4),

we can obtain the factor-augmented vector moving average (FAVMA) representation for X_t

in terms of current and lagged values of η_t and v_t :

$$X_t = B(L)\eta_t + C(L)v_t \quad (6)$$

where $B(L) = (I - D(L)L)^{-1} \Lambda (I - \Phi(L)L)^{-1}$ and $C(L) = (I - D(L)L)^{-1}$.

2.2 Estimation

To estimate the FAVAR model in (3), we adopt the sequential estimation strategy proposed by Stock and Watson. The procedure first estimates the common factors, F_t , and the factor loadings, Λ , by solving the following minimization problem iteratively,

$$\min_{F_t, \dots, F_T, \Lambda, D(L)} T^{-1} \sum_{t=1}^T [(I - D(L)L)X_t - \Lambda F_t]' [(I - D(L)L)X_t - \Lambda F_t]$$

where T denotes the sample size. A preliminary estimate of F_t is produced by the application of principal components analysis to X_t , and a preliminary estimate of $D(L)$ is obtained by OLS estimation of (1). Then, the estimate F_t is updated by taking the principal components of the filtered variables $(I - D(L)L)X_t$, and conditional on the estimated common factors, an estimate of Λ and an updated estimate of $D(L)$ are attained using OLS from (1). This iteration continues until convergence is achieved.³ The first step produces the estimates of F_t ,

³ In our empirical application, 10 iterations were sufficient to complete convergence.

Λ , and $D(L)$. Second, given the final estimate of F_t , one can estimate $\Phi(L)$ by OLS from (2). The FAVAR model in (3) can be constructed using the final estimates of F_t , Λ , and $D(L)$.

In their procedure, Stock and Watson applied the principal components analysis to the entire set of variables in X_t with the number of common factors, r , chosen by the information criteria of Bai and Ng (2002). The common factors correspond to the r principal components associated with the r largest eigenvalues. This approach exploits all available information in the observed data, which is theoretically appealing. In practice, however, an economic interpretation of estimated common factors can be difficult, especially when the numbers of variables and factors are large. Following the lead of Bernanke and Boivin (2003), Bagliano and Morana (2009) proposed an alternative approach that makes it easier to give economic meaning to the common factors. They divided the dataset into different categories of variables and estimated each common factor separately as the principal component having the largest eigenvalue in each category. This method of extracting common factors from each group can also avoid contamination from series potentially unrelated to the phenomenon of interest. If noise is added to the information set as more variables are included, the average size of the common factors will decrease while the correlation across idiosyncratic components will increase. Hence, beyond a certain threshold, increasing the cross-sectional dimension of the information set is not desirable and may adversely affect the explanatory power of the model.

Our strategy is to follow Bernanke and Boivin (2003) and Bagliano and Morana (2009) while taking advantage of a formal test to determine the number of common factors through the Bai and Ng information criterion. Specifically, we first group the variables under consideration into eight blocks: 1) world oil prices, 2) world GDP, 3) regional GDP, 4) regional real exchange rates, 5) regional inflation, 6) regional money growth, 7) regional

exports, and 8) regional imports. The Bai and Ng information criterion indicates that there are three common factors in blocks 3 through 8 and that one factor can represent common movements in blocks 5 and 6. Based on these results and economic theory, we assume five common factors ($r=5$), as follows: 1) the oil price factor, 2) the world GDP factor, 3) the regional GDP factor, 4) the regional real exchange rate factor, and 5) regional nominal factor from the blocks of inflation and money growth. No factors are assigned from the seventh and eighth blocks. A full explanation concerning the estimations of common factors is provided in the empirical analysis of Section 4.

2.3. Identifying structural shocks

The FAVAR model entails structural identification to give economic interpretations of the factor disturbance η_t . As in typical structural VAR models, factor disturbances are related to the underlying structural shocks, denoted as ξ_t , in the following way:

$$\xi_t = H\eta_t \quad (7)$$

Here, H is an invertible ($r \times r$) matrix, and the vector of the structural shocks ξ_t has a mean of zero and an identity covariance matrix, i.e., $E(\xi_t \xi_t') = I_r$. The identification of structural shocks ξ_t amounts to an estimation of the elements in H with proper sets of restrictions. For our model, no further identification is necessary for idiosyncratic disturbances ν_t because they are assumed to be mutually orthogonal in (1), i.e., $\Sigma_\nu = E(\nu_t \nu_t')$ is a diagonal matrix. Only the normalization of Σ_ν is required, and this can be easily achieved from $\Sigma_\nu = \Theta^{-1} \Theta^{-T}$, where Θ is an ($n \times n$) diagonal matrix. The normalized idiosyncratic shock, denoted as ψ_t , is

such that $\psi_t = \Theta v_t$ with a mean of zero and an identity covariance matrix, i.e., $E(\psi_t \psi_t') = I_n$.⁴

Note that identifying ξ_t in (7) is independent of identifying ψ_t according to the orthogonal condition between the two, i.e., $E(\xi_t \psi_t') = E(H \eta_t v_t' \Theta') = 0$. Put altogether, the FAVMA representation in (6) can be rewritten in terms of the structural shocks as

$$X_t = B^*(L)\xi_t + C^*(L)\psi_t, \quad (8)$$

where $B^*(L) = B(L)H^{-1}$ and $C^*(L) = C(L)\Theta^{-1}$. Upon achieving identification, (8) can be utilized to examine how and to what extent the variables in X_t respond to the shocks ξ_t and ψ_t over time by means of the impulse response and variance decomposition analysis.

For the identification of ξ_t in (7), we make use of block lower-triangular exclusion restrictions, as shown by the third example in Stock and Watson (2005). The basic idea is to estimate H by imposing Wold causal ordering on the blocks of variables through the relationship $B^*(0) = \Lambda H^{-1}$ ($\because B(0) = \Lambda$ in (6)).⁵ To see this, partition X_t into r groups of variables, each with m_i elements, where $m_1 + \dots + m_r = n$. In our case of five blocks with 62 variables ($r=5$ and $n=62$), $B(0)^*$ has the following block lower-triangular structure:

$$B(0)^*_{(62 \times 5)} = \begin{bmatrix} B_{0,11}^* & 0 & 0 & 0 & 0 \\ B_{0,21}^* & B_{0,22}^* & 0 & 0 & 0 \\ B_{0,31}^* & B_{0,32}^* & B_{0,33}^* & 0 & 0 \\ \vdots & \vdots & \vdots & B_{0,44}^* & 0 \\ B_{0,51}^* & B_{0,52}^* & B_{0,53}^* & B_{0,54}^* & B_{0,55}^* \end{bmatrix} \quad (9)$$

⁴ While the orthogonality between idiosyncratic disturbances is a standard assumption, it is possible to relax such that v_t are correlated with each other and Σ_v is no longer a diagonal matrix. Then, additional $n(n-1)/2$ restrictions are required to identify n^2 parameters in Θ , apart from the orthogonal condition of $E(\psi_t \psi_t') = \Theta \Sigma_v \Theta' = I_n$. A difficulty is that economic theory does not provide the necessary information for modelling interactions between the idiosyncratic components of variables. The situation becomes practically implausible when the number of variables is large, as in our case of $n=62$.

⁵ Several alternative identification procedures are available, for example, based on restrictions on the long-run impact matrix $B^*(1) = \sum_{i=0}^{\infty} B_i^*$ or restrictions on the factor loading matrix Λ . See Stock and Watson for an excellent survey.

where $B_{0,ij}^*$ is an $(m_i \times 1)$ vector measuring the responses of the variables in block i to structural shock j . The five blocks are organized in the following sequence: world oil price block, world GDP block, regional GDP block, regional real exchange rate block, and regional nominal block. The structural shocks (ξ_t) arising from each of the blocks are assigned as the world oil price shock, world GDP shock, regional GDP shock, regional real exchange rate shock, and regional nominal shock.

Under this identification scheme, the structural shocks can have a contemporaneous effect on the variables in a lower block, but they are not allowed to affect the variables in an upper block contemporaneously. For example, the world oil price block can have a contemporaneous effect on all other variables, but the variables in the oil price block react only with a one-period lag to the other four structural shocks. The regional nominal shock ordered last is not allowed to affect the variables in all other blocks contemporaneously but only subsequently, whereas the inflation and real exchange rate variables in the regional nominal block are affected contemporaneously by all of the structural shocks. Regarding the three regional structural shocks, the ordering is determined based upon the relative speeds of adjustments to shocks, as in Bernanke *et al.* (2005): the shocks related to relatively slow-moving variables (GDP and real exchange rates) come before the shocks originating from relatively fast-moving variables (nominal variables). The block lower triangular structure in (9) identifies H from $B^*(0) = \Lambda H^{-1}$ and the orthogonal condition between structural shocks (i.e., $E(\xi_t \xi_t') = H \Sigma_\eta H'$). ξ_t in (7) are then identified, and their effects on the variables can be obtained from (8). There were two more blocks of exports and imports in our model, and, by construction, the variables in these blocks are contemporaneously affected by all five structural shocks. Stock and Watson provide a full account of the estimation procedure.

3. Data description

The empirical procedure outlined above is undertaken for 10 major countries in East Asia: ASEAN5 (Indonesia [IN], Malaysia [MY], Singapore [SG], Thailand [TH], and the Philippines [PH]), China [CN], Hong Kong [HK], Taiwan [TW], Japan [JP], and Korea [KR]. These countries were selected based on their institutional and economic significance in the region. Except for Taiwan, they are also the signatories of the *Chiang Mai Initiative*. The ASEAN5 are the five original member countries of ASEAN, and all have seen substantial development through regional free-trade agreements and policy coordination efforts, thereby improving financial integration. The non-original member countries of ASEAN (now the ASEAN10) are not included in this study because they are not as economically significant and because the data are severely limited. China, Hong Kong, and Taiwan, constituting greater China, share several common features, such as language and cultural backgrounds, although they exhibit distinctive economic characteristics. Japan and Korea are two major industrialized countries in East Asia in close geographic and economic proximity to each other.

We use seasonally adjusted quarterly data for real GDP [GDP], real exchange rate [REX], CPI inflation [INF], M1 money growth [DMO], real exports [EXT], and real imports [IMT] for each of the 10 East Asian countries over the period of 1993:Q1 to 2010:Q4. A coherent set of quarterly data was not readily available prior to 1993 for many countries. Coincidentally, East Asian economies began to interact actively since the early 1990s. The real exchange rate is defined in terms of U.S. dollars for consistency across countries, and M1 money growth is used to capture movements in monetary policy and liquidity. To reflect the general conditions of the world economy, we utilize data on the world oil price (WR_OIL) and world GDP (WR_GDP). The former denotes the average of the U.K. Brent, Dubai, and West Intermediate prices. The latter is obtained by aggregating the real GDPs of the U.S. and

the EU; this accounts for about 50 percent of world GDP according to the 2010 IMF statistics. There are 62 variables altogether. All data were drawn from Global Insight except for real exports and real imports, which were drawn from the IMF's *International Financial Statistics*. Except for CPI inflation and M1 money growth, the variables are in logarithms and are transformed into first differences under the assumption that they are $I(1)$ processes.⁶ Furthermore, these stationary variables are normalized to have a mean of zero and unit variances to avoid size effects, as the variables with relatively large variance can dominate the factor estimates. The FAVAR model in (3) is estimated using the lag length of $p=q=3$ for $D(L)$ and $\Phi(L)$, together with a constant, and a time dummy for the period of 1997:Q3 to 1998:Q1 to take the Asian financial crisis into account.

4. World and regional common factors

As discussed earlier, all variables under consideration are grouped into eight blocks according to their economic relevance: world oil price (block 1), world GDP (block 2), regional GDP (block 3), regional real exchange rates (block 4), regional inflation (block 5), regional money growth (block 6), regional exports (block 7), and regional imports (block 8). Blocks 3 through 8 contain 10 variables, respectively, corresponding to the 10 East Asian countries. We apply principal components analysis to each of these blocks, and the common factor is chosen as the principal component that has the largest eigenvalue. Table 1 reports the fractions of the variation explained by the four principal components, PC_i for $i=1, 2, 3$, and 4, where PC_1 has the largest eigenvalue, PC_2 has the second largest eigenvalue, and so on. The remaining principal components contribute little and are not reported. Starting from block 3 of the regional GDPs, the first principal component, PC_1 , accounts for 67 percent of the total variation and more than 50 percent of the variation in the individual GDPs of all

⁶ The augmented Dickey-Fuller test confirmed that all variables were characterized as an $I(1)$ process.

countries. The second principal component, PC_2 , explains only an additional 7 percent of the total variation. Moving to block 4 of regional real exchange rates, more than 50 percent of the total variation is attributable to the first principal component, PC_1 , which also accounts for over 66 percent of the variation in the individual real exchange rates except in Japan, Hong Kong, and China. In Japan, PC_1 accounts for 30 percent of the variation in the real exchange rate, while PC_3 and PC_4 make smaller but significant contributions. In Hong Kong and China, PC_2 and PC_3 are, respectively, the most influential determinants of real exchange rates. The failure of PC_1 in these countries may be partly due to differences in the exchange rate system.⁷ These exceptions only pertain to specific countries, and the principal components other than PC_1 contribute no significant gain in summarizing movements in the real exchange rate block as a whole.

