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The Impact ofExternal Shocks in East Asia: Lessonsfrom a Structural VAR Model with Block Exogeneity

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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 1990.1-2010.4,a structural VAR model with block exogeneity (SVARX model) relying on a comprehensive set of external shocks.We firstly document a risingimpact of these external shocks on domestic variables since the mid 1990s. Finally, real oil priceand U.S. GDP shocks have a significant impact on domestic activity and lead to more symmetric responses, compared to U.S. monetary shock and MSCI Index financial shocks.

Keywords:external shocks, East Asia, SVARX model.

JEL Classification: F32, F33, F42.

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1. Introduction

The Asian crisis in 1997-98 has highlighted the role of regional contagion in financial crisis. The vulnerability of East Asian countries to these regionalcontagion effectshas 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 tradeand 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 toassess 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 shock most significantly affects output fluctuations.[3] Their main finding is that a monetary union would not be desirable in the East Asian area because economies are prone to country-specific – that

[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), Guillaumin (2009), Lombardi (2010) and Oh (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.

is asymmetric – shocks. Some papers implement dynamic unobserved factor models. Results are mixed. 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 Japanese Yen-US 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), over the period 1960-2000, find that county-specific shocks remain the main driver of output fluctuations except for Japan.

A second strand of research relies on structural vectorautoregression (VAR) 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 VAR 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 three shocksin a tridimensional VAR for five Southeast Asian countries over the period 1970-1995. The identified shocks are the folowing: external, domestic (supply-related) and domestic (demand-related) shocks. The external shock is considered as a simultaneous combination of supply and demand external shocks. His results show a strong correlationof responses to these shocks – including the external one- suggesting that these countries are suitable for a monetary union. Rüffer et al. (2007) develop VAR 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 structural VAR 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. Over the period 1986M1-2000M12, Maćkowiak (2007) obtains three main results. Firstly, external disturbances other than US monetary policy shock explain a significant share of the variance of domestic variables in emerging countries. Secondly, US 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.More recently, Gimet (2011) has studiedthe vulnerability of East Asian

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

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 asymmetric.

One important shortcoming of these studies is that no one so far has engaged in a systematic examination of a comprehensive set of distinct external shocks. East Asian economies are indeed linked through a number 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 external shocks in order to quantify their respective impact on East Asian countries. More precisely we address two main issues: firstly the extent to which the vulnaribility of East Asian countries can be attributed to external factors, and secondly which of these factors leads to asymmetric or symmetric reactions between the considered economies. The external shocks include real oil prices shocks, trade shocks, a financial external shock, and a monetary external shock. 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, in particular concerning monetary policy reaction functions (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. Our sample covers the period from 1990Q1 to 2010Q4. However, in order to check if the rising liberalisation of East Asian economies since the mid 1990 has lead to a growing importance of these external factors and more symmetric responses, we replicate our estimations over theperiodfrom 1996Q1 to 2010Q4.

The results of the paper show a rising impact of external shocks on domestic variables since the mid 1990's. Moreover, oil price and tradeshocks 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. Finally, responses to external real shocks are positively correlated, while responses to external monetary and financial shocks are less symmetric, revealing an economic integration process evolving faster than the monetary one in the area.

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 discusses on the nature (symmetric or asymmetric) of responses to external shocks. Section 6 concludes.

2. Methodological Framework

2.1. SVAR model with block exogeneity

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

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

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 external 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 MSCI index[6] (*MSCI*).

[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]Stock index calculated by Morgan Stanley Capital International (http://www.msci.com/) made up of 1500 stocks in the developed countries. We use this world index but excluding the Japanese Kokusai Index.

The first external shock focuses on supply shocks proxied by the real oil price. Indeed, most of these economies import raw materials for their industries (Cushman and Zha, 1997). Astheir growth heavily still depends on exports to industrialised countries, especially with the United States, trade shock is approximed by U.S. GDP shock.The thirdexternal 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 between 80 and 95% (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, in these economies, there has been a trend towards open capital accounts. In particular, these economies 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. This is why we also retain an external financial shock able to capture stress on financial markets and proxied bythe MSCI index.

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 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 enough small that they do not alter world variables.[8]This assumption implies the block exogeneity restriction $A_{12}(s)=0$ for each $s=0,1,...,p$ which 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.

2.2. Identification scheme

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

[7]We chose 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.

[8]We have run Granger non-causality tests in order to check this hypothesis. Results are availableuponrequestfrom the authors.

restrictions and exogeneity assumptions. Following Maćkowiak (2007) and Sato et al. (2009), 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, we assume that real oil prices are not contemporaneously affected by the three others external shocks. We obtain three additional constraints. Identification of the U.S. monetary policy follows the work of Leeper at al. (1996) in which the Fed Funds rate can respond contemporaneously to changes in the real oil price. Furthermore, the Fed Funds rate can also respond to changes in the real U.S. GDP (Christiano et al., 1999). The link between real and financial sectors is complex as stressedin Bernanke (1995), Bernanke et al. (1997) or Boivin (2002). These authors demonstrate that a shock on the real GDP affects contemporaneously the stock market index but not *vice-versa*. This link is also assumed for emerging markets in Sato et al. (2009).[9]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.In order to take into account financial crises that have hit East Asian economies (Asian crisis, recent world crisis), we introduce two dummy variables: the firstone equals to 1 from 1997Q2 to 1998Q3 and 0 otherwise; the second one equals to 1 from 2008Q3 to 2009Q2 and 0 otherwise.

2.3. Data

We use quarterly data over the period 1990Q1-2010Q4[10]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

[9]See, for a literature review, BIS (2011).
[10]Source material is described in Appendix A.

agreements). The sample includes China, South Korea, Hong Kong SAR, Indonesia, Japan, Malaysia, the Philippines, Singapore and Thailand.[11]

Every variable except U.S.interest rate (*Fed Funds*) have been turned into logarithms. GDP data (or, if unavailable, industrial production data) and producer price index have been deseasonalized.[12]We first test the order of integration for each variable before running cointegration tests.[13]Finally, due to the shortness of the data set in sub-periods, we set the lag length of the SVARX to one, as in Canova (2005), instead of applyingthe 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 atdifferent 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 thisdecomposition are reported in tables B1 to B.3 and B.4 to B.6 for the all-period sample (1990Q1-2010Q4) and the sub-period sample (1996Q1-2010Q4) respectively.

Table B.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 blockof the table displays the fraction that can be explained by all external shocks.

For all studied countries, except Indonesia, 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 Hong Kong are especially sensitive to these shocks insofar as the latter explain respectively 58.8 and 36.8 of their real GDP variance. External shocks tend to be persistent as their weight in the real GDP variances increases with time horizon. The sub-sample period – from 1996Q1 to 2010Q4 – exhibits a clear increase in the influence of external shocks. More precisely, at the short-run horizon, these shocks explain more than 15

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

[12]Census X-12 method.

[13]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 root and cointegration tests are available upon request from the authors.

percent of the real GDP variances. At long-run horizon (16-20 periods), external shocks increasingly matter, confirming the persistence observed in the all period sample. Such evolutions are linked tothe increase in the openness degree in East Asian countries since the end-90s'.[14]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 rise in its 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. Indeed, producer prices are more prone to international influences than consumption prices. From this perspective, the high impact of external shocks on PPI partly mirrors the rising trend in the trade openness in many East Asian countries. Table B.2 suggests that the more a country is opened, the more external shocks exert an influence on domestic prices (see, for instance, Singapore and Hong Kong). In countries with lower trade openness, the increasing influence on 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. The sub-period sample does not significantly change the results. Consistent with the increase in the trade openness after the Asian crisis, the short-run influence on external shocks increases in all countries except Indonesia.[15]

The influence of external shocks on the nominal exchange rates (NER thereafter) offers a very different picture in the two samples for the short-horizon (1-4 periods). Indeed, while in the all period sample external shocks account for less than 10 percent of the NER variances in six countries, the number falls to two countries for the sub-period sample. In other words, the influence of external shocks has risen over the period 1996Q1-2010Q4. At the long-run horizon, the two samples suggest a dramatic increase in the impact of external shocks. In the all period, we note that external shocks explain more than 25 percent of the variance in all countries. This persistence of external shocks is confirmed in the sub-period sample except for Singapore. The increase in oil dependence of the region seems to explain this evolution. Indeed, the relative importance of each external shocksuggests that East Asian countries are more sensitive to real shocks than to monetary and financial shocks. Interestingly, the sub-period sample (TablesB.4 to B.6) does not qualitatively change this result.More precisely, Table B.4 shows that domestic GDP tend to be more influenced by real oil prices shocks and

[14]The area is characterised by a decrease of trade dependence on the US benefiting Southeast Asia and, though less so, the *Asean*. This intra-area trade shift 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), Petri (2006) and Guillaumin (2009).

[15]Indonesia is the only country in our sample exhibiting a declining trend in trade openness after 1998.

U.S. GDP ones at both short- and long-run horizons. The impact of real oil prices shocks is stronger on PPI variances. In all countries, except China, 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 oil prices shocks on PPI. Finally, in the two samples, variances of nominal exchange rates are mainly explained by oil shocks at long horizon. Such evolution mirrors the growing dependence of many East Asian countries to oil since the end of 1990's. The recent sub sample period has been marked by a dramatic increase in the oil price which has definitively 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.

