The Impact of External Shocks in East Asia: Lessons from a Structural VAR Model with Block Exogeneity

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Jean-Pierre Allegret[*] Cécile Couharde[†] Cyriac Guillaumin[‡]

Abstract: In this paper, we examine the relative importance of external shocks in domestic fluctuations of East Asian countries and check if these shocks lead to asymmetric or symmetric reactions between the considered economies. To this end, we estimate, over the period 1990Q1-2012Q2, a structural VAR model with block exogeneity (SVARX model) relying on a comprehensive set of external shocks. We document a rising impact of these external shocks on domestic variables since the mid 1990s. We also show that real oil price and U.S. GDP shocks have a significant impact on domestic activity and lead to more symmetric responses, compared to U.S. monetary shock and financial shocks.

Keywords: external shocks, East Asia, SVARX model.

JEL Classification: F32, F33, F42.

Résumé : Dans cet article, nous examinons l'importance des chocs externes sur les fluctuations domestiques des pays d'Asie de l'Est et vérifions si ces chocs conduisent à des réactions symétriques ou asymétriques des pays étudiés. Pour cela, nous estimons, sur la période 1990T1-2012T2, un modèle VAR structurel avec contrainte d'exogénéité (modèle SVARX) intégrant plusieurs types de chocs externes. Nous montrons un impact croissant de ces chocs externes sur les variables domestiques depuis le milieu des années 1990. Nous montrons également que les chocs sur le prix réel du pétrole et sur le PIB américain ont un impact significatif sur l'activité domestique et conduisent à des réactions davantage symétriques, en comparaison au choc monétaire américain et aux chocs financiers.

Mots-clés : Chocs externes, Asie de l'Est, modèle SVARX.

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1. Introduction

The Asian crisis in 1997-98 has highlighted the role of regional contagion in financial turmoil. The vulnerability of East Asian countries to these regional contagion effects has been explained by their high openness degree (Corsetti et al., 1999), as well as by their interdependence (Kaminsky et al., 2003). This crisis has prompted these countries to strengthen their monetary cooperation on the regional scale in order to improve their monetary stability. Thus, in the aftermath of this crisis, a first wave of initiatives to implement cooperative devices between East Asian countries occurred.[1] After an initial belief in the "decoupling myth" (Eichengreen and Park, 2008) mainly explained by the dramatic increase in intra-regional trade and the leading role of China in the region, the global dimension of the subprime crisis following the Lehman Brothers collapse has once again raised the issue of the vulnerability of East Asian countries to external fluctuations. In response to the global crisis, the authorities have strengthened their financial cooperation by signing an agreement officialising the multilateralisation step of the Chiang Mai Initiative announced in early 2009. These agreements created a $120 billion fund meant to prevent a liquidity crisis in one of the signing countries.[2]

The emphasis placed on external shocks is understandable given some structural characteristics of East Asian countries, particularly their trade and financial openness and questions their rising effort in coordination and policy harmonization on a regional scale. Therefore recent literature has put the emphasis on external shocks in the region. Indeed investigating the responses to these shocks can give an additional indication, to the unique analysis of domestic shocks, on the homogeneity degree between the area's countries and on the convergence process of their policies.

Several methods have been used in order to assess this issue. A first strand of research decomposes cycles into specific and common components. Using a tridimensional VAR between 1971Q1 and 1997Q2, Chow and Kim (2003) identify, in addition to country-specific shocks, global and regional ones in order to check to what extent each type of shock affects most significantly output fluctuations.[3] They evidence that a monetary union would not be desirable in the East Asian area because economies are prone to country-specific – that is asymmetric – shocks. Some studies rely on dynamic unobserved factor models and lead to

[1] Main measures are the following: the ASEAN Surveillance Process in October 1998; the Economic Review and Policy Dialogue in May 2000; the Chiang Mai Initiative in May 2000 which established a regional financial arrangement under the form of bilateral swaps.

[2] See for instance Aizenman and Pasricha (2010), Oh (2010) and Lombardi (2010), for the details of these agreements.

[3] Global shock is approximated by the United States while Japan is used as a proxy for the regional shock.

mixed results. Moneta and Rüffer (2009) find – over the period 1975Q1-2005Q3 – that the degree of business cycles synchronization has increased since 1990 except for China and Japan. Oil prices and the Japanese Yen-U.S. Dollar exchange rate are among the main drivers of this business cycle co-movement, while world activity and international financing conditions are less important. Lee and Azali (2006) show that country-specific shocks remain, over the period 1960-2000, the main driver of output fluctuations except for Japan.

A second strand of research relies on structural vector autoregression (SVAR) models to identify the nature and the impact of external shocks on East Asian economies. Huang and Guo (2006) estimate over the period 1970-2002 a four-dimensional SVAR including a global external shock modelled as a global supply shock. External disturbances are not only significant, but they are also positively correlated among East Asian countries suggesting their symmetric nature. Ng (2002) analyses, in a tridimensional SVAR for five Southeast Asian countries over the period 1970-1995, three shocks including an external shock and two domestic shocks (supply-related and demand-related shocks). The external shock is considered as a simultaneous combination of supply and demand external shocks. His results show a strong correlation of responses to these shocks – including the external one – suggesting that these countries are suitable for a monetary union. Rüffer et al. (2007) develop SVAR models with sign restrictions for nine East Asian countries and India over the period 1979Q1-2003Q4. Their model aggregates different variables – accounting for monetary, financial, commodity prices and real shocks – as external factors exerting an influence on macroeconomic fluctuations. They find that business cycles are mainly driven by external factors.

In order to study the importance of external disturbances as a source of macroeconomic fluctuations in emerging markets[4], Maćkowiak (2007) draws up SVAR models with block exogeneity. His models encompass as external shocks the Federal Fund rates, the world commodity prices, the U.S. money stock, the U.S. aggregate output, and the U.S. aggregate price level. Maćkowiak (2007) highlights three main results over the period 1986M1-2000M12. Firstly, external disturbances other than US monetary policy shock explain a significant share of the variance of domestic variables in emerging countries. Secondly, U.S. monetary policy shock amounts for less than 10 per cent of macroeconomic fluctuations in emerging countries. Finally, all external shocks tend to be persistent as their impacts increase over longer horizons.

[4] His sample includes eight emerging countries whose six East Asian economies: Hong Kong, Malaysia, the Philippines, Singapore, South Korea, and Thailand.

More recently, Gimet (2011) has studied the vulnerability of East Asian countries to international financial crises using a structural Bayesian vector autoregression. She compares two major crises episodes: the Asian crisis (1997M1-1999M12) and the subprime crisis (2007M1-2009M12). Her results show that the financial vulnerability of East Asian economies has decreased but responses to international financial shocks are still asymmetric. Finally, Sato et al. (2011) assess the potential role played by external shocks in the East Asian countries. Using a SVAR model with block exogeneity they identify, over the period 1978Q1-2007Q4, the impact of three external shocks (world oil price changes and the real GDP growth in the USA and Japan) on two domestic variables: the real GDP growth and inflation. They also test the real GDP growth in China instead of Japan as an external shock. The sample period is divided into three sub-samples: 1978Q1-1987Q4; 1988Q1-1996Q4; 1999Q1-2007Q4 to capture the dynamic of each external shock and the economic dynamic of East Asian countries. Their results show a strong effect of external shocks and especially the U.S. and Japanese shocks before the financial crisis of 1997-1998. After the financial crisis, the U.S. shock had become the dominant source of the disturbance in most economies, except for China which is dominated by the Japanese shock. Their findings also evidence that the U.S. influence in East Asia is still asymmetric and strong. Moreover, the world oil price is less significative at the beginning of the period, while more powerful during the end of 1990's and the 2000's, especially for China, Hong Kong, Singapore and Thailand.

One important shortcoming of these studies is that no one so far has engaged in a systematic examination of a comprehensive set of several distinct external shocks including real, monetary and financial shocks. East Asian economies are indeed linked through differents types of channels; and the extent to which economies respond to external shocks may vary depending on the nature of the foreign shock.

To overcome this drawback, we define, in this paper, several types of external shocks in order to quantify their respective impact on East Asian countries. Those external shocks include a real oil price shock, a trade shock, a financial shock, and a monetary shock. More precisely we focus on the respective influence of real, monetary and financial shocks to explain the vulnaribility of East Asian countries. The effect and relative importance of external shocks are determined using a Structural VAR model with block exogeneity (SVARX model) in which external variables are not affected by domestic shocks either contemporaneously or with lags. Such VAR models exhibit dynamic responses consistent with *a priori* theoretical priors linked to the open economy framework. In addition, as stressed by Buckle et al. (2007), the imposition of exogeneity permits the inclusion of more international variables in order to

integrate the diversity of shocks hitting domestic economies, while reducing the number of paramaters to estimate. As a consequence, such model improves the quality of estimations (Cushman and Zha, 1997). As the model assumes that the emerging market is an open economy, it is then possible to estimate to what extent macroeconomic fluctuations in the emerging market are caused by external shocks. Using this framework, we identify the nature and the weight of different external shocks affecting a sample of East Asian countries.

The results of the paper show a rising impact of external shocks on domestic variables since the mid 1990's. Moreover, oil price and trade shocks have a significant impact on domestic activity, compared to external monetary and financial shocks. This finding suggests that trade channels are above all significant in East Asian economies and that these economies are less exposed to external financial and monetary shocks.

The rest of the article is structured as follows. Section 2 explains the methodological framework and discusses its main assumptions. Section 3 presents the results of the variance decomposition for the variables contained in the SVARX model. The dynamic responses of domestic variables to the different external shocks are analysed in Section 4. Section 5 concludes.

2. Methodological Framework

2.1. SVAR model with block exogeneity

In order to assess more accurately the effects of external shocks on East Asian countries, we consider the following structural VAR model with block exogeneity (SVARX model):

$$\sum_{s=0}^{p}\begin{bmatrix} A_{11}(s) & A_{12}(s) \\ A_{21}(s) & A_{22}(s) \end{bmatrix}\begin{bmatrix} y_1(t-s) \\ y_2(t-s) \end{bmatrix} = \begin{bmatrix} \varepsilon_1(t) \\ \varepsilon_2(t) \end{bmatrix}$$

with p the number of lags and where $A_{12}(s)=0$ for each $s=0,1,...,p$. $y_1(t-s)$ is a vector of external variables and $y_2(t-s)$ is a vector of domestic variables. $\varepsilon_1(t)$ is a vector of structural shocks of external origin and $\varepsilon_2(t)$ is a vector of structural shocks of domestic origin. $\varepsilon(t)=[\varepsilon_1(t),\varepsilon_2(t)]'$ is a Gaussian random vector satisfaying $E[\varepsilon(t)|y(t-s),s>0]=0$ and $E[\varepsilon(t)\varepsilon(t)'|y(t-s),s>0]=I$ with I the identity matrix.

