



# IMF Working Paper

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## Emerging Asia's Impact on Australian Growth: Some Insights From GEM

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Asia and Pacific

**Emerging Asia's Impact on Australian Growth: Some Insights From GEM**

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**Abstract**

Over the last decade, GDP growth in emerging Asia was roughly twice as fast as average world growth. The IMF's Global Economy Model (GEM) is used to estimate the impact that emerging Asia's growth differential has had on Australia. The simulation analysis, which replicates some key features from the last decade, suggests that roughly 25 percent of Australia's growth over the last decade has been from emerging Asia's growth differential over that period. Looking ahead, the analysis suggests that should emerging Asia continue to grow in a similar fashion, Australia's growth dividend could almost double. On the other hand, if growth in emerging Asia remained strong, but became more balanced across the tradable and nontradable goods sectors then Australia's growth dividend would be slightly lower than the estimate for the last decade.

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## I. INTRODUCTION

Rapid growth in emerging Asia over the last decade has had a significant impact on the world economy. With that growth skewed toward the export sector, the import of competitively priced goods from emerging Asia has helped keep inflation in tradable goods prices low. On the other hand, the increase in demand for raw materials associated with this rapid growth has also been a factor raising commodity prices. Australia has been uniquely positioned to benefit from both of these developments and its terms of trade have improved to record highs. With a relatively small manufactured goods sector, Australia has long relied on imported manufactured goods and competitively priced goods from emerging Asia have become a significant share of imports in Australia. In addition, Australia's endowment of key commodities heavily demanded by emerging Asia has buoyed export volumes and notably increased export incomes.

This paper uses a version of the IMF's Global Economy Model (GEM) to estimate the impact of emerging Asia's rapid growth on Australian GDP over the last decade and potentially the next. GEM's flexible multi-region and multiple-good structure make it a particularly useful tool for examining this issue. A four-region version of GEM is used. The regions are calibrated to represent Australia, emerging Asia, the United States, and remaining countries. To capture the two main channels through which emerging Asia's growth has impacted Australia, commodity exports and the import of competitively priced manufactured goods, the model has been configured with three goods: a tradable commodity good, used as an input; a tradable finished good (manufactures); and a nontradable finished good.

Two stylized facts from the last decade form the basis of the simulation analysis. The first is the gap in tradable sector productivity growth between emerging Asia and other countries that underlies the differential in real GDP growth witnessed over roughly the last decade. The second is the increase in the share of imports coming from emerging Asia evident in trade data.

The simulation analysis that examines the last decade suggests that a sizable portion of Australia's growth can be explained through its trading relationship with emerging Asia. The simulation includes two key elements. The first is a 10-year increase in emerging Asia's real GDP of 50 percent driven by tradable sector productivity growth, which broadly captures emerging Asia's growth differential and its apparent driver. Second, the increase in imports from emerging Asia in other countries' import bundles also replicates the increases seen in the data. Together these two factors raise Australian real GDP by almost 11 percent, roughly 25 percent of the increase over the period. The simulation results suggest that the impact on Australia is several times larger than the impact on the United States and the block of remaining countries when considered as an aggregate.

Looking ahead, should emerging Asia grow in a similar fashion and Australia's share of imports from this region rise by a similar amount, the impact on Australia will be even larger. The simulation analysis suggest that over the next 10 years, a 50 percent increase in emerging Asia's real GDP driven by tradable sector productivity growth would raise Australian GDP by 18 percent. This larger impact reflects both the increase in emerging Asia's economic size and Australia's growing integration with emerging Asia. Again this

growth dividend is much larger for Australia than for the United States or the block of remaining countries. However, should emerging Asia's growth continue to outperform, but become more balanced with productivity growth in both the tradable and nontradable sectors contributing equally, the growth dividend is roughly cut in half.