Blocks 5 and 6 contain inflation and money growth variables. These two blocks may be efficiently merged into one to reflect nominal movements in the region. To test this possibility, Table 2 reports the results obtained by applying the Bai and Ng (2002) information criterion. The IC_{p2} statistics select one common factor among 20 variables of inflation and money growth. When the two blocks are merged, Table 1 shows that the first principal component corresponding to the largest eigenvalue accounts for over 50 percent of the total variation and a large fraction of the variation in individual variables across countries, save for a few cases. As the other principal components do not contribute much, the first principal component is interpreted as the nominal factor that is responsible for common movements in blocks 5 and 6. We do not extract any common factor from the export and import blocks of 7 and 8. Economic theory suggests that exports are determined mainly by world GDP and real exchange rates, with imports determined mainly by domestic GDP and

⁷ Unlike the other countries, which adopt floating exchange rates, Hong Kong operates a fixed exchange rate regime by pegging its currency to the U.S. dollars. From 1995 to 2005, the Chinese currency, the yuan, was also pegged to the U.S. dollar. In July 2005, China announced a shift of its exchange rate regime to a managed float, tying the value of the yuan to a broad basket of foreign currencies. However, the yuan's movement vis-à-vis the U.S. dollar has been relatively stable compared to other regional currencies.

real exchange rates. This prediction is confirmed by the test results in Tables 1 and 2. The IC_{p2} information criterion chooses two common factors in each of two combined block groups: 2, 4, and 7 for the export function and 3, 4, and 8 for the import function. In the export function, the first and second principal components are mainly associated with movements in world GDP and the real exchange rate, while, in the import function, they are mainly associated with movements in domestic GDP and the real exchange rate. The sum of these two principal components explains more than 62 (62) percent of the total variation and between 57 (42) and 79 (80) percent of the individual exports (imports) across countries. To sum up, we assume that the three common factors characterize the regional blocks of 3 through 8. The presence of three common factors is statistically confirmed by the Bai and Ng information criterion ($IC_{p2} = -0.136$) in Table 2. Together with the world oil price and world GDP, a total of five common factors are present in the model: the world oil price factor, the world GDP factor, the regional GDP factor, the regional real exchange rate factor, and the regional nominal factor.

Figure 1 illustrates how well the common and idiosyncratic components represent individual countries' GDPs, the key variable in this study, over time. Note that the two components are mutually exclusive and collectively exhaustive by the assumptions. It is apparent that the common components and GDP evolve closely in tandem for all countries, whereas the idiosyncratic components play a minor role.⁸ This yields tentative evidence that GDP movements in the region are synchronized, lending support to the feasibility of a currency union. For the Asian financial crisis of 1997 and 1998, the idiosyncratic components exert improved explanatory power yet are outperformed by the common components with the possible exception of Thailand. Figure 2 reports the standard deviations of common and idiosyncratic components together with those of actual series across countries. In the model,

⁸ While not reported due to space limitations, the common and idiosyncratic components of other regional variables have very similar implications. These results are available upon request.

there are two sources of heterogeneity between countries: asymmetric transmission of common shocks and idiosyncratic shocks. It is shown that the standard deviations of the common components exceed those of the idiosyncratic components in all variables. The observed heterogeneity is mainly attributable to the asymmetric transmission of common shocks rather than idiosyncratic shocks; the idiosyncratic components exhibit a low level of dispersion across countries over the sample period.⁹ Apparently, the evidence for East Asia is quite distinct from the experiences of euro countries. Based on an analogous FAVAR model, Eickmeier (2009) found that the idiosyncratic component accounted for a large portion of the movements in GDP and prices for a number of member countries over the period of 1980 to 2003. Furthermore, the dispersion of both GDP and prices across euro countries is mainly due to idiosyncratic shocks, while little else is explained by the asymmetric transmission of common shocks.

5. Structural analysis

This section examines how and to what extent the identified structural shocks underlying the common components are transmitted to each country and cause cross-country heterogeneity by means of impulse responses and variance decompositions.

5.1. Variance decompositions

Forecast error variance decompositions provide a way to assess the relative importance of structural shocks in accounting for variations in variables. Tables 3.1 through 3.5 present the forecast error variance decompositions at various horizons along with one-

⁹ One notable exception is the Asian financial crisis, during which the standard deviations of idiosyncratic components increase substantially, becoming almost as large as those of common components. While there should be other reasons, it must be remembered that the crisis had effects of varying magnitudes on countries in the region: Malaysia, the Philippines, Thailand, Korea, and Indonesia were badly hurt, while Japan, Singapore, Hong Kong, Taiwan, and China were resilient. The respective governments implemented various counter policies to stabilize the economy, and the differences in these policies may also have amplified the idiosyncratic components.

standard errors generated by 300 bootstrap replications. Starting from the top panel, the regional GDP shock is the most important determinant, accounting for more than 50 percent of the fluctuations in the GDPs across all countries at the contemporaneous horizon. As the forecasting horizon increases, the strength of the regional GDP shock attenuates and the world GDP shock gains importance instead, except in Indonesia. Both world and regional GDP shocks are equally important in accounting for the variation of GDPs at a horizon of 16 quarters. For Indonesia, the world GDP shock is unimportant across the horizons, and shocks to regional GDP and the real exchange rate explain most of the movements in GDP. The second panel shows that the real exchange rate shock accounts for the bulk of short-run variations in the real exchange rate. This shock continues to be important at long horizons, where the world and regional GDP shocks also account for a sizable portion of the variation in the rate. Two exceptions are Hong Kong and China. In these countries, the idiosyncratic shock contributes significantly to the forecast error variance of the real exchange rate, and its presence is visible even at long horizons. This may be partially due to their different exchange rate systems, as discussed in Section 4. At long horizons, the regional GDP shock is the most important determinant of the real exchange rate in Hong Kong and China.

Moving to the third panel, the nominal shock is most important in explaining the forecast error variance of inflation at short horizons. The exception is Japan, where the shock exerts only marginal effects, and the same is true at long horizons. This is anticipated from the principal component analysis in Table 1, as the common nominal factor accounts for five percent of the variation in the Japanese inflation data. For the other countries, the world oil price shock is also important for short-term variation in inflation, but its importance diminishes as the forecasting horizon increases. At long horizons, the world and regional GDP shocks account for an increasing portion of the forecast error variance of inflation, while the nominal shock remains strong. The fourth panel reports the variance

decompositions for money growth, and the results vary across countries. While the nominal shock accounts for a sizable portion of the variation in money supply, the other shocks appear to be equally or more important in some countries. In particular, the idiosyncratic shock explains between 13 and 44 percent of the contemporaneous variation in money growth across countries. The results do not change much as the forecasting horizon increases. In general, the regional GDP and nominal shocks explain a large portion of the long-run variability in money growth for many countries. The idiosyncratic shock becomes less important, but it still has significant effects in several countries. The persistent presence of idiosyncratic shocks hints at the possibility that these countries exhibit some degree of heterogeneity in their monetary policies, a point we will revisit when discussing the impulse response analysis.

The results for exports and imports in the final two panels display similar patterns. The world and regional GDP shocks play a major role in accounting for the short-term variation in exports and imports. However, there are the exceptions; the real exchange rate shock is more important than the world and regional GDP shocks for exports in the Philippines and Indonesia and for imports in Japan, Thailand, and the Philippines, while the idiosyncratic shock is the most important determinant of Chinese exports and imports. In many countries, the nominal shock also explains a considerable fraction of the forecast error variance of both exports and imports. Prasad and Gable (1998) and Fisher and Huh (2002) similarly reported that nominal shocks are an important determinant of exports and imports in 23 developed countries and the trade balances in the G-7. As the forecasting horizon increases, the contribution of the nominal shock declines but is still significant in some countries, such as Indonesia and China. The world GDP shock increases in importance, becoming the major determinant of both exports and imports in most of the countries at a horizon of 16 quarters. The regional GDP shock remains significant, with strong evidence for

imports in the Philippines and China. For the Philippines and China, the real exchange rate and nominal shocks account for 44 and 58 percent of the variation in their respective exports.

5.2. Impulse responses

Figures 3.1 to 3.5 display the responses of the series in levels to a one-unit shock in each structural disturbance.¹⁰ As shown in Figure 3.1, GDP initially increases following a positive shock to the world oil price and begins to decrease after approximately two quarters, with a few exceptions. An initial increase in GDP is also reported by a group of VAR studies (e.g., Burbidge and Harrison, 1984; Hooker, 1996; Kilian, 2009), though this result is not consistent with standard economic theories. For the Philippines, China, and Indonesia, the responses remain positive over all horizons, and these oil-producing countries appear to capitalize on the rise in the oil price. Similar to the GDP response, exports and imports increase in the first few quarters following the shock and decline thereafter in all countries save Indonesia. The oil price shock causes inflation to rise immediately, while the effects are somewhat mixed as the forecast horizon increases. Figure 3.2 shows the responses to a positive world GDP shock. All of the regional GDPs show an increase, and the responses are similarly hump-shaped with the exception of Indonesia. A positive world GDP shock leads to higher inflation. As the world GDP increases, exports in the region increase, with the effects particularly pronounced in Korea, Japan, and Singapore. Imports also increase due to income effects, except in China, which shows negative responses after five quarters.

Figure 3.3 shows GDP increases in all countries when there is a positive regional GDP shock. Similar to the responses to a world GDP shock, responses are hump-shaped and synchronized between countries. In the variance decomposition analysis, the regional GDP shock was the main cause of short-run movements in GDP, while both world and regional

¹⁰ The standard error bands are not shown to reduce clutter.

GDP shocks were equally important at long horizons. Taken together, the implication is that business cycle fluctuations in the region are synchronized. Exports and imports increase in a similar manner following a regional GDP shock. The exception is China, where both exports and imports decline after an initial increase in the first few quarters. Similar results were found in the Chinese response to a world GDP shock.

Figure 3.4 reports the effects of a shock leading to depreciation in the real exchange rate. Exports exhibit J-curve responses, increasing after an initial decline. The exceptions are the Philippines and Indonesia, where exports never decrease. GDP also declines initially, but the responses afterward differ across countries. Interestingly, GDPs increase in developed economies and decrease in developing economies.¹¹ Real depreciation causes imports to decline at short horizons in most countries. As the time horizon increases, the responses vary depending on the country, but most are not very significantly different from zero. Finally, Figure 3.5 shows that a positive nominal shock leads to higher inflation in all countries. The GDP increases initially, but the effects are short-lived. That nominal shocks have only transitory effects on GDP is documented in many studies (e.g., Eichenbaum and Evans, 1995). The exceptions are China and the Philippines, where the nominal shock continues to increase the GDPs. Exports increase initially due to the accompanied depreciation of real exchange rates. As the real depreciation is transitory (e.g., purchasing power parity), the increase in exports is lessened as the forecasting horizon increases. Imports initially increase for most countries, and this suggests that the income-absorption effect dominates the exchange rate effect.¹² As the income-absorption effect is eroded as GDP declines, the responses of imports

¹¹ One reason may be that the domestic industry in developed economies expands the capacities to substitute imports, which become expensive following a depreciation. Due to capacity constraints, this option may not be available for developing economies.

¹² A positive nominal shock simulates the economy (e.g., an increase in GDP), and the income-absorption effect refers to a resultant increase in imports. The accompanying exchange rate depreciation leads to a decrease in imports, which is referred to as the exchange rate effect.

eventually become negative. Again, exports and imports for China are at odds with the results for other countries in the region.

Earlier, Figures 1 and 2 showed that the common factors well accounted for the movements in the variables and that the heterogeneity present across countries was attributable to the asymmetric transmission of common shocks rather than idiosyncratic shocks. The results of an impulse response analysis can shed light on which common shocks mainly cause asymmetric responses of variables. For a better gauge, Figure 4 depicts the cross-country standard deviations of impulse responses at each forecasting horizon. Among the five common shocks, the regional GDP shock is least responsible for the dispersion of individual GDPs, followed by the world GDP shock. This consolidates our finding that the responses of GDPs are synchronized across countries to regional and world GDP shocks, which are the major determinants of GDP fluctuation. Overall, the evidence supports the feasibility of forming a currency union in the region. The real exchange rate and nominal shocks do not produce much heterogeneity at short horizons, but the effects are significantly amplified as the forecasting horizon increases. They become the two main sources of GDP dispersion at long horizons, while the contribution of these shocks to the forecast error variance of GDP was small.

The nominal shock is also largely responsible for the cross-country dispersion in all other variables. The effects are particularly evident in inflation and money growth, which are directly related to monetary policy. Previously, variance decomposition analysis suggested that country-specific idiosyncratic shocks have persistently significant effects on money growth in a number of countries. Taken together, these results indicate that differences in the monetary policies of different countries may be the major source of cross-country heterogeneity in the region. Currently, there is no mechanism or agreement regarding the coordination of monetary policy in East Asia. This stands in contrast to euro countries, which

underwent a series of adjustment processes (e.g., ERM and EMS) before the euro came into effect in 1999. Some degree of coordination in monetary policy and national economic policy may be required beforehand to reduce such heterogeneity and to prepare a more favorable environment for the eventual, formal establishment of a currency union in the region. Regarding exports and imports, the magnitude of dispersion is considerable, but this may be partially due to a few peripheral cases exhibiting very large responses, as shown in the impulse response analysis. The notable example is China, where exports and imports show extremely strong responses to most types of shocks. To check this effect, Figure 4 also reports the results when China is excluded from the export and import blocks. The dispersion of responses is almost halved in both exports and imports. In fact, the impulse response analysis revealed that, save for a few exceptions, exports and imports show the most synchronized responses irrespective of the structural shocks. As exports and imports are important transmission channels of business cycles, close trade linkages between countries have likely contributed to the synchronization of business cycles in the region.