We consider four external shocks in order to better capture the various sources of vulnerabilities of East Asian countries over the studied period. The vector of external

variables, $y_1(t-s)$, includes the real oil price[5] (*rBrent*), the real U.S. GDP (*U.S. gdp*), the Fed Funds interest rate (*Fed Funds*) and the volatility of the MSCI index (*MSCI*).

The first external shock corresponds to an oil price shock given its potential influence on East Asian economies. Indeed, it can have direct impacts on economic activity but also indirect ones through the monetary responses to them (Bernanke et al., 1997). As the growth of East Asian countries heavily still depends on exports to industrialised countries, especially with the United States, we isolate also a second external shock - a trade shock - which is approximed by an U.S. GDP shock. The third external shock takes into account the transmission of foreign monetary policy which depends on the openness of the capital account and the exchange rate regime. As East Asian economies have adopted an exchange rate pegged to the U.S. dollar or to a currency basket in which the weight of the dollar represents from 80% to 95% of the basket for all the countries considered here, except Japan (Reinhart and Rogoff 2004; Ilzetzki et al. 2009), we may expect that domestic variables should be sensitive to changes in U.S. interest rates. Finally, those economies have increasingly opened their capital accounts. In particular, they have benefited and keep benefiting from capital inflows which turned out to be highly volatile as evidenced by the Asian crisis and more recently by the global crisis. We thus retain an external financial shock able to capture stress on financial markets and proxied by the volatility of the MSCI all country (excluding Japan) index. However, in order to capture the vulnerability of our studied countries to regional financial shocks, we also perform our model by using the volatility of the MSCI Emerging Markets Asia index (i.e. MSCI EM Asia Index).[6]

The vector of domestic variables, $y_2(t-s)$, includes three variables, *i.e.* the real output (y^d), the domestic producer price index[7] (p^d) and the nominal exchange rate against the U.S. dollar (n^d). Introducing the exchange rate is justified by the nature of this variable, which

[5] The real oil price is calculated as the Brent oil price divided by the world GDP deflator. We also have used the U.S. GDP deflator and the U.S. consumer price index. Results, available from the authors, are similar.

[6] For the two financial shocks indicators, we used the realized volatility. Indeed, as stressed, among others, by Racicot et al. (2008), Chan et al. (2009), and Andersen et al. (2010), the realized volatility is an *ex post* nonparametric and unbiased volatility estimator allowing us to obtain an indicator of volatility very close to the true volatility. For both the MSCI World Index excluding Japan and the MSCI Emerging Markets Asia Index, the realized volatility is estimated using daily data over the studied period. Then, we calculated the quarterly average of it. We also calculated volatility of these two index using a GARCH (1,1) model. Results, available upon request from the authors, are very similar with the realized volatility.

[7] We choose producer prices instead of consumption prices in order to avoid the difficulties linked to the presence of prices controls in many studied countries. Indeed, except Japan and Hong Kong, many countries in the region subsidize directly or indirectly oil prices (the Philippines, Singapore, South Korea and Thailand), use prices regulation (China) or the two instruments (Indonesia and Malaysia). As a result, it is difficult to interpret consumption prices responses to oil prices shocks.

constitutes an important transmission mechanism for any shock, as showed by Cushman and Zha (1997).

The model is formulated separately for each country and assumes that East Asian countries are small enough not to affect world variables. This assumption implies for the block exogeneity restriction $A_{12}(s)=0$ for each $s=0,1,...,p$ and thus indicates that domestic shocks $\varepsilon_2(t)$ do not affect the external variables in the vector $y_1(t-s)$ either contemporaneously or with lags. We assume that the real oil price is not affected by domestic structural shocks, following Roubini and Setser (2004), Cunado and Perez (2005) or Fan et al. (2007). This assumption also applies to China, as in Cong et al. (2008) and Jin (2008).

2.2. Identification scheme

The identification of the structural form requires imposing $n(n-1)/2$ restrictions, with *n* the number of variables, *i.e.* twenty-one here as we consider seven variables. The model implies short and long runs restrictions and exogeneity assumptions.

Following Maćkowiak (2007) and Sato et al. (2011), we impose the following constraints. The block exogeneity restriction implies that domestic structural shocks, $\varepsilon_2(t)$, do not affect the vector of external variables, $y_1(t-s)$, at time *t* or $t-s$. We thus obtain twelve constraints. Regarding the external block, following Hahn (2003), Jiménez-Rodriguez and Sánchez (2005), Ito and Sato (2006) and Blanchard and Gali (2007), we assume that real oil prices are not contemporaneously affected by the three other external shocks.[8] We obtain three additional constraints. Identification of the U.S. monetary policy follows the works of Leeper et al. (1996) and Bernanke et al. (1997) in which the Fed Funds rate can respond contemporaneously to changes in the real oil price.[9] Furthermore, the Fed Funds rate can also respond to changes in the real U.S. GDP (Christiano et al. 1999).[10] The link between real and financial sectors is complex, as stressed by Bernanke and Gertler (1995), Bernanke et al. (1997) or Boivin (2002).[11] These authors demonstrate that a shock on the real GDP affects

[8] We have performed Granger causality tests in order to check this hypothesis. We find double way causality for U.S. and Chinese GDP on the one side, and oil prices on the other side. Results are available upon request from the authors.

[9] See, for example, Kilian and Lewis (2011) for a literature review about the responses of the Fed to oil price shocks.

[10] Leeper et al. (1996), Bernanke et al. (1997) and Christiano et al. (1999) estimated different VAR models or SVAR models using restrictions (linked with the economics theory or with the observation of facts) in order to study the responses of the U.S. monetary policy to different shocks.

[11] These authors used VAR models or SVAR models with restrictions. Bernanke and Gertler (1995) used different VAR models to study the credit market channel of monetary policy transmission but they also analyzed this topic and his consequences on the real economy from facts and data.

contemporaneously the stock market index but not *vice-versa*. This link is also assumed for emerging markets in Sato et al. (2011).[12] Following this literature, we assume that (*i*) the real U.S. GDP is not affected by the U.S. interest rate and the stock market volatility and (*ii*) the U.S. interest rate is not affected by short term stock market volatility. Thus, we get three additional constraints. Regarding the domestic block, we impose three long-run zero restrictions, as in Blanchard and Quah (1989), Clarida and Gali (1994) and Sims and Zha (1999), where: (*i*) a domestic demand shock has no impact on the domestic product and (*ii*) a monetary domestic shock has no impact on the domestic product and on the nominal exchange rate.

We use *SURE* (*Seemingly Unrelated Regression Equations*) estimation with the above block exogeneity assumption to identify structural shocks by imposing both contemporaneous and long-run restrictions.

2.3. Data

Data are quarterly data and cover the period from 1990Q1 to 2012Q2 in order to include the main economic episodes which have characterized the integration process of East Asian countries (1997-1998 crisis, 2007-2008 crisis, setting up of financial and monetary regional agreements). However, in order to check if the rising liberalisation of East Asian economies since the mid 1990 has lead to a growing importance of external factors and more symmetric responses, we replicate our estimations over the period 1996Q1-2012Q2. The sample includes China, South Korea, Hong Kong SAR, Indonesia, Japan, Malaysia, the Philippines, Singapore and Thailand.[13]

GDP (or, if unavailable, industrial production) data, producer price index and nominal exchange rates come from the IMF's *International Financial Statistics*. Oil price matches the Brent oil price taken from the IMF's *International Financial Statistics* and the database of EIA (Energy Information Administration). Real oil price is obtained by deflating oil price using the World GDP deflator taken from the World Bank database. The U.S. short-term interest rate (*Fed Funds*) comes from the database of Saint-Louis' *Fed. MSCI* index comes from the *Datastream* database. Each of the estimated SVAR model includes a dummy *crisis* variable so as to consider the Asian crisis. Introducing such a variable allows us to control aberrant points. Following Rüffer et al. (2007), its value is set to 1 from 1997Q2 to 1998Q3,

[12] See, for a literature review, BIS (2011).

[13] Brunei, Cambodia, Myanmar, and Vietnam were removed from the sample because of the lack of data availability.

and to 0 the rest of the time. We also introduce a dummy variable which equal to 1 from 2008Q3 to 2009Q2 and 0 otherwise in order to take into account the effects of the world crisis started with the *subprime* crisis (Berthaud and Colliac, 2010).

A logarithmic transformation has been applied to all variables, except the U.S. interest rate (*Fed Funds*). GDP data (or, if unavailable, industrial production data) and producer price index have been deseasonalized.[14] We first test the order of integration for each variable before running cointegration tests.[15] Finally, due to the shortness of the data set in sub-periods, we set the lag length of the SVARX to one[16], as in Canova (2005), instead of applying the usual Akaike's, Schwartz and Hannan-Quinn's information criteria.

3. The importance of external shocks in the variance of domestic variables

In order to determine the ability of external shocks to explain domestic variables fluctuations at different horizons, and the relative importance of each shock, we perform a standard variance decomposition exercise for the variables contained in the SVARX model. The results of this decomposition are reported in tables A.1 to A.6 for the all-period sample (1990Q1-2012Q2) and the sub-period sample (1996Q1-2012Q2) respectively.

Table A.1 presents the variance decomposition of the forecast error of (log) real GDP. The first four blocks of rows shows the fraction of the total variance of real GDP that can be accounted by each type of external shock, while the last block of the table displays the fraction that can be explained by all external shocks.

For all studied countries, over a short-run horizon (1-4 periods), the all period sample shows that external shocks explain at least 11 percent of the real GDP variances. Japan and Malaysia are especially sensitive to these shocks insofar as the latter explain respectively 62.0 and 30.2 of their real GDP variance. External shocks tend to be persistent as their weight in the real GDP variances increases with time horizon. The only exception is Hong Kong. The sub-sample period – from 1996Q1 to 2012Q2 – exhibits a clear increase in the influence of external shocks. More precisely, at the short-run horizon, these shocks explain more than 15 percent of the real GDP variances. At long-run horizon (16-20 periods), external shocks increasingly matter, confirming the persistence observed in the whole period sample. Such

[14] Census X-12 method.

[15] In this respect, we have run usual ADF and Phillips-Perron (PP) tests. We also have tested for structural breaks by using firstly Perron (1989) test with exogenous break dates. In that case, we chose 1997.2 as a break date: it is indeed after the second quarter of 1997 that the crisis develops in earnest (Rüffer et al., 2007). We also have used the methodology developed by Zivot and Andrews (1992) and Clemente et al. (1998) in order to test unit roots with endogenous break dates. Details of unit roots and cointegration tests are available upon request from the authors.

[16] We also estimate our models with two lags. Results are quite similar.

evolutions result from the increasingly openness degree of East Asian countries since the end-90s'.[17] Over this sub-period sample, only Hong Kong exhibits a declining share of external shocks in the GDP variance. Such trend – that contrasts with the increasingly trade openness over the same period - may be due to the stabilizing influence of China after 1997.