Australia's economic fortunes becoming increasingly tied to emerging Asia has several important policy implications. First, adjustment within Australia to the impact of emerging Asia implies significant resource reallocation across sectors and policy can maximize the benefits by facilitating that reallocation. Second, Australia's longer-term growth potential will have a large externally determined component, the magnitude of which will likely be highly uncertain. Policies focused on long-term objectives will need to factor in this uncertainty. Finally, although the simulation analysis presented here assumes that emerging Asian growth occurs smoothly, in reality it is likely to be more variable. Policy will need to be well positioned to respond to the resulting volatility. For fiscal policy, this could imply allowing larger swings in the fiscal balance than would occur in economies less exposed to large exogenous shocks. For monetary policy, continuing to fully utilize the flexibility provided in the specification of the inflation target will be important. Financial sector regulation and supervision that erred toward conservatism would also be prudent.

Another interesting result in the simulation analysis is the adjustment in real exchange rates required to maintain external balance. With productivity growth in the tradable goods sector driving the growth differential in emerging Asia, the Balassa-Samuelson effect suggests that there should be significant pressure for emerging Asia's real exchange rate to appreciate. Although the simulation that replicates the past decade does in fact suggest that substantial appreciation is required, the inclusion of commodities into the framework moderates the magnitude of the required appreciation. Emerging Asia is a net importer of commodities, the relative price of which is highly sensitive to increases in demand owing to a fixed factor in commodity production. Consequently, the import of increasingly expensive commodity goods helps balance emerging Asia's current account leaving less work for the exchange rate to do.

In the simulation analysis that estimates what the future impact might be, rising commodities prices play an even larger role in moderating the extent of the required appreciation in emerging Asia's real exchange rate. The analysis also illustrates that if emerging Asia's growth was to remain notably faster than most other regions of the world, but become more balanced across the tradable and nontradable goods sectors, a significant depreciation of emerging Asia's real exchange rate would be required to maintain external balance. Consequently, if there are undervalued exchange rates in the region, more balanced growth could help resolve exchange rate disequilibria. The underlying equilibrium exchange rate would decline over time bringing it more in line with the actual exchange rate and thereby moderate required exchange rate adjustment.

The remainder of the paper is organized as follows. Section II provides an overview of GEM. Section III presents the stylized facts that serve as the basis for the simulation analysis. Section IV contains the simulation results. Section V concludes.

## II. THE MODEL

GEM is a multi-region, multiple-good model of the world economy that is derived from optimizing foundations.<sup>1</sup> In each region there are households, firms, and a government. Households maximize utility derived from the consumption of goods and leisure. Firms combine capital and labor, with either non-energy commodities or land to maximize the net income from goods production. Governments consume goods financed through non-distorting taxes and adjust short-term nominal interest rates to provide nominal anchors.

### A. Households

Households are infinitely lived, consume goods, and are the monopolistic suppliers of differentiated labor inputs to all domestic firms. Households exhibit habit persistence in consumption contributing to real rigidities in economic adjustment. Monopoly power in labor supply implies that households' wages contain a markup over the marginal rate of substitution between consumption and leisure. Because of adjustment costs in wage contracts, aggregate nominal rigidities arise through wage bargaining. Households own all domestic firms, the domestic capital stock, and the land, which they rent to domestic firms. The markets for capital and land are competitive. Capital accumulation is subject to adjustment costs that contribute to gradual economic adjustment. The supply of land is fixed.

### B. Firms

Firms produce three types of goods: a nontradable good; a tradable noncommodity good; and a tradable non-energy commodity good. Goods are assumed to be differentiated, leading to market power that enables firms to charge a markup over the marginal cost of production. Goods prices are subject to adjustment costs that, along with slowly adjusting wages, give rise to the gradual adjustment of prices to economic disturbances. The characteristics of the final bundle of goods consumed in each region reflect the preferences of households and firms over all goods and, consequently, international trade is driven by the interaction of preferences and relative prices.

