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Asia's Rebalancing and Growth

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Keywords

Rebalancing, Export-led growth, Asia, VAR, Multi-country simulation model.

JEL Classification

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The paper investigates the impact of Asia's demand rebalancing and supply-side productivity changes on long-term economic growth in Asia and worldwide. Results from a panel vector autoregression model show that a productivity-neutral demand rebalancing shock has no permanent effect on Asian output, whereas labor productivity shocks have significant, positive, and permanent effects. Simulations using a global intertemporal multi-sector general equilibrium model suggest that labor productivity shocks increase the foreign GDP over time, but rebalancing shocks have a negative international spillover effect. In addition, labor productivity shocks helps rebalancing. Structural reforms promoting labor productivity growth along with rebalancing policies across Asia can achieve higher economic growth worldwide.

1. Introduction

One pressing challenge facing Asian economies is maintaining strong economic growth by rebalancing via two engines: domestic and external demand. Fostering domestic demand while preserving high productivity growth is crucial for achieving balanced and sustainable economic growth.

For the past half-century, most Asian economies have maintained strong growth largely by relying on outward-oriented strategies. Adopting these policies has helped Asian economies grow rapidly by exploiting large external markets and imitating advanced technologies. Increased economic integration and closer trading relationships with global markets have bolstered the region's growth.

In recent years, however, there has been mounting recognition that Asian economies must reduce their reliance on external demand while promoting domestic demand. While export-led growth has served Asian nations well, it has also engendered some economic vulnerability. The region's experience during the recent global financial crisis underscores the devastating effects that recession in Western economies, causing a sudden collapse of global trade and financial flows, can have on Asian economies.

Looking ahead, despite the rapid economic recovery in the United States, it is still uncertain whether growth in demand from high-income countries will be sufficient to support Asia's export-led growth. The theory of "secular stagnation," as posited by Summers (2013), predicts the opposite. It suggests that global demand will remain below global supply, as desired saving exceeds desired investment worldwide. This novel post-crisis global environment seems to necessitate an Asian rebalancing.

In fact, Asian economies have shown resilience and have recovered from the global financial crisis more rapidly than many Western economies. Strong and stable growth in China has undoubtedly benefitted the rest of Asia. High demand from China has supported export-led recovery for its trading partners. Asian economies have become increasingly interdependent: trade within Asia now accounts for over half of Asia's total trade. China plays a central role in Asian production networks, and segmented production for global supply chains has stimulated trade and direct investment in the region, with China as a hub. China is currently the largest trading partner for Korea and the 10 Association of Southeast Asian Nations (ASEAN) economies.

China's long-term growth potential, however, is not pre-ordained. China's recent economic slowdown has triggered worries about a looming crisis, with significant vulnerabilities and risks posed by potential property bubbles, shadow banking, and local government debt burdens. Even though China should be able to avoid a financial crisis or steep economic downturn, it will likely experience a slowdown in its growth rate to 5-6% over the coming decade (Lee 2017). China's inevitable growth slowdown, along with a possibility of long-term stagnation among advanced economies, threatens the stable growth of Asian economies. Considering the prospect of a global growth slowdown and significant downside risk in China, Asian economies would be wise to move beyond undue reliance on export-oriented development strategies. For sustainable growth, Asian countries must rebalance their economic growth engines: domestic and external demand.

Asia's dependence on external demand is higher than that of other regions (Mohommad, N'Diaye, and Unteroberdoerser 2011). Figure 1 shows that export exposure, as measured by the share of exported value-added in GDP, is relatively higher for Asian

economies than for other regions. This measure captures the extent to which the value-added produced in a given economy can be attributed to exports. The conventional measure, the gross export-GDP ratio, tends to overstate the contribution of exports to GDP, as increasing vertical trade integration implies that exports involve a declining share of domestically produced intermediate goods (IMF 2010). The counterpart to high external demand is low domestic demand. As shown in Table 2., most Asian economies have low domestic demand, measured by the sum of consumption, investment and government consumption shares, compared to the OECD average or the United States. Some economies have low consumption shares, while others have relatively low investment ratios. China and Singapore stand out in terms of low consumption-GDP ratio, whereas the Philippines and Indonesia have significantly lower than average investment rates.

In many Asian economies, exports have been the main engine of growth, while domestic demand growth has remained weak.[1] Developing a second domestic growth engine will help reduce this imbalance. To ensure sustainable growth, Asian countries must seek to expand domestic demand, such as by promoting private-sector investment and increasing household expenditures. Supply-side policies that promote productivity in service industries, which meet domestic demand, are also critical for ensuring more balanced and sustainable growth in Asian economies.

The purpose of this paper is to explore the effects of Asia's rebalancing on both Asian and global economies. The analysis empirically investigates the impact of demand-side rebalancing (such as a shift from exports to domestic demand) and supply-side

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[1] When exports are expressed on a value-added basis, they are estimated to make a larger contribution to GDP growth than is suggested by the conventional measure based on net exports (see IMF, 2010).

productivity changes on economic growth via two complementary empirical models, a structural vector autoregression (VAR) model with long-run (LR) restrictions and a multi-country general equilibrium model. Based on the empirical results, we discuss specific policies that can foster domestic-demand-driven growth in Asia.

Section 2 examines the effects of rebalancing on the Asian economies through a three-variable structural VAR model, extending the framework of Gali (1999) and consisting of domestic demand, labor productivity, and output. We assess the effects of domestic demand shocks and labor productivity shocks on output in 10 Asian economies (Japan, Korea, China, India, Taiwan, Singapore, Indonesia, Malaysia, the Philippines, Thailand, and Singapore) since 1950. In this exercise, we focus on the long-term effect on own output by constructing an empirical model that both domestic demand and labor productivity shocks are allowed to affect output in the long run.

We find that rebalancing alone is unlikely to substantially increase average output growth in Asian economies and that enhancing labor productivity is critical for achieving higher economic growth. However, in some countries, including China, productivity-neutral rebalancing shocks can permanently increase long-run output, thus supporting a growth-enhancing effect of rebalancing. We also find that productivity-neutral rebalancing shocks in China have a significant positive spillover effect on output in Korea and Taiwan.

In Section 3, we use an empirically based global intertemporal multi-sector general equilibrium model (a large-scale dynamic stochastic general equilibrium model) to explore what happens in Asia and globally if demand-rebalancing shocks or labor productivity increases occur in China or simultaneously across all Asian economies. The

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model allows for consumption and investment dynamics and cross-border spillovers through trade and financial linkages. This exercise is complementary to the exercise in Section 2. Here we focus on the short-run and medium-run spillover effects on other countries since the model explicitly considers various countries around the world and allows various international spillover mechanisms.[2]

The results from the G-Cubed model suggest that even foreign countries benefit more from labor productivity increase in Asia than from rebalancing itself. Rebalancing shocks have a negative spillover effect on other countries. However, labor productivity shocks have a positive spillover effect over time. In addition, labor productivity shocks help rebalancing.

The major spillovers between economies occur through trade and capital flows. In the short run, permanent supply shocks tend to be negatively transmitted to foreign GDP because capital flows into Asian economies, which experience productivity growth, and thus out of foreign economies. As Asian incomes rise, however, global GDP will also eventually rise if medium- and long-term income effects dominate short-term capital relocation effects. In contrast, a shift in Asia from export-focused to domestic-focused demand has no long-run impact on growth but does lead to a short-term relocation of capital to Asia, which reduces investment in foreign economies. The extent to which the demand switch within Asia raises or lowers GDP in a non-Asian economy depends on the extent of trade with Asia (which has a positive effect) versus the extent of short-term capital reallocation (which has a negative effect).

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[2] In this model, demand side shocks are not allowed to affect output in the long run, to be consistent with most theory and the empirical result in Section 2, so we focus on the short-run and medium-run effects.

To our knowledge, no paper has attempted to assess the impacts of Asia's rebalancing policies through both a structural VAR model and a global general equilibrium model. The results of the two different empirical approaches can provide useful insights for further evaluation and design of Asia's rebalancing policies from two different angles. The comparison between output impacts of demand rebalancing and supply-side productivity increases will also help facilitate more balanced and practical policy discussions. Indeed, there are very few past studies that analyzed the effects of rebalancing on economic growth using VAR models, although there are some past studies on relation between exchange rate and rebalancing using VAR models, for example, Ma, McCauley, and Lam (2013), Kim and Kim (2016), Kim and Lee (2015), and Zhang and Sato (2012). In the literature using large scale structural models, there are studies by McKibbin and Sachs (1991) exploring US and Japanese imbalances in the 1980s; Lee, McKibbin and Park (2006) evaluating transpacific trade imbalances during the early 2000s and Kumhof and Laxton (2013) and McKibbin, Stoeckel and Lu (2014) exploring the adjustment of trade balances to the aftermath of monetary and fiscal policies in response to the global financial crisis. However, no previous study has assessed the Asia's demand rebalancing as well as supply-side productivity changes on long-term economic growth in Asia and worldwide.

There is a caveat for our analysis. Our analysis is based both on historical data, comprising sample periods from more than 50 years ago and calibrated structural parameters. If rebalancing involves fundamental structural change or there were some big structural changes in the economy during the sample period, a different empirical result and/or conclusion may be obtained.

This paper proceeds as follows. Section 2 explains the structural VAR model and investigates the effects of demand rebalancing and productivity rises on output. Section 3 adopts a large-scale intertemporal general equilibrium model of the global economy to explore how demand rebalancing and labor productivity shocks affect Asian economies, as well as their spillovers worldwide. Section 4 provides concluding observations.

2. VAR Analysis of the Effects of Rebalancing and Productivity Shocks on Asian Economies

In this section, we investigate the effects of demand rebalancing and productivity increases on output via a structural VAR model, explained in the next subsection.

2.1 Structural VAR model with Long-Run Restrictions

Let the underlying economic relationship for country i ($i=1…I$) be described by the following structural vector moving average (VMA)-form equation:

$$y_t^i = d^i + G^i(L)e_t^i \tag{1}$$

where $G^i(L)$ is a matrix polynomial in the lag operator L, y_t^i is an $n \times 1$ data vector, n is the number of variables in the model, d^i is an $n \times 1$ constant vector, and e_t^i denotes an $n \times 1$ vector of structural disturbances. Under the assumption that structural disturbances are mutually uncorrelated, $\mathrm{var}(e_t^i)$ becomes a diagonal matrix (Λ^i) of the variances of structural disturbances.

This structural model needs to be identified using the estimated reduced-form VAR model:

$$B^i(L)y_t^i = c^i + u_t^i, \qquad (2)$$

where $B^i(L)$ is a matrix polynomial in the lag operator L, c^i is an $n \times 1$ constant vector, u_t^i denotes an $n \times 1$ vector of reduced form residuals, and $\text{var}(u_t^i) = \Sigma^i$. There are several ways of uncovering the structural system (1) from the estimated reduced-form system (2); in this paper, we adopt the long-run restriction method pioneered by Blanchard and Quah (1989), who suggested imposing zero restrictions on the elements of the long-run structural parameters *G(1)*.

Consider the following moving-average representation of a structural VAR model (corresponding to equation (1)) that includes three non-stationary variables, which are not co-integrated with one another: X_1, X_2, and X_3.

$$\begin{bmatrix} dX_{1,t}^i \\ dX_{2,t}^i \\ dX_{3,t}^i \end{bmatrix} = \begin{bmatrix} d_1^i \\ d_2^i \\ d_3^i \end{bmatrix} + \begin{bmatrix} G_{11}^i(L) & G_{12}^i(L) & G_{13}^i(L) \\ G_{21}^i(L) & G_{22}^i(L) & G_{23}^i(L) \\ G_{31}^i(L) & G_{32}^i(L) & G_{33}^i(L) \end{bmatrix} \begin{bmatrix} e_{1,t}^i \\ e_{2,t}^i \\ e_{3,t}^i \end{bmatrix}_t^i \qquad (3)$$

where $G_{jk}(1) = 0$ for jk = 12, 13, 23 and $dX_t = X_t - X_{t-1}$.

The long-run identifying restrictions ($G_{jk}(1) = 0$ for jk = 12, 13, 23) imply that:

1. The second structural shock ($e^i_{2,t}$) does not have permanent effects on the first variable ($X^i_{1,t}$).

2. The third structural shock ($e^i_{3,t}$) does not have permanent effects on the first and the second variables ($X^i_{1,t}$, $X^i_{2,t}$).

Note that the first structural shock ($e^i_{1,t}$) is allowed to permanently affect all three variables, the second structural shock ($e^i_{2,t}$) is allowed to permanently affect only the second and third variables ($X^i_{2,t}$, $X^i_{3,t}$), and the third structural shock ($e^i_{3,t}$) is allowed to permanently affect only the third variable ($X^i_{3,t}$). The system is recursive in terms of long-run effects.

In some parts of this paper's analysis, we estimate a model for each country. In others, we assume a panel structure (where $B^i(L) = B^m(L)$, $\Sigma^i = \Sigma^m$, $G^i(L) = G^m(L)$, and $\Lambda^i = \Lambda^m$ for $\square\ i,\ m$) and estimate the model for a group of countries. In the panel system, we use individual fixed effects ($d^i \neq d^m$ and $c^i \neq c^m$ for $i \neq m$) to control for country-specific factors that are not included in the model.