External shocks exert a stronger influence on producer price index (PPI) than on GDP in all countries except Hong Kong and Indonesia. As producer prices are more prone to international influences than consumption prices, the high impact of external shocks on PPI partly mirrors the rising trend in the trade openness in many East Asian countries. Table A.2 suggests that the more a country is opened, the more external shocks exert an influence on domestic prices (see, for instance, Singapore and Malaysia). In countries with lower trade openness, the increasing influence of external variables on PPI variance rests on trade specialization in manufactures exports (as in China, Japan, and South Korea). As for the GDP, external shocks exert a persistent influence on domestic prices. Results over the sub-period sample do not change significantly. Related to the increasingly trade openness after the Asian crisis, the short and long-run influence of external shocks increases in all countries. The growing influence of external shocks is especially striking for Hong Kong and Indonesia.

The impact exerted by external shocks on nominal exchange rates (NER thereafter) does not significantly differ in the two samples for the short-horizon (1-4 periods). External shocks account for more than 10 percent of the NER variances in all countries except Hong Kong (for the two samples) and Japan (for the all period only). In addition, we observe a rise in the influence of external shocks over the period 1996Q1-2012Q2. The two samples suggest a dramatic increase in the long run impact of external shocks. Over the whole period, external shocks explain more than 35 percent of the variance in all countries except Hong Kong for the period 1990Q1-2012Q2. This persistence of external shocks is confirmed in the sub-period sample except for Singapore.

Among the different external shocks, the increase in oil dependence of the region seems to play an important role. Indeed, the relative weight of each external shock suggests that East Asian countries are more sensitive to real shocks than to monetary and financial shocks. Interestingly, results over the sub-period sample (Tables A.4 to A.6) do not change significantly. More precisely, Table A.4 shows that domestic GDP tend to be more influenced by the oil price shock and the U.S. GDP one at both short- and long-run horizons. The impact

[17] Southeast Asia and, though less so, the *Asean* has benefited from the decrease in trade with the U.S. Enhanced regional trade is confirmed by (i) a strong dependence on Japan, China and, to a lesser extent, Korea and Singapore, and by (ii) a supremacy loss of Japan in favour of China on the regional level, between 1996 and 2007. See, for example, Zebregs (2004) and Petri (2006).

of the oil price shock is stronger on PPI variances. In all countries, except Hong Kong and Indonesia, this shock accounts for more than 20 percent of the PPI variance at short-run. As suggested by its share in PPI variance at long-horizon (16-20 periods), this shock is particularly persistent. The sub-period sample shows a clear increase in the influence of the oil price shock on PPI. Finally, in the two samples, variances of nominal exchange rates are mainly explained by the oil shock at long horizon. Such evolution mirrors the growing dependence of many East Asian countries to oil since the end of 1990's. The sub sample period has been marked by a dramatic increase in the oil price which has exacerbated transmission effects of oil price on domestic variables especially in open economies as most East Asian countries. The increase in the sensitivity of domestic variables to oil shocks is very important in countries bearing a dramatic deterioration of their net oil trade balances (exports minus imports) since the end of 1990s': Hong Kong, South Korea, Japan, and China.

For the majority of countries under review, the U.S. GDP shock explains a lower share of domestic GDP variances than the oil price shock over the whole sample. The influence of the U.S. GDP shock decreases in many East Asian countries for all horizons on the most recent period. Such evolutions can be explained by two major changes that have taken place in the external trade of our sample's countries. Firstly, since the early 1990s, intra-regional trade has increased at the expense of the trade with the United States. The main part of the decline in the U.S. share has occured after 2000. The second major change in the region has been the growing trade influence of China. If the trade with China represents an increased proportion of the total intra-regional trade since the early 1980s, the share of Chinese exports has increased dramatically after 2000 (Zebregs, 2004). The higher share of China in intra-regional trade has been accompanied by an increasing role of China in international trade, particularly with Europe and the United States (Gaulier et al., 2005; Kim and Woo, 2007). At the same time, trade composition has changed in East Asia. On the one hand, the share of parts and components in total trade has increased. On the other hand, trade integration has been accompanied by a growing similarity in the commodity composition of exports, except for Indonesia (Petri, 2006; Allegret and Essaadi, 2011). These evolutions suggest an increasing indirect influence of the U.S. GDP shock *via* the role of China in the region. This indirect influence is confirmed by Allegret and Essaadi (2011) who find that total intra-regional imports of China are cointegrated with the U.S. GDP. Variances of producer prices and nominal exchange rates are weakly explained by the U.S. GDP shock in the two samples. The latter finding could be explained by the tendancy of East Asian economies to monitor exchange rates within the region and attempts to keep the relative value of their currencies in

line with the value of selected regional currencies. These "competitive" adjustments in exchange rates are allegedly made so as to maintain the competitiveness of their exports on global markets.

International monetary shocks (Fed funds disturbances) and international financial shocks (MSCI World Index excluding Japan disturbances) exert the weakest influence on domestic variables in most of our studied countries. This result holds whatever the sample period and is in accordance with litterature on this issue (Maćkowiak 2007; Moneta and Rüffer 2009; Gimet 2011). Despite recent progress, East Asian countries – except Hong Kong, Japan, and Singapore – still exhibit low financial openness index (Pongsaparn and Unteroberdoerster, 2011). More precisely, the use of the Chinn and Ito's country ranking over a total number of 169 countries leads to the following ranks for our sample's countries in 2009: Hong-Kong (1^{st}), Japan (1^{st}), Singapore (1^{st}), Indonesia (72^{sd}), South Korea (90^{th}), the Philippines (93^{rd}), Malaysia (102^{sd}), China (111^{th}), and Thailand (111^{th}).[18] As a result, it's doubtful that financial openness can explain the higher influence of external factors on domestic variables variances. Using a *de facto* measure of international financial integration does not qualitatively change this result. In 2007, only Hong Kong, Japan, Malaysia, and Singapore had a gross external assets plus liabilities-to-GDP ratio higher than the unweighted average of emerging countries.[19]

Using the volatility of the MSCI EM Asia index does not lead to results significantly different from those produced by the MSCI World index excluding Japan. Indeed real external shocks remain the main disturbances affecting domestic variables. This result holds for all horizons and for the two samples (see Tables A.7 to A.12). As in the model with the MSCI World Index excluding Japan, the oil shock explains the main share of the GDP and PPI variances. Similarly, U.S. GDP and Fed Funds shocks exert a weak influence on these domestic variables. Interestingly, we find that the influence of MSCI EM Asia index on GDP variance is higher than in the model with the MSCI World Index excluding Japan. However, this result does not hold for countries that are more interconnected with world financial centers (Hong Kong, Japan, and Singapore). Other countries except China are thus more sensitive to the regional financial shock than to the international one. For instance, at short-run, the MSCI World Index excluding Japan amounts for 3.6 percent of the GDP variance in Korea while the

[18] Source: The Chinn-Ito Index, a *de jure* classification of financial openness. Results are similar if we take 2007 as the reference year.

[19] Authors' estimations, relying on the updated and extended database of the External Wealth of Nations Mark II database as described in Lane and Milesi-Ferretti (2007).

MSCI EM Asia shock explains 21.7 percent of this variance. The sub-period 1996Q1-2012Q2 exhibits similar results.

The nominal exchange rate variance is mainly explained by the oil shock. Such result is similar to that found with the MSCI World Index excluding Japan. As for the GDP, the most significant change relates to the influence of the MSCI EM Asia shock. More precisely, over the period 1990Q1-2012Q2, in countries less connected to international financial centers, the MSCI EM Asia shock explains a higher share of the NER variance than the MSCI World Index excluding at all horizons (Korea and Indonesia), only at short-run (Malaysia and Thailand), or at long horizon (Philippines). Interestingly, on the most recent period, while in the model with the MSCI World Index excluding Japan, the influence of the international financial shock on the NER decreases in the previous countries, the model including MSCI EM Asia shock shows a trend in the opposite direction. In other words, our results suggest an increasingly influence of the regional financial shock since 1996. This growing influence is especially important at the long horizon.

4. The impact of external shocks on domestic variables

Tracing out the time paths of the effects of pure shocks on the set of domestic variables, impulse responses allow us to analyze not only the contemporaneous reaction to a specific shock but also the speed of adjustment of the economy, i.e. the time it takes for the shock to disappear. For the model with the MSCI World Index excluding Japan, dynamic responses of each domestic variable to the different external shocks are depicted in figures B.1 to B.4 and B.5 to B.8 respectively for the all-period sample and the sub-period sample. For the model with the MSCI EM Asia index, as responses concerning oil, U.S. GDP, and Fed Funds shocks do not differ from the first model, we report only responses to the MSCI Emerging Markets Asia index shock (Figures B.9 and B.10).

The oil price shock should negatively affect macroeconomic variables through different transmission channels. First of all, such shock induces a supply-side shock effect in which firms bear an increase in their marginal producing costs. Second, oil price shocks are followed by wealth transfer effect from net-importing countries to net-exporting ones. Finally, as stressed by Bernanke et al. (1997), a positive innovation in real oil price is followed by a restrictive monetary policy in order to fight inflationary pressure. Such monetary policy response may exert a negative influence on economic activity. Tang et al. (2010) find that since 2003 a positive oil price shock has been followed by a tight monetary policy in China. These transmission channels suggest an expected negative response of GDP in the aftermath

of a positive oil price shock at least in net oil-importing countries. However, our results, when responses are stastically significant, lead to an opposite relationship: in all studied countries, a positive real oil price shock increases the GDP. The shock is long-lived in all countries, except for Malaysia, South Korea, and Singapore. Our results are consistent with Kilian (2009: 1054) who distinguishes different types of oil shocks: oil supply shocks (driven by pressures on the current physical availability of crude oil), precautionary demand shocks (explained by a significant change in the precautionary demand for oil) and aggregate demand shocks (driven by the global business cycle). While the two first shocks may lead to negative response of economic activity, the latter may lead to a positive one. Since the end of 90's, oil prices shocks are mainly driven by demand shocks. As a result, taking into account the role played by exports in the growth rate of East Asian economies, the increase in oil prices has been mainly originated by a higher growth in advanced countries that, in turn, has lead to an increase in exports and then in the revenue of Asian countries.[20] The sub-period sample confirms the previous findings.

As expected, in all countries and for the two samples, domestic production prices increase following a real oil price shock. It is important to stress that responses of PPI are relatively similar across countries both in terms of contemporaneous reactions and persistence.

In all countries except the Philippines, domestic currencies appreciate in the aftermath of the oil shock. Such result is not surprising for the main oil exporting economies in the region (Singapore, Malaysia for the whole period sample only, and Indonesia). For other countries, the appreciation may rest on the positive relationship between oil prices increases and world growth. Indeed, East Asian countries can reap the benefits of a higher regional GDP in terms of higher export revenues which in turn exert an upward pressure on the NER.