Capital, labor, and commodities are combined to produce the tradable noncommodity good and the nontradable good. The production process is given by:

$$Y = f(A, K, L, Q_C, M_C), \quad (1)$$

where  $Y$  denotes the output of the noncommodity tradable good and the nontradable good,  $A$  denotes the level of productivity,  $K$  is the capital input,  $L$  is the labor input,  $Q_C$  is the domestically produced commodity input, and  $M_C$  is the imported commodity input. The production technology,  $f$ , embodies constant elasticity of substitution. For this application, noncommodities goods production is calibrated to be Cobb Douglas. Producers have a very high elasticity of substitution between imported and domestically produced commodities capturing the notion of a single world market for commodities.

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<sup>1</sup> For a detailed descriptions of GEM's structure and dynamic adjustment properties see Laxton and Pesenti (2003), Hunt (2005), and Hunt and Rebucci (2005).

Commodities are produced combining capital, labor, and a fixed factor, land. The production technology is given by:

$$Q_C = f(A, K, L, Land), \quad (2)$$

where  $Q_C$  is domestically produced commodities,  $A$  denotes the level of productivity,  $K$  represents the capital input,  $L$  denotes the labor input, and  $Land$  is the fixed factor. The production technology,  $f$ , embodies constant elasticity of substitution. For this application,  $Land$  is calibrated to be the most important input into commodities production and the elasticity of substitution among land, labor, and capital is low.

### C. Government

Government spending falls exclusively on nontradable goods. Government spending is financed through a nondistorting tax. The government controls the national short-term nominal interest rate with the objective of providing a nominal anchor for the economy. The nominal anchors in Australia, the United States, and the block of remaining countries are inflation rates. For emerging Asia, the nominal anchor is stability in the nominal exchange rate between the Asian currency and the U.S. dollar.

### D. The Exchange Rate

The key role for the exchange rate in GEM is to maintain external balance. In the short-run, differentials in real interest rates can move exchange rates away from the levels required to maintain current accounts and thus net foreign assets positions at their desired levels. However, ultimately real exchange rates will adjust to maintain external balance.

### E. Parameterization

Parameter values for GEM are derived through calibration. Specific parameter values are determined by balancing several factors: empirical estimates available in the literature, the desired steady-state characterization of the economies, and the model's dynamic adjustment properties. The focus of the calibration for this exercise has been the steady state characteristics, in particular the trading relationships among the four blocks. Empirical evidence on markups and the expenditure shares of GDP in each of the blocks have also been incorporated into the calibration. However, because the shocks under consideration are long-lived, and the focus of the analysis is to understand the long-term trends, less attention has been given to precise calibration of quarterly adjustment dynamics. Behavioral parameters that do not affect expenditure shares or trading relationships have been set identically in all countries/blocks. Nominal and real adjustment cost parameters are also identical although nominal and real dynamics will differ because of different proportions of liquidity constrained households and different markups in goods and labor markets.<sup>2</sup>

Two version of the model are calibrated. The first reflects the characteristics of these blocks as of 1997. The second is calibrated to represent their characteristics as of 2007. The version of the model calibrated to reflect 1997 is used to estimate the historical impact that emerging

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<sup>2</sup> Calibration detail for all of the model's parameters are available from the author on request.

Asian's growth differential may have had on Australia. The version calibrated to reflect 2007 is used to estimate what the future impact might be. The 1997 to 2007 period was chosen because the UN Comtrade data used to calibrate the blocks' trading relationships is only partially complete for 2008 and beyond. Further, 2008 and 2009 data would have the impact of the global financial crisis distorting the 10-year trend. Aside from some steady-state shares in GDP not shown below, the key differences in the calibration between the two periods are in the relative sizes of the countries/blocks and the trading relationships among them, which are detailed in Tables 1 and 2 below.

Table 1: Calibration for Key Trading Relationships, 1997

	Australia	Emerging Asia	United States	Remaining Countries
Relative size	0.014	0.100	0.277	0.609
Imports/GDP	0.19	0.32	0.13	0.08
Noncommodities from				
Australia	0	0.007	0.0004	0.001
Emerging Asia	0.042	0	0.029	0.031
United States	0.039	0.048	0	0.037
Remaining countries	0.089	0.205	0.080	0
Commodities from				
Australia	0	0.004	0.0003	0.001
Emerging Asia	0.005	0	0.0012	0.005
United States	0.002	0.008	0	0.004
Remaining countries	0.011	0.047	0.0155	0

Sources: UN Comtrade and WEO databases, and staff calculations.