2.2 Data and Empirical Model

Total production (i.e., GDP) of each economy can be divided into two parts: that used by the domestic economy and that used by foreign economies. The latter part represents exported goods and services. Based on this, an economic rebalancing from

exports to the domestic sector can be defined as a decline in the export-output ratio or an

increase in the proportion of output that is used domestically (i.e., one minus the export-

output ratio).[3]

To examine the effects of rebalancing on the economy, we construct a three-

variable model that includes the proportion of domestically used output (DY), labor

productivity (LP), and output (Y). The proportion of domestically used output is included

in the model to define shocks in the form of rebalancing. We include labor productivity

since changes in it have significant implications for output growth in most theories;

furthermore, we are also interested in examining the relative roles of rebalancing and

labor productivity improvements in enhancing output growth. Output is included as we

are primarily interested in how it is affected by rebalancing.

We consider 10 Asian countries (Korea, Japan, China, India, Indonesia, the

Philippines, Thailand, Singapore, Malaysia, and Taiwan) using annual data from Penn

World Table 8.0 (Feenstra, Inklaar, and Timmer 2013). For output, GDP in local real

terms is used. To construct labor productivity, real GDP is divided by employment. The

proportion of output that is domestically used is obtained by subtracting the export-output

ratio from one. The estimation period varies for countries, but the earliest sample starts in

1950 and the latest ends in 2011.

Unit root tests show that for all variables, the null hypothesis of a unit root is not

rejected for the level form but is rejected for the differenced form. Cointegration tests

show that the null hypothesis of no cointegration among the three variables is not

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[3] GDP data is constructed as value-added but exports data is constructed as a gross term. Ideally, value-added exports data should be used but the data is available for limited number of countries and sample periods. When we use exports data as a gross term, the proportion of domestically used output can be negative but a negative number does not necessarily cause a special problem in our empirical analysis.

rejected.[4] Therefore, we use all variables in their differenced forms. Logarithms are taken for labor productivity and output, and all variables are multiplied by 100. Table 1 summarizes the sample periods and the average and standard deviation of each (differenced) variable for each country. Two lags are assumed in the VAR model. We first estimate the panel model for all countries and then estimate the individual country models.

Regarding the long-run zero restrictions, we consider two types of orderings among variables. First, we consider the data vector of $\{\, d\log LP_t^i, dDY_t^i, d\log Y_t^i \,\}$ (Model 1). As we assume a recursive structure for the long-run effect, the second shock does not affect labor productivity in the long run but is allowed to affect the export-output ratio in the long run. We label this type of shock a productivity-neutral rebalancing shock, and it is the most important shock for our purposes. In general, rebalancing from exports to the domestic sector may result in changes to overall long-run labor productivity. For example, if a country abandons an unproductive export-oriented industry and expands a highly productive domestic industry, this rebalancing may permanently increase the economy's labor productivity. Further, suppose that output increases permanently as a result of this rebalancing. In this case, it would be difficult to infer whether rebalancing or the productivity rise was the main reason for the long-run output increase. Here we

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[4] Given that the degree of freedom is relatively low for each country but the standard unit root and cointegration tests have weak power, we use the panel unit root test developed by Im, Pesaran, and Shin (2003) and the panel cointegration test developed by Pedroni (2004). When DY (the proportion of domestically used output) is bound between zero and one, conceptually it is likely to be stationary. However, the null hypothesis of unit root in DY is not rejected based on the unit root test of Im, Pesaran, and Shin (2013). When a trend is assumed, the t-bar test statistic Z_{tbar} is 5.28 with a significant level of 1.0. When no trend is assumed, it is 0.57 with a significance level of 0.72. Therefore, we treat DY as a variable with a unit root. of educational attainment for the population, disaggregated by gender and age group (15–24, 25–64, and 15–64) for 146 countries from 2015 to 2040 at five-year intervals.

identify a productivity-neutral rebalancing shock (having a permanent effect on the proportion of output that is domestically used but not on labor productivity) in order to clearly infer the role of rebalancing itself when the long-run labor productivity level is fixed.

Next, the first shock is allowed to permanently affect all variables, including both the domestically used output proportion and labor productivity. As an example of such a shock, suppose there is a positive permanent productivity shock in the domestic sector. Further, suppose that this productivity shock permanently expands the domestic sector and the domestically used output proportion. Then, this shock has a permanent positive effect on both labor productivity and the domestically used output proportion. However, under our identifying assumptions, we cannot exclude that the first shock has a positive permanent effect on labor productivity but a negative or no permanent effect on the domestically used output proportion. Therefore, the exact nature of this first shock is unclear based only on our identifying assumptions. Later, we will try to interpret this shock based on impulse responses. For convenience, we name this shock a (permanent) productivity shock, although it can also permanently affect the domestically used output proportion because the other shock (i.e., the second shock) could include a (permanent) rebalancing shock.

Finally, the third shock is allowed to affect neither labor productivity nor domestically used output proportion in the long run but is allowed to affect long-run output. This shock captures all other shocks with permanent effects on neither labor productivity nor domestically used output proportion. In our analysis, we do not focus on

interpreting the effects of this shock because we are mostly interested in the permanent

shocks to labor productivity and rebalancing.

Second, to supplement the first model, we consider the data vector (y_t^i) of

$\{dDY_t^i, d\log LP_t^i, d\log Y_t^i\}$ (Model 2). In this model, the second shock does not affect

the long-run domestically used output proportion but is allowed to affect long-run labor

productivity. We label it as a rebalancing-neutral productivity shock. We can infer the

role of permanent changes in labor productivity itself when the long-run domestically

used output proportion is fixed.

The first shock is allowed to permanently affect all variables, including both

domestically used output proportion and labor productivity. As in Model 1, the exact

nature of the first shock is unclear based on only the identifying assumptions because

shocks affecting the long-run domestically used output proportion can have different

long-run effects on labor productivity depending on their exact nature. Later we will try

to interpret this shock based on impulse responses. For convenience, we call this shock a

(permanent) rebalancing shock, although it can also permanently affect labor productivity

because this model's second shock is a type of productivity shock.[5]

Gali (1999) identified (permanent) productivity shocks by assuming that only

productivity shocks can affect long-run labor productivity; this identifying assumption

has been widely used in past studies.[6] Our empirical models may be viewed as extending

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[5] The first shock in Model 2 is different from the first shock in Model 1 because rebalancing-neutral
productivity shocks are separately identified in Model 2 while productivity-neutral rebalancing shocks are
separately identified in Model 1. That is, in the first model, the first shock is defined as a shock that can
affect both variables, excluding productivity-neutral rebalancing shocks. Similarly, in the second model, the
first shock is defined as a shock that is allowed to affect both variables, excluding rebalancing-neutral
productivity shocks.

[6] For example, Francis and Ramey (2005), and Bems, Dedola and Smets (2007) apply such a methodology.

Gali (1999) by including the domestically used output proportion in order to additionally identify (permanent) rebalancing shocks that may permanently affect output. As in Gali (1999), we allow productivity shocks to affect long-run output. In addition, we also allow rebalancing shocks to affect long-run output. Our two models differ from one another in how they separate the two types of permanent shocks.[7] Also note that these models are suitable to compare the productivity and rebalancing shocks in their ability to affect the long run output, because these models allow both shocks to affect long-run output.

2.3 Results from Panel Models

First, we report results from the panel models using all 10 countries. Figure   and Figure   report the impulse responses with one-standard-error bands for Models 1 and 2, respectively. Error bands are constructed via the Monte-Carlo integration method suggested by Sims and Zha (1999). Each column of graphs shows the impulse responses for a given type of structural shock, denoted at the top of the column; the responding variable is denoted at the far left of each row. Note that we report the responses in terms of each variable's level (as opposed to difference).

In Model 1, a productivity shock increases labor productivity in the long run, leading to an increase of approximately 6%. The domestically used output proportion decreases temporarily, and output increases to almost 6% above the initial level in the long run. Based on the impulse responses, a productivity shock can be interpreted as a permanent shock to labor productivity that does not significantly increase the long-run domestically used output proportion. The long-run output increase is unsurprising: as per

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[7] There may be a type of rebalancing shock that does not affect long-run output, but such a rebalancing shock cannot be identified in our empirical model. This is unlikely to be a problem, as we are interested in whether there is a rebalancing shock that has an important long-run effect on output.

the standard theory, a permanent increase in labor productivity leads to a permanent increase in output.

The productivity-neutral rebalancing shock permanently increases the domestically used output proportion by 6.5% above the initial level. The long-run effect on labor productivity is zero, as imposed by the model restrictions. Output tends to increase, consistent with the rebalancing argument. However, the size of the long-run effect on output is very small: only a 0.25% rise in output, compared to the 6.5% increase in the domestically used output proportion. In addition, the error bands suggest that the long-run effect is not significant.

In the results, permanent labor productivity and permanent rebalancing shocks are nicely separated. Productivity shocks turn out to be permanent shocks to labor productivity (without significant long-run effects on the domestically used output proportion) while productivity-neutral rebalancing shocks are permanent shocks to the domestically used output proportion (without long-run effects on labor productivity by construction). Therefore, by directly comparing these two shocks' effects, we can infer the relative importance of labor productivity improvement, as opposed to rebalancing, in terms of output growth. Labor productivity shocks have large and significant long-run effects (almost 6.5% output increase). However, rebalancing shocks have small and insignificant long-run effects (only 0.25% output increase), given that rebalancing shocks lead to a significant and huge rise (about 6.5% permanent rise) in the proportion of domestically used output.

Permanent labor productivity and permanent rebalancing shocks are also well separated in Model 2. Rebalancing shocks can be interpreted as permanent shocks to the

domestically-used output proportion that do not have a significant long-run effect on labor productivity, as shown in the impulse responses; rebalancing-neutral productivity shocks are permanent shocks to labor productivity that do not have a long-run effect on the domestically used output proportion, as imposed by a restriction. As in Model 1, the rebalancing shock has no significant long-run effect on output, but productivity shocks have a strong and significant long-run effect on output.

These results suggest that, on average, rebalancing itself (without a rise in labor productivity) is unlikely to substantially increase output growth in these countries. It is important to increase labor productivity continuously in order to achieve higher economic growth. In other words, substantially increasing output growth requires that rebalancing is paired with a continuous rise in labor productivity.

2.4 Results from Individual Country Models

The results from the panel VAR model represent the average results, across the various Asian countries, but there may be cross-country differences. Therefore, we also present results from the individual country models. Figure   to Figure   report the impulse responses with one-standard-error bands. The county names are denoted along the top, while the names of the responding variables are denoted on the far left. Figure   and Figure   show the results from Model 1, whereas Figure   and Figure   show the results from Model 2.

In six countries (India, Indonesia, Malaysia, the Philippines, Singapore, and Taiwan), rebalancing shocks and labor productivity shocks are distinct in terms of their

long-run effects, as in the results of the panel VAR model.[8] However, there are other countries in which the productivity shock in Model 1 significantly affects not only labor productivity but also the domestically used output proportion in the long run (e.g., China, Japan, and Korea).

Consistent with the results of the panel model, the individual country models' results suggest that permanent change in labor productivity is a more fundamental force in terms of its effect on long-run output than are permanent changes in the domestically used output proportion. When labor productivity permanently increases (or decreases), output also permanently increases (or decreases) in all models and all countries, regardless of the type of shock. However, when the domestically used output ratio increases (or decreases) permanently, output often does not change significantly; many such cases are shown in Figure   and Figure .

We can also draw some interesting conclusions regarding the role of rebalancing (given labor productivity) in individual countries, based on the long-run output effect of a productivity-neutral rebalancing shock (Figure). In four countries (China, Indonesia, the Philippines, and Thailand), positive productivity-neutral rebalancing shocks increase output in the long run. This result is consistent with the rebalancing argument. Even without improving long-run labor productivity, permanently rebalancing from exports to the domestic sector would increase long-run output. However, in Japan, Korea, Malaysia, and Singapore, the effect on output is insignificant. In India and Taiwan, long-run output

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[8] That is, in Model 1, the two shocks are distinct because productivity shocks have no significant long-run effect on the domestically used output proportion and, by construction, productivity-neutral rebalancing shocks have no long-run effect on productivity. Similarly, in Model 2, rebalancing shocks have no significant long-run effect on labor productivity; they are thus clearly separated from rebalancing-neutral productivity shocks that, by construction, do not have a long-run effect on domestically used output.

actually decreases in response to a permanent increase in the domestically used output proportion.

The case of China is especially interesting since China is at the center of the current rebalancing debate. The rebalancing effect is stronger in China than in other countries: a permanent increase of 0.76% in the domestically used output proportion leads to a permanent increase of 1.18% in China's output. This strong effect may be related to the significant increase in labor productivity following productivity-neutral rebalancing shocks in China. Although labor productivity does not increase permanent, it increases significantly for several years, which might lead to the significant output rise.

2.5 Effects of Productivity-Neutral Rebalancing Shocks in China on Other Asian Countries

We further examine the effects of a productivity-neutral rebalancing shock and a rebalancing-neutral productivity shock in China on other Asian countries' output. We extend Models 1 and 2 for China to construct a four-variable model by adding each country's output, one by one. The identifying restriction remains as before; a productivity-neutral rebalancing shock, as in Model 1, does not affect long-run labor productivity (but is allowed to affect all other variables in the long run) while a rebalancing-neutral productivity shock, as in Model 2, does not affect the long-run domestically produced output proportion.