As a proxy of economic activity in advanced countries, we expect a positive response of domestic GDP to a positive innovation on the U.S. GDP. Indeed, the high openness degree of East Asian countries makes them very sensitive to the trade channel. This procyclical reaction is verified in all studied countries. However, the size of the GDP responses to the U.S. GDP shock remains narrow. Results over the sub-period sample do not change significantly. This result confirms the decreasing direct influence of the United States, and, more generally, of advanced countries, in the business cycles fluctuations of Asian economies (Kose and Prasad, 2010). In the two samples, the U.S. GDP shock does not exert a significant economic

[20] For instance, as the main engine of growth in the area, recall that Chinese export to European Union-27 and the United States amount to around 38 percent of its total exports (WTO, 2009). At the same time, oil demand from the United States and OECD Europe account for 40 percent of the world demand (US Department of Energy, EIA, 2010).

influence on domestic prices. As East Asian countries have high levels of productive capacity, supply effects may be predominant relative to demand ones on prices behaviour, explaining this weak influence. Finally, a positive U.S. GDP shock is followed by an appreciation of domestic currencies (except in China for the all-period sample). Indeed, Asian countries benefit from an increase in exports that, in turn, improves their growth performance and then tend to appreciate their currencies. However, in all cases, responses are short-lived and their size is small. Similar results are obtained in the sub-period sample. Overall, the U.S. GDP shock exerts a weak influence on nominal exchange rates in the region.

In the two samples, GDP responses to the external monetary shock are either insignificant from a statistical standpoint or short-lived, suggesting a weak impact of the U.S. monetary policy on the economic activity of East Asian countries. In the two samples, domestic prices and nominal exchange rates are weakly affected by Fed Funds shocks. This result mirrors the weak influence of the U.S. monetary policy on the economic activity in the region. In addition, concerning the exchange rates, our result is in line with Maćkowiak (2007) who finds significant responses only at very short-term.

Responses to the external financial shock suggest that, when significant, the increase in the volatility of the MSCI World index excluding Japan exerts a negative influence on the GDP. Indeed, GDP decreases in the aftermath of the shock in Hong Kong, Japan, Korea, Malaysia, Singapore, and Thailand. In the four last countries, the contractionary impact is long-lasting. The sub-sample exhibits more mixed results suggesting a weakening influence of this international financial shock. Only Korea and Thailand experience a long-lasting negative impact of the shock. In the two samples, when significant, an increase in the volatility of the MSCI World index excluding Japan leads to a decrease in the production price index. The size of the responses suggests that the influence of this shock is not important. Except for Hong Kong and Japan – where the nominal exchange rate appreciates at very short-run – in other countries domestic currency depreciates following the financial shock. Responses exhibit long-lasting effects. This result holds in the two samples and can be explained by the higher vulnerabily of emerging currencies characterised by more risky assets – to increased pressures on financial markets (Coudert et al., 2011).

In the model including MSCI EM Asia index, responses of the GDP remain negative – as for the MSCI World Index excluding Japan shock – but they are stronger, especially in countries more linked to the regional financial centers than to international ones. As a result, Korea, Indonesia, Malaysia, Philippines, and Thailand exhibit negative and persistent responses of their GDP to the shock in the two samples (see Figures B.9 and B.10). Except Indonesia for

the sub-sample, responses of the PPI to the MSCI EM Asia shock do not significantly differ from those found for the MSCI World Index excluding Japan. In other words, whatever the external financial shock, production prices do not seem strongly affected. Nominal exchange rates tend to depreciate when the volatility of the MSCI EM Asia index increases, suggesting a vulnerability of emerging currencies when pressures on regional financial markets also increase. On the contrary, the currency appreciates in Hong Kong and Japan confirming the role of these two countries as international financial centers. Results do not change significantly on the period 1996Q1-2012Q2.

5. Conclusion

The aim of this paper was to quantify the importance of a broad set of external shocks in domestic variables fluctuations for a sample of East Asian countries. In this respect, it extends the literature in several dimensions. By considering the impact of a broad set of exogenous shocks on East Asian economies in a unified framework, this paper provides a comprehensive picture of the overall contribution of external shocks to the variances of domestic variables in these economies, and of the relative importance of each type of shock. Moreover, the existing papers that focus on East Asian have been concerned above all with the impact of trade or foreign interest rate shocks. We document in addition the dynamic response of domestic variables to financial stress in these economies.

The general picture that emerges from our results is that external shocks exert meaningful effects on domestic variables in East Asia, especially in the most recent period. To the extent that these shocks cover the most important external constraints faced by East Asian countries, our results suggest that domestic variables are largely more influenced by real external shocks than by external monetary and financial shocks. Indeed, our results on variance decompositions and impulse-response functions show that East Asian countries appear especially sensitive to the trade channel rather than to the monetary channel. Finally, in accordance with their financial openness, those economies seem also affected by financial shocks but at a smaller scale. Countries that do not play a significant role on the world financial markets are more influenced by a regional financial shock than a global one.

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Appendix A

Decomposition of Variance

Tables A.1 to A.6 use the realized volatility of the MSCI World Index excluding Japan

Tables A.7 to A.12 use the realized volatility of the MSCI Emerging Markets Asia Index

Table A.1: the fraction of the variance of the GDP due to external shocks. 1990Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	1.12	12.71	21.53	10.65	46.33	9.16	2.84	3.15	2.95
	16-20	27.13	4.21	9.72	59.18	51.50	45.39	57.57	59.80	11.01
U.S. gdp	1-4	4.03	1.24	3.01	1.15	6.03	11.83	3.27	7.83	5.87
	16-20	17.21	6.48	2.35	0.35	3.49	12.20	0.97	12.95	15.96
FedFunds	1-4	16.79	1.60	1.48	0.75	1.77	1.64	6.07	3.75	0.30
	16-20	13.62	17.18	1.25	3.50	17.94	1.08	10.32	0.24	1.68
MSCI World index	1.40	1.40	3.59	1.52	0.30	7.84	7.60	0.44	1.10	18.45
	16-20	0.62	15.49	0.38	0.08	9.98	10.70	0.34	2.20	20.42
Sum	1-4	23.34	19.13	27.54	12.86	61.97	30.23	12.62	15.83	27.58
	16-20	58.58	43.36	13.70	63.11	82.91	69.36	69.20	75.19	49.08

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.2: the fraction of the variance of PPI due to external shocks. 1990Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	37.27	24.23	5.74	5.57	44.21	57.46	45.46	76.44	57.83
	16-20	66.13	73.15	8.29	22.09	78.94	36.36	67.48	90.73	87.25
U.S. gdp	1-4	0.84	0.11	0.55	0.07	3.89	0.08	0.64	1.54	0.42
	16-20	0.71	1.64	0.15	16.48	1.64	12.73	9.44	2.49	0.11
FedFunds	1-4	0.52	1.66	4.05	0.88	0.44	2.15	0.13	0.28	1.87
	16-20	9.84	4.85	0.59	2.00	0.14	2.89	1.29	0.80	3.70
MSCI World index	1.40	2.06	2.82	2.60	0.10	19.04	2.43	0.93	3.56	7.32
	16-20	1.12	0.70	0.80	0.25	11.11	11.59	0.31	1.10	1.56
Sum	1-4	40.69	28.83	12.94	6.62	67.59	62.12	47.16	81.82	67.44
	16-20	77.81	80.34	9.83	40.82	91.82	63.58	78.52	95.11	92.61

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.3: the fraction of the variance of NER due to external shocks. 1990Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	23.13	19.24	2.32	8.39	0.77	2.91	5.63	13.10	2.56
	16-20	78.55	22.71	6.24	33.43	46.44	14.95	30.58	38.98	8.09
U.S. gdp	1-4	0.88	5.25	0.67	1.03	5.52	0.93	2.55	1.42	3.34
	16-20	0.14	6.37	4.17	8.36	1.39	1.70	13.13	5.96	5.27
FedFunds	1-4	16.65	1.93	0.22	0.21	4.44	0.24	1.70	0.63	1.04
	16-20	9.86	2.39	0.42	1.51	14.42	5.03	5.37	0.12	2.21
MSCI World index	1.40	0.08	5.05	3.15	0.10	8.34	9.10	1.59	6.77	6.73
	16-20	0.07	8.98	2.28	0.07	16.42	19.24	0.96	5.80	23.07
Sum	1-4	40.74	31.46	6.36	9.73	19.07	13.18	11.47	21.92	13.66
	16-20	88.63	40.45	13.11	43.37	78.67	40.92	50.03	50.86	38.64

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.4: the fraction of the variance of the GDP due to external shocks. 1996Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	4.31	15.19	28.07	8.64	58.30	13.68	6.60	3.45	10.29
	16-20	18.54	10.76	25.26	58.28	61.23	51.58	34.41	25.07	46.38
U.S. gdp	1-4	5.58	1.33	4.20	0.78	2.94	17.71	0.26	12.39	12.57
	16-20	5.30	7.89	1.80	0.33	1.25	9.39	0.85	29.84	2.34
FedFunds	1-4	2.74	1.94	0.40	0.08	0.85	0.85	26.57	2.74	0.07
	16-20	15.83	27.34	0.38	1.40	14.90	4.94	31.42	0.31	10.03
MSCI World index	1.40	4.17	0.37	0.21	6.36	6.45	6.50	5.55	3.13	5.05
	16-20	24.02	1.71	1.49	2.98	7.08	1.33	4.88	0.75	3.65
Sum	1-4	16.79	18.82	32.87	15.87	68.54	38.74	39.98	21.71	27.97
	16-20	63.68	47.71	28.92	62.99	84.45	67.24	71.56	55.97	62.40

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.5: the fraction of the variance of PPI due to external shocks. 1996Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	49.68	19.16	20.93	1.28	58.99	57.66	37.89	78.96	55.38
	16-20	68.18	35.88	65.41	7.13	87.25	63.17	58.08	93.88	82.07
U.S. gdp	1-4	0.31	0.85	3.48	1.40	1.90	0.48	0.87	1.06	0.79
	16-20	0.27	3.66	0.63	41.79	0.37	9.52	7.88	0.79	0.57
FedFunds	1-4	4.37	3.56	8.67	3.54	1.23	3.05	0.24	0.43	3.23
	16-20	15.32	10.54	6.91	2.10	3.65	0.62	0.45	0.69	6.67
MSCI World index	1.40	6.05	21.28	17.72	7.05	13.61	3.17	3.56	0.07	2.45
	16-20	6.92	24.80	7.22	7.98	4.62	4.89	6.50	0.03	0.95
Sum	1-4	60.41	44.85	50.80	13.27	75.73	64.36	42.56	80.51	61.85
	16-20	90.69	74.88	80.17	59.00	95.89	78.20	72.91	95.40	90.26