6. Conclusion

This paper empirically investigates the co-movements of key macroeconomic variables for 10 major East Asian countries (ASEAN5, Japan, Korea, and greater China) to shed light on the feasibility of a currency union in the region. The working model is a FAVAR that accommodates a large set of 62 variables consisting of six variables for each country, along with world oil prices and world GDP to capture changes in the world economy. Imposing a short-run block recursive structure, two world shocks and three regional shocks are identified to be responsible for driving the co-movements among variables. The paper examines how and to what extent each country responds to these common shocks, focusing

on the degree of business cycle synchronization across countries, which is a key precondition for considering a regional currency union.

Empirical results reveal that the common shocks explain most of the variation in the key variables across countries. The contributions of country-specific idiosyncratic shocks are marginal. The great majority of countries in the region also show a qualitatively synchronized response to the common shocks. Of particular importance is the finding that individual GDPs produce uniform responses to world and regional GDP shocks, which are the two main sources of GDP fluctuation. Exports and imports, which are important channels of business cycle transmission, exhibit the most homogeneous responses irrespective of the shocks. Overall, the findings lend support to the synchronization of business cycles across countries, and can be interpreted favorably for the consideration of a currency union in East Asia.

Two remaining issues need to be addressed. First, the responses of Chinese exports and imports to virtually all shocks in the model are by far the largest compared to those of other countries. Given the magnitude of Chinese exports and imports, a detailed examination is in order to assess how such large responses may affect the degree of business cycle synchronization in the region. The second issue is related to the finding that nominal shocks in the region produce much less uniform responses. Idiosyncratic shocks also have persistent effects on money growth in a number of countries. Differences in monetary policy may be the main source of cross-country heterogeneity. Such heterogeneities may be smoothed out once a currency union is instituted. Yet, some level of coordination in monetary policy and economic policy may be necessary beforehand in order to speed up convergence and prepare a more favorable environment for the introduction of a currency union in East Asia.

It goes without saying that the evidence presented in this paper does not validate the contention that an East Asian currency union is ready to launch. On a grand scale, there are many additional economic and political factors to be considered. As economic conditions for

an OCA improve, East Asia may consider further monetary and financial cooperation and integration. Many also argue that OCA criteria are often endogenous; that is, joining a monetary union may promote trade integration and capital mobility, thus increasing the degree of symmetry of shocks and business cycle correlations across countries. Moving forward in that direction would require strong political commitment and institutional support, but political cooperation and institutionalization for monetary integration in East Asia are seen as relatively weak; this is an important barrier to regional monetary arrangements. Bayoumi *et al.* (2000) stressed the need for a firm political commitment, and Willet *et al.* (2010) added that close attention should be paid to coordination in monetary, fiscal, and exchange rate policies. Indeed, a regional monetary arrangement is likely to work only when there is strong regional solidarity and political support for the delegation of monetary policy to a supra-national institution (e.g., a regional central bank), with systemic support from other regional institutions such as a customs union. Further studies are warranted prior to discussing any formal arrangement of an East Asian currency union in order to avoid the painful experience of the euro zone.

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Table 1: Principal components analysis results

	PC_1	PC_2	PC_3	PC_4		PC_1	PC_2	PC_3	PC_4
GDP					REX				
<i>Eigenval</i>	6.67	0.69	0.56	0.51	<i>Eigenval</i>	5.09	1.24	0.92	0.84
<i>Prop</i>	0.67	0.07	0.06	0.05	<i>Prop</i>	0.51	0.12	0.09	0.08
<i>Cum Prop</i>	0.67	0.74	0.80	0.85	<i>Cum Prop</i>	0.51	0.63	0.72	0.80
JP_GDP	0.64	0.08	0.00	0.00	JP_REX	0.30	0.15	0.20	0.26
TH_GDP	0.73	0.08	0.00	0.01	TH_REX	0.78	0.01	0.01	0.03
MY_GDP	0.77	0.02	0.03	0.04	MY_REX	0.69	0.01	0.15	0.00
TW_GDP	0.71	0.05	0.01	0.03	TW_REX	0.67	0.00	0.04	0.02
SG_GDP	0.59	0.11	0.00	0.18	SG_REX	0.58	0.02	0.00	0.00
KR_GDP	0.75	0.03	0.06	0.00	KR_REX	0.66	0.01	0.01	0.00
PH_GDP	0.53	0.00	0.44	0.00	PH_REX	0.69	0.01	0.00	0.13
IN_GDP	0.61	0.27	0.01	0.00	IN_REX	0.67	0.00	0.02	0.01
HK_GDP	0.77	0.02	0.01	0.00	HK_REX	0.00	0.61	0.07	0.30
CN_GDP	0.59	0.04	0.00	0.25	CN_REX	0.05	0.39	0.42	0.06
INF+DMO									
<i>Eigenval</i>	10.88	1.77	1.24	1.08					
<i>Prop</i>	0.54	0.09	0.06	0.05					
<i>Cum Prop</i>	0.54	0.63	0.69	0.74					
JP_INF	0.05	0.27	0.08	0.40	JP_DMO	0.07	0.02	0.39	0.02
TH_INF	0.24	0.21	0.08	0.02	TH_DMO	0.87	0.03	0.00	0.00
MY_INF	0.26	0.53	0.02	0.00	MY_DMO	0.90	0.04	0.00	0.00
TW_INF	0.29	0.04	0.00	0.17	TW_DMO	0.56	0.08	0.00	0.00
SG_INF	0.04	0.00	0.52	0.21	SG_DMO	0.77	0.06	0.00	0.00
KR_INF	0.48	0.06	0.00	0.07	KR_DMO	0.66	0.06	0.03	0.03
PH_INF	0.51	0.27	0.00	0.01	PH_DMO	0.78	0.02	0.03	0.00
IN_INF	0.49	0.00	0.00	0.08	IN_DMO	0.82	0.00	0.00	0.00
HK_INF	0.51	0.02	0.07	0.03	HK_DMO	0.89	0.05	0.00	0.00
CN_INF	0.84	0.00	0.00	0.00	CN_DMO	0.84	0.03	0.01	0.03
WR_GDP+REX+EXT					GDP+REX+IMT				
<i>Eigenval</i>	8.37	4.66	1.43	1.03	<i>Eigenval</i>	13.03	5.69	1.51	1.14
<i>Prop</i>	0.40	0.22	0.07	0.05	<i>Prop</i>	0.43	0.19	0.05	0.04
<i>Cum Prop</i>	0.40	0.62	0.69	0.74	<i>Cum Prop</i>	0.43	0.62	0.67	0.71
WR_GDP	0.62	0.09	0.01	0.00	JP_GDP	0.69	0.01	0.01	0.02
JP_REX	0.30	0.05	0.09	0.26	TH_GDP	0.66	0.04	0.00	0.01
TH_REX	0.33	0.44	0.00	0.02	MY_GDP	0.71	0.06	0.01	0.01
MY_REX	0.13	0.61	0.00	0.10	TW_GDP	0.71	0.00	0.00	0.05
TW_REX	0.17	0.50	0.00	0.09	SG_GDP	0.56	0.02	0.00	0.00
SG_REX	0.05	0.61	0.10	0.02	KR_GDP	0.63	0.09	0.04	0.06
KR_REX	0.33	0.33	0.01	0.00	PH_GDP	0.53	0.00	0.01	0.01
PH_REX	0.31	0.37	0.00	0.01	IN_GDP	0.54	0.00	0.01	0.04
IN_REX	0.56	0.23	0.02	0.00	HK_GDP	0.75	0.02	0.00	0.00
HK_REX	0.04	0.03	0.45	0.06	CN_GDP	0.53	0.00	0.02	0.07
CN_REX	0.06	0.00	0.42	0.30	JP_REX	0.17	0.19	0.16	0.03

Table 1: Continued

	PC_1	PC_2	PC_3	PC_4		PC_1	PC_2	PC_3	PC_4
JP_EXT	0.46	0.29	0.02	0.00	TH_REX	0.05	0.72	0.00	0.00
TH_EXT	0.64	0.09	0.02	0.00	MY_REX	0.01	0.75	0.00	0.01
MY_EXT	0.57	0.06	0.02	0.11	TW_REX	0.01	0.63	0.03	0.01
TW_EXT	0.66	0.13	0.00	0.01	SG_REX	0.02	0.63	0.11	0.00
SG_EXT	0.47	0.20	0.05	0.03	KR_REX	0.08	0.58	0.01	0.00
KR_EXT	0.42	0.19	0.01	0.01	PH_REX	0.06	0.65	0.00	0.05
PH_EXT	0.57	0.00	0.03	0.00	IN_REX	0.20	0.58	0.02	0.01
IN_EXT	0.64	0.09	0.05	0.00	HK_REX	0.07	0.00	0.44	0.33
HK_EXT	0.55	0.22	0.00	0.00	CN_REX	0.03	0.02	0.27	0.11
CN_EXT	0.48	0.13	0.12	0.00	JP_IMT	0.42	0.00	0.06	0.07
					TH_IMT	0.69	0.03	0.00	0.04
					MY_IMT	0.67	0.05	0.01	0.00
					TW_IMT	0.76	0.00	0.00	0.00
					SG_IMT	0.64	0.00	0.07	0.01
					KR_IMT	0.55	0.25	0.05	0.02
					PH_IMT	0.60	0.10	0.03	0.00
					IN_IMT	0.37	0.24	0.12	0.00
					HK_IMT	0.77	0.01	0.00	0.01
					CN_IMT	0.54	0.00	0.02	0.18

Notes: In each panel, the first row reports the four largest eigenvalues (*Eigenval*) of the block. The second and third rows report the fractions (*Prop*) and cumulated fractions (*Cum Prop*) of the total variation in the block accounted for by each of the four principal components. The figures that follow are the fractions of the variation in the individual member variables accounted for by each of the four principal components.

Table 2: Test of the number of common factors

$r = 1$	$r = 2$	$r = 3$	$r = 4$	$r = 5$	$r = 6$	$r = 7$	$r = 8$	$r = 9$	$r = 10$
INF+DMO									
0.094	0.097	0.149	0.193	0.226	0.271	0.297	0.321	0.341	0.347
WR_GDP+REX+EXT									
-0.059	-0.325	-0.314	-0.279	-0.248	-0.234	-0.215	-0.192	-0.175	-0.171
GDP+REX+IMT									
-0.101	-0.329	-0.293	-0.257	-0.232	-0.199	-0.175	-0.142	-0.108	-0.066
GDP+REX+INF+DMO+EXT+IMT									
0.077	-0.083	-0.136	-0.119	-0.085	-0.051	-0.009	0.031	0.070	0.118

Notes: Figures are IC_{p2} information criterion statistics developed by Bai and Ng (2002), and those that are shaded are the chosen numbers of common factors. The maximum number of common factors is set to $r=10$.