Table 2: Calibration for Key Trading Relationships, 2007

	Australia	Emerging Asia	United States	Remaining Countries
Relative size	0.015	0.130	0.254	0.601
Imports/GDP	0.21	0.47	0.14	0.11
Noncommodities from				
Australia	0	0.009	0.0004	0.002
Emerging Asia	0.075	0	0.029	0.063
United States	0.026	0.032	0	0.036
Remaining countries	0.086	0.331	0.080	0
Commodities from				
Australia	0	0.006	0.0003	0.001
Emerging Asia	0.010	0	0.0012	0.008
United States	0.001	0.007	0	0.004
Remaining countries	0.012	0.084	0.0155	0

Sources: UN Comtrade and WEO databases, and staff calculations.



### III. KEY STYLIZED FACTS

#### A. Emerging Asia's Growth Differential

Between 1997 and 2007, emerging Asia's real GDP grew by roughly 50 percent more than the average for the world. The increases in real GDP for the countries/regions examined in this paper are presented in Table 3. Within the regional breakdown considered, growth was lowest in the United States, while growth in Australia and the block of remaining countries was closer to world growth.

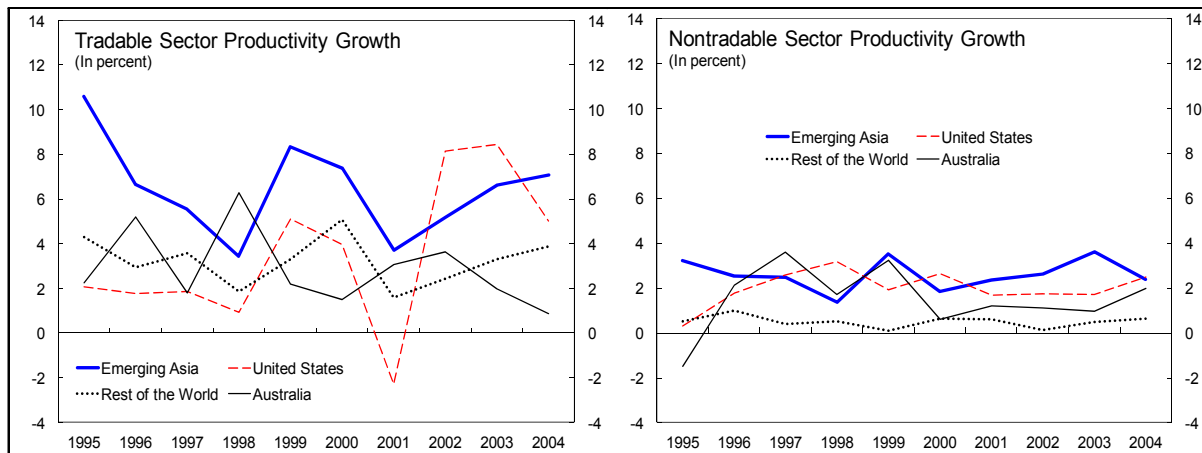
Table 3: Increase in Real GDP Between 1997 and 2007

	Australia	United States	Emerging Asia	Remaining Countries	World
Percent	43.1	35.4	97.3	44.9	47.2

Sources: World Economic Outlook database and staff calculations.

Labor productivity data suggest that emerging Asia's superior growth performance was driven primarily by faster productivity growth in the tradable sector. Annual growth rates in labor productivity in the tradable and nontradable sectors are graphed in Figure 1 and summarized in Table 4.<sup>3</sup> In all countries/regions, tradable sector productivity exceeded that in the nontraded sector, but the differential in emerging Asia is notably wider, suggesting that this was the key feature driving the growth differential. This is consistent with the evidence on sources of growth in emerging Asia presented in Kim, Park, and Park (2010) and Bosworth and Collins (2008).