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.6: the fraction of the variance of NER due to external shocks. 1996Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	23.24	30.14	0.93	12.69	0.94	12.74	1.18	15.56	0.56
	16-20	78.75	69.56	22.49	56.16	42.19	78.72	61.58	4.05	54.74
U.S. gdp	1-4	0.93	3.07	1.55	1.68	11.55	2.43	6.44	3.50	2.45
	16-20	0.17	1.93	4.14	11.29	3.65	5.04	2.07	3.93	1.76
FedFunds	1-4	18.92	2.51	0.33	0.10	7.39	0.14	0.70	0.57	1.89
	16-20	10.41	1.84	7.10	0.52	21.67	0.57	3.35	0.22	2.62
MSCI World index	1.40	2.93	2.73	0.62	3.00	3.77	2.74	6.36	2.29	0.48
	16-20	1.56	2.41	1.50	2.72	12.38	1.09	1.91	0.72	0.21
Sum	1-4	46.02	38.45	3.44	17.46	23.65	18.05	14.68	21.92	5.38
	16-20	90.89	75.73	35.24	70.69	79.88	85.43	68.91	8.92	59.34

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.7: the fraction of the variance of the GDP due to external shocks. 1990Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	7.53	9.04	29.46	1.52	37.37	7.07	0.09	4.80	1.27
	16-20	63.86	3.78	48.33	11.35	49.49	4.60	2.61	2.61	16.83
U.S. gdp	1-4	5.95	2.10	5.88	2.32	6.42	4.87	3.25	2.18	4.12
	16-20	0.51	10.06	7.09	2.27	4.55	10.57	6.95	15.37	8.41
FedFunds	1-4	0.45	0.52	0.08	0.04	4.04	0.04	4.11	1.92	0.29
	16-20	12.76	4.16	2.48	0.04	17.39	2.14	7.33	3.80	1.32
MSCI EM Asia index	1.40	1.83	21.65	4.70	9.85	6.00	17.39	7.86	1.36	20.13
	16-20	0.61	24.66	5.57	12.42	5.42	26.45	10.19	3.40	17.53
Sum	1-4	15.76	33.31	40.11	13.73	53.82	29.37	15.32	10.26	25.80
	16-20	77.74	42.66	63.48	26.08	76.84	43.76	27.09	25.18	44.08

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.8: the fraction of the variance of PPI due to external shocks. 1990Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	9.17	23.14	17.44	21.49	44.75	61.07	24.82	79.86	50.62
	16-20	12.14	75.83	77.82	46.30	89.28	91.94	82.52	96.01	87.74
U.S. gdp	1-4	0.09	0.42	0.43	0.96	2.58	0.10	0.53	0.42	0.22
	16-20	5.81	0.52	0.93	11.92	0.70	0.07	0.66	0.23	0.68
FedFunds	1-4	0.38	0.05	1.23	0.12	0.18	0.02	2.12	0.02	0.11
	16-20	27.06	0.02	0.45	0.12	1.24	0.10	0.29	0.20	0.76
MSCI EM Asia index	1-4	1.32	3.64	1.46	13.63	9.54	0.30	0.49	0.12	1.41
	16-20	0.98	1.43	1.84	10.73	2.90	0.49	0.58	0.02	0.59
Sum	1-4	10.96	27.25	20.56	36.20	57.05	61.49	27.95	80.41	52.35
	16-20	45.99	77.79	81.04	69.07	94.12	92.59	84.05	96.46	89.76

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.9: the fraction of the variance of NER due to external shocks. 1990Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	5.65	17.03	4.55	6.05	0.47	7.66	18.51	22.53	0.68
	16-20	34.12	60.18	14.46	42.34	55.37	78.59	50.53	59.30	67.77
U.S. gdp	1-4	1.59	4.09	1.04	0.69	0.59	0.57	8.31	0.29	0.37
	16-20	1.01	3.09	5.49	8.96	0.46	4.81	1.79	1.44	3.17
FedFunds	1-4	1.75	2.06	0.54	0.21	0.97	0.05	0.64	0.03	2.63
	16-20	10.74	0.87	2.60	0.12	6.20	0.08	2.86	0.57	1.13
MSCI EM Asia index	1-4	1.35	23.76	3.56	12.43	5.49	19.28	1.24	4.72	7.31
	16-20	0.69	10.77	3.85	9.16	3.85	3.70	4.50	2.30	3.35
Sum	1-4	10.34	46.93	9.68	19.38	7.52	27.56	28.70	27.57	11.01
	16-20	46.56	74.91	26.41	60.58	65.88	87.18	59.67	63.60	75.42

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.10: the fraction of the variance of the GDP due to external shocks. 1996Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	0.92	12.88	24.08	9.86	46.61	12.57	2.11	3.48	4.84
	16-20	33.07	11.30	10.54	49.59	50.19	34.37	46.06	57.09	2.62
U.S. gdp	1-4	3.33	1.62	4.08	1.45	5.95	8.79	4.29	8.32	5.40
	16-20	13.77	5.08	5.90	0.55	2.97	9.83	1.24	14.20	14.41
FedFunds	1-4	17.86	1.81	1.05	0.37	2.15	1.14	5.42	3.91	0.28
	16-20	15.48	22.28	0.71	2.01	18.70	1.08	13.45	0.26	3.67
MSCI EM Asia index	1-4	0.16	25.11	4.09	7.96	6.46	16.72	5.76	3.55	23.51
	16-20	0.44	21.17	7.38	5.42	7.16	23.26	3.45	3.50	25.16
Sum	1-4	22.28	41.42	33.31	19.64	61.18	39.22	17.58	19.26	34.03
	16-20	62.76	59.82	24.53	57.56	79.02	68.54	64.21	75.05	45.86

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.11: the fraction of the variance of PPI due to external shocks. 1996Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	37.91	26.25	7.35	5.64	44.20	61.71	46.99	78.88	58.29
	16-20	69.18	76.46	3.77	22.24	82.49	38.99	70.18	94.25	86.29
U.S. gdp	1-4	0.60	0.44	0.38	0.21	4.48	0.09	0.75	1.30	0.46
	16-20	0.45	1.34	0.04	19.22	1.46	7.74	6.18	1.25	0.22
FedFunds	1-4	0.54	1.74	5.09	0.96	0.57	2.40	0.25	0.33	2.17
	16-20	10.13	4.95	0.44	1.00	0.22	2.90	1.14	0.49	4.26
MSCI EM Asia index	1-4	2.60	7.60	3.38	18.34	12.06	0.28	0.26	0.56	0.37
	16-20	0.70	2.66	6.26	14.42	6.02	16.34	1.26	0.14	0.13
Sum	1-4	41.65	36.03	16.20	25.16	61.31	64.47	48.25	81.07	61.28
	16-20	80.45	85.40	10.51	56.87	90.19	65.98	78.76	96.13	90.90

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table A.12: the fraction of the variance of NER due to external shocks. 1996Q1-2012Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	23.73	20.99	2.75	9.03	0.63	5.87	5.47	15.40	1.52
	16-20	80.39	40.47	9.60	30.20	52.34	11.16	18.93	23.75	6.88
U.S. gdp	1-4	1.09	5.18	0.67	0.97	5.58	0.49	2.49	1.49	3.14
	16-20	0.08	5.20	2.79	8.88	1.20	1.44	11.69	6.14	3.40
FedFunds	1-4	16.98	1.44	0.30	0.15	4.58	0.32	1.67	0.67	1.09
	16-20	9.97	1.29	0.53	0.53	13.35	5.16	5.89	0.11	2.18
MSCI EM Asia index	1-4	0.74	23.57	2.64	12.67	4.07	27.52	2.16	9.51	14.95
	16-20	0.13	17.67	2.90	11.43	9.40	32.43	4.75	9.46	22.49
Sum	1-4	42.54	51.18	6.37	22.82	14.87	34.20	11.78	27.07	20.71
	16-20	90.57	64.62	15.81	51.04	76.28	50.20	41.26	39.46	34.95

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Appendix B

Impulse Response Functions

MSCI World Index (ex Japan)