In the major part of our studied countries, U.S. GDP shocks explain a lower share of domestic GDP variances than oil prices shocks over the all-period sample. The sub-period sample shows that the influence of U.S. GDP shocks decreases in many East Asian countries for all horizons. Such evolutions are consistent with two major changes that have occuredin the international trade of our sample's countries.First, since the beginning of 90's, intra-regional trade has increasedat the expense of the trade with the United States. The main part of the decline in U.S. share has occured after 2000. The second major change in the region has been the growing trade influence of China both at the worldwide level and regional one. If the weight of China in the total intra-regional trade has increased since the beginning of the 1980's, we note a major acceleration after 2000 for exports. The higher share of China in intra-regional trade has been accompanied by an increasing role of China in the East Asian countries trade with other areas, particularly the United States.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; Guillaumin, 2009; Allegret and Essaadi, 2011).These evolutions suggest an increasing indirect influence of U.S. GDP shocks *via* the role of China in the region. From this perspective, Allegret and Essaadi (2011) find that total intra-regional imports of China are cointegrated with the U.S. GDP, confirming this indirect influence. Variances of producer prices and nominal exchange rates are weakly explained by U.S. GDP shocks in the two samples. The finding relative to exchange rate 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 globalmarkets.

International monetary shocks (Fed funds disturbances) and international financial shocks (MSCI 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 recent 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, using the Chinn and Ito's country ranking, in 2009, over a total number of 169 countries, the respective ranks for our sample's countries are the following: 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}).[16] 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, Singapore, and Malaysia had a ratio (Stock of external assets + Stock of external liabilities) / GDP higher than the unweighted average of emerging countries.[17]

4. The impact of external shocks on domestic variables

Dynamic responses of each domestic variable to the different external shocks are depicted respectively in figures C.1 to C.4and C.5 to C.8for the all-period sample and the sub-period sample respectively. 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. The extent to which initial responses and adjustment differ gives some information on the feasibility of a monetary union.

Real 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

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

[17] 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).

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, in case of responses 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 South Korea and Singapore. The adjustment of GDP occurs well beyond five quarters. 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 rate of growth 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.[18]The sub-period sample confirms the previous findings. However, for many countries, we note both stronger responses on impact of the oil shocks and fluctuations of GDP.

As expected, in all countries and for the two samples, domestic production prices increase after the real oil prices shocks. It is important to stress that responses of PPI are similar across our studied countries both in terms of contemporaneous reactions and persistence.

In all countries except for the Philippines (in the all-period sample), domestic currencies have appreciated in the aftermath of the oil shocks. Such result is not surprising for the main oil exporting economies in the region (Singapore, Malaysia, and Indonesia). For other countries, the appreciation may rest on the positive relationship between oil prices increases and world

[18] 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).

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 U.S. GDP. Indeed, the high trade 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 shocks remains narrow. The sub-period sample does not qualitatively change results, even if responses of domestic GDP to U.S. GDP shock are less accentuated. 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, U.S. GDP shocks do not exert a significant economic 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, positive U.S. GDP shocks are 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. Similar results are obtained in the sub-period sample. Overall, U.S. GDP shock exerts a weak influence on nominal exchange rates in the region.

In the all-period sample, GDP responses to the external monetary shock are either insignificant from a statistical standpoint or short-lived. The sub-period sample accentuates this finding. Only the Philippines exhibit a consistent negative response to Fed Funds shocks. The responses of GDP in other countries suggest that the U.S. monetary policy does not exert a significant impact on economic activity in 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 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.

The external financial shock does not seem to exert a significant impact on domestic GDP and prices in the region, even in the sub-period sample. In other words, despite progress in the financial deepening in East and South-East Asian countries since the end 90s', wealth effects remain weak in these economies. The only exceptions are the more financial developed countries – such as Japan and Singapore – where positive innovations on MSCI are followed by a short-lived increase in GDP. Nominal exchange rates are weakly affected by the

international financial shock.The short-term responses are insignificant in many countries except Indonesia and South Korea where the NER depreciates.Overall, these last results confirm the relative low exposition of East Asian economies to financial shocks mainly explained by their relative low financial openness.

5. Correlationsof Domestic Variables Responses to External Shocks

Recent developments in the European Monetary Union have shown that a key criterion for the success of a monetary union is that the responses of external shocks which hit the economies should be reasonably well correlated. In order to investigate more deeply this issue, we calculate the correlations of domestic variables responses to external shocks, following the work of Agenor et al. (1999) and Canova (2005). Indeed, positive correlations can be interpreted as reflecting symmetric responses while negative or not statistically different from zero correlations will reflect asymmetric reponses.Correlations of domestic variables responses to external shocks are depicted respectively in tables D.1 to D.3 and D.4 to D.6 for the all-period sample and the sub-period sample respectively.

The two samples exhibit a contrasting picture concerning the correlation of GDP responses to real oil prices shock. More precisely, even if correlations are positive for many pairs of countries in the all-period sample (for instance Indonesia-China; Malaysia-Indonesia; Philippines-Hong Kong), no clear trend emerges. The sub-period sample offers a more coherent picture. More precisely, two sub-groups are distinguished. First, New industrialized economies (NIEs) – Hong Kong, Singapore, and South Korea – tend to have higher correlations between them and also with China. Second, countries from the ASEAN have higher bilateral correlations of GDP responses to oil shock. Globally speaking, the degree of correlation of GDP responses to U.S. GDP shock is close to that found forthe oil price shock. Except the Philippines, countries whose trade specialization is founded on manufactures are especially correlated with other countries inthe region (China, Japan, Hong Kong, South Korea). These symmetric responses suggest that more advanced countries in the region tend to transmit U.S. GDP shocks to other economies and confirm the indirect influence exerted by the United States. Correlations of GDP responses to the international monetary policy shock are very different in the two samples. In the sub-period sample, we see a striking decrease in the number of symmetric responses mainly explained by China and Hong Kong. Thisdecrease

stems from the move of exchange rate regimes towards higher flexibility[19], whileChina and Hong Kong have kept their rigid exchange rate regime. The sub-period sample shows an even greater decrease in the degree of symmetry of the GDP responses to the international financial shock. This result is consistent with the low degreeof international financial integration found in the region. In addition, recurrent changes in capital controls measures since the Asian crisis in countries such as Indonesia, Malaysia, South Korea, and Thailand have certainly exerted a negative impact on this degree of symmetry.

In the two samples, domestic prices responses to real oil prices shock tend to be symmetric for the major part of our studied countries. China and Hong Kong are outliers. Higher correlations are observed in oil exporting countries with major oil importing countries. From this perspective, real oil prices shocks create interdepencies in the region.Tables D.2 and D.5 display few symmetric responses of domestic prices to the U.S. GDP shocks in the two samples. We observe some pairwises of positive correlations (especially for Malaysia and Thailand in the all-period sample; and Singapore in the sub-period one). Responses of producer prices (PPI) to the Fed Funds shocks are weakly correlated in the two samples. More precisely, if we consider all external shocks and all responses correlations, we see that PPI responses to the external monetary shocks are in most cases asymmetric. In the two samples, more financially opened countries – Hong Kong, Japan, Singapore, and South Korea – tend to have more symmetric responses with other East Asian economies. External financial shocks exhibit lower positive correlations of PPI responses in the all-period sample. At the oppositve, responses appear much more symmetric over the period 1996Q1-2010Q4. Like the external monetary shock, responses to the external financial shock show that more financially opened countries have higher correlations with other economies.Overall, these results suggest that prices correlations have improved after 1996 in East Asian economies.

In the two samples, responses of nominal exchange rates (NER) to real oil price shocks are the most correlated. Such result is consistent with the increasing oil dependence of the region. In addition, as stressed above, South-East Asian oil exporters have strong relationships with other countries in the region. While China is an outlier in the all-period sample, this country appears significantly more correlated with other economies in the sub-period sample. This

[19]In the aftermath of the Asian financial crisis, some countries moved towards more flexible arrangements (Indonesia, the Philippines, South Korea, and Thailand) while others abided their exchange rate regimes (China (conventional peg), Hong Kong (hard peg), Singapore (managed floating) and Japan (floating regime). Malaysia exhibits a more contrasting evolution: immediately after the Asian crisis the authorities adopted a floating regime, but, in the aftermath of the decision to control capital movements (September 1998), Malaysia moved towards a conventional peg until the end of 1999 when they chose intermediate regime. See: the Reinhart and Rogoff's classification until 2007; the Bubula and Ötker-Robe's classification until 2006; and the IMF's Annual Report after 2008. All these sources are *de facto* classification.

finding is consistent with changes in the prices controles strategy followed by Chinese authorities. As China met increasing difficulties to control raw material prices, from 1998 to 2001, Chinese authorities implemented reforms liberalizing oil pricing system.[20] As a consequence, domestic oil prices are increasingly correlated tothe world market. In turn, this change inenergy prices strategy may have favouredan increasing symmetry in the responses of China *vis-à-vis* other East Asian countries. NER responses of U.S. GDP shocks show high correlation degrees in the two samples except for China. As stressed above, the fixed exchange rate regime and strict capital controls in this country may represent impediments to promote convergence towards neighbourings countries. New industrialized countries and ASEAN economies exhibit strong correlations. NER responses to the external monetary shock display more positive correlations in the all-period sample than in the sub-period one. Such result is surprising if we consider the convergence of many studied countries towards more flexible exchange rate arrangements after 2000. The comparison of the two samples suggests that the decrease in the correlation degrees over the period 1996Q1-2010Q4 may be explained by countries with extreme regimes (China and Hong Kong on the one hand; Japan and Singapore on the other hand) which are consistently less positively correlated with other economies in the region.This finding suggests that the move towards more flexible regimes occurs inside intermediate regimes. The external financial shock induces especially weak symmetric responses of NER in the two samples, revealing a weak influence of financial variables on nominal exchange rates.