Figure 9 displays the impulse responses to a productivity-neutral rebalancing shock in China. A positive productivity-neutral rebalancing shock in China strongly and significantly affects the outputs of Korea and Taiwan. The long-run increases in Korean

and Taiwanese output exceed 3% and 2%, respectively, and are even stronger than the long-run increase in Chinese output. On the other hand, long-run output decreases are significant in the Philippines and India, exceeding 2% and 1%, respectively. This result may imply that Chinese rebalancing propagates differently across different Asian countries. The rebalancing of China from external to internal demand would increase not only China's output but also that of Korea and Taiwan but would negatively affect the Philippines and India. The country-specific effects seem associated with the strength of manufacturing trade linkages with China: such links are strong with Korea and Taiwan, while those with the Philippines and India are weak.

Figure 9 displays the impulse responses to a rebalancing-neutral productivity shock in China. Such shocks negatively affect many other Asian economies; such effects are significant in Thailand, Singapore, Japan, and the Philippines, in which long-run output declines by 2-3%. However, positive effects are found in Korea and Indonesia.

2.6 Effects of Consumption and Investment Shocks

We investigated the effects of rebalancing shocks, defined as changes in the proportion of domestically used output. In the next section, which uses a global intertemporal multi-sector general equilibrium model, we consider shocks to consumption and investment as examples of rebalancing shocks, as introducing shocks to the proportion of domestically used output is not computationally straightforward. Therefore, to improve comparability with the next section's results, we also test a model including consumption or investment (in proportion to output) instead of the proportion of domestically used output. We estimate the panel model and the individual country

models using the same structures as in the baseline models. We test two types of identifying assumptions (Models 1 and 2) and in each case, we simply replace the proportion of domestically used output with the consumption-output or investment-output ratio.

The results are broadly consistent with those of the baseline models. In the panel VAR models, the output effects of permanent labor productivity shocks are far stronger than those of permanent consumption-output ratio or investment-output ratio shocks. In particular, an increase in consumption-output or investment-output ratio without a strong labor productivity increase has a relatively small effect on output. In the individual country estimations, a permanent change in labor productivity has a more fundamental effect on long-run output than do permanent changes in the consumption-output and investment-output ratios. When labor productivity permanently increases (or decreases), output also permanently increases (or decreases) in all models and for all countries. However, when the consumption-output or investment-output ratio permanently increases (or decreases), output often does not change significantly, especially when labor productivity does not increase significantly. On the other hand, an increase in investment-output ratio tends to be associated with an increase in labor productivity and output more strongly than an increase consumption-output ratio does. Figures 11 and 12 report the effects of productivity-neutral rebalancing shocks and rebalancing-neutral productivity shocks, respectively, when consumption-output ratio is used.

3. **Impacts of Asia's Rebalancing Policies on Asia and the World Economy: Simulations from the G-Cubed Model**

This section investigates the effects of growth rebalancing in Asia through supply-side and demand-side changes using a global economic model.

3.1 The Model

The model used in this section is the G-Cubed model, which is an intertemporal general equilibrium model of the world economy. Its theoretical structure is outlined in McKibbin and Wilcoxen (2013) and Lee and McKibbin (2014). A number of earlier studies (summarized in McKibbin and Vines (2000)) show that the G-Cubed modeling approach has proven useful for assessing wide-ranging issues across a number of countries since the mid-1980s.[9]

The model is based on explicit intertemporal optimization by each economy's agents (consumers and firms). In contrast to static computable general equilibrium (CGE) models, time and dynamics are of fundamental importance in the G-Cubed model. The G-Cubed model is known as a DSGE (dynamic stochastic general equilibrium) model in the macroeconomics literature and an intertemporal general equilibrium (IGE) model in the CGE literature. The main difference with small-scale DSGE models is the considerable disaggregation of countries and sectors.

In order to track the macro time series, agents' behavior is modified to allow for short-run deviations from optimal behavior due to either myopia or restrictions on the ability of households and firms to borrow at the risk-free bond rate on government debt. Thus, aggregate consumption is a weighted average of consumption based on wealth (current asset value and expected future after-tax labor income) and that based on current

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[9] These issues include German unification in the early 1990s; fiscal consolidation in Europe in the mid-1990s; the formation of NAFTA; the Asian financial crisis; and the productivity boom in the US.

disposable income. Similarly, aggregate investment is a weighted average of investment based on Tobin's Q (a market valuation of the expected future change in the marginal product of capital relative to the cost) and that based on a backward-looking version of Q. In the model software, it is possible to change the information set of forward-looking agents after a scenario begins.

The model allows for short-run nominal wage rigidity (by different degrees in different countries) and therefore allows for significant periods of unemployment, depending on the labor market institutions in each country. Equilibrium between aggregate demand and aggregate output is maintained via flexible prices, which cause both demand and short-term supply to adjust. There is an explicit treatment of the holding of financial assets, including money, which is introduced into the model through the restriction that households require money to purchase goods.

Global accounting identities are imposed on the model (for example, for every borrower there is a lender), thereby avoiding the fallacy of composition. Likewise, the model carefully treats stock-flow relations, such as by accumulating current account deficits into foreign claims on domestic output, which must be serviced by future trade surpluses. On the fiscal side, the accumulation of fiscal deficits into government debt must be serviced using future revenues, though it does not need to be paid off completely.

The model distinguishes between the stickiness of physical capital within sectors and countries and the flexibility of financial capital, which immediately flows to where expected returns are the highest. This important distinction leads to a critical difference between the quantity of physical capital available at a given time to produce goods and

services and the valuation of that capital resulting from decisions about financial capital allocation.

As a result of this structure, the G-Cubed model contains rich dynamic behavior, driven by both asset accumulation and wage adjustment to a neoclassical steady state. It embodies a wide range of assumptions about individual behavior and empirical regularities in a general equilibrium framework. The interdependencies are captured using an algorithm that solves for the rational expectations equilibrium of the global economy.

In the model version used here there are six sectors (energy, mining, agriculture, manufacturing durables, manufacturing non-durables, and services) as well as a generic capital-producing sector in each country that draws largely on the durable manufacturing sector for inputs. Seventeen countries/regions are used; within Asia, Japan, Korea, China, India, and Indonesia are included as individual economies with the other economies included in "Rest of Asia" (see Table 2.)

3.2 Simulation Results

The simulations are designed to address two questions:

1) How does an increase in Chinese (and all Asian economies') domestic demand propagate throughout Asia and globally?

2) How does a surge in economy-wide labor productivity growth in China (and all Asian economies) propagate throughout Asia and globally?

We answer these questions by considering four scenarios. The first is a positive exogenous shock of 3% of GDP in the aggregate consumption equation in China,

sustained forever.[10] The second is an identical shock across all Asian economies (China, India, Indonesia, Japan, Korea, and other Asia). Although the shock is permanent, overall consumption eventually returns to below the baseline level due to endogenous consumption changes. Because consumption has been brought forward through the exogenous shock, future consumption will eventually fall below baseline to maintain the condition that the present value of consumption equals that of income.

In the third scenario, China experiences a rise in labor productivity growth of 1 percentage-point per year from 2014 to 2053, after which the growth rate decays gradually, returning to baseline in 2100.[11] The next scenario assumes the same labor productivity shock but implemented across all Asian economies.

In generating these scenarios, the model is solved from 2013 to 2100 under exogenous assumptions about population and productivity growth, tax rates, monetary policy rules, and other issues.[12] This paper focuses on the difference between the model solutions with the shocks imposed relative to the baseline. In the following results, a zero implies no deviation from the baseline and a positive number implies a number higher than in the baseline. The results for GDP are expressed as a percent deviation from the baseline; those for trade are given as percentages of baseline GDP's deviation from baseline.

Finally, note that we are mostly interested in the short-run and the medium-run effects in the current analysis. In the current model, demand shocks are not likely to have

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[10] We focus on a consumption rate increase. The effects of an investment rate increase are qualitatively similar.

[11] The reason for the particular time path is to ensure the long-run steady state of the model is preserved while enabling a long period of more rapid productivity growth to occur until around 2050.

[12] For the details of generating a long-term forecast using an intertemporal model, see McKibbin et al. (2007).

long run real effects, as in the most theoretical models, and the comparison of long run

effects between supply and demand shocks is not likely to be meaningful. Such a model

feature is not unrealistic because our empirical analysis in Section 2 suggested that

demand shocks (or rebalancing shocks) tend to have no long run real effects.

3.2.1.   Demand Shocks

The results for exogenous rises in consumption demand are shown in Figure 2

through Figure 1. Figure 2 shows the percentage changes in GDP over time for a

subgroup of Asian countries (China, Japan, Korea, and India) and two non-Asian

countries (USA and Australia) when only China rebalances demand as well as when all

of Asia does. Figure 3 depicts the results for changes in the trade balance for the same set

of countries. Figure 1 gives a snapshot of the spillovers to GDP in all countries at three

points in time: years 1, 10, and 20 of the shock.

The rise in consumption demand does not have a permanent effect on output in

China or other Asian economies, but consumption shocks in China as well as across Asia

have some short-run positive effects on output. However, one notable result is that the

rise in demand in China and across Asia tends to be negatively transmitted to other

countries. Spillovers between economies mainly occur through trade and capital flows. A

shift towards domestic demand in Asia has no long-term impacts on growth but does lead

to a short-term relocation of capital into Asia to build capacity to satisfy increased

demand for domestic goods. This capital relocation reduces investment in foreign

economies. The extent to which the domestic demand increase in Asia raises or lowers

GDP in a non-Asian economy depends on its extent of trade with Asia (which has a

positive effect) versus the extent of short-term capital relocation (which has a negative effect). In the long run, the consequences on global demand and output are negative because the demand switch raises consumption in the short run at the expense of the long run. Greater short-run consumption must be financed either by borrowing from foreigners, which must be repaid, or via lower investment, which reduces the long-term productive capacity of an economy.

The results for the change in trade balances show the extent of international capital movements through the balance of payments identity. Deterioration in the trade balance implies a capital inflow whereas an improvement implies a capital outflow. When all Asian economies simultaneously stimulate consumption, there is a worsening of trade positions in Asia and an improvement elsewhere. However, this does not translate into higher GDP outside Asia. The policy shifts reduce investment in non-Asian economies and lower the stock market valuations in the economies that reduced private wealth and therefore consumption. The falls in investment and consumption are sufficient to lower short-term demand through Keynesian accelerator and multiplier channels; this reduces GDP. Over time, as the capital stock falls (relative to baseline) due to the shift of capital away from non-Asian economies, the supply side also contracts in non-Asian economies; this leads to a persistent decline in GDP. The quantitative impact depends on trade patterns: countries trading with Asia will experience more positive trade stimuli that can offset the capital relocation effect. This can be seen from Figure 1, which shows that economies like Australia experience smaller GDP declines than do those like the Eurozone because Australia gains from expanding exports to Asia but loses more as a result of the capital outflow and valuation effects of the global demand shift.

A rise in consumption in China (or Asia more broadly) has the expected effect of shifting trade balances towards greater trade deficits (or smaller trade surpluses) in Asian economies, but it does not raise GDP in non-Asian economies because of the interaction between capital relocation and short-run Keynesian accelerator effects through private investment. These results may depend on the model's various trade elasticities and elasticities of substitution in production and consumption, but the parameterization used in this study is realistic because the latter are estimated from the data and the trade elasticities are calibrated based on other empirical studies.

3.2.2. Productivity Increases

The results of a sustained rise in productivity growth in China and across Asia are shown in Figure   through Figure 1. Recall that the shock is a permanent increase in labor productivity growth from periods 1-50 and then a return to steady-state productivity growth. Productivity will be permanently higher in the long run.

The spillover impacts of the productivity shock on non-Asian economies are very different from the results for the consumption demand shift in Asia. While the demand shock was negatively transmitted between countries, the supply shock is positively transmitted over time because higher Asian wealth (productivity growth creates output) is eventually spent on goods from around the world, thus raising income worldwide. In the short run, there is a relocation of capital into China and Asian economies as the marginal product of capital rises due to higher labor productivity growth. There is also a rise in demand for inputs to build the new capital stock, some of which come from non-Asian economies. Australia is a case in point: the Asian productivity boom raises short-term

GDP in Australia as greater mining and energy exports are fueled by Asia's investment boom. The United States, on the other hand, experiences a capital outflow effect larger than the trade effect; US GDP initially falls below baseline as a result.

The shifts in trade flows shown in Figure 1 are as expected in the sense that countries experiencing a productivity surge attract capital inflows, which raise these economies' exchange rates and contract net exports. Countries losing capital experience trade balance surpluses. In fact, the U.S. experiences persistent trade balance surpluses. This implies that a productivity increase in Asia helps to resolve trade imbalance between Asia and the U.S.[13]

Figure 1 shows the worldwide spillovers. Note that, under the Chinese productivity shock, countries that trade more with China (i.e., Australia, Japan, Korea, Indonesia, other Asia, and OPEC) experience a more rapid rise in GDP than the countries that do not. Thus, for a productivity shock, in contrast to an Asian consumption increase, it is possible for the trade effect to dominate the capital relocation effect.

4. Concluding Remarks

Effective rebalancing will require a combination of policy measures to boost domestic demand and bolster production capacities to meet this demand. This paper's empirical results support the argument that Asian economies need consistent adjustments, including both demand-side rebalancing and supply-side productivity increases. However, from a global perspective, productivity-enhancing policies that create additional wealth are more beneficial than policies that merely shift consumption across time.

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[13] A country like Australia that does not experience the productivity surge still experiences a short-run trade deficit as capital flows into Australia in response to rising returns in the mining and energy sectors that expand to export to Asia.

Consumption-directed policies facilitate trade rebalancing but with a much lower return to global GDP than is offered by supply-side policies.