Figure 1: Annual Labor Productivity Growth



<sup>3</sup> The computations are derived using data that were maintained in the IMF's Research Department to support the assessment of real effective exchange rates. However, it is necessary to use the 1995–2004 period to proxy the evolution of productivity over the last decade because this database is no longer updated due to the high cost.

Table 4: Average Annual Labor Productivity Growth, 1995–2004

	Australia	Emerging Asia	United States	Remaining Countries <sup>1</sup>
Tradables	2.9	6.5	3.5	3.2
Nontradables	1.5	2.6	2.0	0.5
Productivity gap	1.4	3.9	1.5	2.7

<sup>1</sup> The Euro Area, the United Kingdom, and Japan are used to proxy the remaining countries.

### B. Share of Imports From Emerging Asia

In the regions examined, the share of imports from emerging Asia rose sharply over the last decade.<sup>4</sup> Emerging Asia's shares of imports in the other countries/regions considered are contained in Table 5 for 1997 and 2007. For Australia and the block of remaining countries, the increase was dramatic, 15.6 and 18 percentage points respectively. For the United States it was more modest, but still notable at 6.1 percentage points.

Table 5: Share of Imports From Emerging Asia in Total Noncommodity Imports  
(In percent)

	Australia	United States	Remaining Countries
1997	24.4	26.6	44.6
2007	40.0	33.7	62.6
Change	15.6	6.1	18.0

Sources: UN Comtrade database and staff calculations.

<sup>4</sup> Given the significant disruptions to world trade that occurred during the global financial crisis, the 1997 to 2007 period was assumed to better capture the underlying trends in world trade used as a basis for this analysis.

#### IV. SIMULATION ANALYSIS

The Global Economy Model's (GEM) optimizing foundations and multiple-good structure make it particularly well suited to examine the impact of emerging Asia on Australia. In GEM, international trade is driven by tastes and technology. Consequently, the model can be used to capture the impact, via trade, of rising productivity growth in emerging Asia. The model's multiple-good structure also allows for the analysis of productivity growth in specific sectors, such as tradable goods, which has significant implications for how exchange rates need to adjust to maintain external balance. Finally, because the model can be configured to incorporate commodities, it can effectively capture the impact on countries like Australia that are highly dependent on commodity exports.

In GEM, commodities are used as an intermediate input in the production of tradable and nontradable goods. Unlike the other two goods in the model, there is a fixed factor, land, used in commodity production along with capital and labor. Consequently, the relative price of commodities is more responsive to changes in demand conditions than are other relative prices. This feature of the model helps capture the impact that the increase in emerging Asia's demand for commodities has had on prices and thus its impact on a commodity exporter like Australia. The tradable good is assumed to be more commodity intensive than the nontradable good given nontradables include a larger proportion of services with little if any commodity component. The parameters that determine commodity intensity in nontradables are roughly half as large as those in the tradable sector.<sup>5</sup>

##### A. Estimating the Historical Impact

The model is used to estimate the impact of rising tradable sector productivity growth in emerging Asia over a 10-year period. Productivity in the manufactured goods sector is increased gradually over a 10-year period by an amount sufficient to increase the level of emerging Asia's GDP by 50 percent relative to baseline. The shock is implemented assuming that people must learn about its persistence. When agents have perfect foresight under long-lived shocks that have significant implications for wealth, rational expectations models, like GEM, can produce adjustment dynamics unlike that seen in actual data. To address this and generate closer-to-real-world adjustment dynamics, the shock is implemented assuming that each period, agents must generate forecasts of the persistence in productivity growth. Here the learning is calibrated so that agents initially learn slowly about the persistence. However, as the duration of the shock increases, agents start to learn more quickly. A more detailed description of the learning process is contained in the Appendix. The baseline can be helpfully thought of as a balanced growth path and the simulation representing the marginal impact of emerging Asia's growth differential. Although the model's calibration of preferences over domestic and imported manufactured goods leads to a considerable increase in the share of imports from emerging Asia, it is necessary to impose an additional small