6. 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 abroad set of exogenous shocks on East Asian economies in a unified framework, this paperfirstly providesa 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 ofshock. Finally, the existing papers that focus on East Asian had beenconcerned above all with the impact of trade orforeign interest rate shocks. We document in addition the dynamic response of domestic variables to financial stress in these economies.The general picture that emerges is that external shocksexert meaningful effects on domestic variables in East Asia, especially

[20] For more details, see Tang et al. (2010) and Duaet al. (2010).

in the most recent period. To the extent that these shocks cover the mostimportant external contingencies 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.

Our results on variance decompositions and impulse responses functions show that East Asian countries appear especially sensitive to the trade channel. Correlations of responses of domestic variables to external shocks displaytwo main findings. Firstly, in the two period samples, responses to external real shocks are especially positively correlated. As these shocks are at the same time the most relevant for our studied countries, such symmetric responses make a monetary union suitable within the region. Japan and new industrialized countries – including China – are the main driving forces explaining such correlations. Secondly, in the sub-period sample, responses of domestic variables to external monetary and financial shocks are less symmetric, thus justifying the reinforcement of monetary and financial cooperation between the area's countries. We attribute this result to a higher diversity in the exchange rate regimes in the aftermath of the Asian crisis, asKawai (2009) and Chow (2011) who stress the prevalence of diverse and uncoordinated exchange rate arrangements after the Asian financial crisis. In this respect, our findings alsoquestion the "China's dominance hypothesis" (Fratzcher and Mehl, 2011; Ito, 2010)and the stabilizing role played bythe renminbi since mid-2000's. In addition, there is no convergence in the monetary regimes in the region. For instance, the analysis of the correlations among inflation targeters countries[21] does not reveal a particular high degree of symmetry in the responses of domestic variables to external shocks. This leads us to a more nuanced position than Rose (2011) about the ability of inflation targeting to promote synchronization.

[21]South Korea (January 2000); Thailand (May 2000); the Philippines (January 2002); and Indonesia (July 2005). Date of inflation targeting adoption in the brackets.

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Appendix A

Data description

The data used in section 4 are quarterly, covering the period 1990Q1-2009Q4. The sample includes the following countries: China, South Korea, Hong Kong SAR, Indonesia, Japan, Malaysia, Philippines, Singapore, and Thailand. Brunei, Cambodia, Myanmar, and Vietnam were removed from the sample because of the lack of available data.

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. Its value is set to 1 for quarters 1997Q2 and 1998Q3, 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.

Appendix B

Decomposition of Variance

Table B.1: the fraction of the variance of the GDP due to external shocks. 1990Q1-2010Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	2.48	7.22	25.93	0.51	46.53	4.19	7.56	4.49	4.70
	16-20	31.44	12.51	42.32	1.87	59.83	11.58	11.25	2.89	24.37
U.S.gdp	1-4	15.2	2.54	8.26	2.53	4.67	10.02	0.38	5.95	10.19
	16-20	6.41	10.17	7.81	2.48	2.34	18.34	11.20	30.87	4.42
FedFunds	1-4	0.04	0.31	0.41	0.09	2.20	0.16	18.84	2.50	0.80
	16-20	2.47	1.97	1.30	0.02	13.13	0.57	21.26	1.24	0.89
MSCI index	1-4	0.29	1.91	2.23	2.21	5.38	15.21	1.21	7.02	0.97
	16-20	3.90	0.81	1.45	4.26	4.53	3.49	1.31	3.21	5.26
Sum	1-4	18.01	11.98	36.82	5.34	58.77	29.58	27.99	19.96	19.66
	16-20	44.22	25.46	52.87	8.64	79.84	33.98	45.03	38.2	34.93

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 B.2: the fraction of the variance of PPI due to external shocks. 1990Q1-2010Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	15.75	24.58	27.03	24.21	53.70	59.33	26.68	77.79	46.35
	16-20	38.53	58.61	89.61	45.70	92.80	90.12	78.57	93.81	85.34
U.S. gdp	1-4	0.05	0.04	0.94	1.34	1.36	0.17	1.14	0.40	0.24
	16-20	4.49	1.58	0.36	9.76	0.35	0.50	1.33	0.39	0.55
FedFunds	1-4	2.13	0.27	0.09	0.16	0.05	0.02	1.46	0.05	0.05
	16-20	22.14	0.73	0.62	0.32	0.82	0.09	0.31	0.42	0.84
MSCI index	1-4	10.75	10.20	8.58	1.03	9.24	0.75	3.69	0.69	2.47
	16-20	14.83	10.93	1.26	3.53	2.81	0.59	1.28	0.15	0.38
Sum	1-4	28.68	35.09	36.65	26.75	64.34	60.27	32.97	78.93	49.11
	16-20	79.98	91.85	71.65	59.30	96.77	91.3	81.49	94.77	87.11

Notes: ‘‘1–4’’ stands for the average between 1 quarter after a shock and 4 quarters after a shock. ‘‘1–8’’ stands for the average between the first quarter after a shock and 8 quarters after a shock. ‘‘8–16’’ stands for the average between 8 quarters after a shock and 16 quarters after a shock. ‘‘16–20’’ stands for the average between 16 quarters after a shock and 20 quarters after a shock.

Table B.3: the fraction of the variance of NER due to external shocks. 1990Q1-2010Q4

Shock	Horizon	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
Oil price	1-4	5.47	14.59	4.26	3.93	0.57	5.87	10.74	21.26	0.22
	16-20	9.63	69.65	21.08	34.43	57.95	81.43	13.11	57.35	70.20
U.S. gdp	1-4	1.62	5.06	2.54	1.71	0.01	1.95	13.36	1.59	1.17
	16-20	1.90	3.88	6.45	8.62	0.19	4.86	10.11	1.33	5.10
FedFunds	1-4	2.25	5.09	0.58	0.44	0.89	0.36	0.73	0.19	4.35
	16-20	22.17	2.37	2.32	0.37	7.88	0.17	2.67	0.22	1.37
MSCI index	1-4	0.19	1.15	0.73	1.39	0.16	0.69	1.41	1.68	0.65
	16-20	13.21	1.37	0.65	3.39	4.65	0.24	0.73	0.74	0.69
Sum	1-4	9.53	25.90	8.11	7.46	1.63	8.87	26.25	24.72	6.29
	16-20	46.92	77.27	30.50	46.81	70.66	86.70	26.62	59.65	77.36

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 B.4: the fraction of the variance of the GDP due to external shocks. 1996Q1-2010Q4

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 index	1-4	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 B.5: the fraction of the variance of PPI due to external shocks. 1996Q1-2010Q4

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 index	1-4	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 B.6: the fraction of the variance of NER due to external shocks. 1996Q1-2010Q4

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 index	1-4	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
	8-16	83.65	67.60	20.18	59.91	75.14	78.61	47.01	10.17	30.83
	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.