Table 3.1: Forecast error variance decompositions at the contemporaneous horizon

	WR_OIL		WR_GDP		GDP		REX		NOM		IDS	
JP_GDP	0.10	(14)	33.32	(10)	58.49	(14)	0.00		0.00		8.09	(02)
TH_GDP	8.09	(16)	31.60	(08)	49.55	(18)	0.00		0.00		10.76	(06)
MY_GDP	3.54	(11)	12.65	(04)	70.88	(11)	0.00		0.00		12.93	(01)
TW_GDP	8.62	(12)	24.26	(12)	60.96	(14)	0.00		0.00		6.17	(02)
SG_GDP	0.04	(13)	36.90	(08)	59.53	(16)	0.00		0.00		3.54	(04)
KR_GDP	9.27	(13)	22.18	(07)	58.31	(14)	0.00		0.00		10.24	(03)
PH_GDP	0.07	(16)	33.33	(15)	60.01	(27)	0.00		0.00		6.60	(18)
IN_GDP	7.41	(13)	0.25	(11)	68.45	(23)	0.00		0.00		23.89	(11)
HK_GDP	10.28	(12)	18.83	(08)	61.38	(13)	0.00		0.00		9.51	(03)
CN_GDP	5.56	(18)	31.00	(14)	59.13	(19)	0.00		0.00		4.31	(09)
JP_REX	0.80	(20)	1.99	(20)	1.51	(14)	89.87	(24)	0.00		5.82	(12)
TH_REX	1.25	(13)	11.27	(14)	4.57	(15)	77.59	(16)	0.00		5.33	(09)
MY_REX	2.98	(10)	9.29	(14)	5.88	(12)	73.93	(14)	0.00		7.93	(05)
TW_REX	17.01	(14)	7.00	(10)	0.11	(15)	71.75	(20)	0.00		4.13	(07)
SG_REX	10.28	(10)	4.24	(09)	1.86	(12)	80.22	(16)	0.00		3.40	(04)
KR_REX	14.39	(15)	23.00	(08)	7.95	(12)	47.41	(12)	0.00		7.25	(02)
PH_REX	0.19	(11)	11.50	(12)	7.61	(11)	73.92	(13)	0.00		6.79	(06)
IN_REX	0.59	(14)	18.24	(06)	7.39	(15)	64.58	(15)	0.00		9.21	(05)
HK_REX	2.35	(17)	27.96	(11)	48.43	(14)	0.74	(18)	0.00		20.51	(16)
CN_REX	0.16	(02)	3.43	(04)	8.25	(05)	23.36	(05)	0.00		64.80	(08)
JP_INF	1.77	(15)	42.43	(17)	17.15	(09)	20.22	(16)	4.73	(23)	13.69	(08)
TH_INF	47.40	(13)	4.43	(13)	9.46	(14)	5.75	(07)	30.34	(25)	2.61	(06)
MY_INF	47.78	(17)	13.57	(07)	0.21	(11)	0.43	(08)	32.50	(23)	5.50	(03)
TW_INF	18.64	(13)	1.38	(17)	5.73	(17)	12.80	(13)	50.11	(18)	11.34	(07)
SG_INF	11.73	(13)	18.01	(07)	25.11	(17)	7.60	(14)	15.90	(16)	21.64	(05)
KR_INF	38.04	(10)	0.29	(15)	0.01	(08)	0.01	(14)	55.28	(23)	6.38	(12)
PH_INF	39.66	(13)	13.11	(08)	1.75	(10)	8.00	(17)	34.43	(22)	3.05	(05)
IN_INF	15.02	(15)	4.35	(13)	2.88	(12)	5.21	(13)	66.29	(20)	6.25	(12)
HK_INF	38.59	(11)	0.26	(15)	0.79	(18)	0.14	(15)	57.18	(24)	3.04	(06)
CN_INF	17.13	(15)	16.45	(13)	17.23	(12)	10.10	(15)	33.59	(23)	5.49	(14)
JP_DMO	6.90	(13)	2.99	(07)	8.50	(16)	29.37	(14)	13.93	(25)	38.32	(13)
TH_DMO	0.78	(09)	3.11	(14)	24.85	(16)	4.34	(14)	22.85	(20)	44.06	(12)
MY_DMO	9.39	(13)	24.09	(13)	12.99	(16)	0.17	(07)	37.48	(19)	15.89	(06)
TW_DMO	50.10	(16)	0.27	(20)	0.29	(20)	9.39	(14)	0.70	(22)	39.24	(09)
SG_DMO	0.00	(15)	20.19	(11)	18.91	(17)	32.75	(08)	6.45	(22)	21.70	(11)
KR_DMO	1.30	(11)	7.65	(11)	19.44	(11)	0.01	(17)	28.43	(25)	43.18	(13)
PH_DMO	3.73	(10)	0.42	(19)	52.25	(17)	3.88	(14)	23.53	(22)	16.19	(09)
IN_DMO	29.42	(07)	0.92	(09)	11.64	(11)	3.15	(11)	42.06	(22)	12.80	(09)
HK_DMO	27.71	(10)	2.17	(12)	31.13	(20)	0.03	(15)	26.47	(25)	12.50	(13)
CN_DMO	1.47	(18)	2.93	(13)	6.49	(14)	6.65	(07)	67.76	(20)	14.70	(07)
JP_EXT	4.46	(15)	56.00	(08)	25.00	(12)	0.09	(06)	5.50	(05)	8.94	(03)
TH_EXT	40.28	(17)	11.28	(09)	4.21	(19)	1.11	(12)	37.23	(07)	5.89	(04)
MY_EXT	16.67	(15)	27.35	(09)	13.00	(16)	4.14	(08)	33.55	(06)	5.30	(07)
TW_EXT	10.49	(15)	36.27	(11)	31.53	(13)	0.20	(04)	17.35	(04)	4.16	(02)
SG_EXT	3.90	(17)	29.38	(12)	49.15	(14)	1.80	(07)	7.07	(05)	8.69	(07)
KR_EXT	12.10	(16)	27.99	(10)	32.55	(14)	4.32	(08)	19.50	(06)	3.54	(02)
PH_EXT	4.25	(12)	11.10	(18)	5.44	(24)	37.87	(09)	9.42	(20)	31.92	(07)
IN_EXT	22.84	(14)	0.16	(08)	0.05	(15)	24.76	(21)	44.96	(17)	7.23	(14)
HK_EXT	0.28	(13)	28.07	(08)	48.78	(16)	0.49	(06)	1.87	(06)	20.51	(02)
CN_EXT	12.25	(16)	24.04	(11)	14.93	(19)	1.51	(13)	20.50	(10)	26.78	(06)
JP_IMT	17.88	(08)	4.37	(16)	6.97	(21)	29.79	(08)	31.29	(10)	9.70	(07)
TH_IMT	2.18	(17)	27.16	(06)	0.06	(17)	33.00	(06)	0.82	(10)	36.78	(04)
MY_IMT	12.87	(17)	34.28	(10)	17.04	(16)	0.01	(06)	28.45	(06)	7.34	(04)
TW_IMT	3.77	(12)	56.33	(11)	28.17	(16)	3.70	(06)	2.34	(04)	5.69	(02)
SG_IMT	6.09	(13)	25.68	(07)	32.98	(12)	2.14	(04)	20.18	(03)	12.94	(04)
KR_IMT	2.51	(14)	17.27	(08)	40.00	(15)	11.94	(05)	17.64	(08)	10.64	(02)
PH_IMT	17.33	(20)	1.57	(11)	23.51	(16)	31.65	(08)	14.13	(09)	11.81	(08)
IN_IMT	19.94	(12)	1.12	(14)	8.44	(14)	9.05	(22)	50.91	(14)	10.54	(18)
HK_IMT	4.40	(15)	18.01	(08)	58.10	(15)	1.20	(06)	2.33	(05)	15.96	(03)
CN_IMT	6.76	(14)	0.36	(12)	17.33	(17)	0.36	(18)	24.09	(09)	51.11	(15)

Note: Figures in parentheses are one-standard errors computed using 300 bootstrap replications of the model. 'IDS' in the last column denotes the idiosyncratic shock.

Table 3.2: Forecast error variance decompositions at the one-quarter horizon

	WR_OIL		WR_GDP		GDP		REX		NOM		IDS	
JP_GDP	9.07	(10)	39.02	(11)	44.20	(12)	0.64	(01)	4.56	(02)	2.51	(01)
TH_GDP	8.01	(15)	33.29	(12)	49.89	(18)	1.57	(03)	0.88	(03)	6.37	(04)
MY_GDP	7.25	(11)	38.96	(06)	40.73	(13)	6.79	(01)	2.41	(01)	3.87	(01)
TW_GDP	3.64	(11)	44.83	(10)	41.83	(14)	5.10	(02)	1.76	(02)	2.84	(02)
SG_GDP	0.42	(13)	48.56	(09)	43.85	(15)	0.89	(01)	4.74	(03)	1.54	(02)
KR_GDP	4.48	(10)	41.87	(10)	41.64	(14)	7.28	(01)	0.42	(05)	4.31	(02)
PH_GDP	10.26	(18)	29.55	(15)	43.84	(24)	5.57	(07)	7.18	(04)	3.60	(13)
IN_GDP	2.33	(10)	1.06	(05)	44.95	(18)	22.41	(08)	17.73	(06)	11.51	(04)
HK_GDP	5.49	(11)	58.17	(08)	29.16	(12)	0.41	(01)	2.92	(04)	3.86	(01)
CN_GDP	3.46	(16)	35.25	(13)	56.40	(18)	0.17	(03)	1.12	(09)	3.60	(05)
JP_REX	1.17	(16)	1.01	(16)	10.08	(12)	79.31	(21)	2.15	(06)	6.28	(08)
TH_REX	1.23	(14)	24.34	(14)	4.34	(14)	60.87	(15)	4.03	(04)	5.19	(08)
MY_REX	4.28	(10)	15.88	(15)	21.10	(12)	53.67	(15)	0.58	(01)	4.49	(07)
TW_REX	20.66	(16)	14.70	(12)	0.38	(18)	59.18	(19)	3.19	(03)	1.89	(04)
SG_REX	12.61	(11)	9.83	(08)	7.60	(13)	63.70	(16)	1.36	(02)	4.90	(05)
KR_REX	12.75	(14)	28.49	(10)	6.79	(12)	43.37	(13)	5.29	(03)	3.32	(02)
PH_REX	0.18	(11)	17.85	(13)	15.41	(09)	57.16	(14)	2.96	(03)	6.44	(04)
IN_REX	1.76	(13)	28.33	(09)	6.93	(13)	54.81	(15)	0.00	(02)	8.16	(05)
HK_REX	9.11	(15)	17.05	(10)	42.37	(13)	1.73	(17)	1.79	(08)	27.95	(12)
CN_REX	0.28	(04)	8.83	(04)	14.53	(05)	24.38	(06)	1.27	(01)	50.71	(10)
JP_INF	10.48	(17)	42.94	(18)	19.32	(10)	12.75	(14)	5.74	(23)	8.78	(04)
TH_INF	38.12	(12)	5.13	(12)	15.96	(16)	8.15	(06)	30.18	(22)	2.45	(08)
MY_INF	48.15	(12)	12.96	(10)	2.39	(13)	2.95	(08)	31.64	(22)	1.90	(04)
TW_INF	21.39	(17)	11.83	(15)	8.30	(15)	9.07	(12)	41.57	(16)	7.84	(07)
SG_INF	12.08	(12)	41.02	(08)	16.88	(12)	8.53	(09)	16.87	(06)	4.61	(02)
KR_INF	30.66	(16)	1.52	(14)	2.16	(10)	18.61	(12)	41.81	(21)	5.24	(06)
PH_INF	38.65	(09)	7.72	(11)	7.95	(07)	6.25	(15)	37.48	(22)	1.94	(04)
IN_INF	19.40	(16)	3.65	(10)	5.79	(10)	3.33	(10)	65.87	(21)	1.96	(09)
HK_INF	36.02	(12)	1.73	(15)	7.65	(16)	1.70	(11)	50.42	(23)	2.47	(04)
CN_INF	13.47	(15)	23.28	(13)	22.64	(11)	6.82	(11)	27.48	(19)	6.31	(09)
JP_DMO	30.79	(14)	11.33	(11)	11.07	(16)	15.64	(10)	8.10	(22)	23.07	(06)
TH_DMO	1.79	(09)	2.91	(13)	30.62	(12)	3.57	(11)	25.34	(20)	35.77	(07)
MY_DMO	8.17	(13)	18.91	(14)	13.34	(14)	0.25	(07)	46.67	(17)	12.66	(04)
TW_DMO	18.79	(15)	31.11	(13)	27.04	(18)	2.75	(08)	15.04	(20)	5.27	(04)
SG_DMO	8.73	(15)	18.83	(11)	14.80	(14)	27.06	(10)	18.26	(20)	12.32	(07)
KR_DMO	0.94	(10)	5.26	(08)	16.47	(11)	40.63	(12)	20.78	(23)	15.92	(07)
PH_DMO	3.46	(13)	11.77	(15)	43.45	(15)	3.86	(13)	22.77	(16)	14.69	(05)
IN_DMO	21.27	(09)	4.33	(08)	14.32	(14)	17.47	(10)	35.80	(21)	6.81	(06)
HK_DMO	32.35	(12)	6.11	(14)	12.07	(23)	6.89	(10)	37.93	(24)	4.66	(06)
CN_DMO	5.60	(17)	5.01	(18)	7.62	(14)	6.07	(08)	60.71	(16)	14.98	(05)
JP_EXT	19.10	(09)	46.00	(09)	18.62	(10)	1.40	(04)	13.16	(04)	1.72	(01)
TH_EXT	28.81	(13)	25.62	(09)	5.36	(13)	4.16	(08)	33.31	(03)	2.74	(02)
MY_EXT	20.01	(14)	32.57	(14)	17.33	(16)	2.21	(05)	24.11	(06)	3.77	(02)
TW_EXT	11.98	(12)	38.35	(10)	23.91	(12)	4.95	(06)	19.58	(04)	1.22	(01)
SG_EXT	6.24	(14)	39.29	(13)	32.75	(12)	2.24	(05)	16.91	(05)	2.56	(02)
KR_EXT	7.67	(12)	46.09	(14)	22.74	(13)	2.76	(05)	19.26	(03)	1.47	(01)
PH_EXT	6.19	(15)	37.52	(17)	6.91	(20)	15.15	(10)	21.65	(13)	12.59	(05)
IN_EXT	24.05	(12)	0.25	(05)	0.10	(13)	13.09	(16)	56.66	(18)	5.86	(08)
HK_EXT	13.81	(11)	47.34	(07)	24.23	(11)	0.81	(04)	11.05	(05)	2.75	(01)
CN_EXT	5.49	(14)	52.68	(10)	12.89	(14)	2.41	(06)	6.42	(03)	20.12	(02)
JP_IMT	9.16	(12)	40.31	(10)	10.45	(15)	18.43	(05)	14.05	(05)	7.60	(01)
TH_IMT	26.23	(14)	36.23	(05)	3.15	(12)	11.34	(04)	18.91	(04)	4.13	(01)
MY_IMT	14.47	(15)	41.67	(09)	22.04	(16)	1.71	(04)	17.75	(04)	2.36	(01)
TW_IMT	13.48	(12)	43.97	(10)	24.55	(15)	5.32	(05)	10.91	(05)	1.77	(01)
SG_IMT	9.82	(11)	38.08	(09)	22.40	(12)	3.48	(03)	22.29	(03)	3.92	(01)
KR_IMT	7.08	(13)	39.97	(13)	22.26	(14)	23.70	(04)	4.21	(05)	2.80	(01)
PH_IMT	25.11	(16)	17.74	(11)	26.73	(14)	12.36	(07)	11.23	(07)	6.83	(03)
IN_IMT	24.91	(15)	3.96	(10)	8.68	(19)	6.88	(10)	52.26	(10)	3.32	(06)
HK_IMT	15.55	(13)	38.27	(06)	25.29	(13)	0.88	(03)	17.72	(05)	2.28	(01)
CN_IMT	7.58	(16)	15.50	(11)	8.91	(16)	6.31	(11)	8.51	(08)	53.19	(06)

Note: Figures in parentheses are one-standard errors computed using 300 bootstrap replications of the model. 'IDS' in the last column denotes the idiosyncratic shock.