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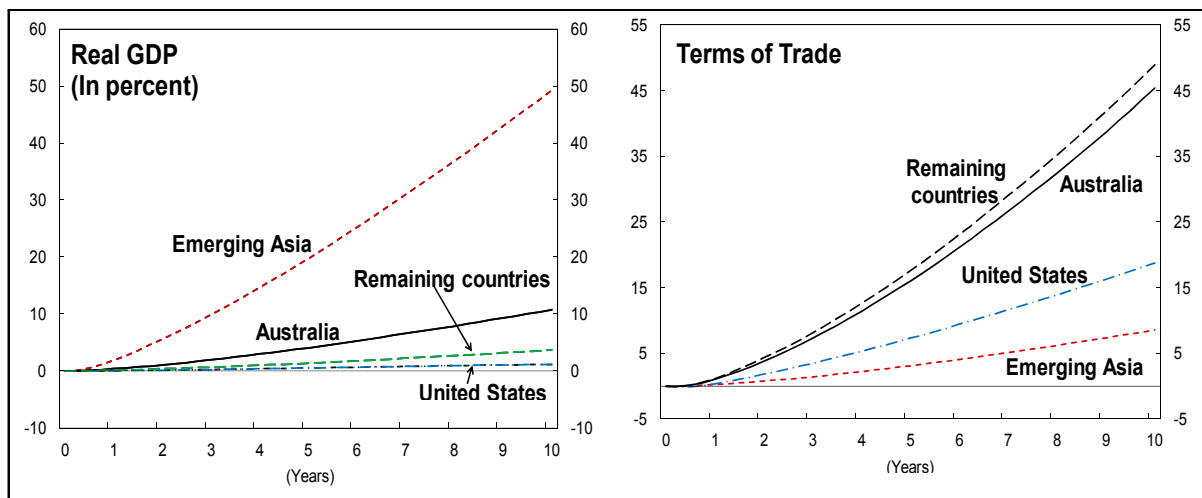
<sup>5</sup> This is not the case for emerging Asia where the parameters that determine the commodity intensity of nontradable goods are  $\frac{3}{4}$  of the size of the parameters that determine the commodity intensity of tradable goods. As emerging Asia urbanizes, infrastructure and housing, which are commodity intensive, represent a significant share of nontradables.

increase to replicate the historical rise in Australia and the block of remaining countries. The simulation results for some key macro variables are presented in Figures 2, 3, and 4.

### Real Activity

Australian GDP increases significantly more than does U.S. GDP or that in the block of remaining countries (Figure 2). Australian GDP rises by 11 percent compared to an increase of just under 2 percent in the United States and roughly 4 percent in the block of remaining countries. Looking to the relative improvements in the terms of trade provides part of the answer to the GDP outcome. Over the 10-year period, the proxy for the terms of trade based on starting period shares indicates that the terms of trade for Australia and the block of remaining countries increases significantly more than in the United States.<sup>6</sup> This reflects two factors. The first is the share of commodities in the export baskets of Australia and remaining countries, the real U.S. dollar price for which rises by 20 percent. The second is the dramatic increase in the share of competitively priced imports from emerging Asia in their import bundles. However, despite similar improvements in the terms of trade in Australia and remaining countries, the impact on Australian GDP is much larger because trade is a much larger share of GDP in Australia.

Figure 2. GDP Impact of Productivity Growth Gap in Emerging Asia's Tradable Sector  
(Percent deviation from baseline)



<sup>6</sup> The terms-of-trade proxy contained in the figures is based on starting period volumes and actual period prices. An alternative measure based on actual volumes and prices shows a much larger increase in the terms of trade for all blocks except emerging Asia, where the terms of trade decline. The ideal chain-weighted index would lie somewhere between the two, but is too complex to add to already complicated model code.