Appendix C Impulse Response Functions

Table C.1: Impulse Response Functions to an *oil* shock – 1990Q1-2010Q4

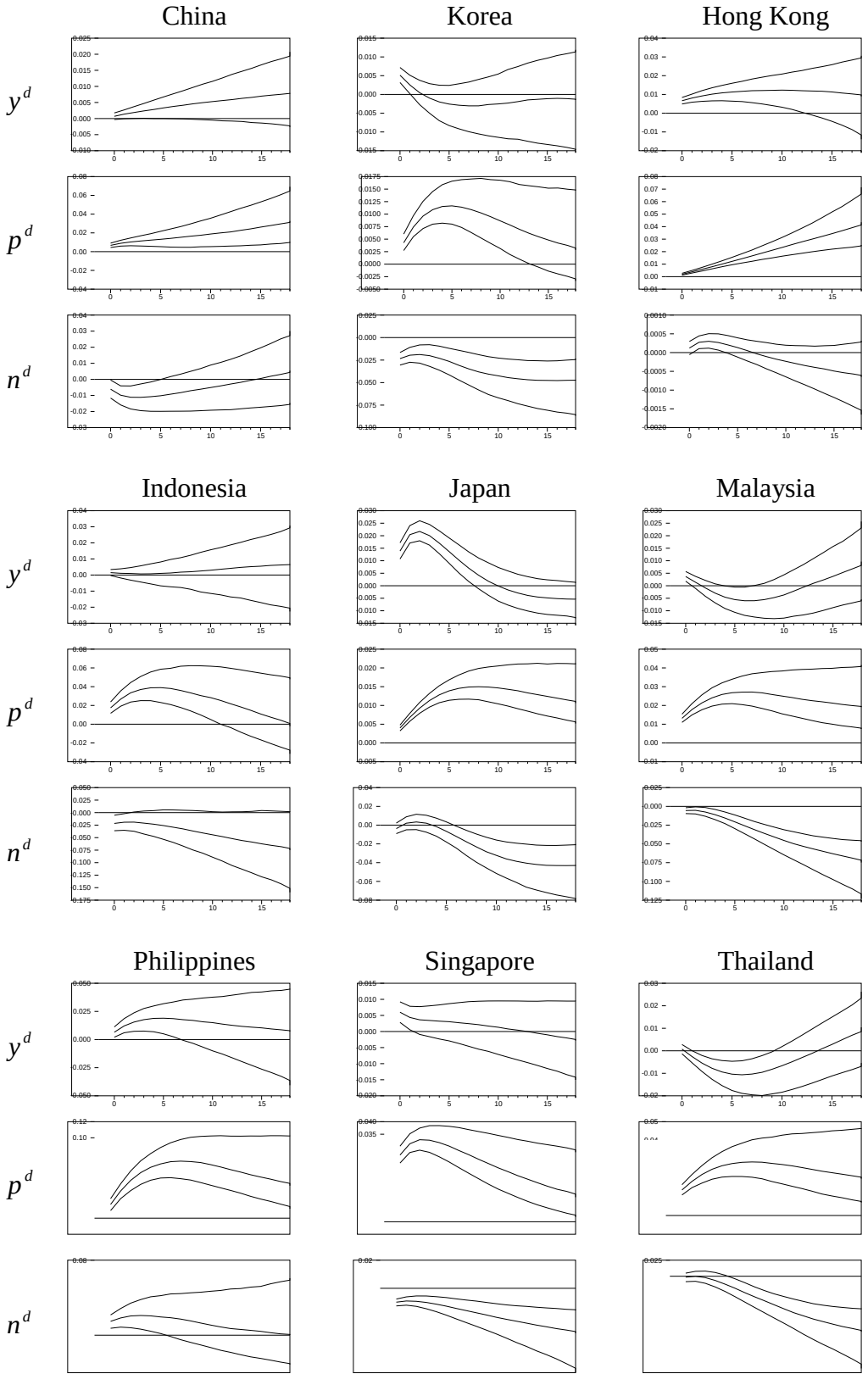


Table C.2: Impulse Response Functions to an *US GDP* shock – 1990Q1-2010Q4

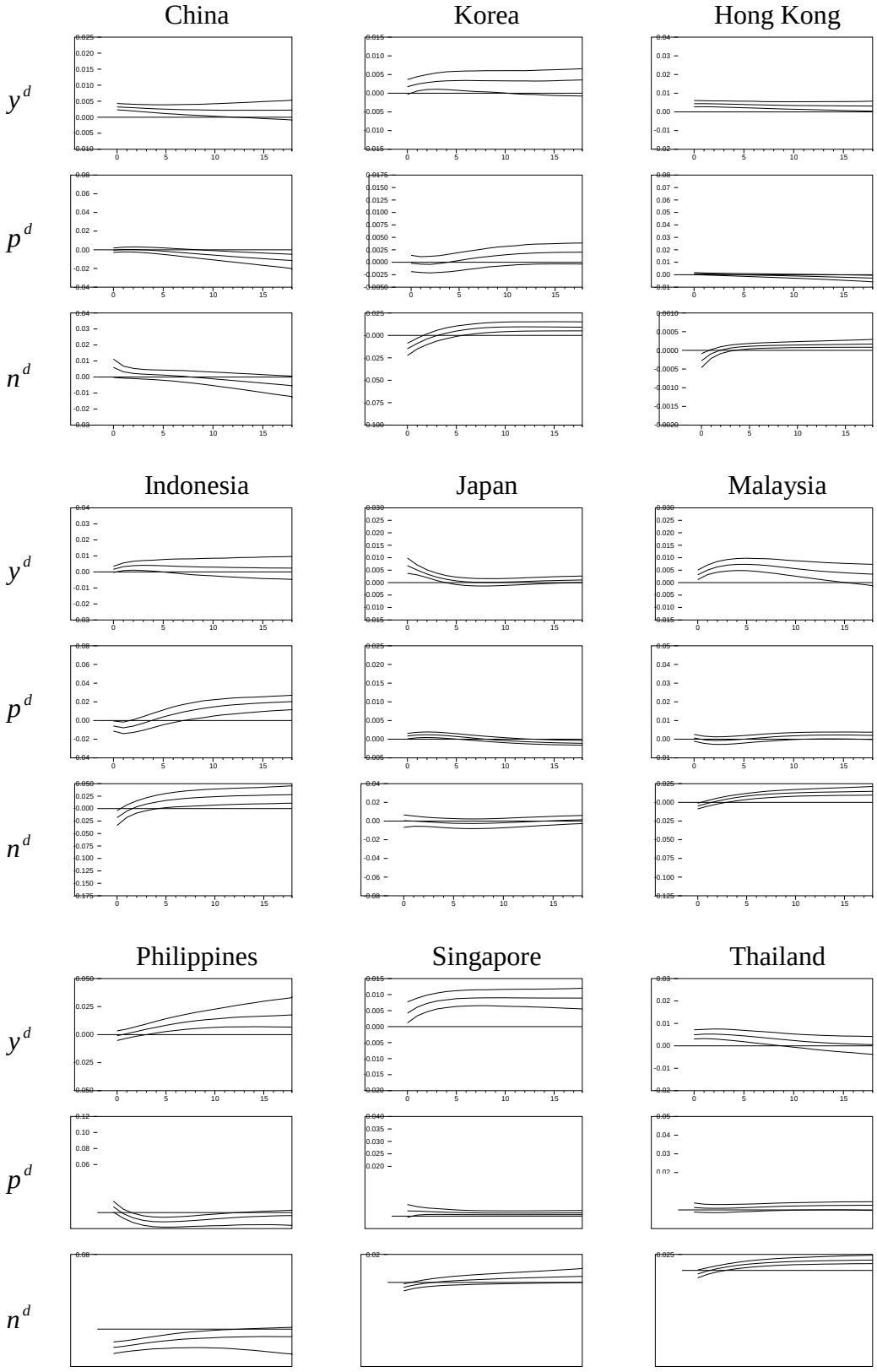


Table C.3: Impulse Response Functions to an *US Monetary* shock – 1990Q1-2010Q4

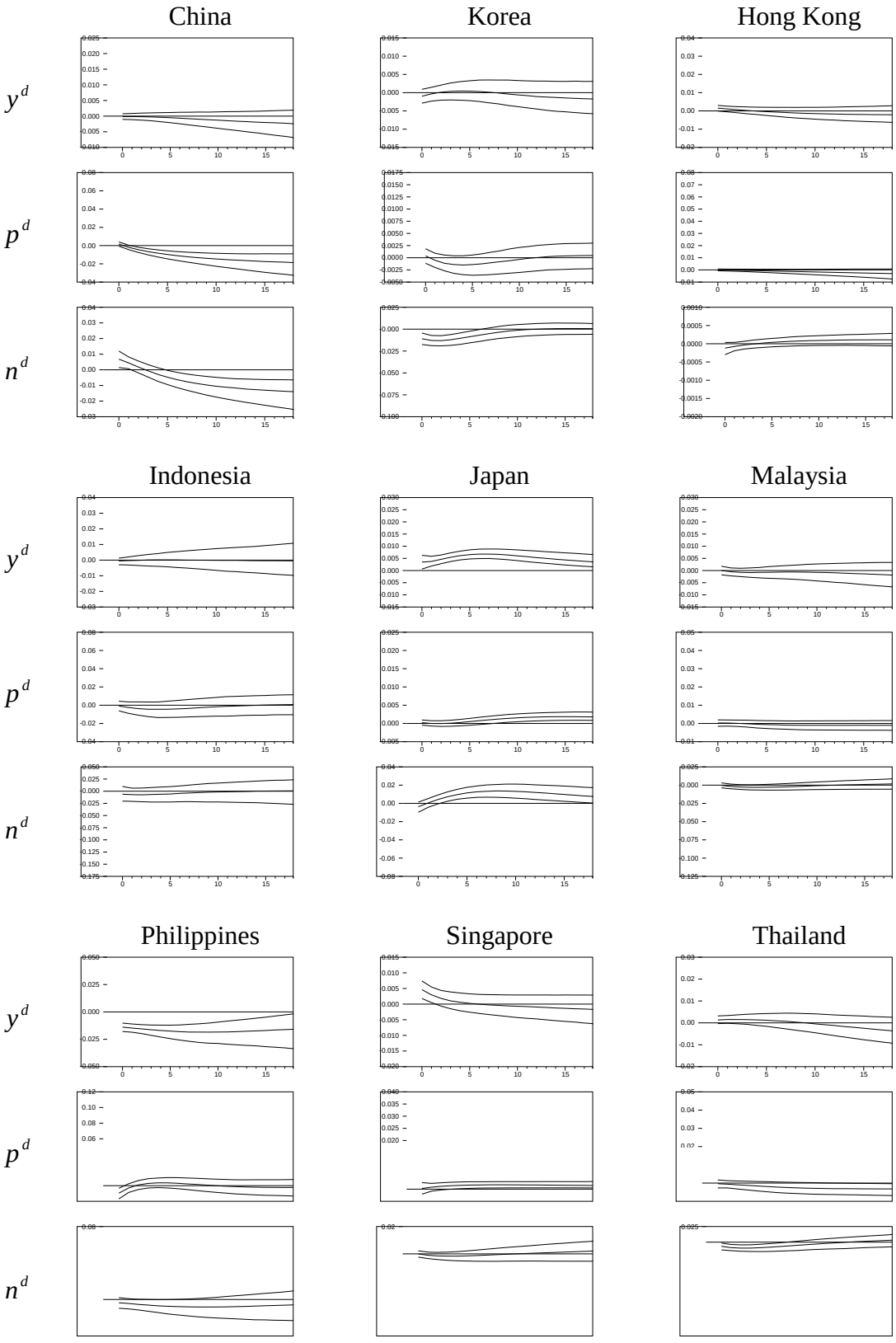


Table C.4: Impulse Response Functions to a *MSCI Financial* shock – 1990Q1-2010Q4