Demand rebalancing involves expanding domestic demand for goods and services. Policies can seek either to encourage greater consumption or to stimulate investment. Specific policies should be tailored to the unique circumstances of each individual economy, but the overall policy package could include several different policies to stimulate domestic demand.[14] First, strengthening domestic consumption requires policies that transfer more corporate savings to households. Policies that encourage firms to pay dividends to households or increase workers' wages will strengthen the links between corporate profits, household income, and consumption. Second, additional government spending on health, education, and housing will reduce households' precautionary motivation to save. Policies that mitigate risk and reduce the uncertainty faced by households will encourage lower savings and higher spending. Greater public provision of social services and more extensive social safety nets will enhance consumer confidence and boost consumption. Third, governments should prioritize fostering a more welcoming climate for investment. The entire region's business environment lags those of the world's most competitive economies due to serious shortcomings in institutional quality and skill levels. Greater government investment in infrastructure can foster both rebalancing and increased productivity.

Structural reforms can lead to productivity increases and supply-side adjustments, thus facilitating demand rebalancing. Such adjustments will likely involve a resource shift from tradable to non-tradable goods. Policies to foster these adjustments include

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[14] See Lee (2010).

eliminating subsidies and factor-price distortions that favor export industries while damaging domestic industries. Asian governments should deregulate and encourage investment in service-sector growth areas, including healthcare, education, information technology, and telecommunications. Removing regulatory distortions in services will raise productivity in not only the service sector but also other sectors for which services such as transportation and telecommunications are important production inputs. Lee and McKibbin (2014) show that enhancing service-sector productivity can be a second growth engine, propelling strong and sustainable Asian growth in the future.

In an uncertain global environment, Asian economies must continue to pursue policies that will lessen vulnerabilities and rebalance sources of growth. Asia's policy adjustment will have significant spillovers for the global economy. While demand rebalancing can help increase output in some Asian economies, it is important to adopt structural reforms that promote labor productivity growth along with rebalancing policies across all major Asian economies. Better-structured and more effective rebalancing, both country-specific and Asia-wide, can lead Asia and the world economy onto a higher and more-sustainable economic growth path.

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Table 1. Sample Periods and Basic Data Properties

Countries	Sample Periods	d log LP		d DY		d log Y		DY	
		mean	st dev	mean	st dev	mean	St dev	mean	St dev
China	1952–2011	5.17	5.56	-0.39	0.82	7.41	5.57	94.54	6.12
Indonesia	1960–2011	2.85	4.40	0.39	3.62	5.18	3.91	81.45	7,32
India	1960–2011	3.00	3.39	-0.04	0.26	4.90	3.10	97.00	1.15
Japan	1950–2011	4.14	4.62	-0.22	1.34	4.96	5.13	87.03	3.99
Korea	1960–2011	4.55	2.88	-0.74	1.74	6.69	3.77	81.94	12.57
Malaysia	1960–2011	3.30	3.55	-0.06	4.04	6.20	3.96	51.14	15.93
Philippines	1960–2011	1.07	4.20	-0.12	1.70	4.31	3.02	89.31	5.69
Singapore	1960–2011	3.82	5.01	0.80	18.08	7.39	4.05	-42.61	41.64
Taiwan	1960–2011	4.49	5.53	-0.43	1.71	5.88	5.91	84.38	9.57
Thailand	1960–2011	4.71	2.97	-0.82	2.50	7.15	3.14	69.03	16.88

Notes: Y is GDP, LP denotes labor productivity, and DY denotes the proportion of domestically used output.

Source: Annual data from Penn World Table 8.0 (Feenstra et al. 2013).

Table 2. Countries/regions included in the G-cubed Model

United States	China
Japan	India
United Kingdom	Indonesia
Germany	Other Asia
Rest of the Eurozone	Latin America
Canada	Other emerging economies
Australia	Eastern Europe & former USSR
Korea	Oil-exporting & Middle East
Rest of the OECD	

Source: McKibbin and Wilcoxen (2013).

Figure 1. Share of Export Value-Added in GDP, 2000 and 2008
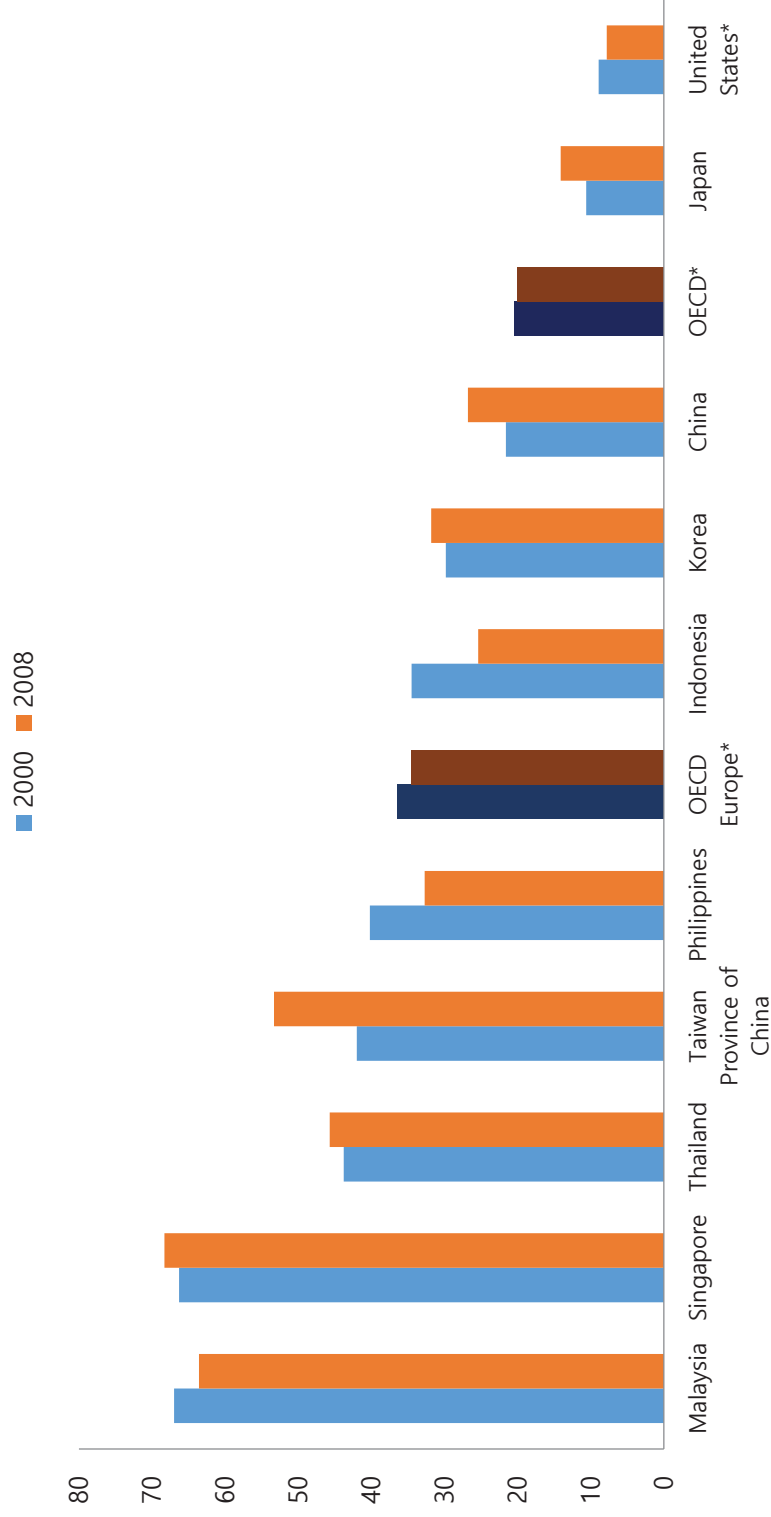
Note: * indicates 2005 data for 2008.

Source: IMF, Regional Economic Outlook: Asia and Pacific April 2010.

Figure 2. Share of Domestic Demand

(In percent of GDP; 2004-09 average)

Legend: GOV, INV, CON
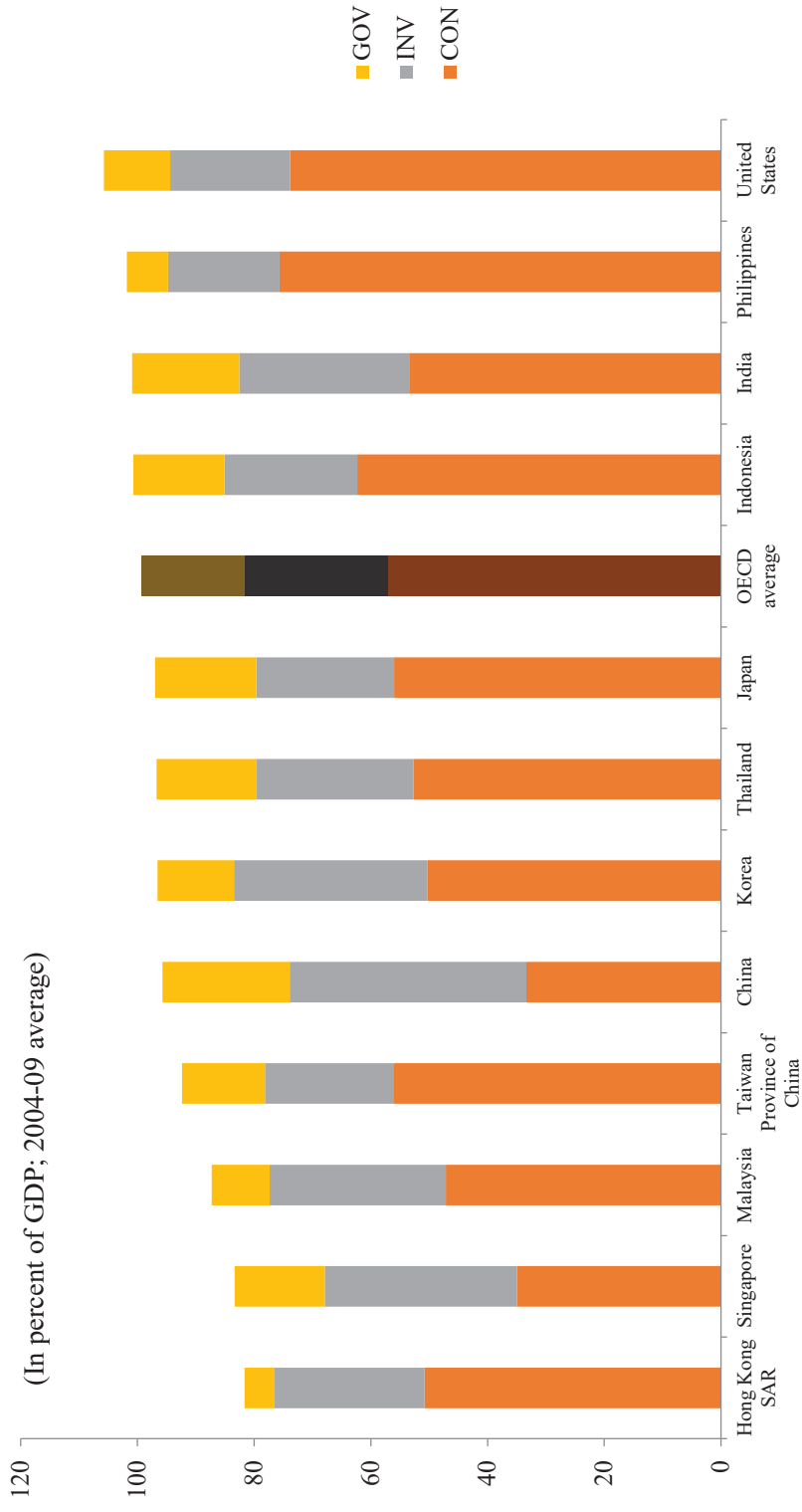
Source: The Penn World Table 8.0 (Feenstra et al. 2013)