Table 3.3: Forecast error variance decompositions at the four-quarter horizon

	WR_OIL		WR_GDP		GDP		REX		NOM		IDS	
JP_GDP	3.33	(13)	44.73	(14)	46.30	(12)	2.37	(02)	2.46	(05)	0.81	(01)
TH_GDP	2.58	(17)	37.85	(13)	52.19	(18)	1.89	(06)	3.00	(05)	2.49	(03)
MY_GDP	5.29	(17)	44.80	(10)	37.47	(16)	4.54	(02)	6.56	(04)	1.35	(01)
TW_GDP	5.28	(15)	49.81	(10)	39.34	(18)	2.04	(04)	2.50	(08)	1.04	(02)
SG_GDP	2.61	(16)	52.49	(11)	40.07	(18)	0.99	(03)	3.09	(04)	0.76	(02)
KR_GDP	6.56	(12)	42.93	(11)	36.56	(15)	3.88	(04)	7.01	(06)	3.06	(06)
PH_GDP	9.30	(17)	30.35	(11)	42.07	(19)	8.43	(05)	7.83	(04)	2.02	(01)
IN_GDP	0.67	(12)	9.31	(04)	46.01	(18)	32.43	(11)	7.72	(06)	3.86	(02)
HK_GDP	7.72	(17)	56.54	(10)	22.34	(18)	0.70	(02)	9.90	(08)	2.80	(01)
CN_GDP	1.27	(16)	30.41	(14)	63.47	(21)	0.67	(05)	2.30	(11)	1.88	(04)
JP_REX	6.11	(16)	0.77	(16)	17.58	(16)	71.65	(17)	0.92	(13)	2.97	(03)
TH_REX	0.72	(14)	35.64	(10)	8.67	(11)	43.21	(15)	6.61	(08)	5.15	(08)
MY_REX	2.27	(09)	23.68	(14)	33.72	(12)	36.54	(15)	1.15	(04)	2.65	(08)
TW_REX	15.76	(16)	22.51	(12)	2.46	(15)	56.21	(19)	1.87	(09)	1.18	(02)
SG_REX	4.73	(10)	20.55	(10)	22.15	(17)	45.63	(18)	3.38	(06)	3.55	(02)
KR_REX	7.36	(18)	37.59	(15)	15.52	(13)	30.47	(12)	3.78	(06)	5.28	(03)
PH_REX	1.85	(10)	23.52	(15)	24.71	(09)	40.31	(16)	2.45	(03)	7.16	(04)
IN_REX	1.11	(14)	23.79	(10)	10.69	(10)	54.74	(15)	4.63	(03)	5.05	(03)
HK_REX	15.57	(12)	8.93	(14)	23.21	(14)	6.82	(15)	7.43	(15)	38.04	(11)
CN_REX	0.39	(06)	19.05	(04)	22.53	(11)	22.68	(06)	5.08	(03)	30.27	(13)
JP_INF	3.41	(16)	41.59	(16)	43.10	(11)	3.97	(13)	4.72	(22)	3.22	(03)
TH_INF	26.18	(12)	7.89	(15)	29.90	(15)	9.33	(10)	23.52	(21)	3.19	(05)
MY_INF	34.13	(12)	19.06	(09)	13.89	(17)	1.59	(07)	29.80	(20)	1.53	(02)
TW_INF	17.93	(14)	20.08	(14)	9.44	(14)	7.91	(08)	36.35	(16)	8.30	(04)
SG_INF	6.34	(16)	49.97	(10)	28.12	(14)	4.94	(10)	9.14	(10)	1.48	(01)
KR_INF	21.39	(14)	5.03	(09)	23.22	(13)	12.16	(11)	32.32	(15)	5.88	(04)
PH_INF	23.09	(08)	15.58	(10)	17.96	(10)	3.91	(13)	38.04	(19)	1.43	(05)
IN_INF	16.07	(15)	2.37	(09)	9.60	(12)	6.53	(07)	64.15	(21)	1.28	(04)
HK_INF	23.89	(13)	7.09	(17)	23.24	(16)	3.30	(09)	40.01	(22)	2.46	(02)
CN_INF	11.46	(16)	24.19	(16)	29.48	(15)	4.97	(11)	19.97	(16)	9.94	(07)
JP_DMO	25.76	(10)	9.72	(14)	20.68	(17)	16.06	(09)	6.51	(18)	21.26	(04)
TH_DMO	15.93	(17)	11.36	(14)	10.98	(08)	8.39	(10)	42.78	(17)	10.55	(05)
MY_DMO	24.78	(15)	7.75	(14)	11.43	(12)	4.39	(08)	46.10	(18)	5.54	(03)
TW_DMO	12.36	(13)	38.43	(12)	34.49	(20)	1.43	(08)	10.70	(20)	2.58	(02)
SG_DMO	8.60	(11)	20.85	(12)	19.79	(12)	25.24	(11)	12.08	(17)	13.43	(05)
KR_DMO	9.31	(09)	6.87	(13)	28.41	(13)	29.84	(13)	14.36	(17)	11.20	(04)
PH_DMO	4.86	(18)	10.45	(17)	45.65	(16)	2.53	(13)	22.85	(15)	13.66	(03)
IN_DMO	18.95	(12)	3.87	(08)	11.19	(14)	30.07	(11)	29.99	(21)	5.93	(04)
HK_DMO	26.09	(14)	13.78	(10)	20.52	(21)	6.09	(10)	30.72	(18)	2.80	(04)
CN_DMO	30.73	(18)	4.15	(20)	8.84	(17)	9.69	(08)	36.86	(16)	9.73	(04)
JP_EXT	6.35	(14)	53.60	(11)	32.39	(13)	1.48	(04)	5.47	(05)	0.71	(01)
TH_EXT	13.95	(16)	47.27	(12)	13.59	(11)	3.75	(05)	19.69	(04)	1.76	(01)
MY_EXT	7.84	(15)	52.70	(17)	27.33	(17)	1.00	(06)	8.68	(08)	2.44	(02)
TW_EXT	5.16	(16)	50.34	(14)	31.22	(12)	1.99	(05)	10.35	(06)	0.94	(01)
SG_EXT	2.21	(15)	52.86	(12)	34.48	(13)	1.60	(05)	7.54	(05)	1.31	(01)
KR_EXT	3.36	(15)	62.29	(16)	23.27	(14)	2.26	(08)	7.81	(05)	1.00	(02)
PH_EXT	12.23	(19)	29.27	(19)	9.19	(20)	36.24	(09)	8.35	(12)	4.72	(03)
IN_EXT	12.75	(15)	11.17	(08)	12.20	(16)	15.44	(14)	44.45	(16)	3.99	(03)
HK_EXT	5.23	(15)	58.25	(09)	29.05	(16)	1.34	(04)	4.52	(06)	1.61	(01)
CN_EXT	10.49	(19)	29.69	(17)	7.40	(13)	5.02	(03)	37.20	(05)	10.20	(01)
JP_IMT	5.41	(15)	62.75	(10)	22.23	(16)	3.94	(03)	3.51	(06)	2.16	(01)
TH_IMT	11.88	(14)	51.20	(09)	11.12	(15)	13.96	(05)	9.32	(04)	2.52	(01)
MY_IMT	6.17	(17)	55.96	(12)	27.33	(16)	1.88	(05)	7.18	(05)	1.49	(01)
TW_IMT	5.79	(16)	52.99	(10)	32.83	(17)	2.30	(05)	4.82	(07)	1.27	(01)
SG_IMT	2.87	(15)	58.41	(12)	25.50	(13)	3.39	(03)	8.12	(04)	1.71	(01)
KR_IMT	4.31	(16)	47.34	(16)	24.41	(15)	12.54	(05)	10.09	(07)	1.32	(01)
PH_IMT	4.84	(18)	33.26	(11)	49.36	(14)	7.13	(06)	2.65	(06)	2.76	(01)
IN_IMT	14.87	(19)	20.11	(11)	21.83	(20)	2.74	(03)	38.95	(10)	1.50	(01)
HK_IMT	6.29	(15)	51.14	(07)	32.43	(15)	1.49	(03)	7.07	(05)	1.57	(01)
CN_IMT	5.47	(20)	19.71	(13)	4.92	(15)	2.80	(11)	18.55	(12)	48.55	(04)

Note: Figures in parentheses are one-standard errors computed using 300 bootstrap replications of the model. 'IDS' in the last column denotes the idiosyncratic shock.

Table 3.4: Forecast error variance decompositions at the eight-quarter horizon

	WR_OIL		WR_GDP		GDP		REX		NOM		IDS	
JP_GDP	7.32	(14)	41.22	(16)	38.70	(13)	4.92	(02)	7.12	(07)	0.72	(01)
TH_GDP	2.31	(17)	36.14	(13)	51.73	(19)	1.66	(07)	5.48	(08)	2.69	(04)
MY_GDP	7.66	(19)	43.87	(12)	32.57	(17)	3.43	(02)	11.12	(05)	1.34	(01)
TW_GDP	8.18	(16)	48.27	(12)	35.38	(19)	2.72	(06)	4.36	(10)	1.09	(03)
SG_GDP	4.27	(16)	54.32	(13)	37.68	(21)	0.79	(04)	2.25	(06)	0.69	(02)
KR_GDP	9.13	(13)	41.36	(12)	29.67	(15)	3.24	(05)	12.85	(08)	3.76	(07)
PH_GDP	7.40	(17)	30.90	(13)	42.20	(19)	10.93	(06)	6.75	(04)	1.83	(01)
IN_GDP	0.65	(12)	7.33	(05)	44.28	(19)	40.67	(13)	4.04	(05)	3.03	(02)
HK_GDP	12.04	(19)	52.39	(12)	15.37	(20)	1.25	(02)	16.44	(09)	2.51	(01)
CN_GDP	0.97	(16)	26.04	(20)	62.56	(23)	2.73	(05)	6.08	(10)	1.63	(05)
JP_REX	11.17	(16)	0.58	(16)	16.61	(17)	67.07	(17)	2.02	(14)	2.56	(03)
TH_REX	0.54	(15)	36.20	(09)	10.00	(11)	38.23	(15)	9.73	(10)	5.29	(08)
MY_REX	1.79	(09)	23.20	(14)	37.01	(12)	34.37	(16)	1.11	(05)	2.52	(08)
TW_REX	15.01	(16)	24.75	(14)	2.11	(12)	55.51	(19)	1.50	(12)	1.12	(02)
SG_REX	4.11	(10)	20.24	(12)	24.55	(18)	41.59	(19)	6.79	(08)	2.72	(01)
KR_REX	6.98	(18)	36.68	(17)	13.39	(13)	28.56	(12)	5.93	(09)	8.47	(05)
PH_REX	1.40	(10)	25.30	(18)	29.29	(12)	32.69	(17)	4.02	(05)	7.30	(04)
IN_REX	1.95	(15)	19.03	(14)	8.30	(10)	60.51	(15)	3.96	(03)	6.25	(04)
HK_REX	13.54	(12)	12.48	(14)	31.72	(14)	3.71	(13)	3.06	(17)	35.49	(09)
CN_REX	0.26	(08)	25.89	(05)	28.96	(14)	19.08	(07)	6.13	(04)	19.67	(14)
JP_INF	2.69	(16)	42.19	(16)	46.31	(12)	2.67	(14)	3.15	(23)	2.99	(03)
TH_INF	25.67	(13)	6.15	(17)	27.09	(16)	13.62	(10)	23.36	(22)	4.10	(04)
MY_INF	33.58	(12)	18.83	(10)	13.71	(19)	1.85	(08)	30.38	(21)	1.65	(02)
TW_INF	15.62	(15)	19.33	(15)	7.83	(14)	9.81	(08)	38.23	(18)	9.18	(05)
SG_INF	5.27	(17)	54.45	(12)	27.43	(17)	3.77	(11)	7.44	(12)	1.64	(01)
KR_INF	19.39	(15)	4.45	(09)	31.24	(14)	10.15	(11)	27.38	(15)	7.40	(04)
PH_INF	20.73	(08)	17.18	(11)	19.01	(12)	4.11	(12)	37.49	(20)	1.47	(06)
IN_INF	13.81	(16)	3.96	(11)	13.73	(12)	4.06	(13)	63.21	(20)	1.22	(03)
HK_INF	20.47	(14)	7.72	(18)	28.45	(15)	3.03	(07)	37.54	(23)	2.80	(03)
CN_INF	10.66	(15)	22.89	(16)	27.82	(16)	4.47	(11)	18.57	(16)	15.60	(07)
JP_DMO	21.49	(09)	9.37	(18)	17.36	(20)	14.62	(10)	12.50	(19)	24.66	(04)
TH_DMO	11.88	(18)	15.54	(18)	9.91	(08)	13.86	(10)	39.98	(16)	8.84	(05)
MY_DMO	21.35	(15)	11.24	(15)	13.67	(12)	7.07	(09)	41.61	(18)	5.06	(03)
TW_DMO	8.37	(14)	44.74	(12)	35.94	(21)	1.15	(10)	7.17	(19)	2.63	(03)
SG_DMO	7.88	(13)	18.02	(12)	25.60	(15)	21.83	(11)	11.10	(19)	15.57	(04)
KR_DMO	12.45	(09)	6.28	(18)	27.63	(15)	26.58	(14)	13.72	(18)	13.33	(04)
PH_DMO	4.39	(17)	12.72	(20)	44.45	(17)	4.86	(13)	18.35	(16)	15.23	(04)
IN_DMO	18.90	(15)	3.15	(08)	10.43	(15)	28.38	(12)	32.50	(21)	6.62	(05)
HK_DMO	23.47	(14)	18.24	(12)	21.62	(22)	5.80	(10)	28.14	(18)	2.73	(04)
CN_DMO	30.50	(19)	4.31	(23)	11.24	(17)	11.91	(10)	33.88	(17)	8.15	(05)
JP_EXT	5.92	(16)	56.97	(12)	29.97	(14)	2.03	(05)	4.36	(06)	0.75	(01)
TH_EXT	10.47	(18)	58.16	(14)	11.54	(13)	2.86	(06)	14.75	(07)	2.22	(01)
MY_EXT	7.09	(15)	56.30	(18)	21.78	(16)	3.18	(07)	8.88	(10)	2.77	(02)
TW_EXT	4.27	(18)	54.58	(15)	30.00	(13)	1.60	(06)	8.35	(07)	1.20	(01)
SG_EXT	2.61	(16)	58.29	(14)	32.19	(14)	1.05	(06)	4.50	(06)	1.36	(01)
KR_EXT	2.74	(17)	68.50	(18)	21.71	(15)	1.49	(09)	4.59	(06)	0.97	(02)
PH_EXT	20.54	(20)	17.90	(22)	4.36	(21)	38.59	(09)	15.81	(13)	2.81	(04)
IN_EXT	8.23	(18)	24.54	(09)	18.25	(18)	12.96	(12)	31.90	(14)	4.13	(04)
HK_EXT	6.82	(17)	60.23	(11)	23.73	(17)	0.96	(05)	6.65	(08)	1.61	(01)
CN_EXT	19.90	(21)	7.20	(19)	3.21	(13)	7.95	(02)	56.90	(07)	4.83	(01)
JP_IMT	9.50	(18)	59.53	(11)	18.66	(18)	4.81	(04)	5.94	(08)	1.56	(01)
TH_IMT	9.41	(15)	58.37	(11)	8.65	(15)	11.93	(06)	8.52	(05)	3.12	(01)
MY_IMT	5.03	(20)	62.19	(15)	23.75	(17)	1.54	(06)	5.77	(05)	1.72	(01)
TW_IMT	5.51	(18)	56.37	(11)	30.97	(18)	1.68	(06)	3.84	(07)	1.64	(01)
SG_IMT	3.17	(17)	64.62	(15)	23.38	(14)	2.26	(04)	4.89	(06)	1.68	(01)
KR_IMT	5.52	(18)	47.41	(19)	20.46	(15)	8.34	(05)	16.94	(09)	1.34	(02)
PH_IMT	4.08	(20)	33.27	(13)	47.59	(15)	8.78	(08)	3.73	(05)	2.56	(01)
IN_IMT	8.65	(21)	30.32	(13)	28.23	(21)	2.57	(03)	28.94	(11)	1.29	(01)
HK_IMT	6.98	(16)	55.62	(07)	28.13	(15)	1.36	(04)	6.10	(06)	1.81	(01)
CN_IMT	7.63	(21)	8.67	(14)	30.85	(15)	0.45	(12)	30.15	(15)	22.25	(05)