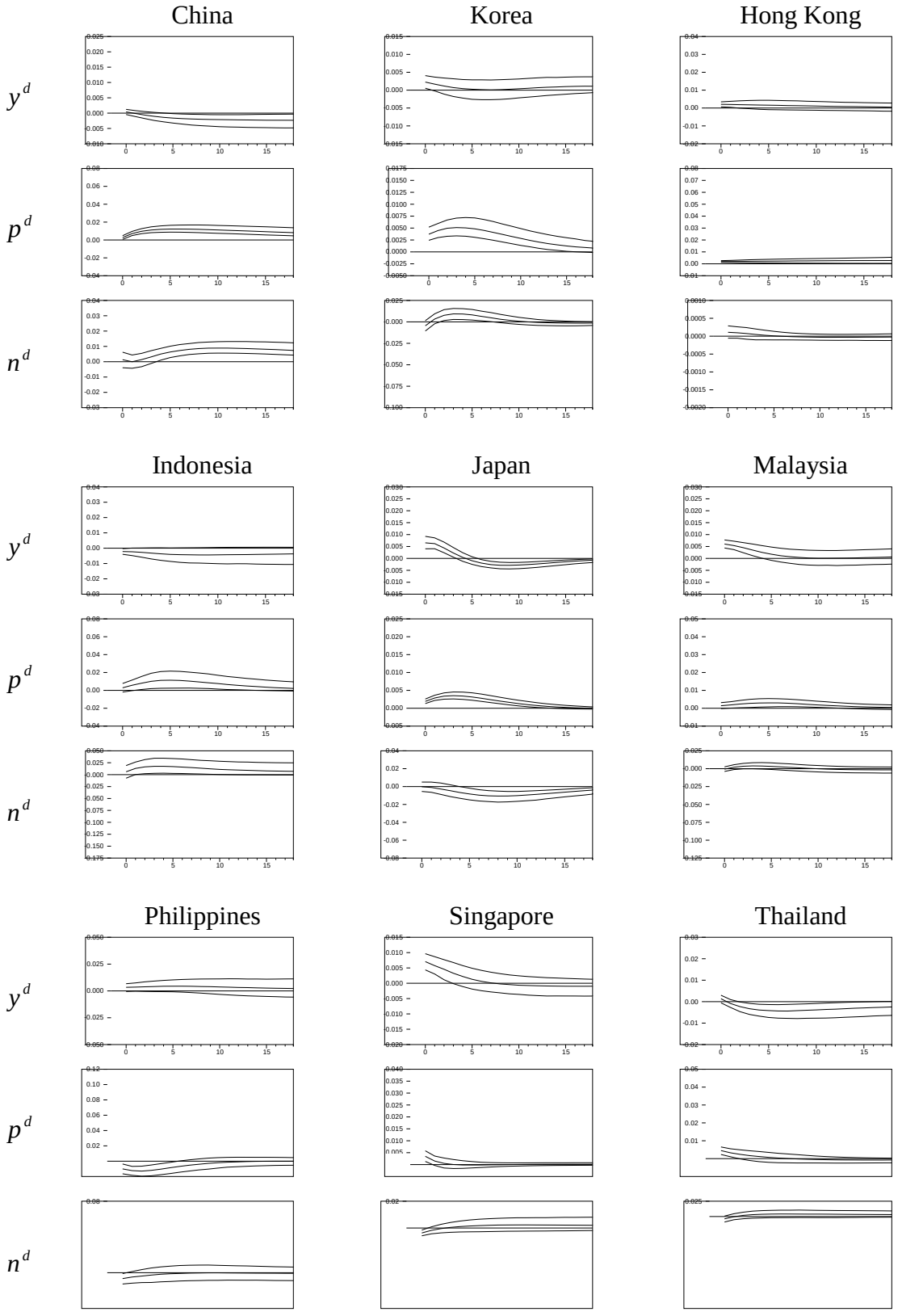


Table C.5: Impulse Response Functions to an *oil* shock – 1996Q1-2010Q4

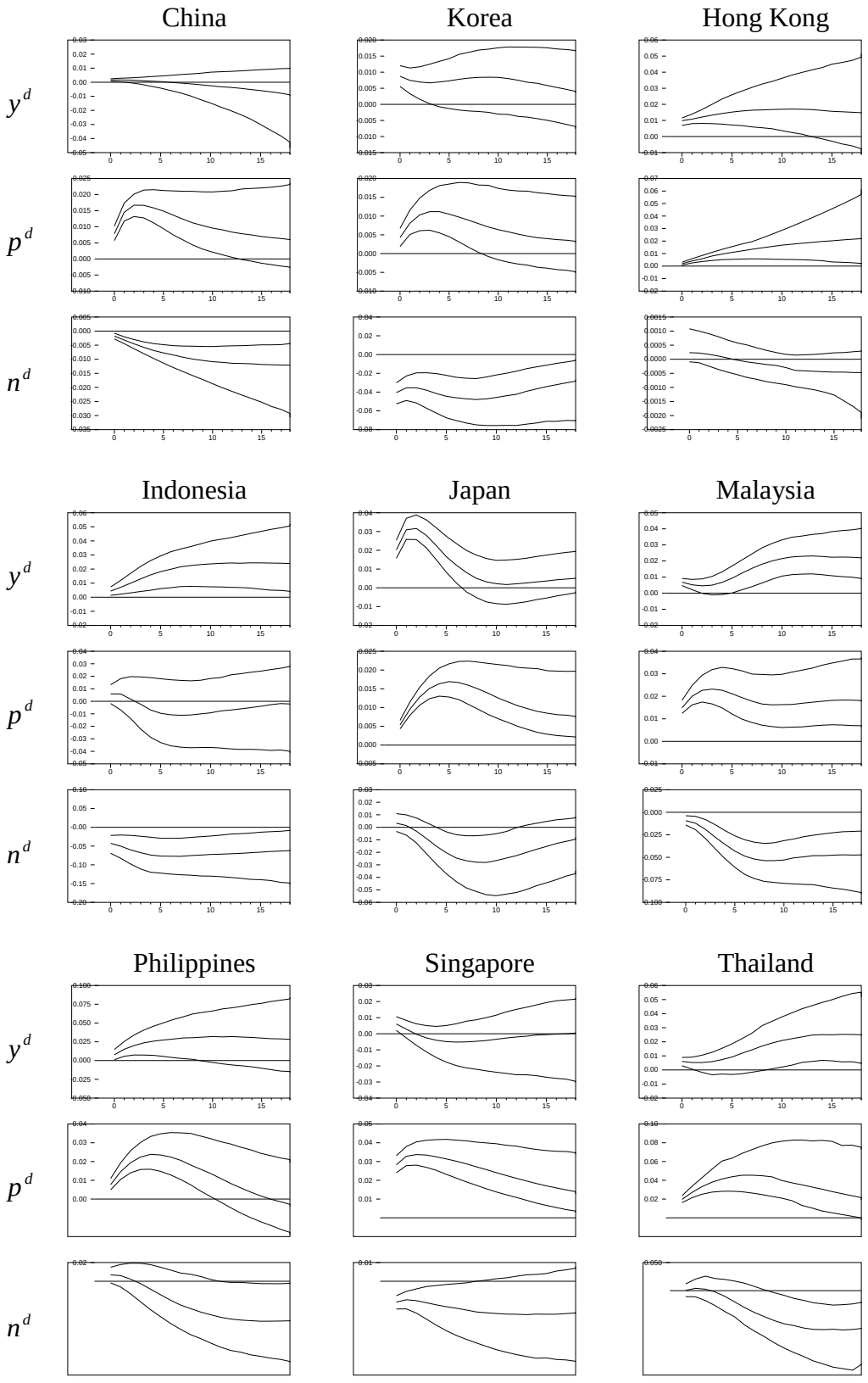


Table C.6: Impulse Response Functions to an *US GDP* shock – 1996Q1-2010Q4