Figure 3. Impulse Responses: Model 1, Panel Structure
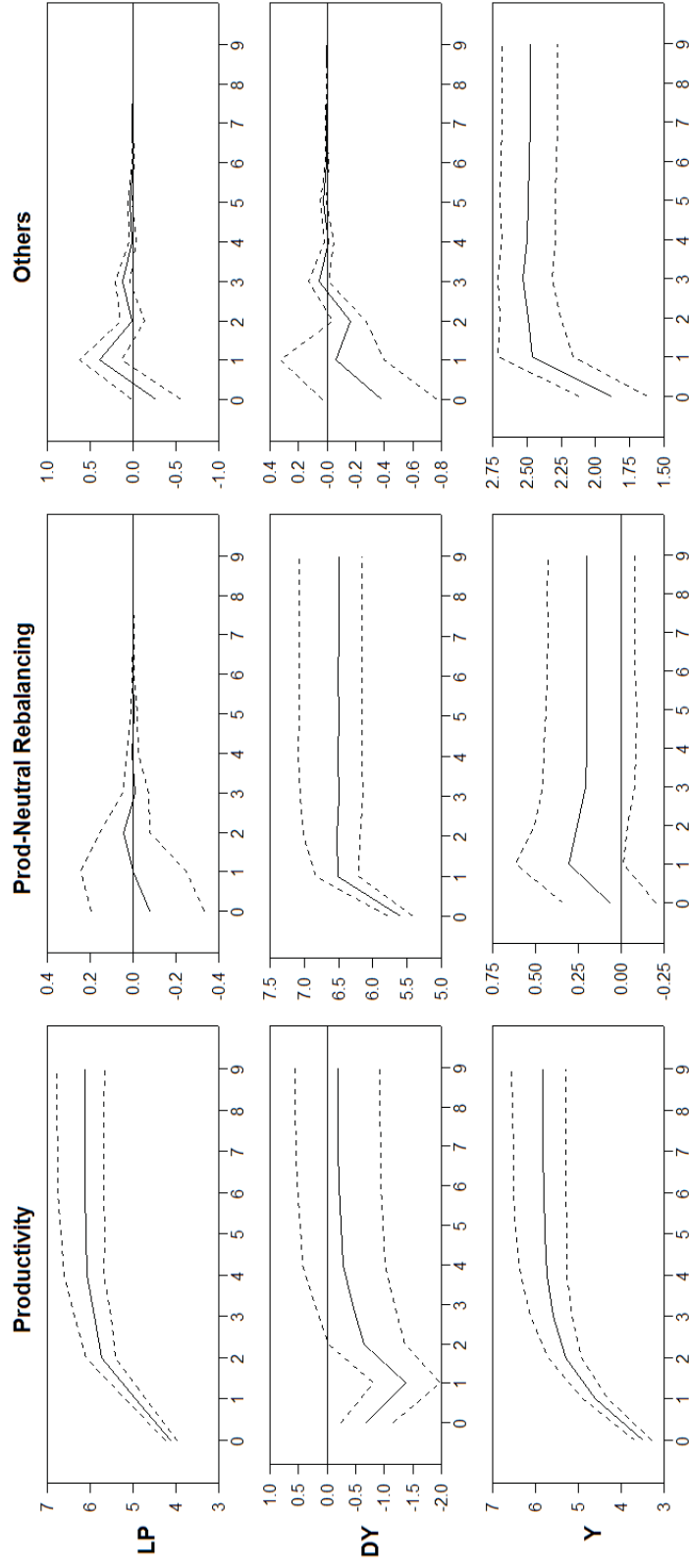
Note: LP is labor productivity, DY is the proportion of domestically used output and Y is output (GDP)

Figure 4. Impulse Responses: Model 2, Panel Structure
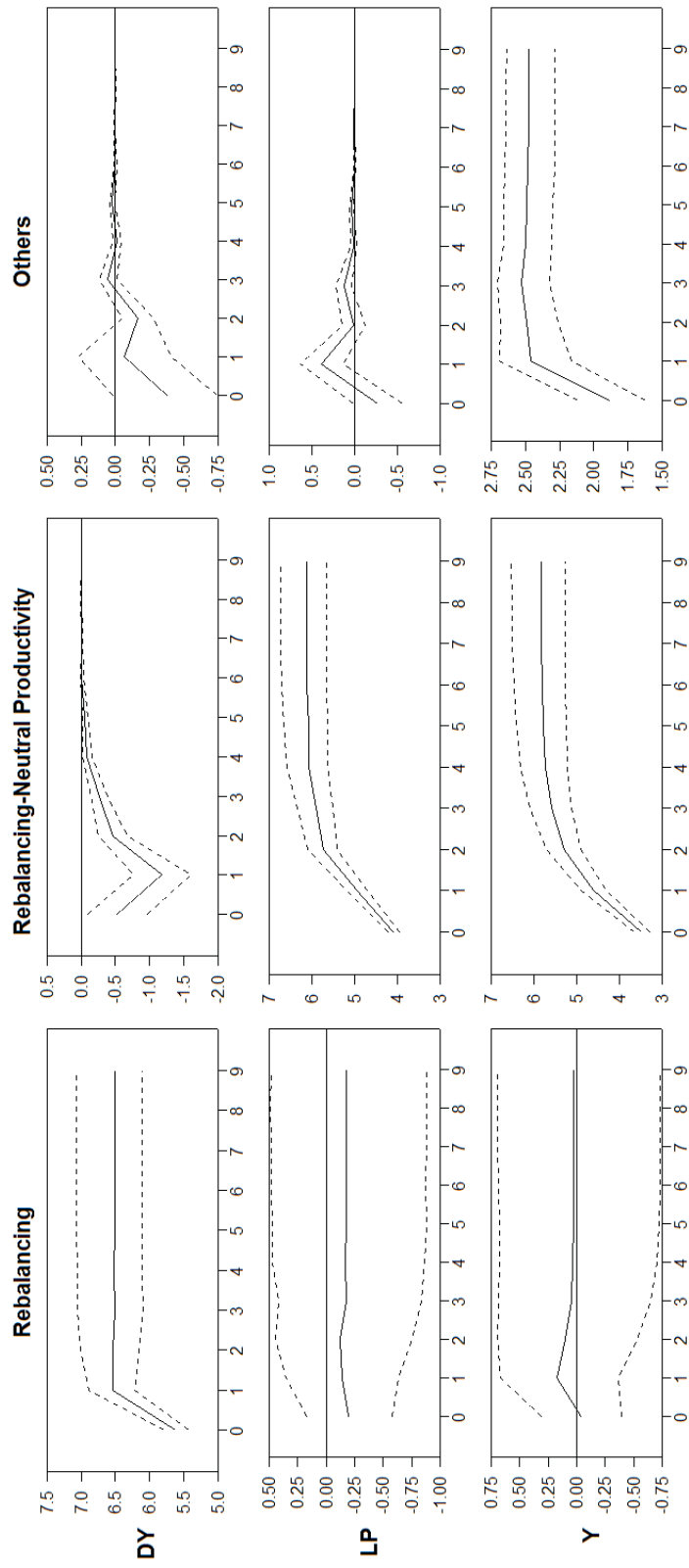
Note: See Figure 4.