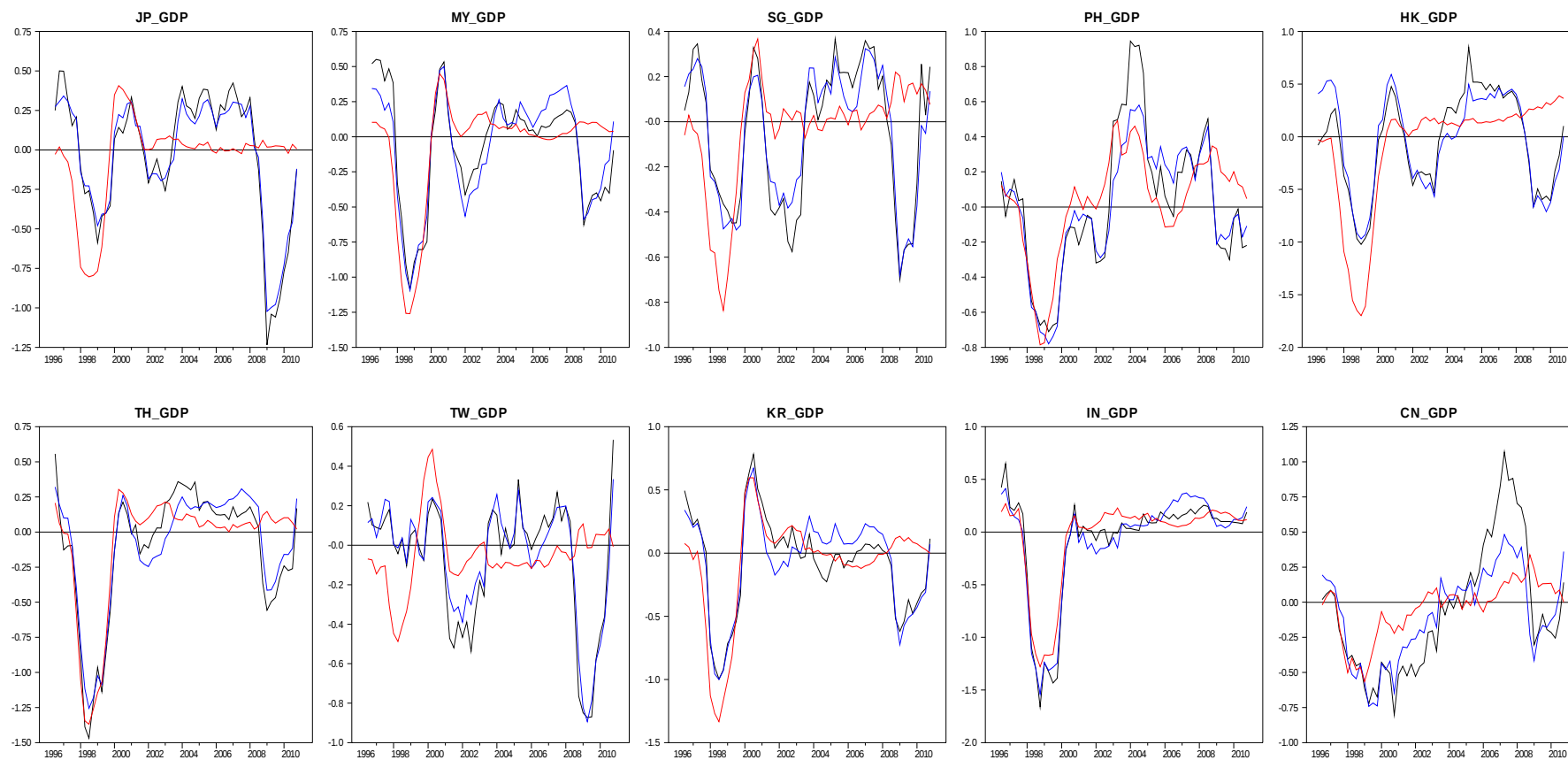
Note: Figures in parentheses are one-standard errors computed using 300 bootstrap replications of the model. 'IDS' in the last column denotes the idiosyncratic shock.

Table 3.5: Forecast error variance decompositions at the 16-quarter horizon

	WR_OIL		WR_GDP		GDP		REX		NOM		IDS	
JP_GDP	8.24	(15)	38.84	(17)	33.88	(14)	8.91	(03)	9.45	(07)	0.68	(01)
TH_GDP	1.34	(16)	35.50	(13)	53.78	(19)	2.18	(08)	4.48	(09)	2.72	(04)
MY_GDP	7.52	(21)	44.61	(14)	31.93	(18)	2.34	(02)	12.25	(06)	1.36	(01)
TW_GDP	8.76	(17)	48.04	(15)	33.68	(20)	3.60	(07)	4.83	(12)	1.09	(03)
SG_GDP	4.72	(16)	55.27	(16)	37.34	(22)	0.45	(04)	1.57	(08)	0.65	(02)
KR_GDP	11.28	(14)	38.54	(14)	23.52	(16)	3.86	(05)	18.93	(09)	3.86	(09)
PH_GDP	7.96	(17)	28.83	(15)	40.76	(21)	12.79	(07)	7.99	(05)	1.66	(01)
IN_GDP	1.76	(12)	5.30	(08)	40.44	(20)	48.05	(14)	2.16	(06)	2.30	(02)
HK_GDP	13.76	(20)	49.08	(14)	12.33	(21)	2.95	(03)	19.57	(10)	2.31	(01)
CN_GDP	1.46	(16)	21.30	(22)	58.32	(24)	6.50	(06)	11.14	(10)	1.28	(06)
JP_REX	12.69	(17)	0.32	(17)	13.92	(18)	68.37	(18)	2.49	(16)	2.21	(04)
TH_REX	0.42	(16)	35.53	(08)	11.09	(12)	36.20	(16)	11.77	(11)	4.99	(09)
MY_REX	2.08	(09)	21.75	(16)	37.19	(12)	34.96	(17)	1.75	(07)	2.28	(08)
TW_REX	14.46	(16)	26.45	(15)	2.08	(12)	54.79	(19)	1.14	(14)	1.08	(02)
SG_REX	4.52	(10)	17.60	(13)	24.26	(18)	41.48	(19)	10.07	(09)	2.07	(01)
KR_REX	5.88	(18)	37.81	(18)	10.95	(15)	24.15	(12)	9.05	(11)	12.16	(07)
PH_REX	1.19	(11)	26.34	(21)	31.53	(13)	29.45	(18)	4.53	(06)	6.94	(04)
IN_REX	1.89	(16)	15.25	(16)	5.82	(11)	67.24	(16)	2.91	(04)	6.90	(04)
HK_REX	5.50	(13)	11.63	(17)	38.27	(14)	13.29	(14)	8.47	(18)	22.83	(09)
CN_REX	0.21	(09)	27.16	(06)	31.29	(15)	18.76	(08)	7.07	(05)	15.52	(15)
JP_INF	1.57	(17)	42.84	(16)	48.54	(13)	1.69	(15)	2.56	(24)	2.79	(04)
TH_INF	24.26	(15)	4.76	(19)	26.17	(18)	16.64	(09)	23.56	(22)	4.61	(04)
MY_INF	33.09	(13)	17.25	(12)	13.19	(20)	2.28	(09)	32.67	(21)	1.52	(02)
TW_INF	12.50	(15)	19.77	(18)	6.08	(14)	9.18	(09)	42.25	(19)	10.22	(05)
SG_INF	3.39	(18)	57.22	(13)	28.80	(19)	2.52	(13)	6.40	(14)	1.67	(02)
KR_INF	18.05	(16)	3.32	(09)	40.68	(15)	6.78	(13)	23.06	(16)	8.12	(04)
PH_INF	19.35	(09)	17.76	(13)	19.45	(13)	4.06	(14)	37.96	(21)	1.42	(07)
IN_INF	14.20	(17)	3.61	(14)	14.29	(13)	2.07	(07)	64.79	(21)	1.04	(03)
HK_INF	17.25	(14)	7.86	(19)	33.12	(15)	2.32	(12)	36.56	(24)	2.89	(03)
CN_INF	8.77	(15)	22.46	(17)	27.48	(16)	3.84	(12)	15.24	(18)	22.22	(08)
JP_DMO	20.41	(09)	9.11	(20)	13.91	(21)	10.80	(11)	15.83	(20)	29.95	(04)
TH_DMO	12.29	(20)	15.31	(20)	8.81	(09)	11.53	(12)	42.59	(16)	9.47	(06)
MY_DMO	21.29	(17)	10.30	(17)	13.67	(12)	7.96	(10)	42.38	(20)	4.40	(04)
TW_DMO	5.88	(15)	47.84	(12)	37.96	(22)	0.74	(12)	4.92	(20)	2.65	(04)
SG_DMO	6.17	(14)	15.38	(13)	29.54	(16)	18.07	(12)	11.47	(20)	19.38	(05)
KR_DMO	11.69	(09)	6.13	(21)	32.99	(17)	20.43	(15)	12.55	(18)	16.22	(05)
PH_DMO	3.37	(18)	18.05	(22)	43.24	(18)	3.87	(13)	13.39	(17)	18.08	(06)
IN_DMO	19.55	(17)	2.59	(09)	10.32	(16)	26.67	(13)	32.36	(21)	8.51	(06)
HK_DMO	21.80	(14)	20.61	(14)	22.58	(22)	5.15	(11)	27.29	(19)	2.57	(05)
CN_DMO	30.91	(20)	2.77	(25)	9.73	(18)	17.09	(11)	32.39	(18)	7.11	(06)
JP_EXT	4.40	(17)	59.40	(13)	29.18	(15)	3.31	(05)	2.94	(07)	0.77	(01)
TH_EXT	6.78	(20)	68.18	(16)	9.94	(14)	2.63	(06)	9.88	(08)	2.59	(01)
MY_EXT	6.03	(15)	56.53	(21)	16.98	(16)	8.24	(09)	9.37	(11)	2.86	(03)
TW_EXT	2.71	(20)	58.38	(16)	29.78	(15)	1.33	(07)	6.45	(08)	1.36	(01)
SG_EXT	2.32	(17)	61.70	(15)	31.28	(15)	0.70	(06)	2.58	(07)	1.41	(01)
KR_EXT	3.04	(18)	71.46	(19)	20.83	(16)	1.31	(09)	2.43	(07)	0.94	(03)
PH_EXT	20.99	(20)	13.10	(24)	2.02	(22)	44.30	(09)	17.57	(15)	2.01	(04)
IN_EXT	4.88	(19)	29.37	(11)	20.58	(19)	14.65	(12)	26.21	(15)	4.31	(04)
HK_EXT	6.42	(17)	62.36	(13)	21.34	(17)	1.18	(05)	7.04	(08)	1.66	(01)
CN_EXT	18.73	(21)	1.95	(21)	4.48	(12)	13.66	(03)	58.05	(08)	3.12	(01)
JP_IMT	10.21	(19)	58.08	(13)	17.24	(19)	6.56	(05)	6.50	(09)	1.41	(01)
TH_IMT	6.48	(16)	67.26	(13)	6.68	(15)	8.47	(07)	7.29	(05)	3.82	(01)
MY_IMT	3.67	(21)	66.52	(18)	21.42	(18)	2.00	(07)	4.55	(05)	1.84	(02)
TW_IMT	3.76	(19)	59.70	(13)	31.11	(19)	1.03	(06)	2.50	(08)	1.89	(01)
SG_IMT	3.00	(17)	68.65	(16)	22.19	(15)	1.34	(05)	3.10	(06)	1.72	(01)
KR_IMT	6.40	(19)	46.85	(22)	17.57	(15)	4.60	(05)	23.29	(11)	1.29	(02)
PH_IMT	2.72	(21)	32.78	(15)	46.97	(16)	11.53	(09)	3.43	(05)	2.58	(01)
IN_IMT	6.45	(23)	32.95	(14)	30.44	(22)	2.14	(03)	26.81	(12)	1.21	(01)
HK_IMT	5.44	(17)	60.34	(08)	27.20	(15)	0.86	(04)	4.12	(06)	2.04	(01)
CN_IMT	4.01	(20)	11.91	(15)	42.98	(15)	0.49	(14)	25.77	(16)	14.83	(06)