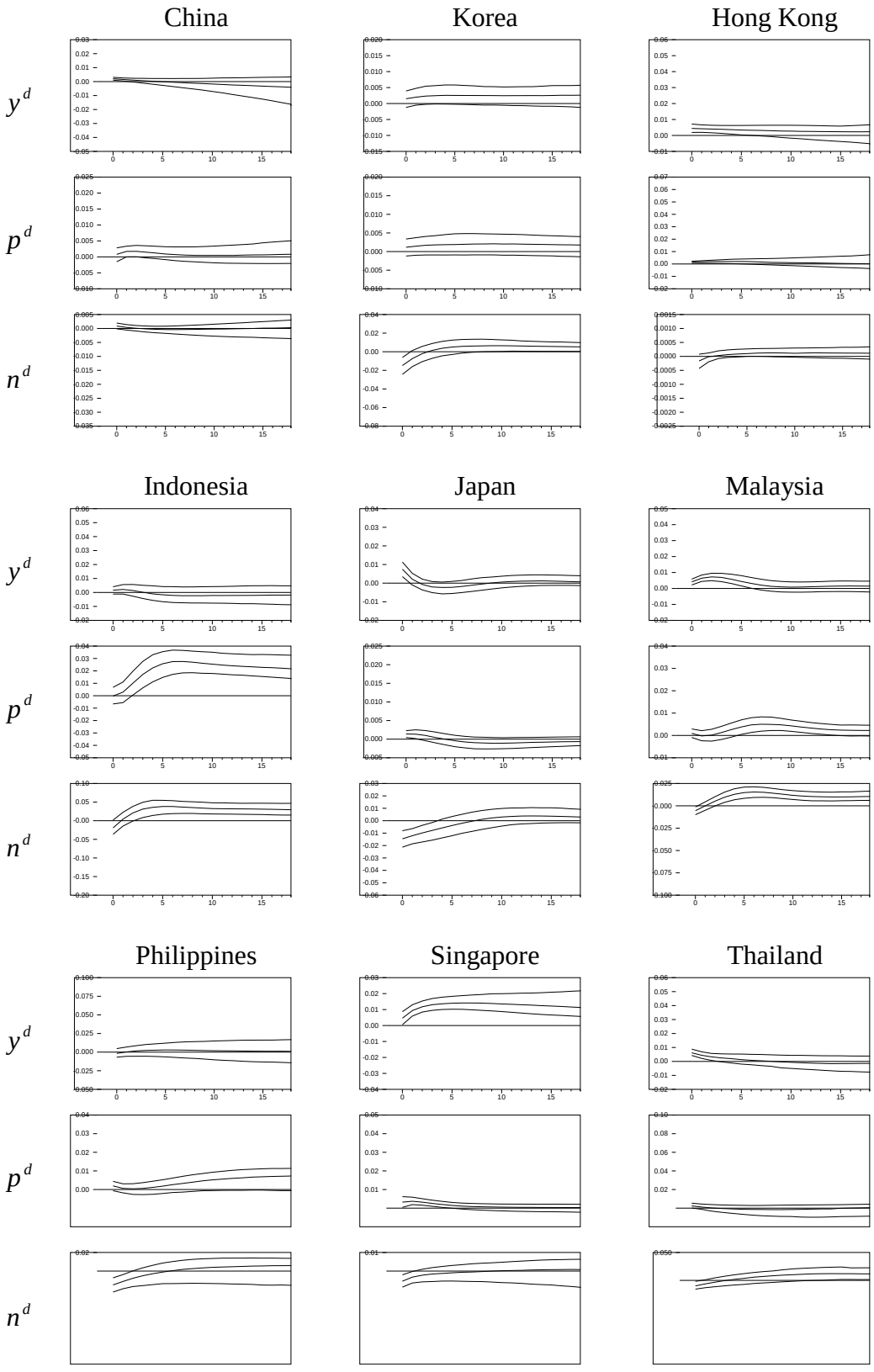


Table C.7: Impulse Response Functions to an *US Monetary* shock – 1996Q1-2010Q4

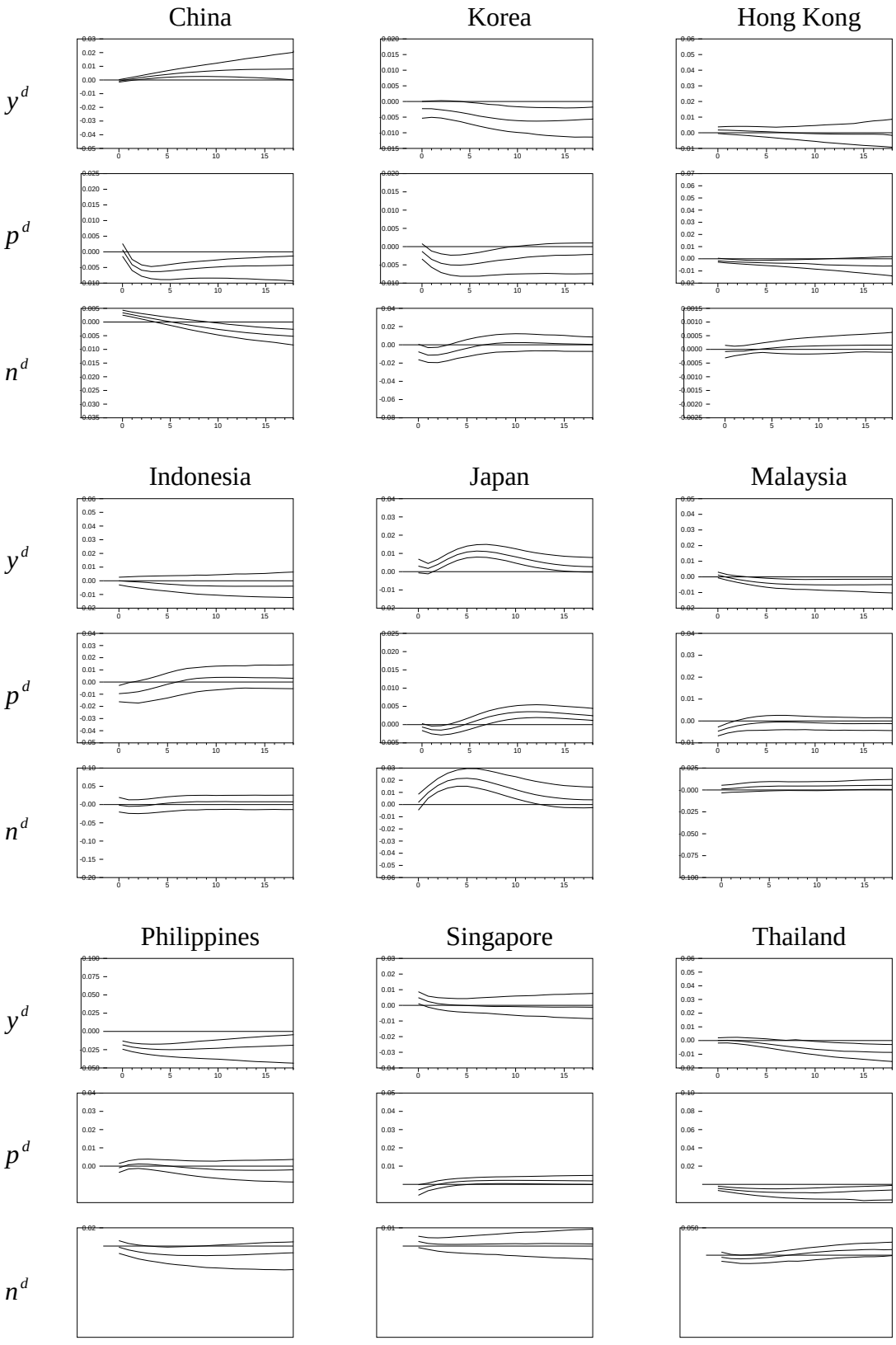
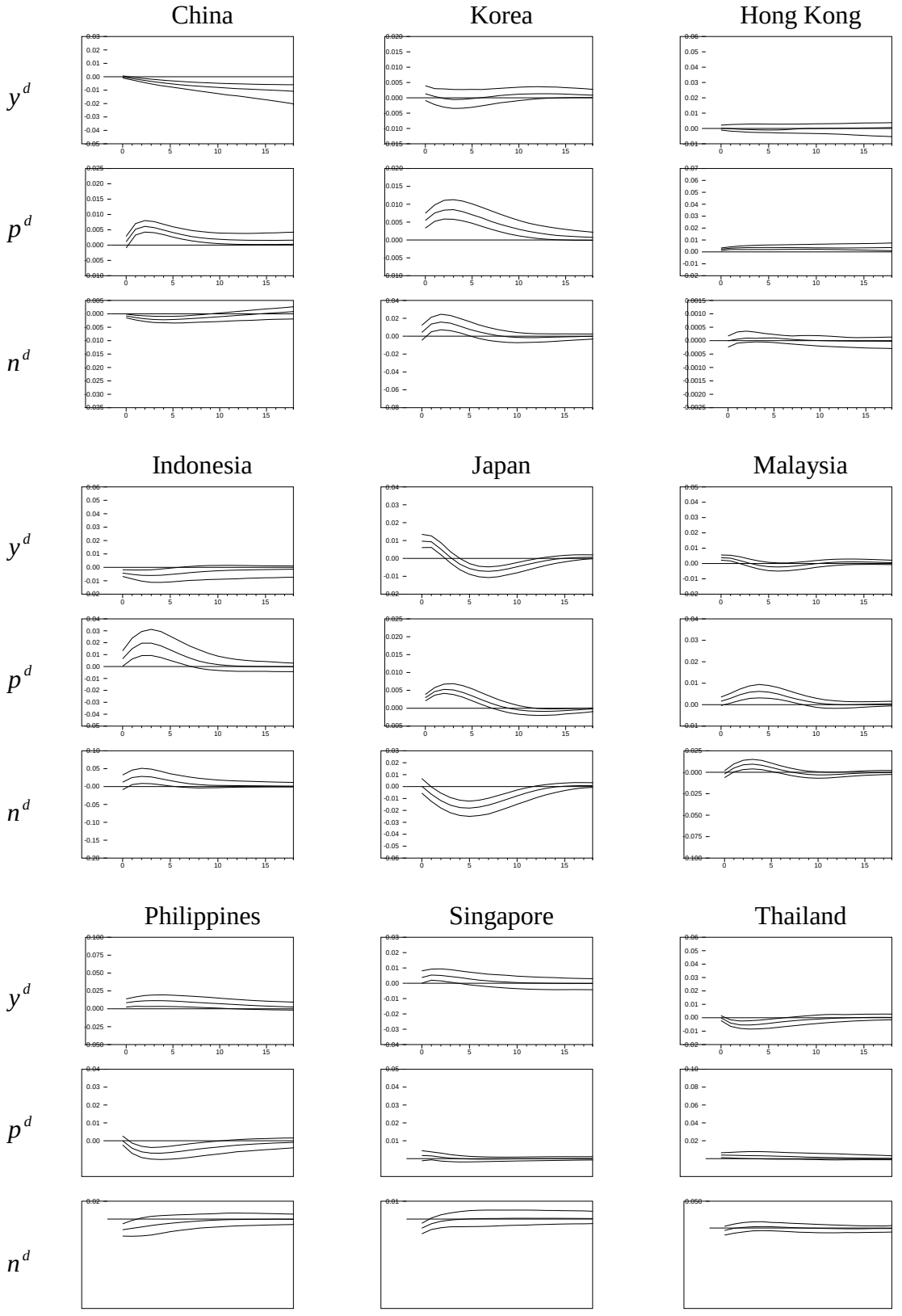