Figure 5. Impulse Responses to Productivity Shocks: Model 1, Individual Countries
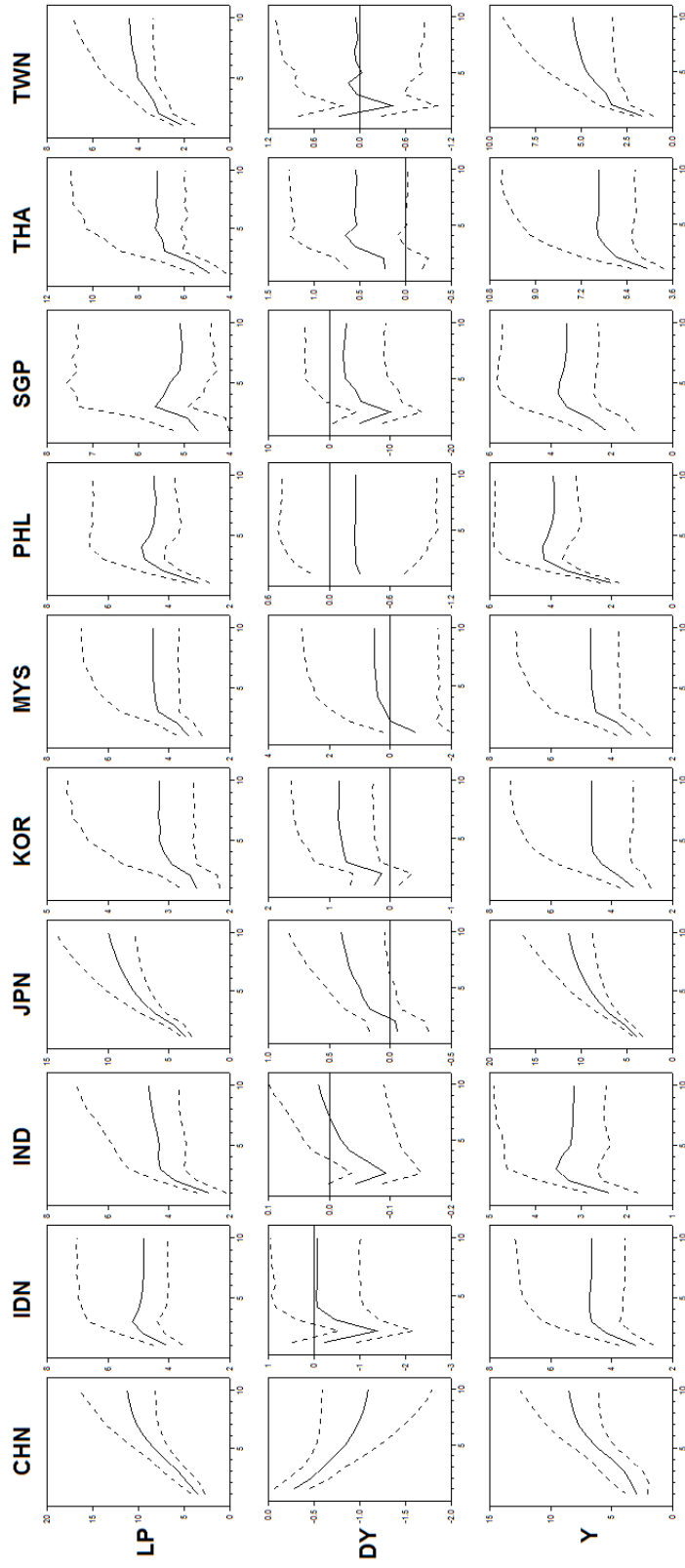
Figure 6. Impulse Responses to Productivity-Neutral Rebalancing Shocks: Model 1, Individual Countries
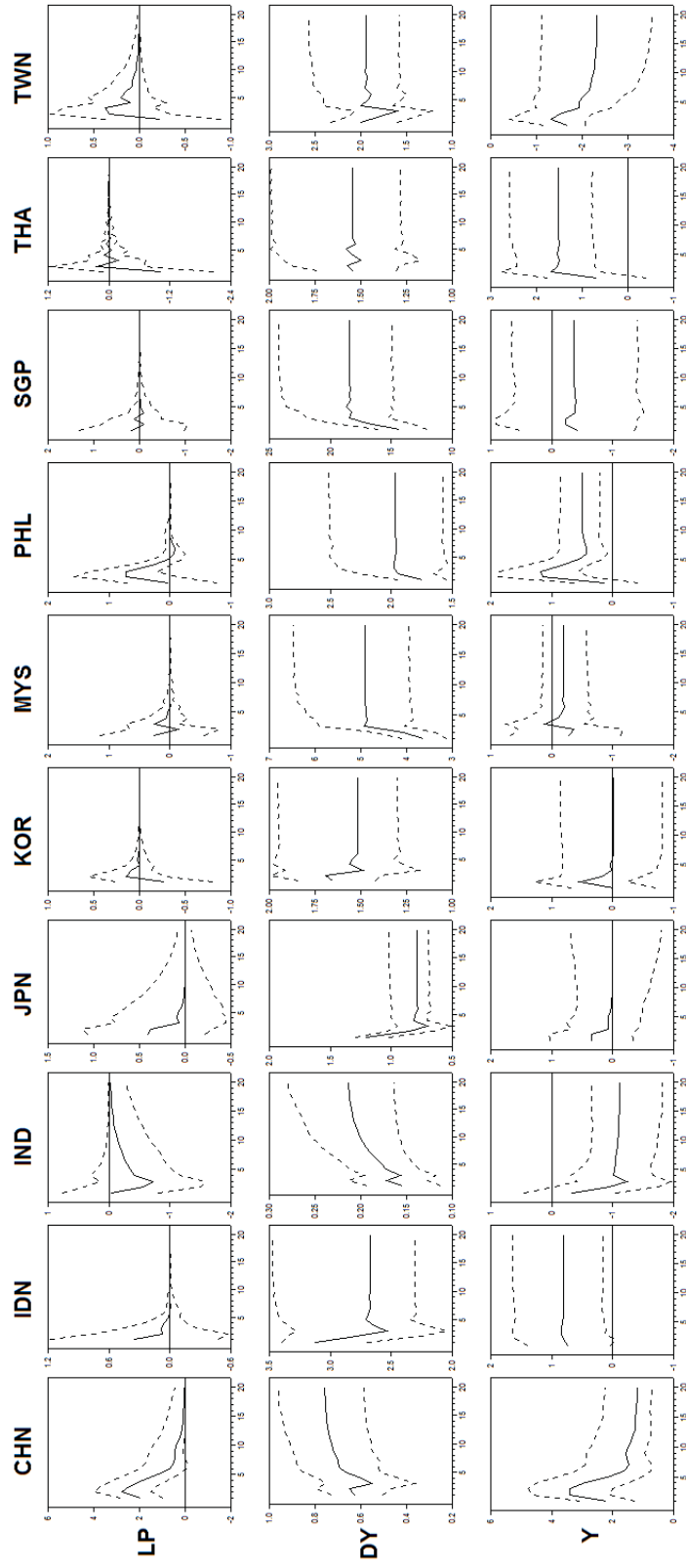
Figure 7. Impulse Responses to Rebalancing Shock: Model 2, Individual Countries
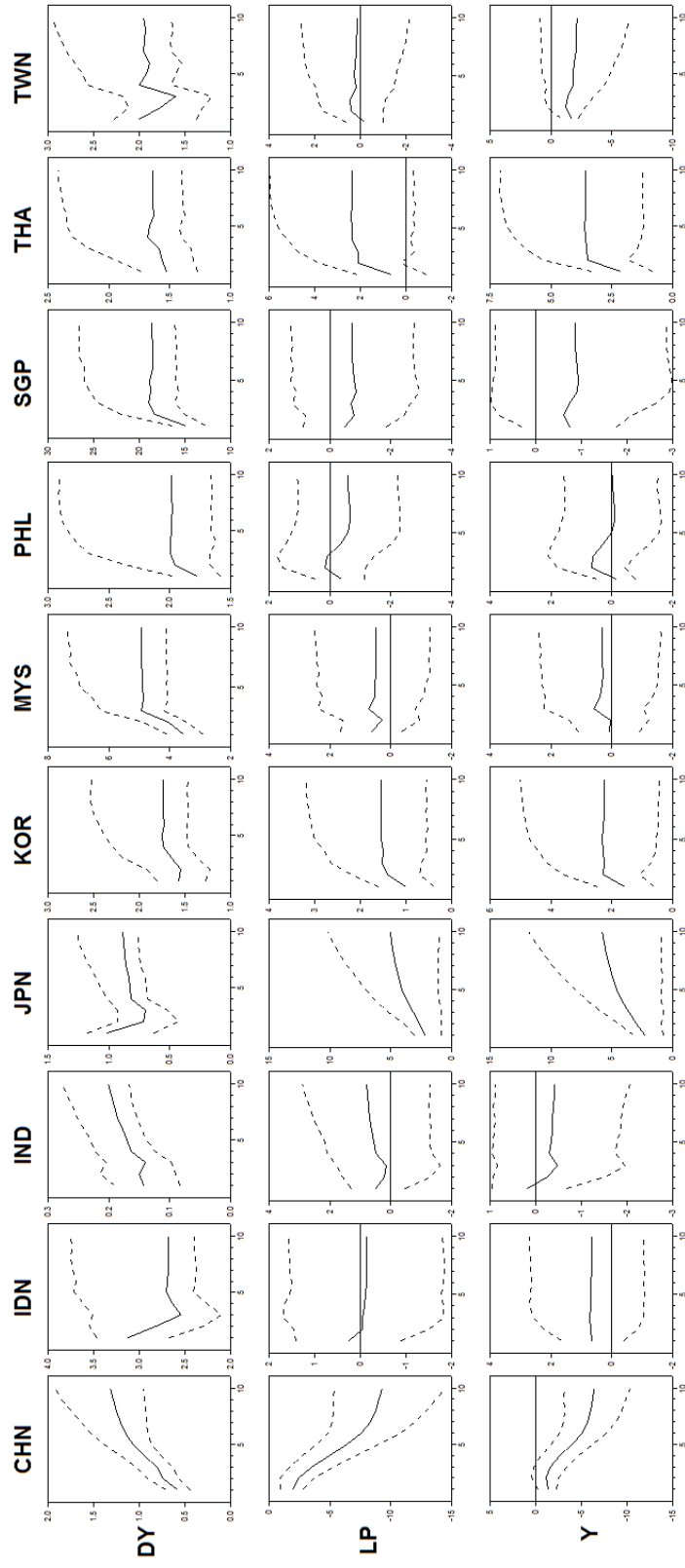
Figure 8. Impulse Responses to Rebalancing-Neutral Productivity Shocks: Model 2, Individual Countries
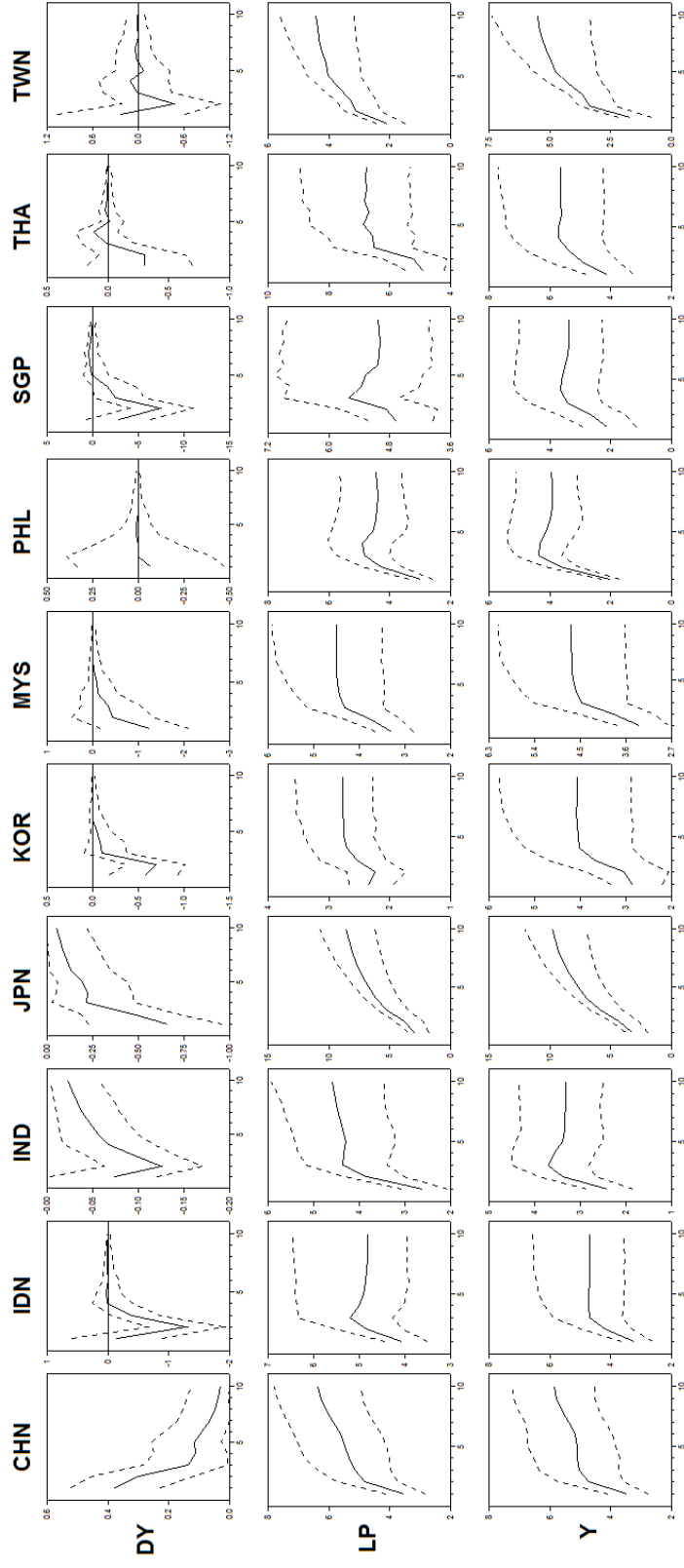
Figure 9. Impulse Responses of Foreign Output to Productivity-Neutral Rebalancing Shocks in China: Model 1
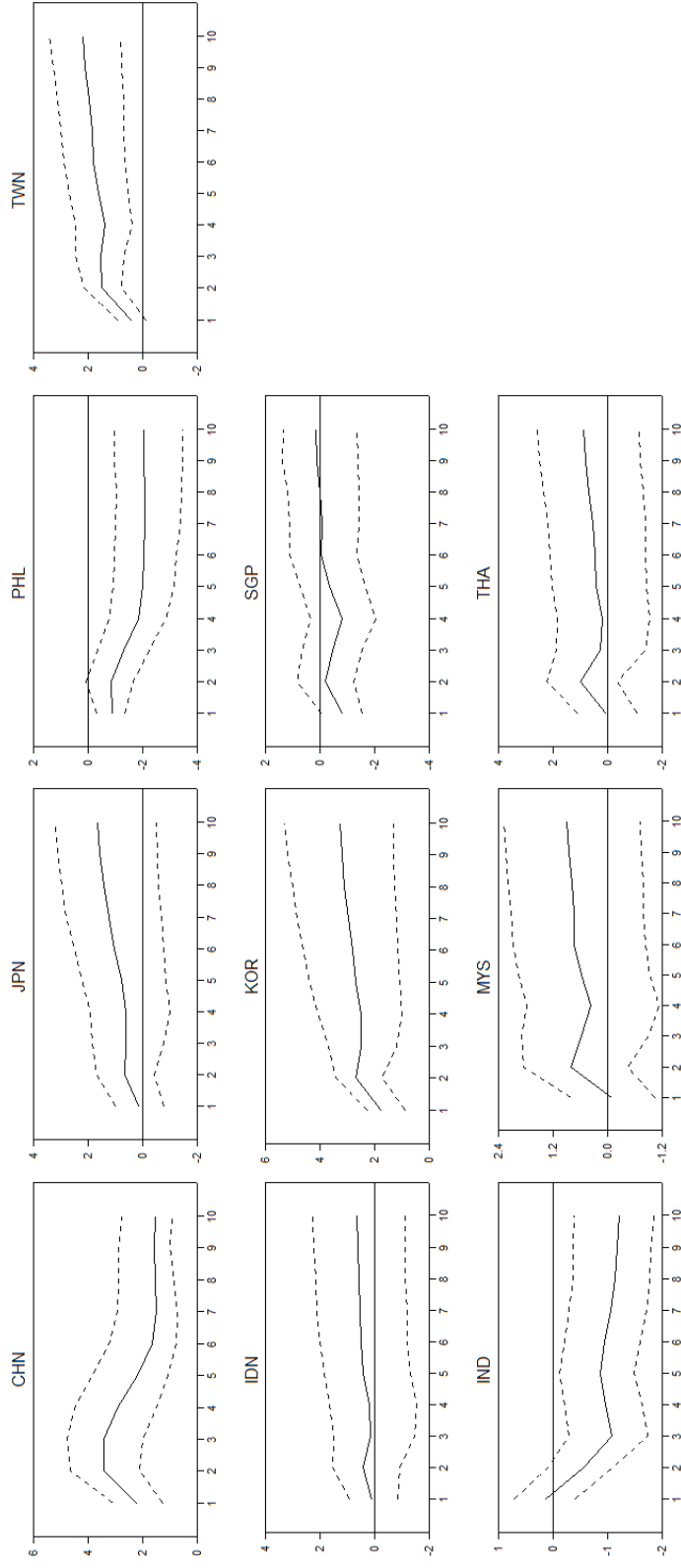
Figure 10. Impulse Responses of Foreign Output to Rebalancing-Neutral Productivity Shocks in China: Model 2
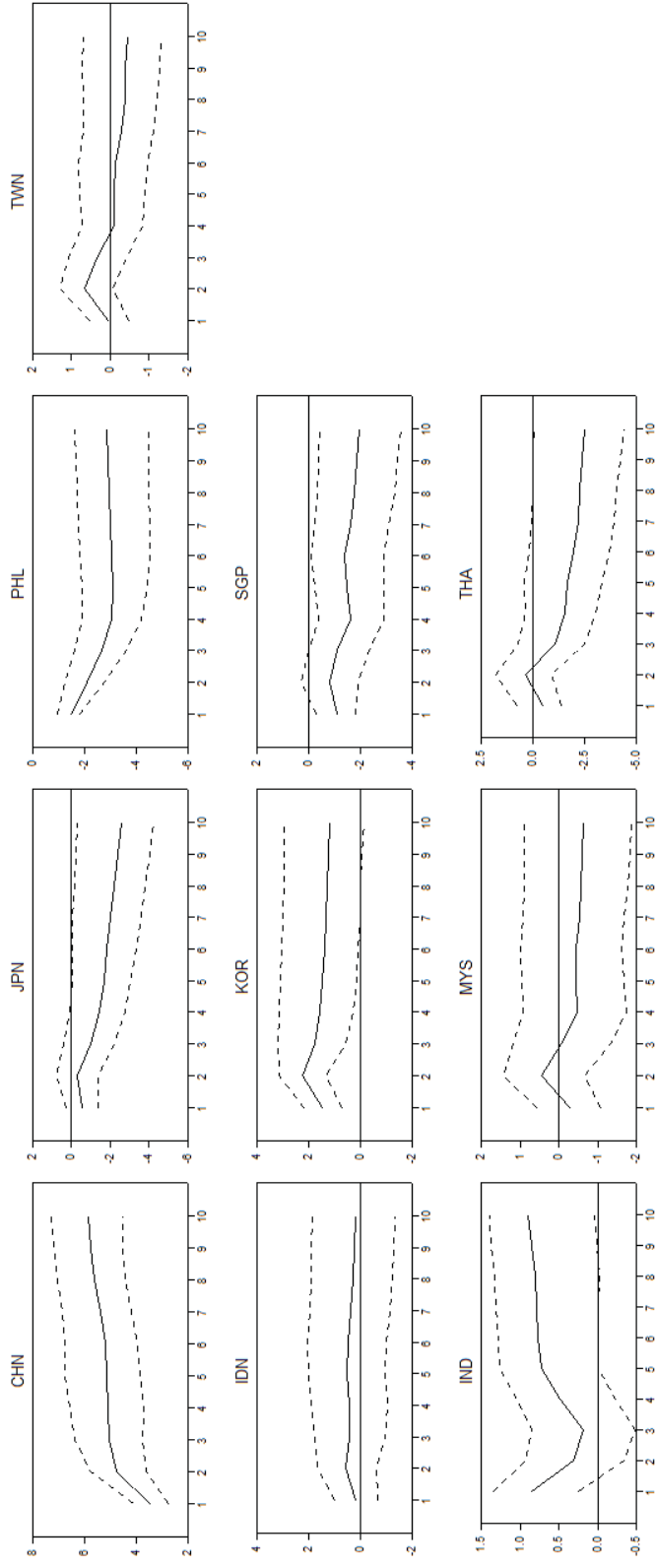