Figure B.1: Impulse Response Functions to an *oil* shock – 1990Q1-2012Q2

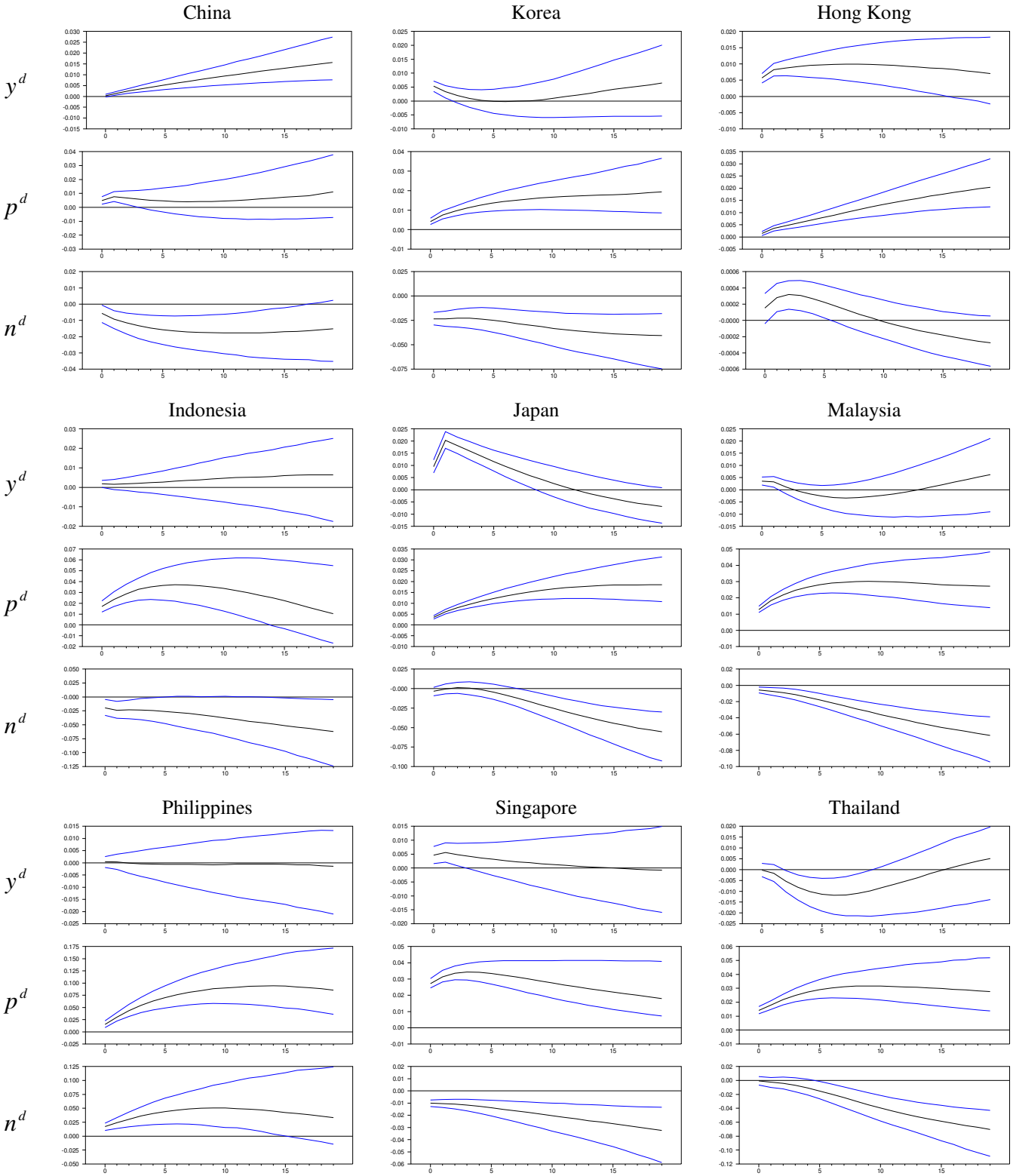


Figure B.2: Impulse Response Functions to an *US GDP* shock – 1990Q1-2012Q2

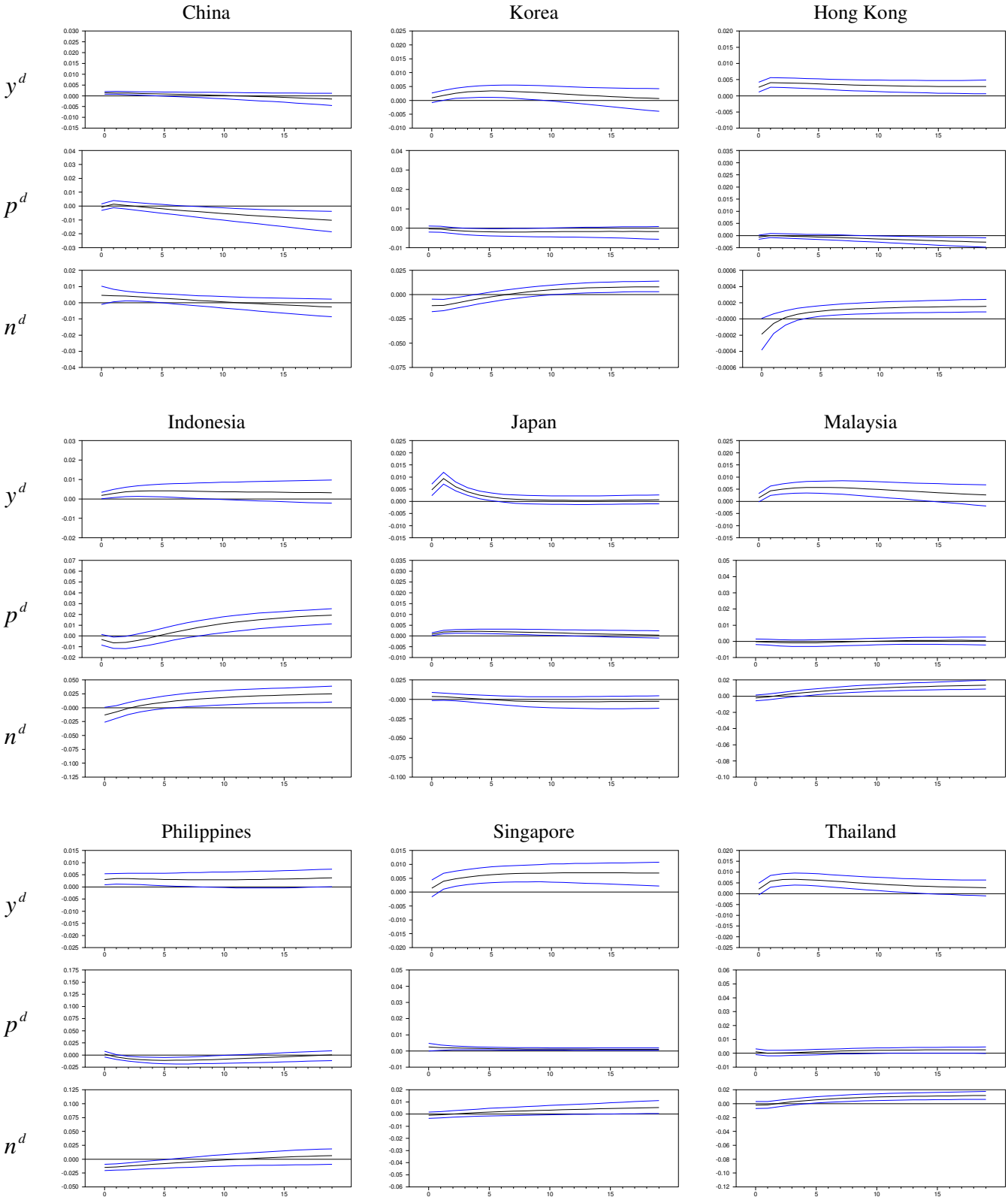


Figure B.3: Impulse Response Functions to an *US Monetary* shock – 1990Q1-2012Q2

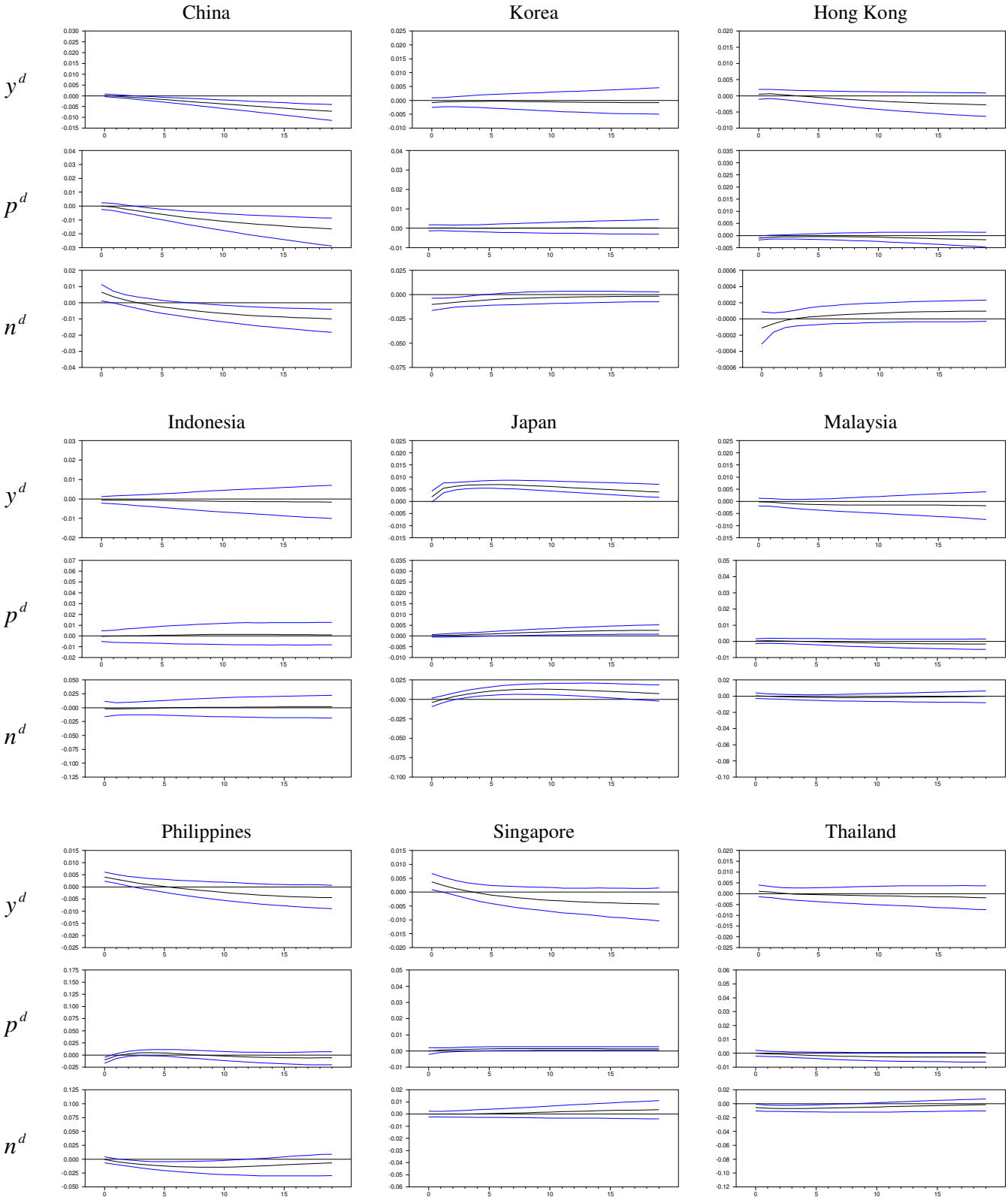


Figure B.4: Impulse Response Functions to a *MSCI Financial* shock – 1990Q1-2012Q2