Table C.8: Impulse Response Functions to a *MSCI Financial* shock – 1996Q1-2010Q4



Appendix DCorrelations of domestic variables to external shocks

Table D.1: correlation of y^d – 1990Q4-2010Q4

Oil price	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.42	1							
Hong Kong	-0.59*	-0.43	1						
Indonesia	0.91***	-0.02	-0.85**	1					
Japan	-0.95***	0.35*	0.53***	-0.89**	1				
Malaysia	0.48**	0.56***	-0.98***	0.79***	-0.44	1			
Philippines	-0.42	-0.64**	0.91***	-0.75**	0.48**	-0.95***	1		
Singapore	-0.99***	0.38*	0.64***	-0.92**	0.91***	-0.54*	0.44**	1	
Thailand	0.55***	0.50***	-0.99***	0.83***	-0.51*	1.00***	-0.95***	-0.59*	1
U.S. gdp	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.74**	1							
Hong Kong	0.92***	-0.43	1						
Indonesia	0.31	0.37*	0.64***	1					
Japan	0.86***	-0.94**	0.60***	-0.18	1				
Malaysia	0.17	0.45**	0.52***	0.93***	-0.35	1			
Philippines	-0.99***	0.68***	-0.95***	-0.41	-0.78**	-0.30	1		
Singapore	-0.88**	0.96***	-0.64**	0.16	-0.98***	0.28	0.83***	1	
Thailand	0.87***	-0.39	0.98***	0.68***	0.51***	0.62***	-0.93**	-0.58*	1
Fed Funds	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.92***	1							
Hong Kong	0.93***	0.71***	1						
Indonesia	-0.10	0.30	-0.45	1					
Japan	0.36*	0.68***	0.00	0.87***	1				
Malaysia	0.80***	0.68***	0.71***	-0.07	0.39**	1			
Philippines	0.37*	0.00	0.69***	-0.94**	-0.72**	0.18	1		
Singapore	0.86***	0.59***	0.97***	-0.57*	-0.10	0.77***	0.74***	1	
Thailand	0.98***	0.96***	0.84***	0.08	0.53***	0.83***	0.19	0.77***	1
MSCI index	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.50***	1							
Hong Kong	0.78***	-0.15	1						
Indonesia	0.97***	0.68***	0.61***	1					
Japan	0.92***	0.76***	0.50***	0.99***	1				
Malaysia	0.99***	0.57***	0.71***	0.99***	0.96***	1			
Philippines	-0.18	-0.94**	0.47**	-0.40	-0.51**	-0.27	1		
Singapore	1.00***	0.51***	0.77***	0.97***	0.93***	0.99***	-0.19	1	
Thailand	0.80***	0.89***	0.27	0.89***	0.91***	0.82***	-0.71**	0.80***	1

Note: significant at 1% (***), 5% (**), 10% (*).The correlation coefficients were calculated over 20 quarters.

Table D.2: correlation of p^d – 1990Q4-2010Q4

Oil price	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.75**	1							
Hong Kong	0.99***	-0.70**	1						
Indonesia	-0.84**	0.98***	-0.77**	1					
Japan	0.25	0.38*	0.37*	0.30	1				
Malaysia	-0.17	0.75***	-0.06	0.68***	0.90***	1			
Philippines	-0.03	0.62***	0.09	0.56***	0.96***	0.98***	1		
Singapore	-0.96***	0.85***	-0.96***	0.89***	-0.15	0.29	0.13	1	
Thailand	0.27	0.37*	0.39**	0.28	1.00***	0.89***	0.95***	-0.17	1
U.S. gdp	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.97***	1							
Hong Kong	0.99***	-0.96***	1						
Indonesia	-0.95***	1.00***	-0.95***	1					
Japan	0.99***	-0.99***	0.97***	-0.98***	1				
Malaysia	-0.92**	0.96***	-0.88**	0.94***	-0.97***	1			
Philippines	-0.19	0.02	-0.08	-0.05	-0.16	0.23	1		
Singapore	0.66***	-0.81**	0.71***	-0.85**	0.72***	-0.68**	0.55***	1	
Thailand	-0.96***	1.00***	-0.96***	1.00***	-0.99***	0.95***	0.00	-0.82**	1
Fed Funds	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.43	1							
Hong Kong	0.94***	-0.67**	1						
Indonesia	-0.63*	0.96***	-0.84**	1					
Japan	-0.92**	0.72***	-0.95***	0.84***	1				
Malaysia	0.97***	-0.46	0.89***	-0.62*	-0.94**	1			
Philippines	-0.28	-0.74**	0.03	-0.56*	-0.09	-0.22	1		
Singapore	-0.77**	-0.23	-0.51*	-0.01	0.50***	-0.74**	0.82***	1	
Thailand	0.99***	-0.57*	0.97***	-0.74**	-0.97***	0.97***	-0.12	-0.66**	1
MSCI index	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.35*	1							
Hong Kong	0.09	-0.90**	1						
Indonesia	0.84***	0.77***	-0.42	1					
Japan	0.36*	0.99***	-0.88**	0.76***	1				
Malaysia	0.54***	0.95***	-0.75**	0.91***	0.93***	1			
Philippines	-0.07	-0.94**	0.95***	-0.52*	-0.95***	-0.78**	1		
Singapore	-0.88**	0.07	-0.49	-0.50*	0.02	-0.10	-0.27	1	
Thailand	-0.51*	0.62***	-0.90**	-0.01	0.60***	0.40**	-0.80**	0.79***	1

Note: significant at 1% (***), 5% (**), 10% (*).The correlation coefficients were calculated over 20 quarters.

Table D.3: correlation of n^d – 1990Q4-2010Q4

Oil price	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.90**	1							
Hong Kong	-0.94**	0.99***	1						
Indonesia	-0.98***	0.95***	0.97***	1					
Japan	-0.89**	1.00***	0.99***	0.95***	1				
Malaysia	-0.93**	0.98***	0.98***	0.99***	0.98***	1			
Philippines	-0.99***	0.95***	0.97***	0.99***	0.94***	0.96***	1		
Singapore	-0.96***	0.97***	0.99***	1.00***	0.97***	1.00***	0.98***	1	
Thailand	-0.94**	0.98***	0.99***	0.99***	0.98***	1.00***	0.97***	1.00***	1
U.S. gdp	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.86**	1							
Hong Kong	-0.81**	0.96***	1						
Indonesia	-0.90**	0.99***	0.97***	1					
Japan	-0.47	-0.05	-0.10	0.05	1				
Malaysia	-0.92**	0.99***	0.94***	0.99***	0.09	1			
Philippines	-0.90**	0.99***	0.91***	0.98***	0.08	0.99***	1		
Singapore	-0.96***	0.97***	0.93***	0.99***	0.19	0.99***	0.98***	1	
Thailand	-0.91**	0.99***	0.95***	1.00***	0.08	1.00***	0.99***	0.99***	1
Fed Funds	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.95***	1							
Hong Kong	-0.99***	0.89***	1						
Indonesia	-0.90**	0.98***	0.81***	1					
Japan	-0.70**	0.51***	0.80***	0.34*	1				
Malaysia	-0.58*	0.76***	0.44**	0.87***	-0.16	1			
Philippines	0.19	-0.01	-0.33	0.18	-0.83**	0.62***	1		
Singapore	-0.74**	0.87***	0.62***	0.95***	0.03	0.98***	0.49***	1	
Thailand	-0.81**	0.91***	0.71***	0.97***	0.15	0.94***	0.40**	0.99***	1
MSCI index	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.27	1							
Hong Kong	-0.97***	0.11	1						
Indonesia	-0.16	0.98***	-0.02	1					
Japan	-0.85**	-0.16	0.85***	0.30	1				
Malaysia	-0.42	0.98***	0.28	0.95***	-0.05	1			
Philippines	0.94***	-0.02	-0.99***	0.10	-0.85**	-0.20	1		
Singapore	0.92***	-0.07	-0.98***	0.04	-0.76**	-0.25	0.99***	1	
Thailand	0.83***	0.18	-0.94**	0.29	-0.80**	0.00	0.97***	0.97***	1

Note: significant at 1% (***), 5% (**), 10% (*).The correlation coefficients were calculated over 20 quarters.