Figure 11. Impulse Responses to Productivity-Neutral Rebalancing Shocks: Model 1 with Consumption-Output Ratio, Individual Countries
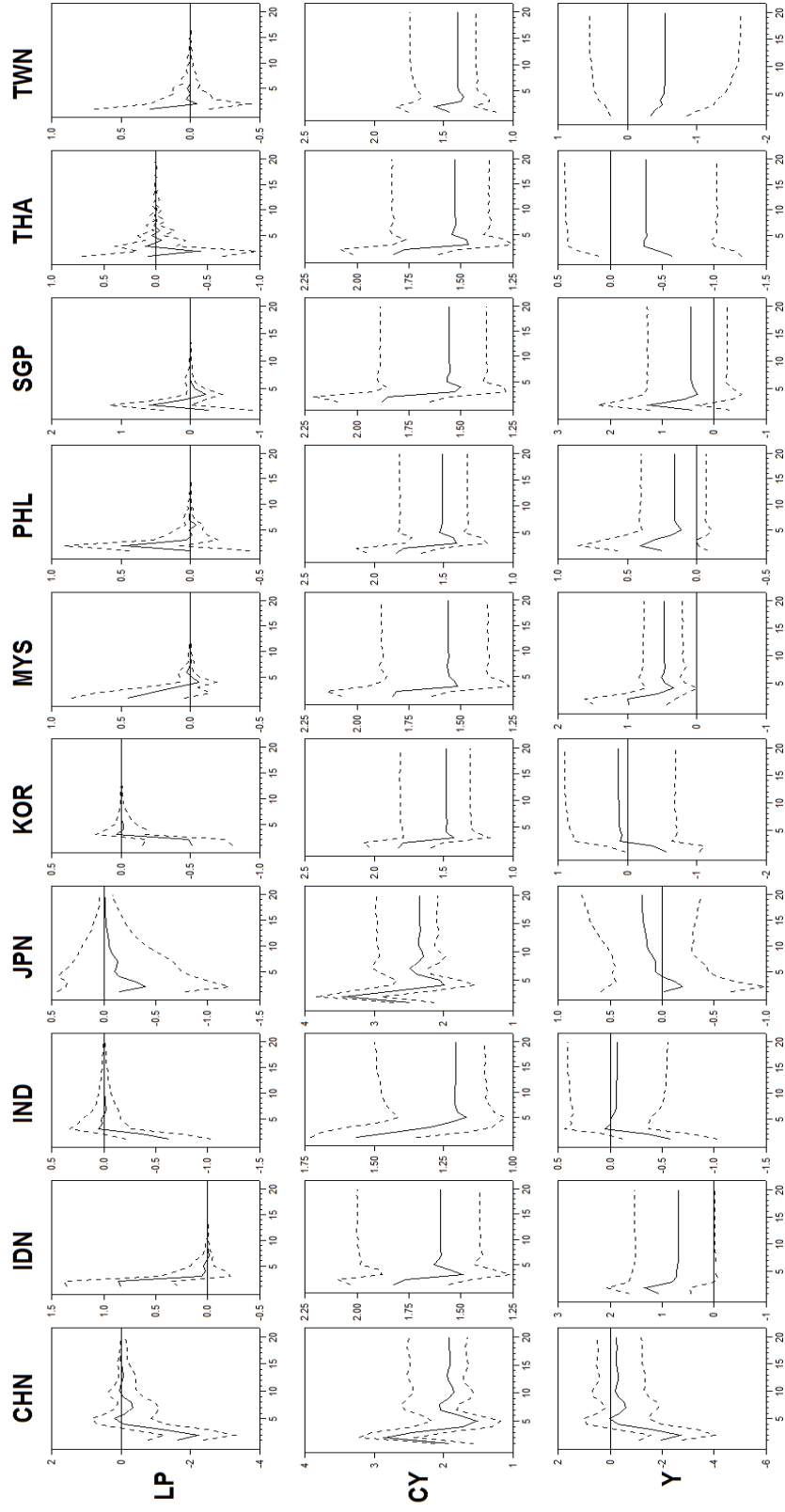
Figure 12. Impulse Responses to Rebalancing-Neutral Productivity Shocks: Model 2 with Consumption-Output Ratio, Individual Countries
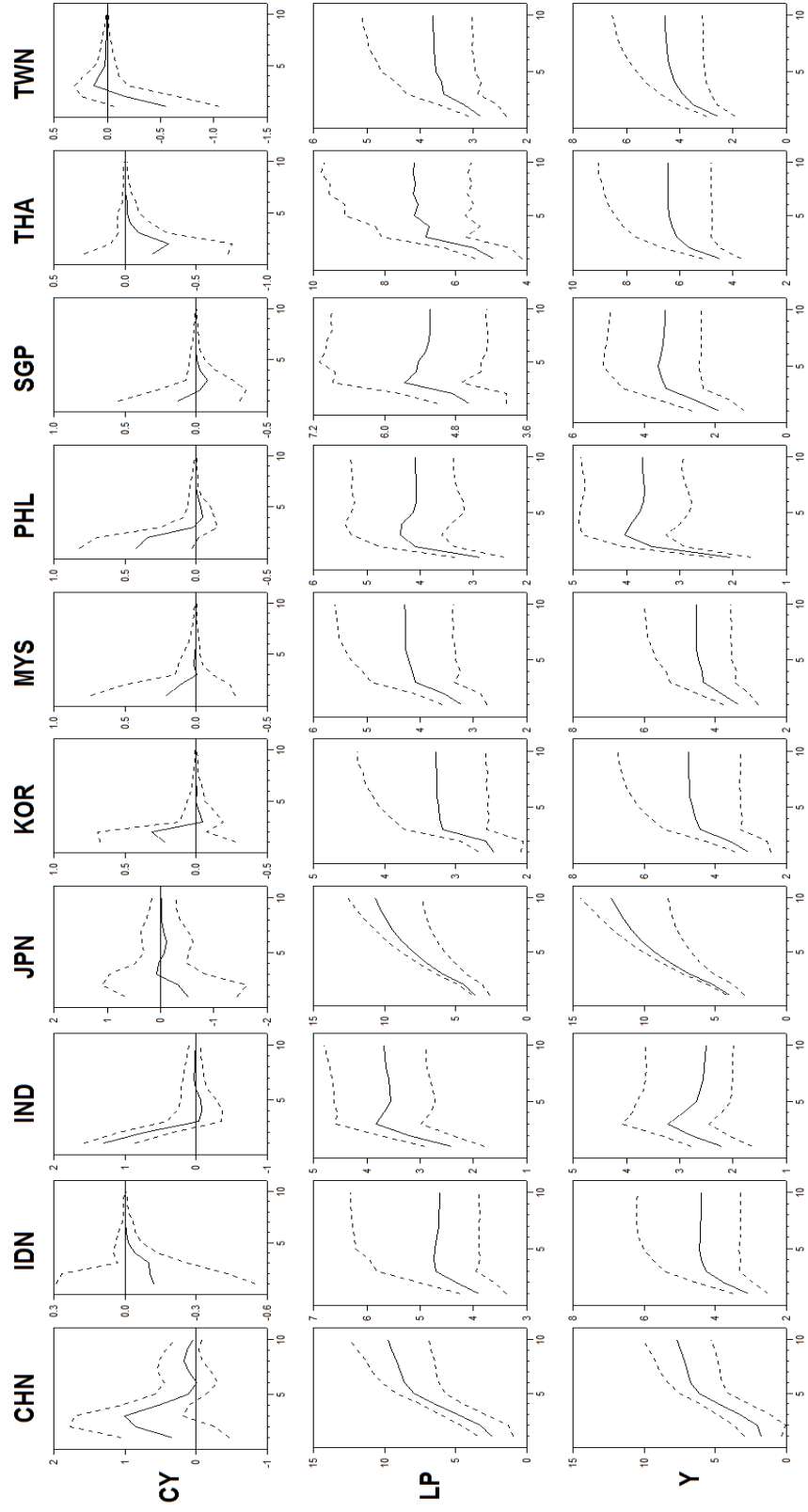
Figure 23. GDP Effects of Demand Shocks in China and All of Asia
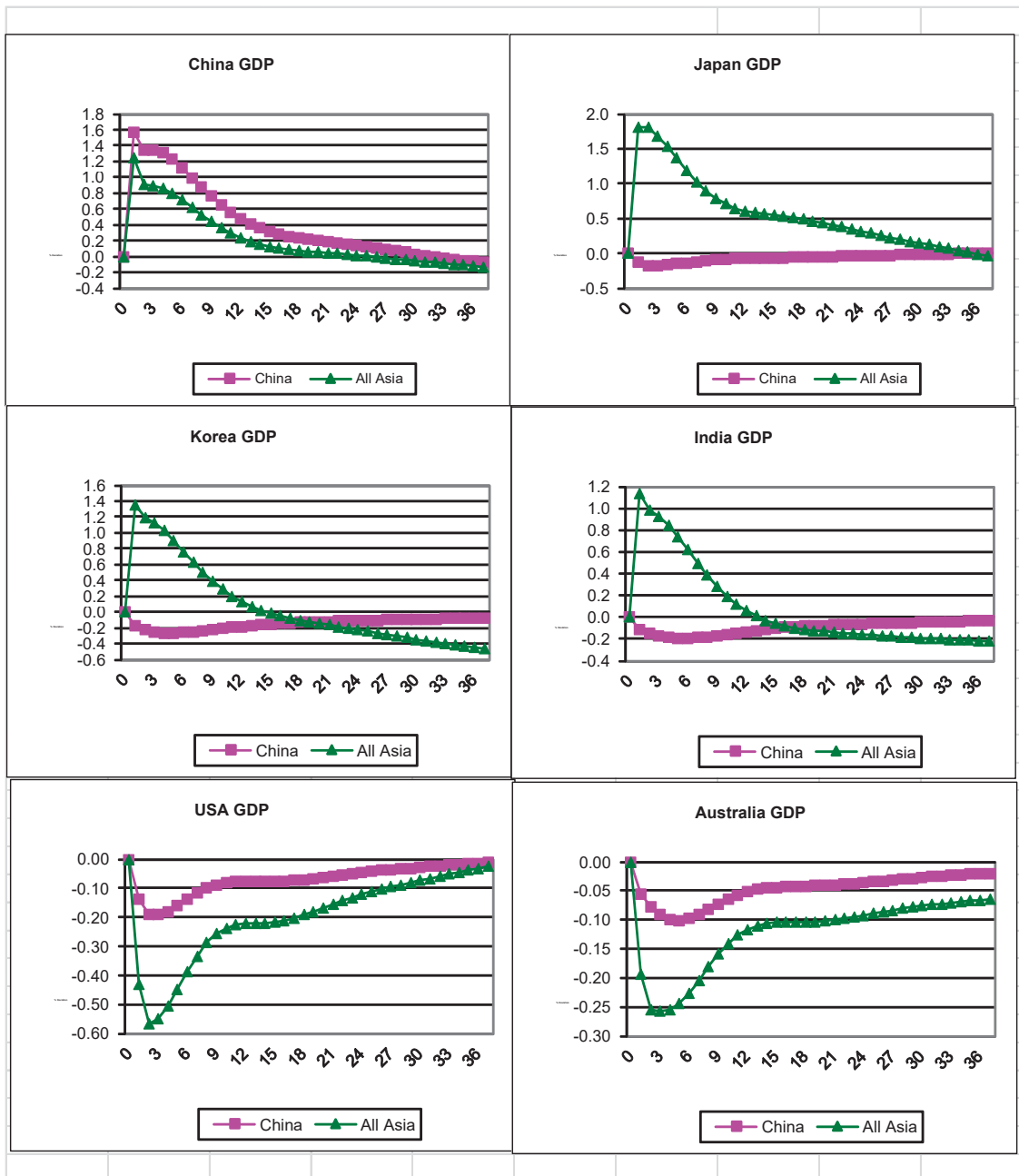
Figure 34. Trade Balance Effects of Demand Shocks in China and All of Asia
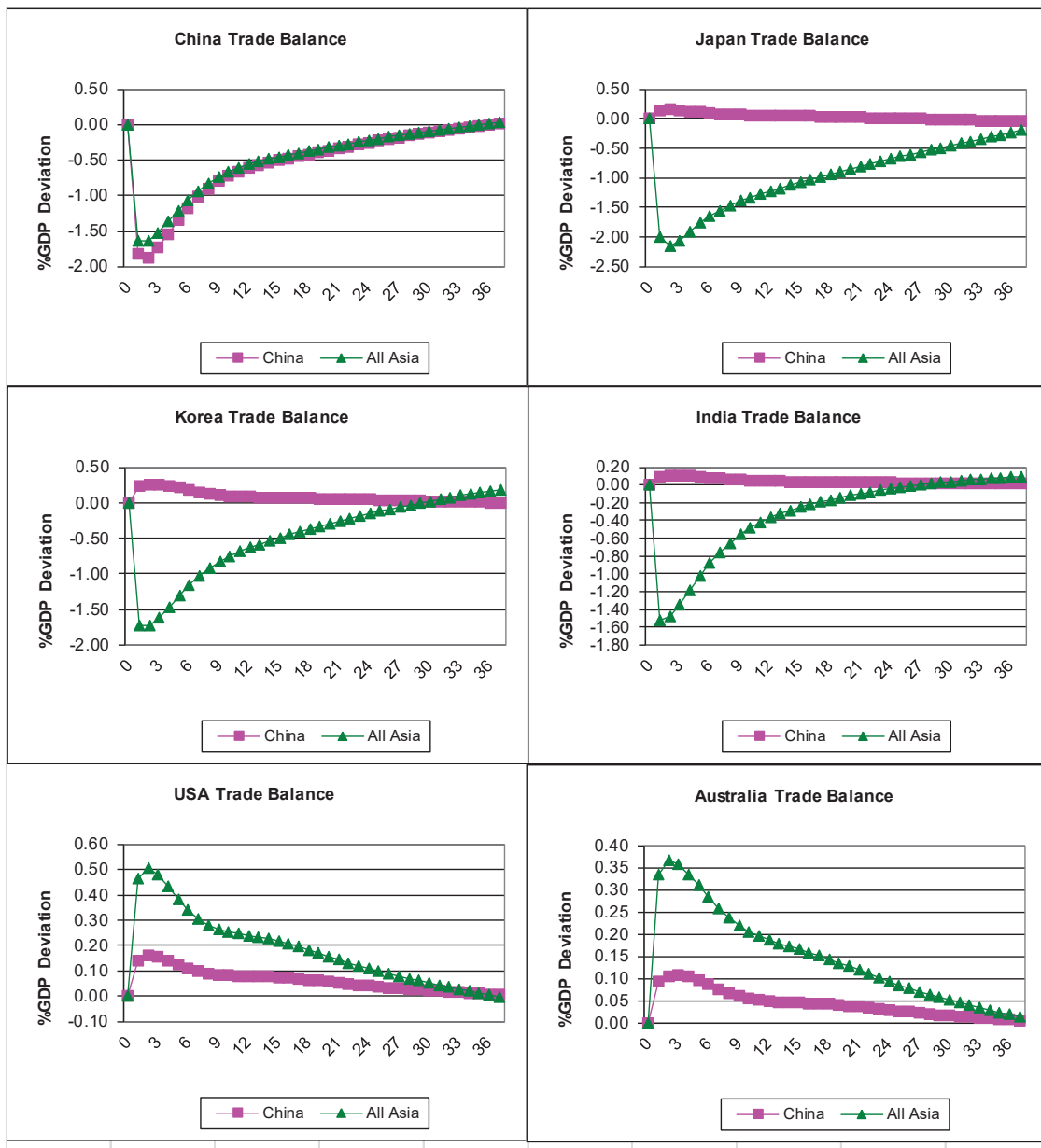
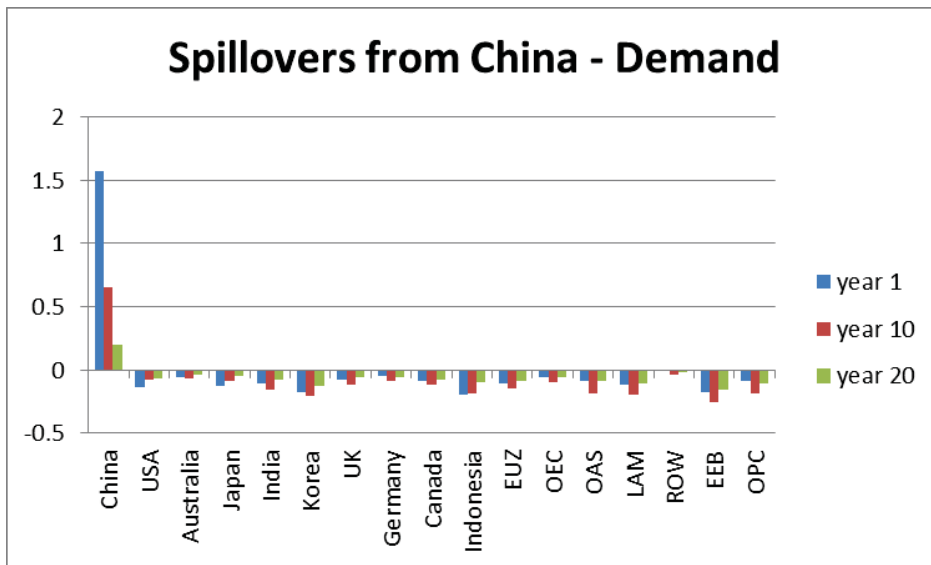**Figure 15. Global Spillovers from Demand Shocks in China and All Asia**
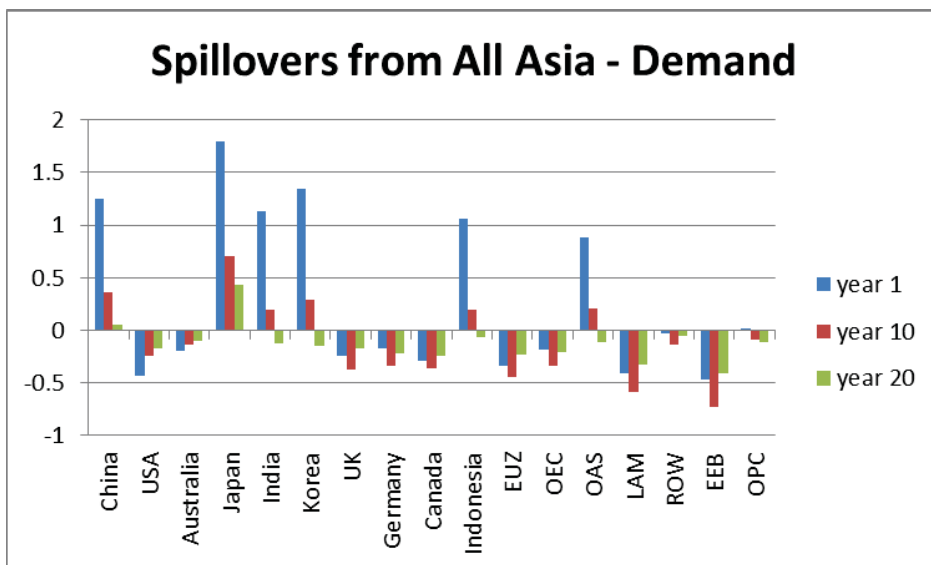
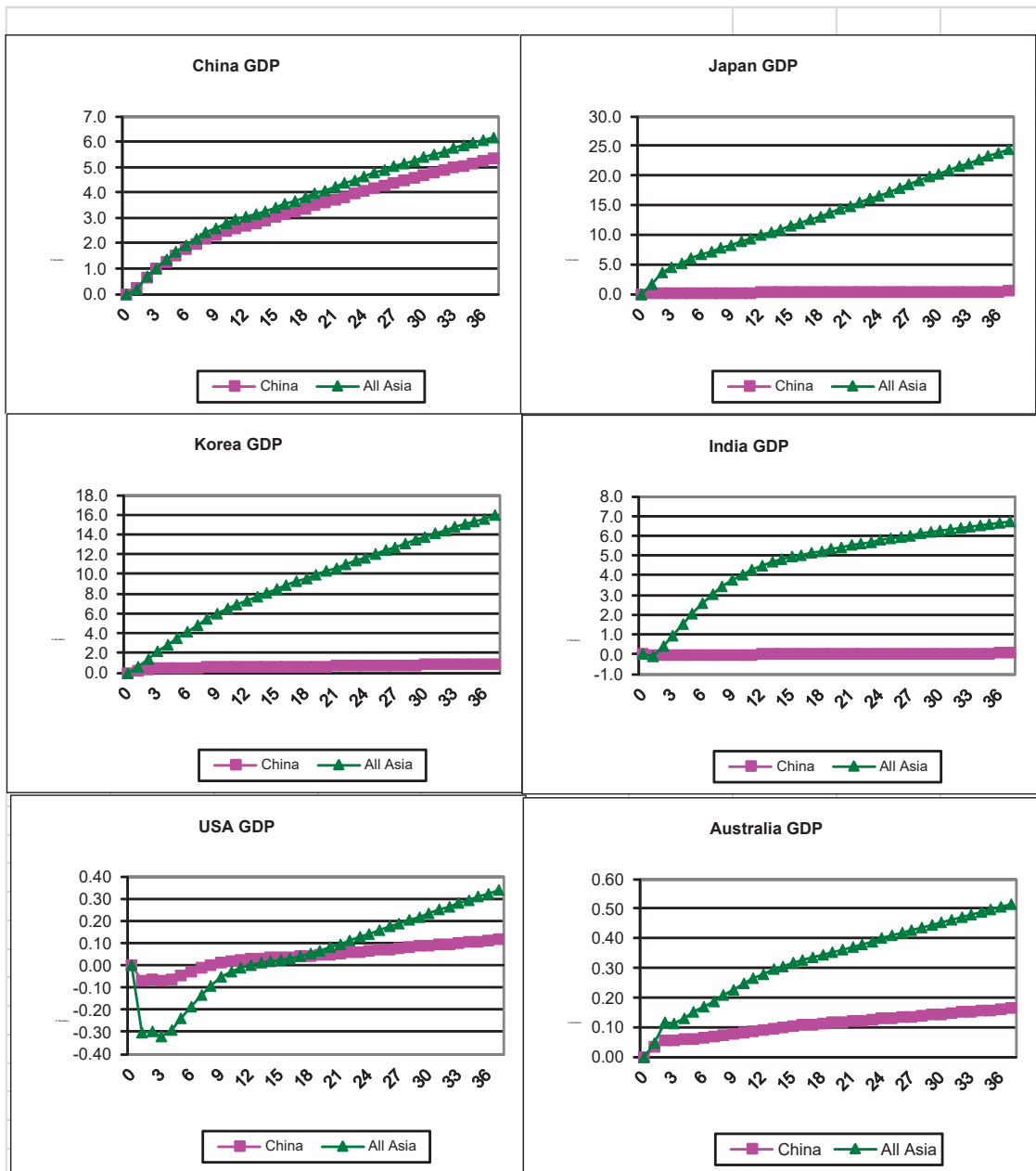**Figure 16. GDP Effects of Productivity Shocks in China and All of Asia**