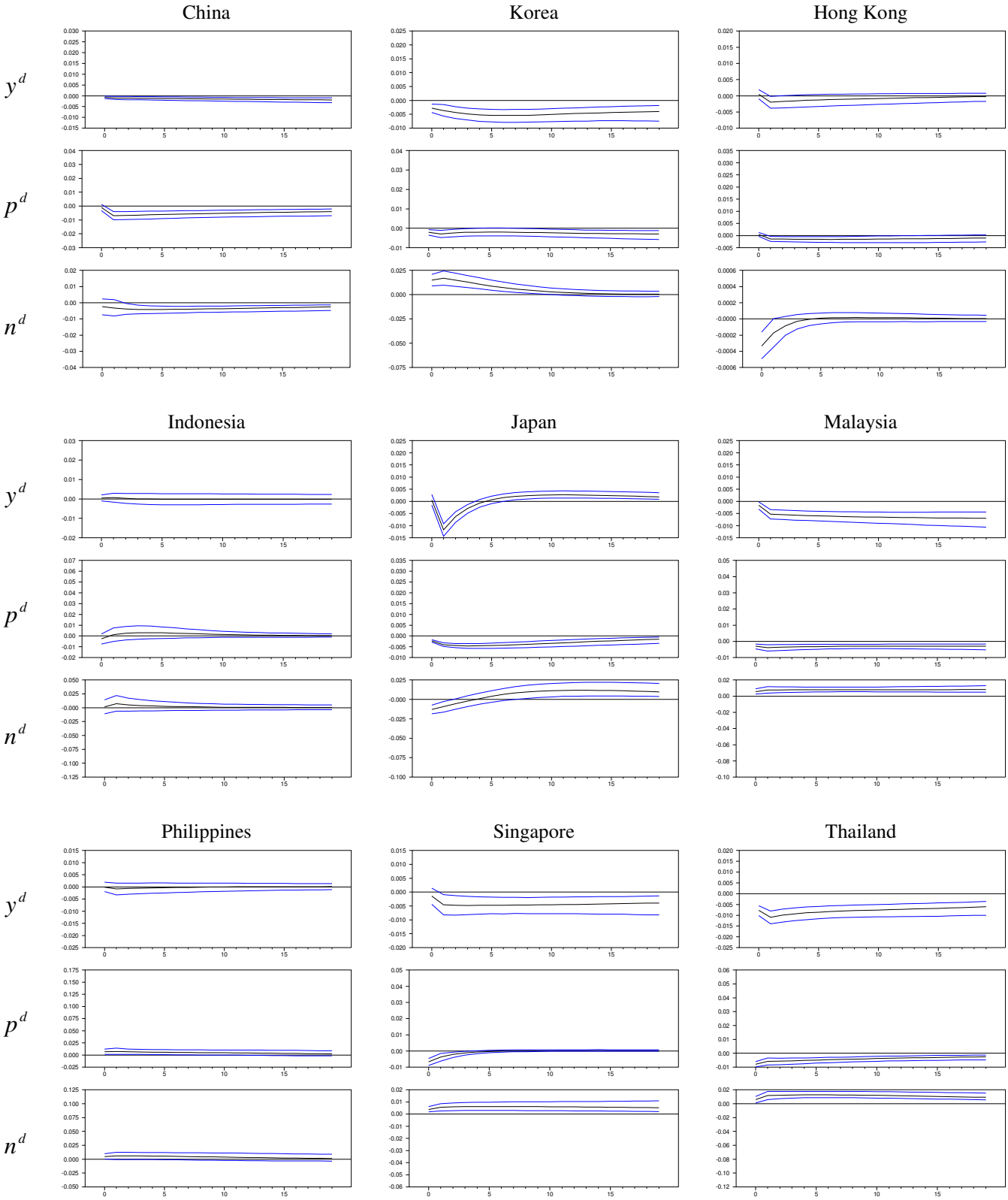


Figure B.5: Impulse Response Functions to an *oil* shock – 1996Q1-2012Q2

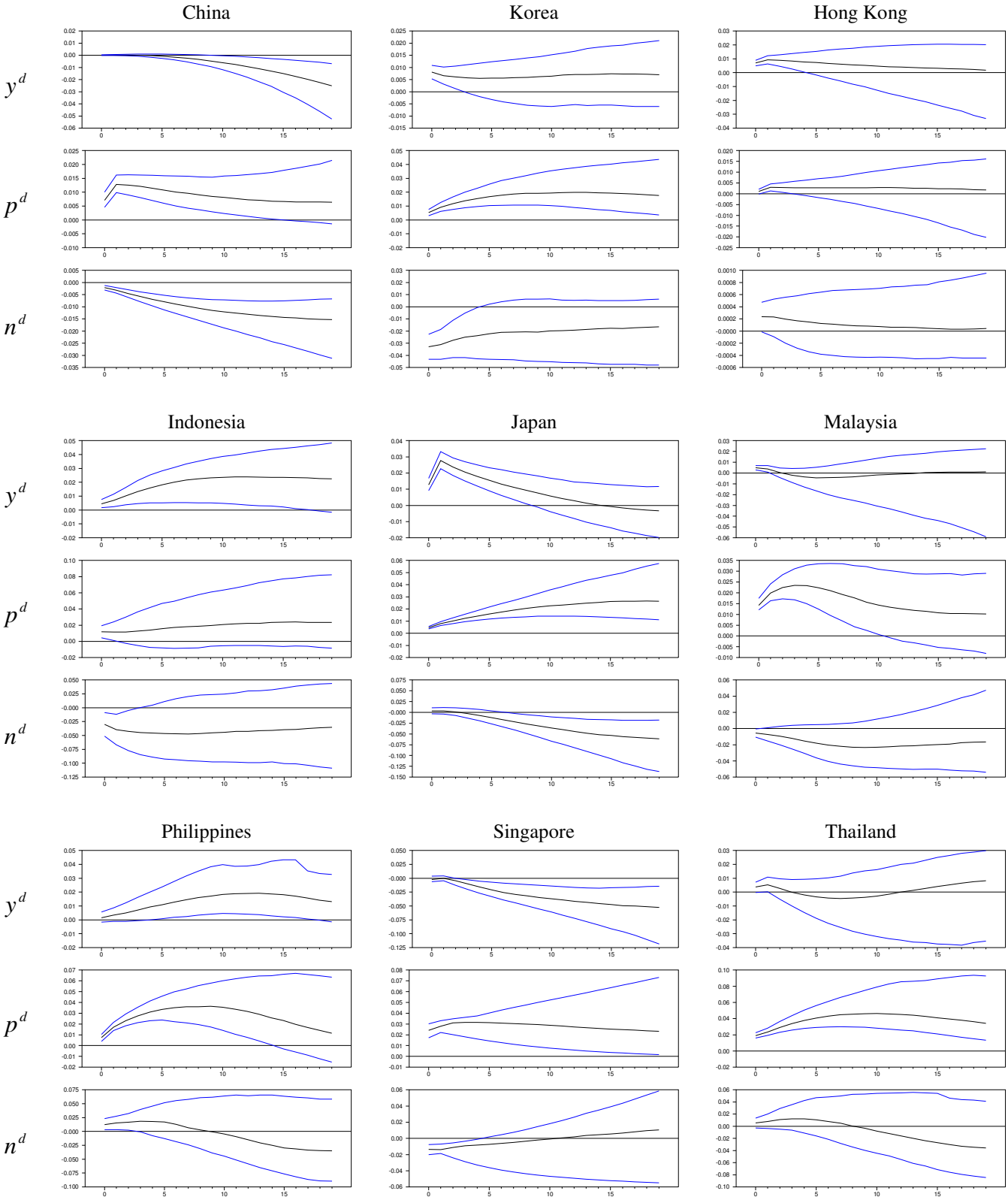


Figure B.6: Impulse Response Functions to an *US GDP* shock – 1996Q1-2012Q2

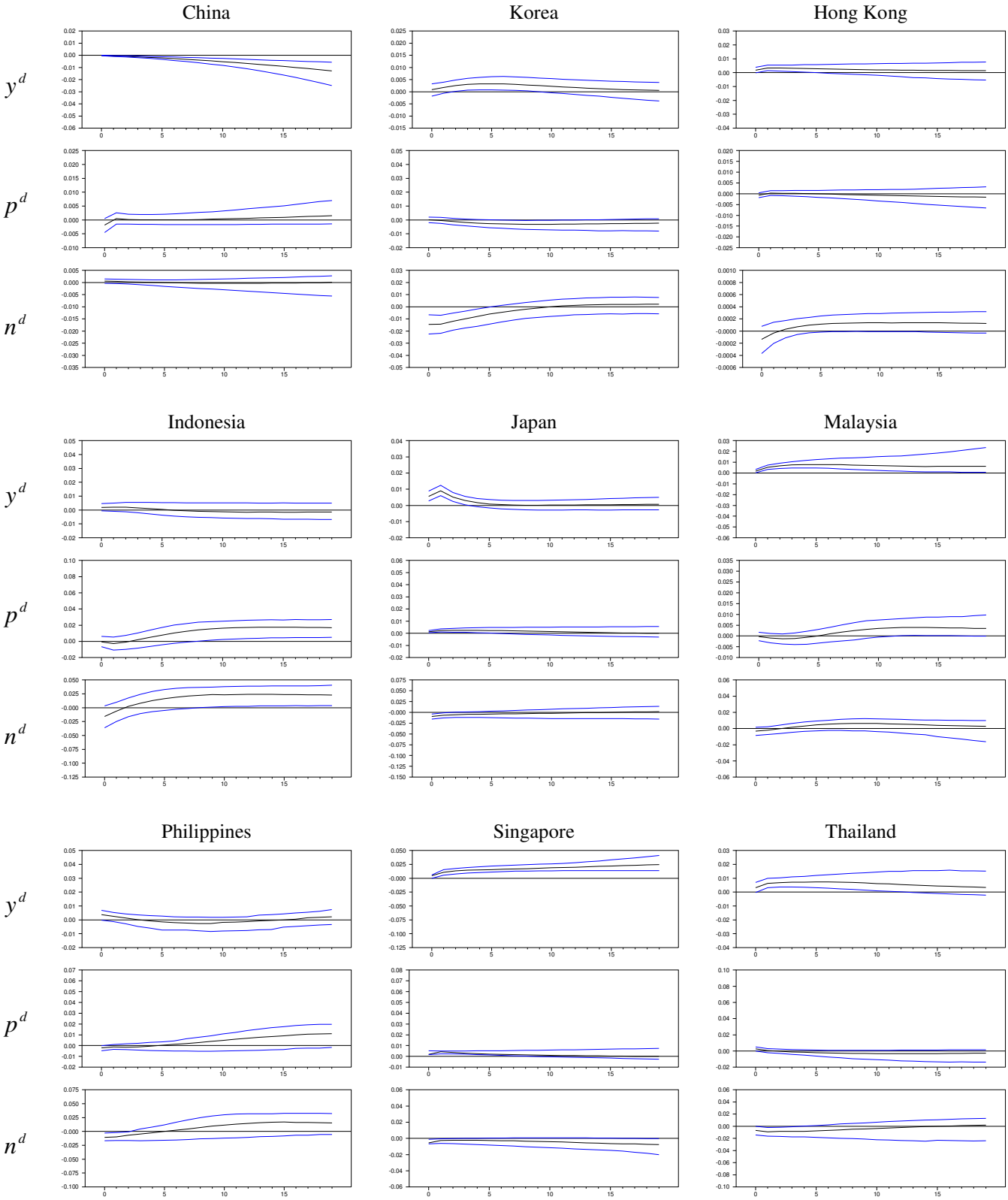


Figure B.7: Impulse Response Functions to an *US Monetary* shock – 1996Q1-2012Q2

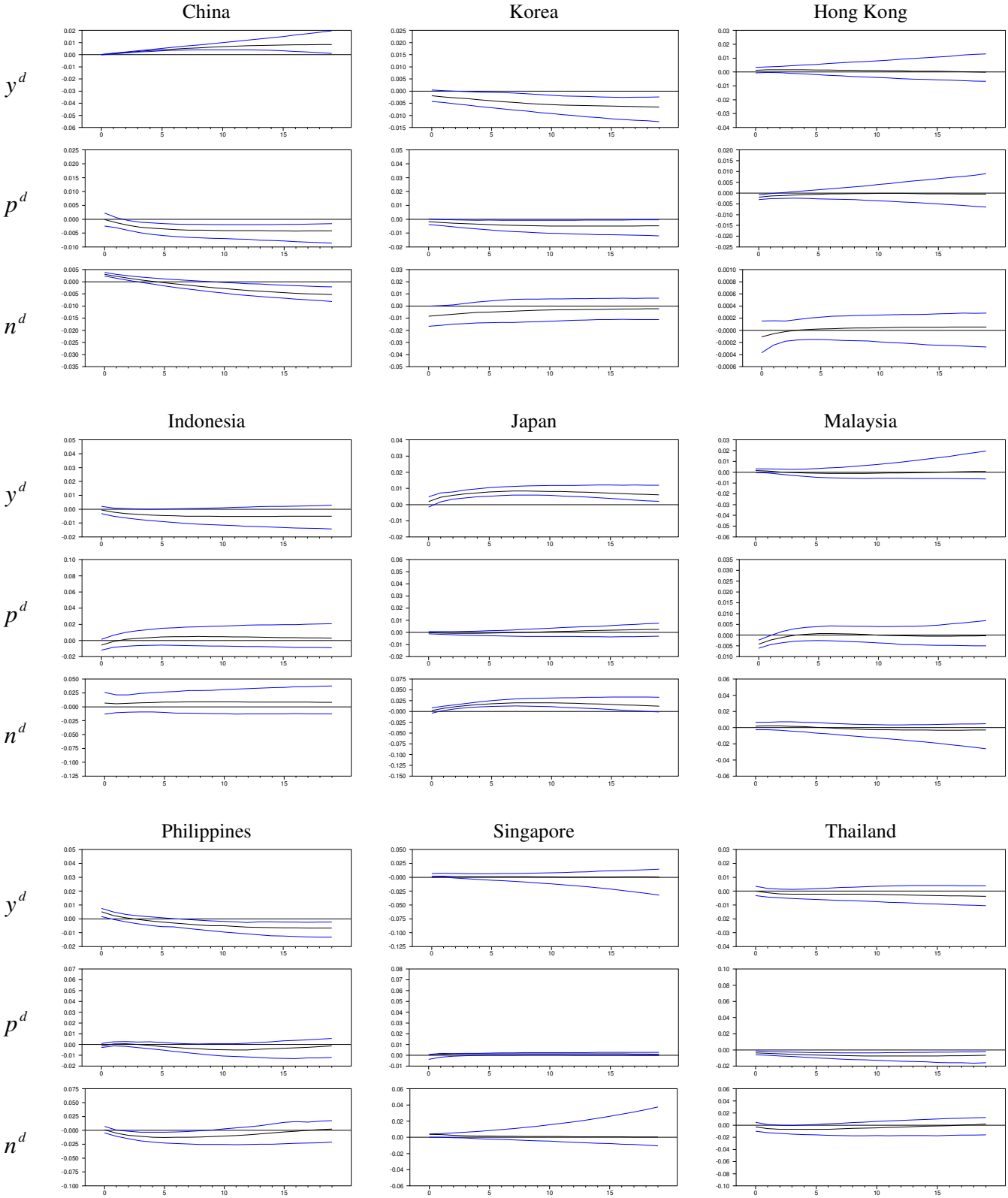