Table D.4: correlation of y^d – 1996Q4-2010Q4

Oil price	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.51***	1							
Hong Kong	0.54***	0.14	1						
Indonesia	-0.84**	-0.68**	-0.63**	1					
Japan	0.72***	0.43**	0.61***	-0.92**	1				
Malaysia	-0.92**	-0.29	-0.67**	0.86***	-0.86**	1			
Philippines	-0.87**	-0.73**	-0.62*	0.99***	-0.85**	0.84***	1		
Singapore	0.74***	0.79***	0.55***	-0.97***	0.87***	-0.73**	-0.96***	1	
Thailand	-0.97***	-0.38	-0.66**	0.87***	-0.82**	0.98***	0.87***	-0.74**	1
U.S. gdp	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.37	1							
Hong Kong	0.99***	-0.32	1						
Indonesia	0.79***	-0.66**	0.81***	1					
Japan	0.09	-0.92**	0.00	0.33*	1				
Malaysia	0.71***	-0.16	0.77***	0.83***	-0.22	1			
Philippines	-0.04	0.94***	0.01	-0.45	-0.95***	0.05	1		
Singapore	-0.78**	0.87***	-0.74**	-0.85**	-0.66**	-0.48	0.65***	1	
Thailand	0.89***	-0.74**	0.87***	0.91***	0.48**	0.63***	-0.48	-0.97***	1
Fed Funds	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.97***	1							
Hong Kong	0.49**	-0.63**	1						
Indonesia	-1.00***	0.98***	-0.54*	1					
Japan	0.00	0.20	-0.75**	0.05	1				
Malaysia	-0.97***	0.88***	-0.31	0.95***	-0.21	1			
Philippines	0.23	-0.44	0.92***	-0.29	-0.89**	0.00	1		
Singapore	-0.92**	0.83***	-0.38	0.90***	-0.08	0.96***	-0.05	1	
Thailand	-0.94**	0.98***	-0.75**	0.96***	0.30	0.84***	-0.54*	0.83***	1
MSCI index	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.78**	1							
Hong Kong	0.97***	-0.88**	1						
Indonesia	-0.89**	0.96***	-0.96***	1					
Japan	0.32	0.10	0.11	-0.03	1				
Malaysia	0.17	0.33	-0.05	0.17	0.96***	1			
Philippines	0.83***	-0.93**	0.95***	-0.96***	-0.19	-0.35	1		
Singapore	0.95***	-0.81**	0.92***	-0.90**	0.44**	0.26	0.79***	1	
Thailand	-0.74**	0.95***	-0.87**	0.96***	0.12	0.30	-0.95***	-0.79**	1

Note: significant at 1% (***), 5% (**), 10% (*).The correlation coefficients were calculated over 20 quarters.

Table D.5: correlation of p^d – 1996Q4-2010Q4

Oil price	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.98***	1							
Hong Kong	-0.77**	-0.74**	1						
Indonesia	0.44**	0.28	-0.49	1					
Japan	0.70***	0.82***	-0.39	-0.31	1				
Malaysia	0.34*	0.19	-0.14	0.82***	-0.25	1			
Philippines	0.89***	0.95***	-0.75**	0.05	0.89***	-0.11	1		
Singapore	0.96***	0.94***	-0.90**	0.46**	0.63***	0.21	0.90***	1	
Thailand	0.62***	0.74***	-0.43	-0.42	0.96***	-0.43	0.88***	0.59***	1
U.S. gdp	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.52*	1							
Hong Kong	0.34*	-0.37	1						
Indonesia	-0.62*	0.97***	-0.29	1					
Japan	0.77***	-0.90**	0.61***	-0.91**	1				
Malaysia	-0.61*	0.78***	0.10	0.89***	-0.69**	1			
Philippines	-0.63**	0.70***	-0.90**	0.65***	-0.89**	0.30	1		
Singapore	0.75***	-0.66**	0.84***	-0.67**	0.90***	-0.40	-0.96***	1	
Thailand	0.84***	-0.80**	0.68***	-0.79**	0.97***	-0.55*	-0.93**	0.93***	1
Fed Funds	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.87***	1							
Hong Kong	0.17	-0.28	1						
Indonesia	-0.01	0.41**	-0.96***	1					
Japan	0.15	0.54***	-0.89**	0.98***	1				
Malaysia	-0.69**	-0.42	-0.66**	0.64***	0.53***	1			
Philippines	-0.50*	-0.81**	0.73***	-0.86**	-0.93**	-0.19	1		
Singapore	-0.65**	-0.31	-0.80**	0.74***	0.62***	0.97***	-0.30	1	
Thailand	0.58***	0.25	0.78***	-0.77**	-0.68**	-0.98***	0.36*	-0.99***	1
MSCI index	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.90***	1							
Hong Kong	0.40**	0.47**	1						
Indonesia	0.95***	0.99***	0.47**	1					
Japan	0.93***	0.97***	0.29	0.98***	1				
Malaysia	0.90***	0.93***	0.51***	0.96***	0.93***	1			
Philippines	-0.78**	-0.79**	-0.87**	-0.82**	-0.69**	-0.85**	1		
Singapore	0.36*	0.23	-0.59*	0.24	0.37*	0.05	0.27	1	
Thailand	0.85***	0.97***	0.28	0.95***	0.97***	0.85***	-0.63*	0.43**	1

Note: significant at 1% (***), 5% (**), 10% (*).The correlation coefficients were calculated over 20 quarters.

Table D.6: correlation of n^d – 1996Q4-2010Q4

Oil price	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	0.26	1							
Hong Kong	0.78***	-0.16	1						
Indonesia	0.91***	0.54***	0.58***	1					
Japan	0.71***	0.76***	0.33	0.93***	1				
Malaysia	0.98***	0.39**	0.76***	0.96***	0.81***	1			
Philippines	0.98***	0.21	0.80***	0.83***	0.61***	0.94***	1		
Singapore	-0.94**	0.07	-0.88**	-0.73**	-0.45	-0.87**	-0.96***	1	
Thailand	0.91***	0.06	0.81***	0.67***	0.41**	0.84***	0.97***	-0.95***	1
U.S. gdp	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.47	1							
Hong Kong	-0.58*	0.93***	1						
Indonesia	-0.65**	0.94***	0.99***	1					
Japan	-0.23	0.94***	0.76***	0.78***	1				
Malaysia	-0.72**	0.82***	0.93***	0.96***	0.60***	1			
Philippines	-0.29	0.98***	0.85***	0.86***	0.98***	0.71***	1		
Singapore	-0.66**	-0.28	0.00	0.02	-0.55**	0.21	-0.47	1	
Thailand	-0.20	0.96***	0.81***	0.81***	0.99***	0.65***	1.00***	-0.55*	1
Fed Funds	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.85**	1							
Hong Kong	-0.91**	0.96***	1						
Indonesia	-0.92**	0.98***	0.96***	1					
Japan	0.55***	-0.31	-0.24	-0.45	1				
Malaysia	-0.96***	0.85***	0.95***	0.89***	-0.31	1			
Philippines	0.15	-0.41	-0.50	-0.27	-0.71**	-0.38	1		
Singapore	-0.52*	0.25	0.18	0.40**	-0.97***	0.29	0.76***	1	
Thailand	-0.96***	0.79***	0.81***	0.89***	-0.75**	0.86***	0.10	0.72***	1
MSCI index	China	Korea	Hong Kong	Indonesia	Japan	Malaysia	Philippines	Singapore	Thailand
China	1								
Korea	-0.54	1							
Hong Kong	-0.66	0.98	1						
Indonesia	-0.70	0.98	0.99	1					
Japan	0.93	-0.56	-0.69	-0.68	1				
Malaysia	-0.50	0.96	0.96	0.92	-0.59	1			
Philippines	0.42	-0.78	-0.69	-0.78	0.25	-0.58	1		
Singapore	0.17	-0.50	-0.37	-0.48	-0.06	-0.25	0.92	1	
Thailand	-0.69	0.41	0.57	0.50	-0.87	0.57	0.13	0.48	1

Note: significant at 1% (***), 5% (**), 10% (*).The correlation coefficients were calculated over 20 quarters.