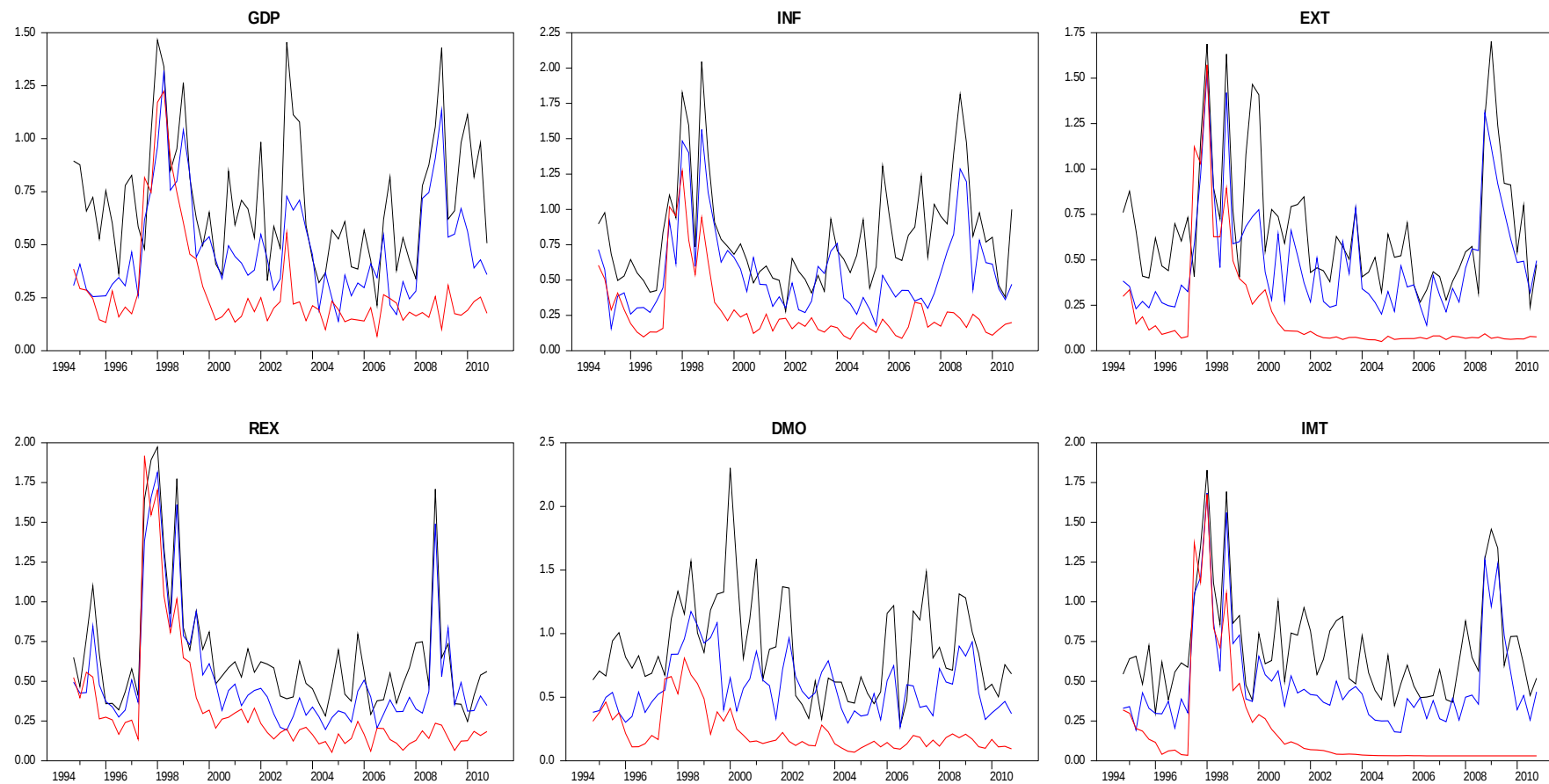
Note: Figures in parentheses are one-standard errors computed using 300 bootstrap replications of the model. 'IDS' in the last column denotes the idiosyncratic shock.

Figure 1: Common and idiosyncratic components of individual countries' GDPs



Notes: The panels shows GDP series (black), together with their common (blue) and idiosyncratic (red) components. All series are shown as eight-quarter centered moving averages for a better visuality.

Figure 2: Dispersion of common and idiosyncratic components



Note: The panels show standard deviations of series (black), common components (blue), and idiosyncratic components (red).