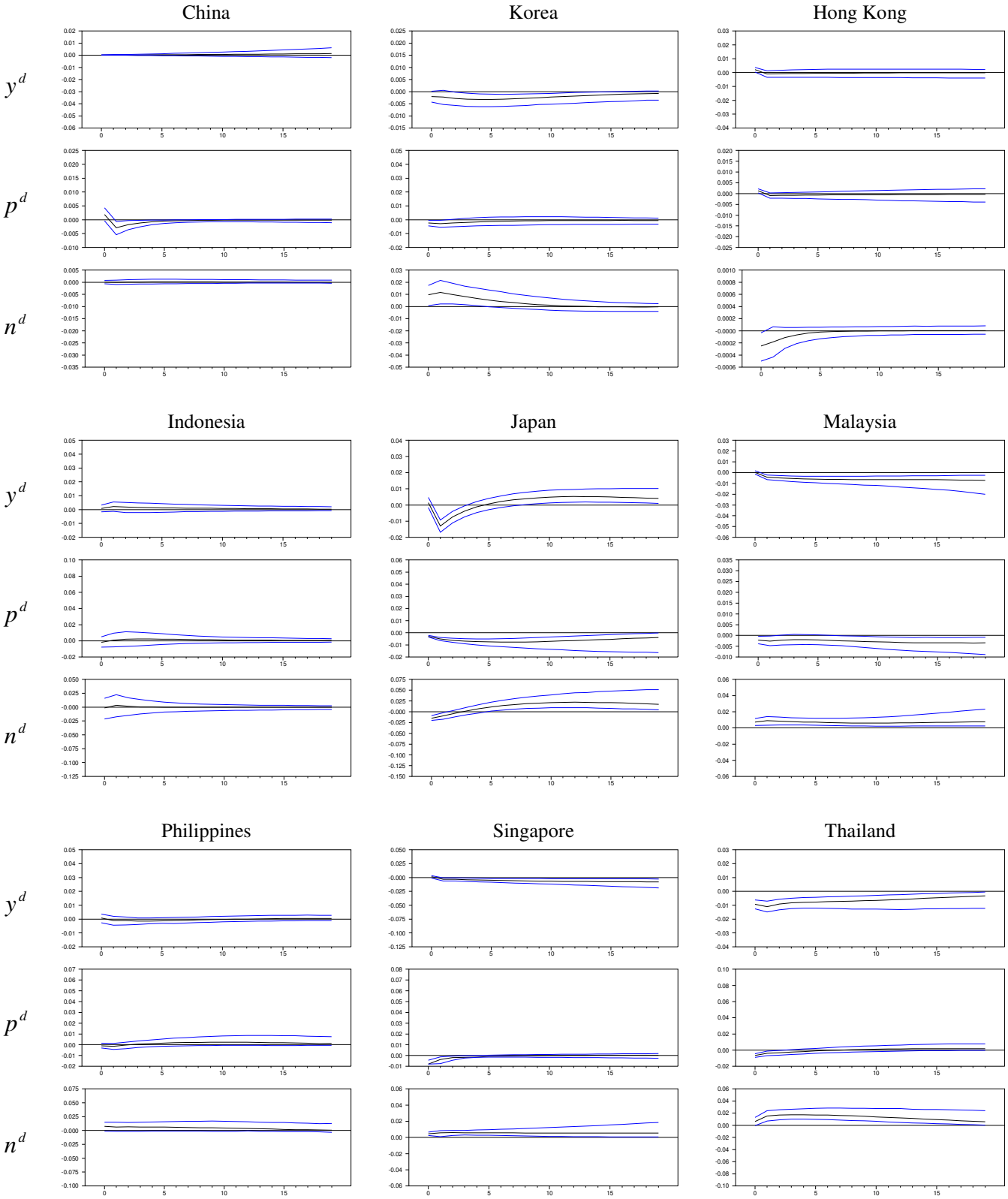


Figure B.8: Impulse Response Functions to a *MSCI Financial* shock – 1996Q1-2012Q2



MSCI Emerging Markets Asia Index

Figure B.9: Impulse Response Functions to a *MSCI Emerging Markets Asia Index* shock – 1990Q1-2012Q2

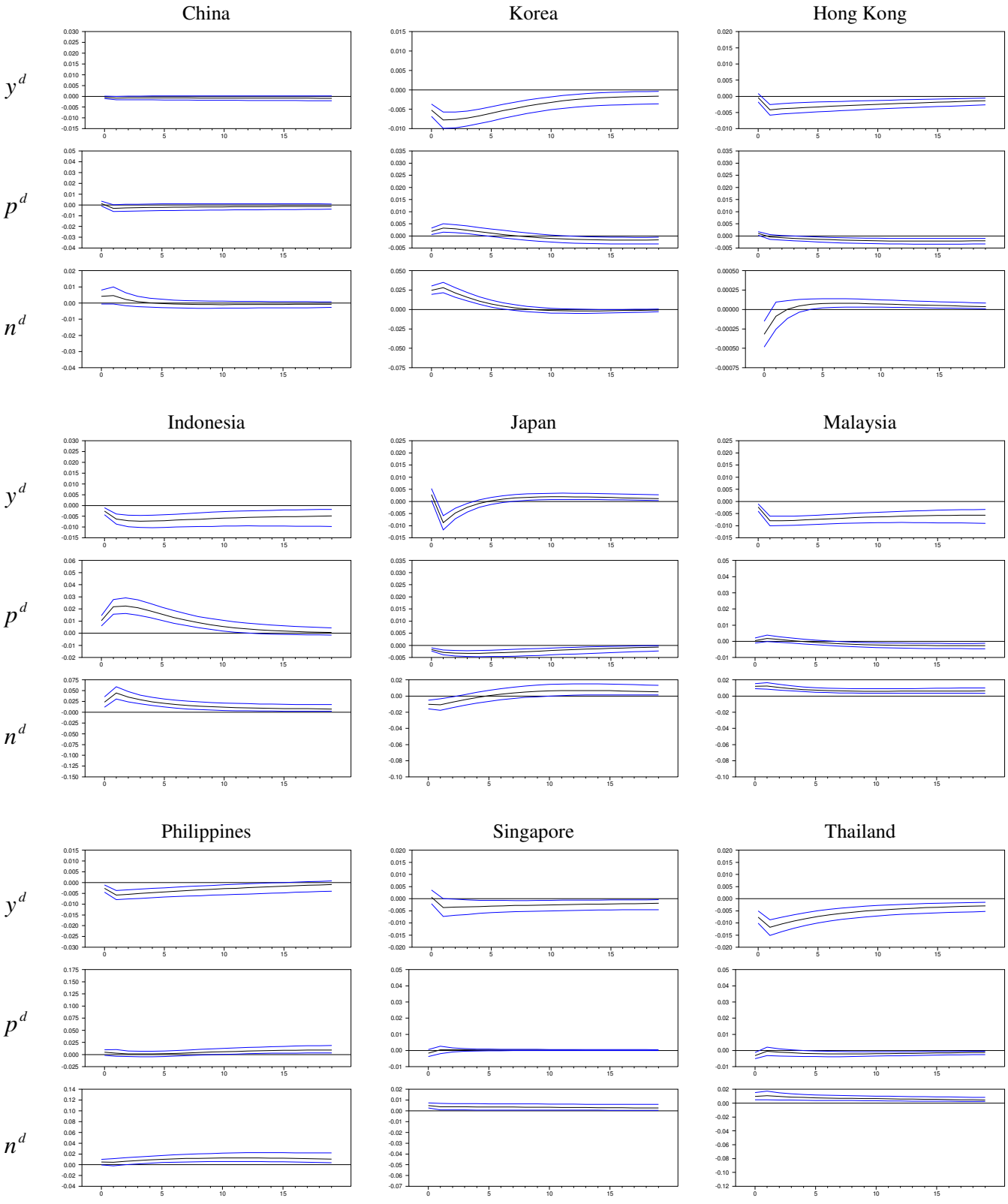


Figure B.10: Impulse Response Functions to a *MSCI Emerging Markets Asia Index* shock – 1996Q1-2012Q2