Figure 17. Trade Balance Effects of Productivity Shocks in China and All of Asia
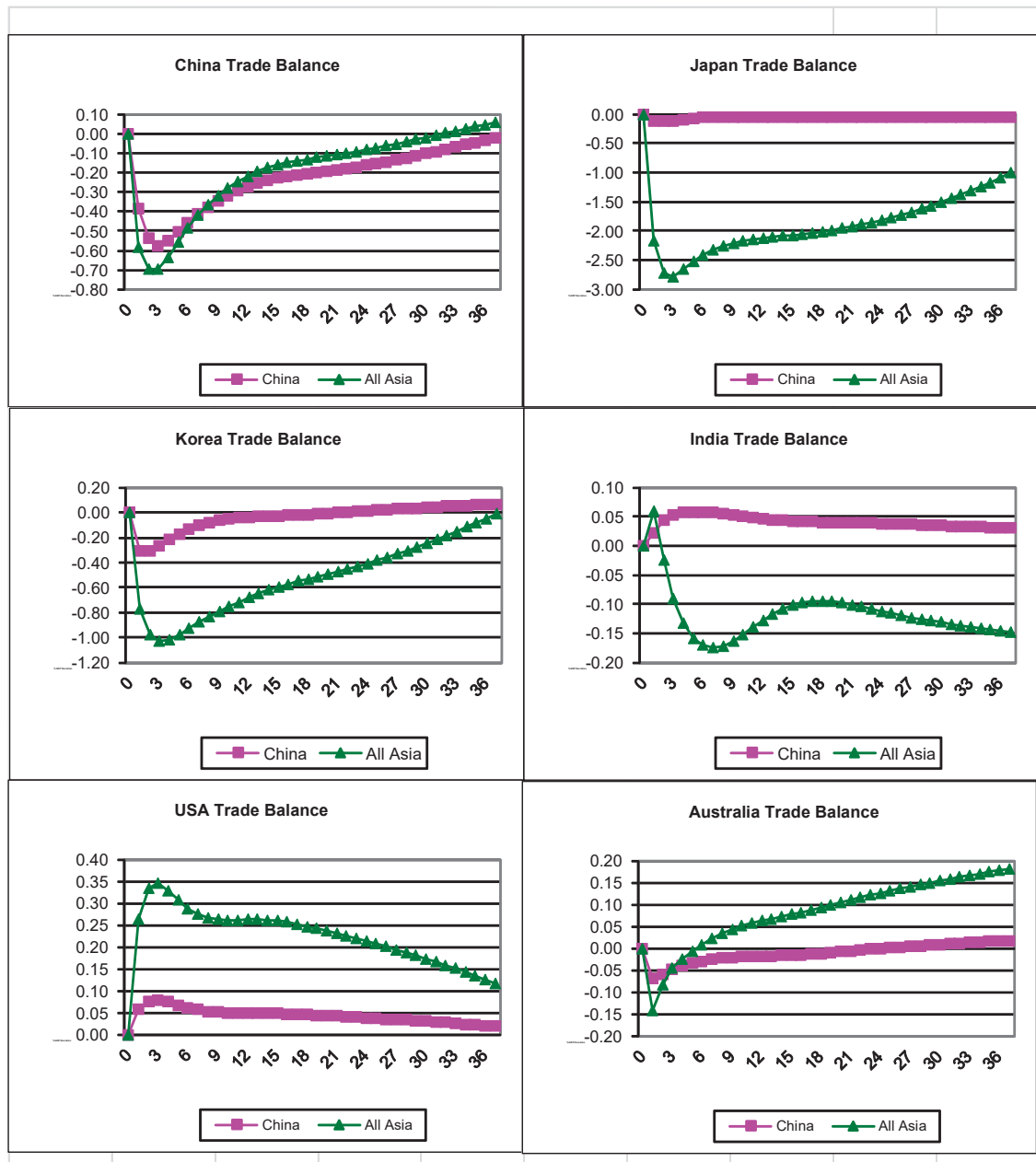
Figure 18. Global Spillovers from Productivity Shocks in China and All of Asia