Figure 3.1: Responses of the series in levels to world oil price shocks

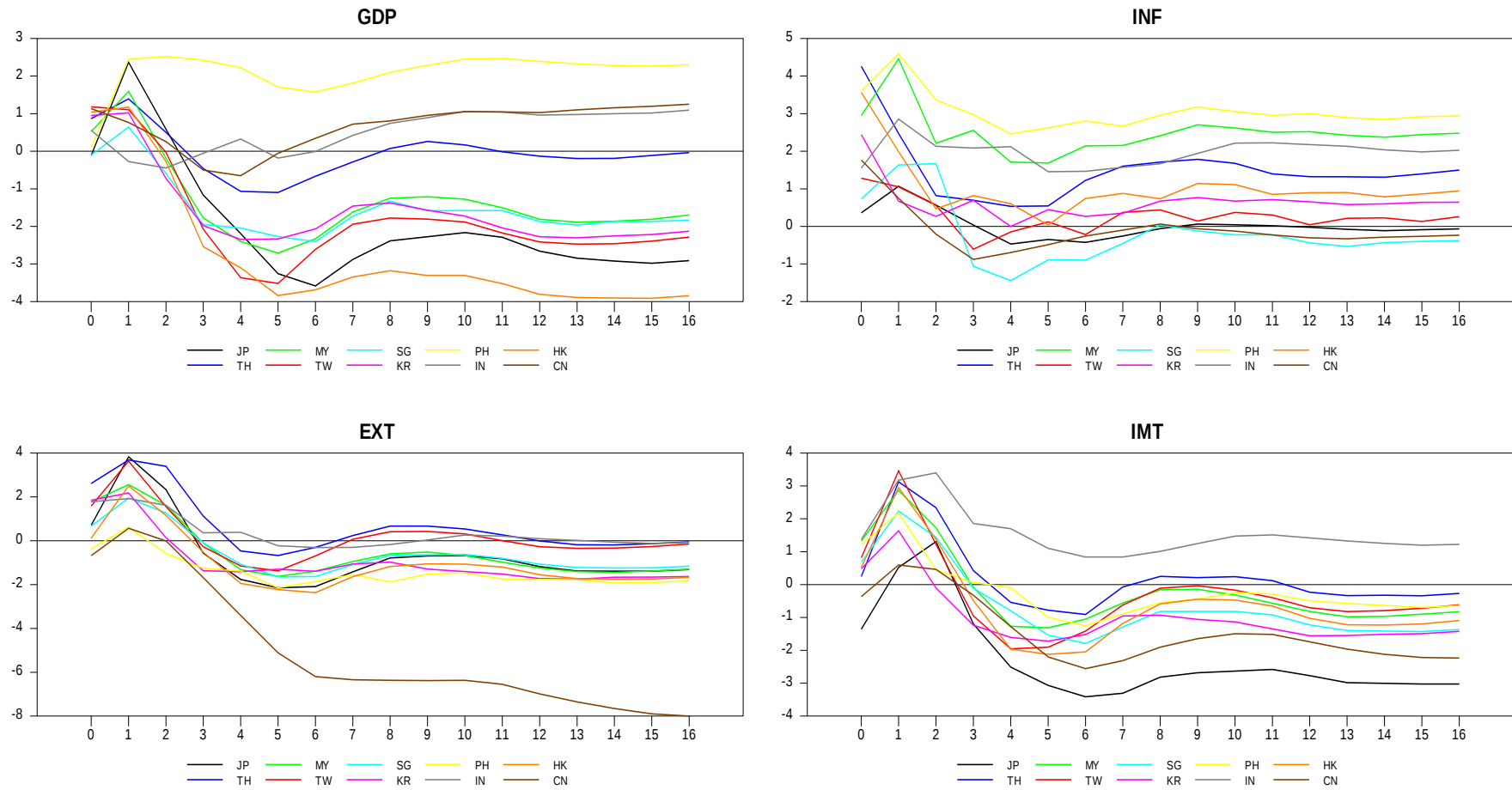


Figure 3.2: Responses of the series in levels to world GDP shocks

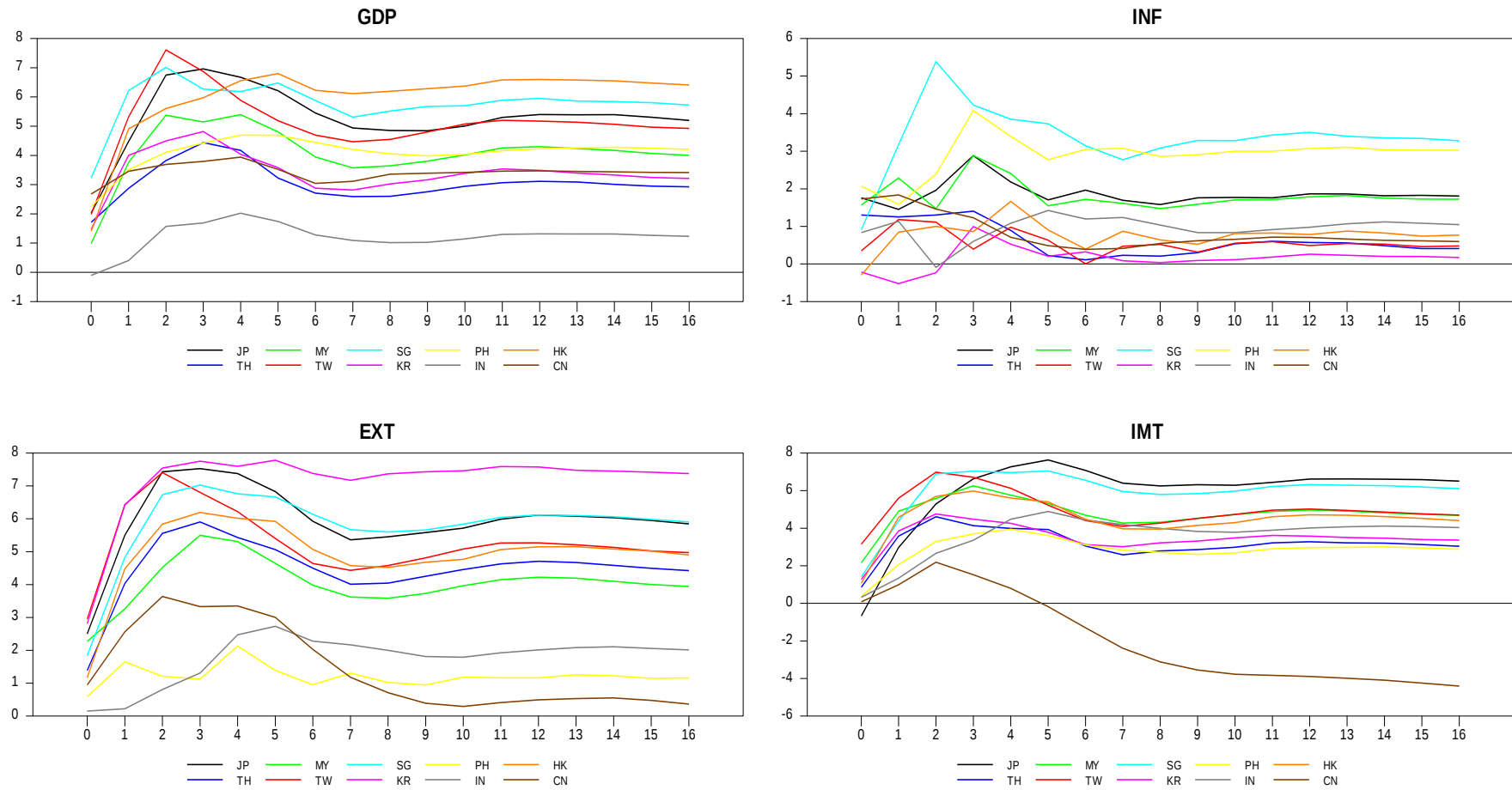


Figure 3.3: Responses of the series in levels to regional GDP shocks

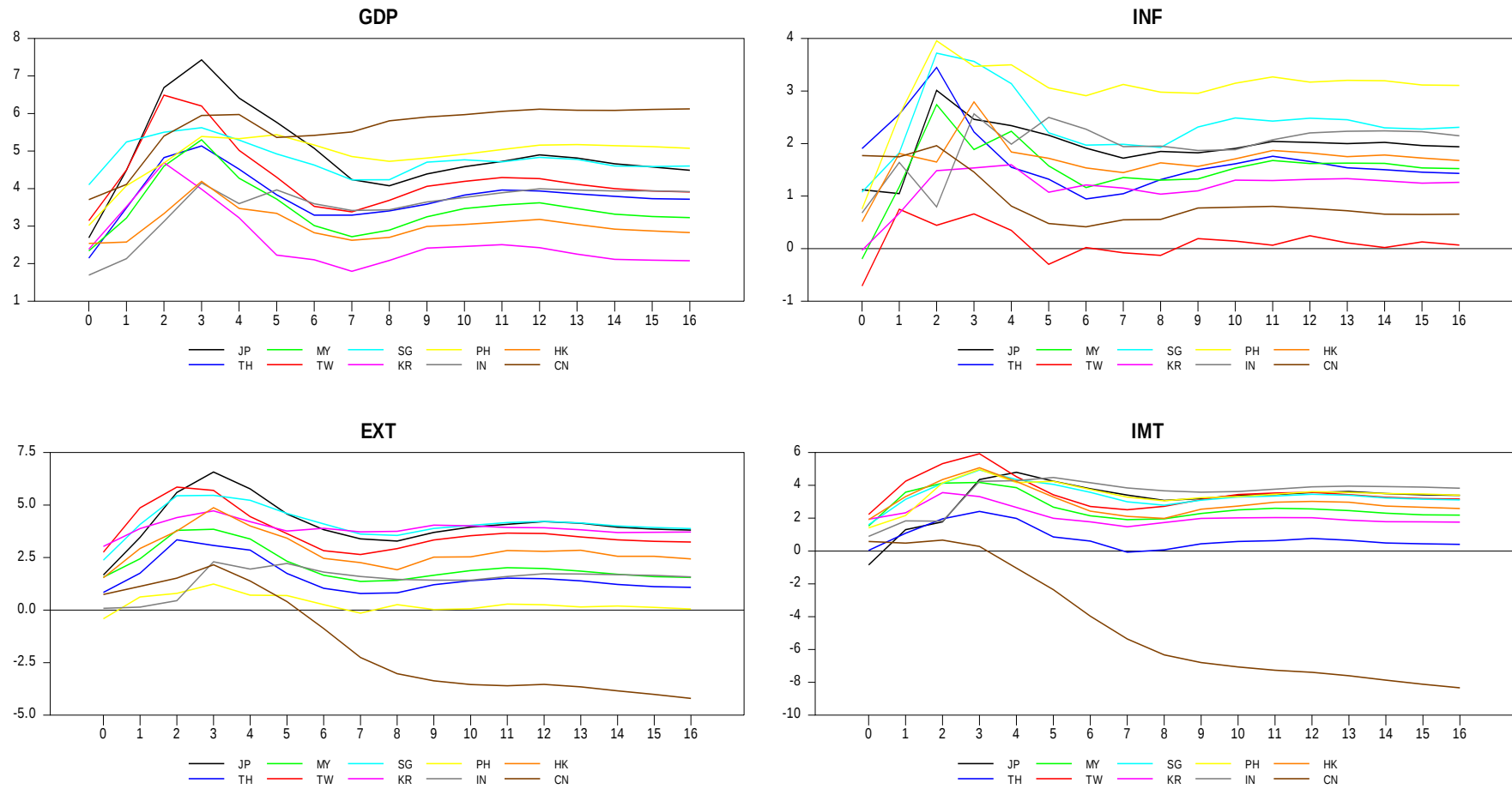


Figure 3.4: Responses of the series in levels to regional real exchange rate shocks

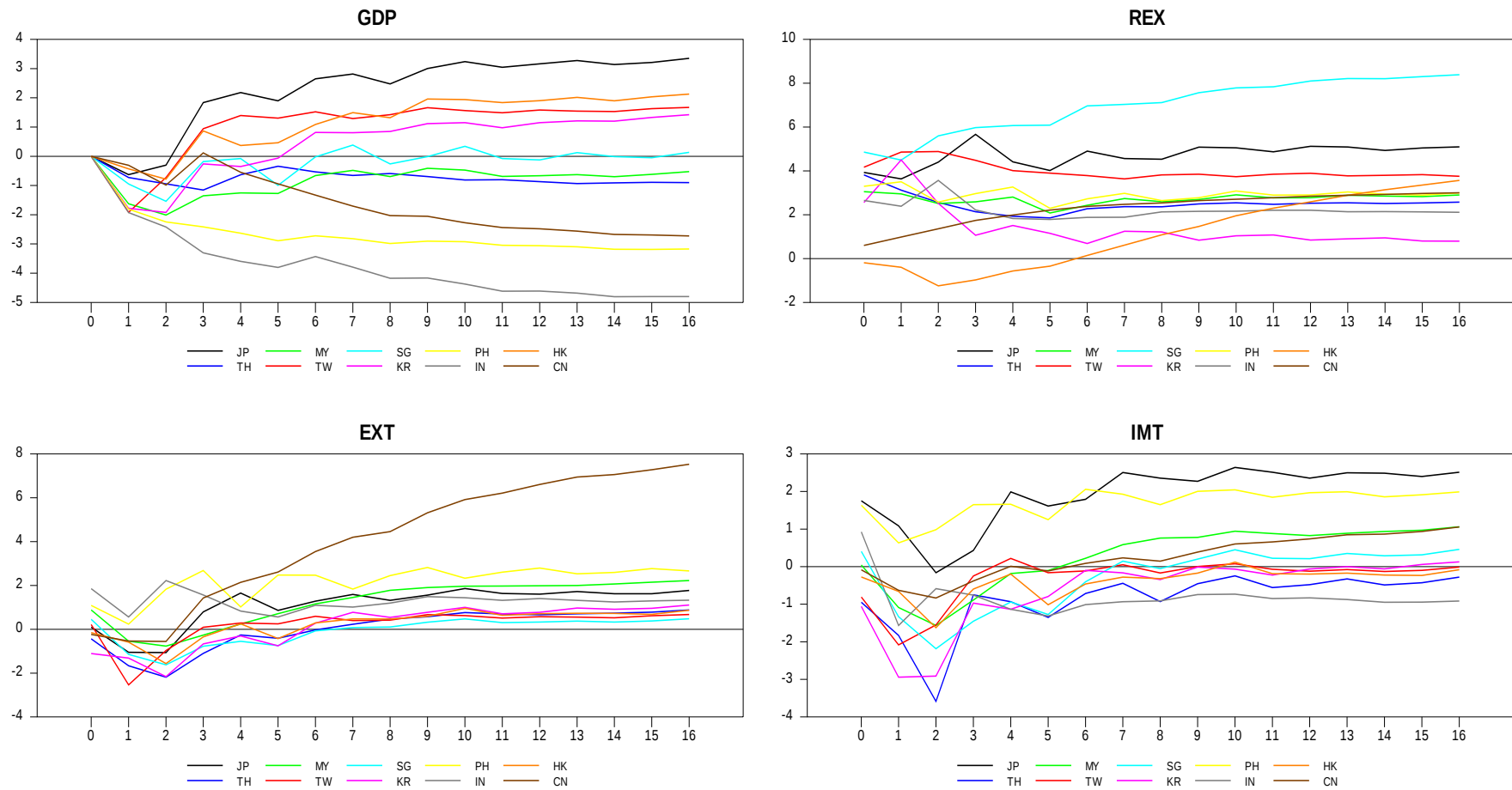


Figure 3.5: Responses of the series in levels to regional nominal shocks

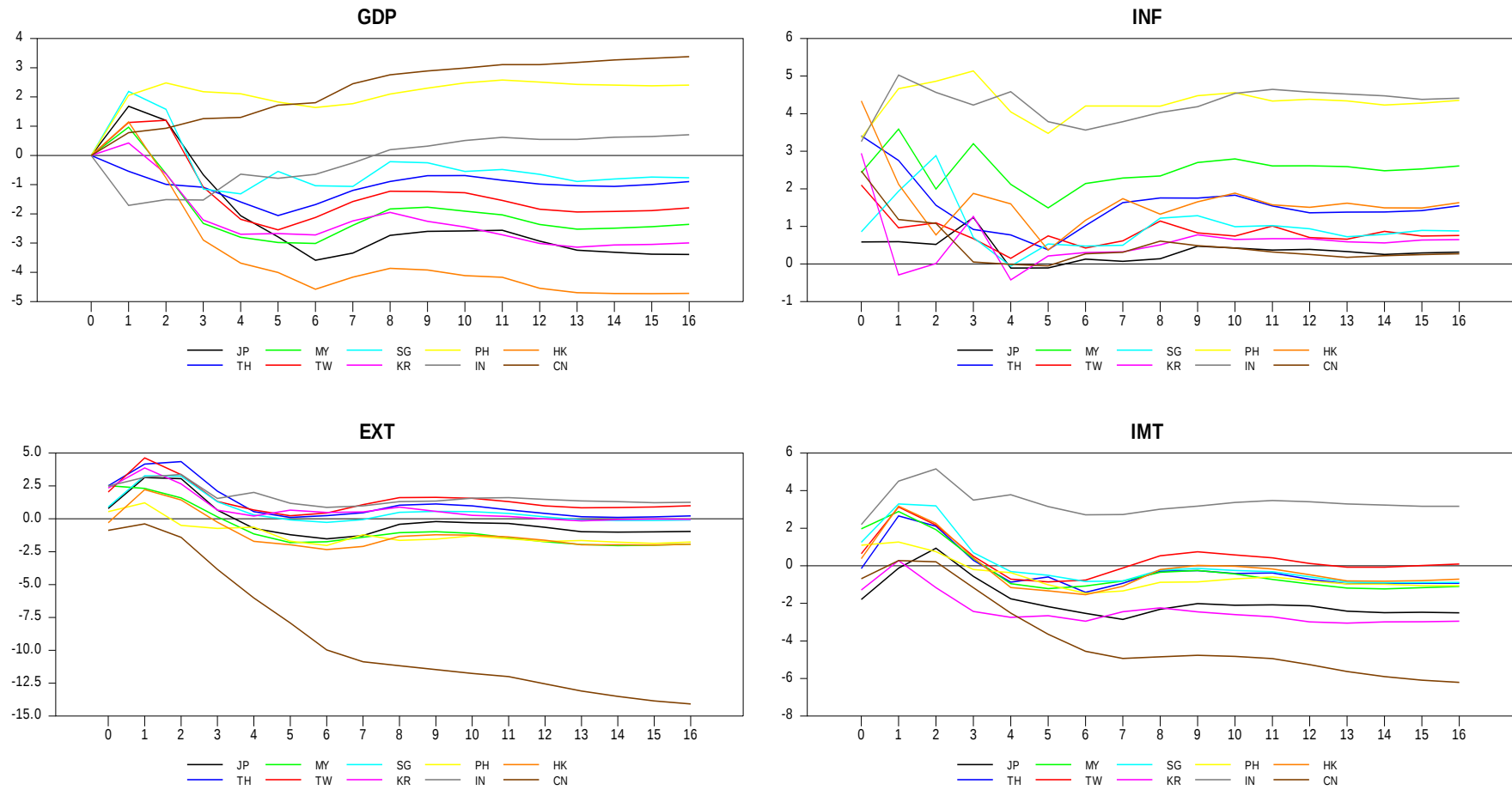


Figure 4: Dispersion of the responses