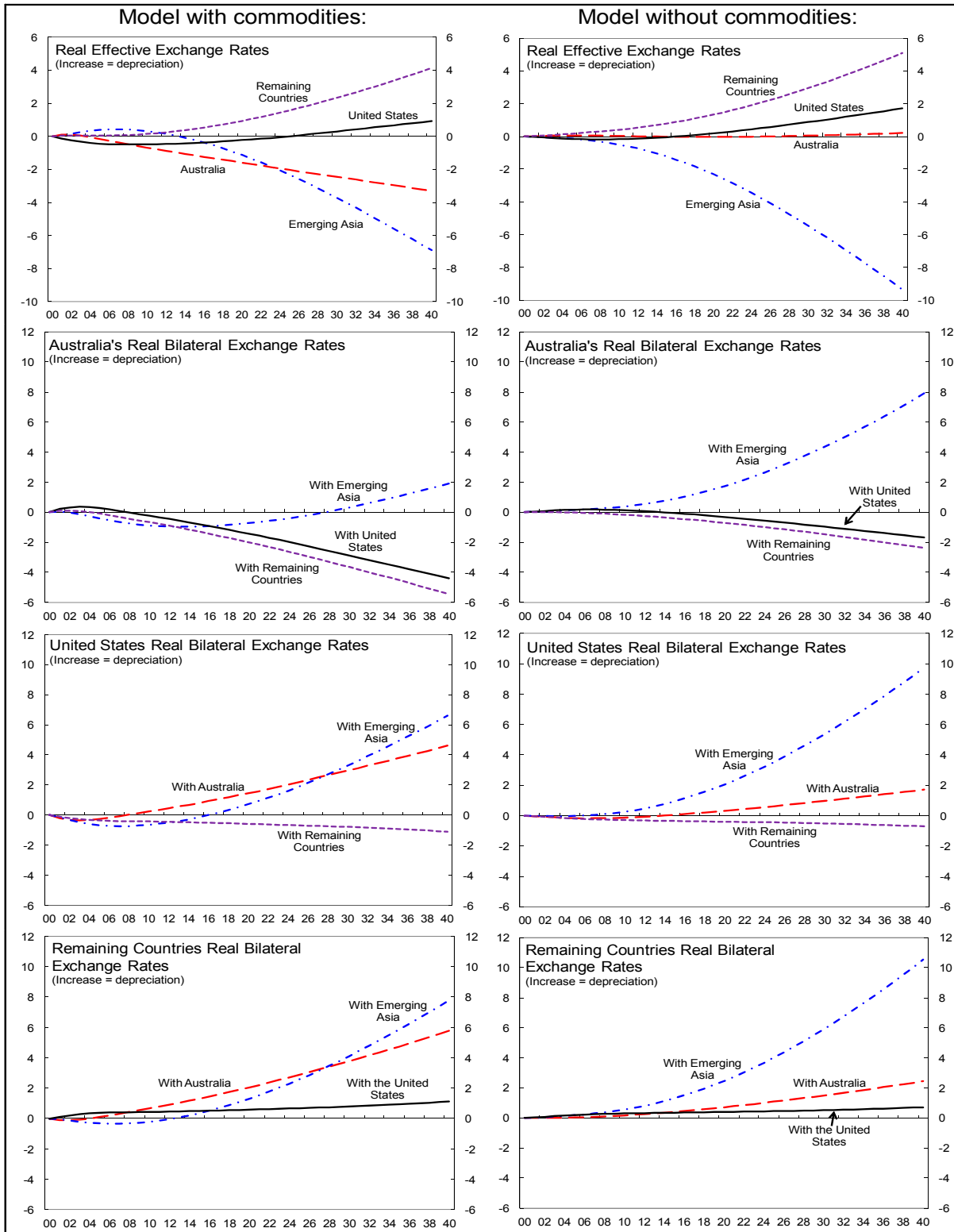
## Real Exchange Rates

As noted earlier, the key role for the exchange rate in GEM is to maintain current accounts and net foreign asset positions at their desired levels. The addition of the tradable commodity good provides some insights on the required adjustments in real exchange rates necessary to maintain external balance. In Figure 3, the behavior of real exchange rates to the shock is presented under two alternative versions of the model. The left-hand column is the response under the version of the model that includes commodities and that is used throughout the paper. The right-hand column presents the response of exchange rates under a simpler two-good version of the model. This version excludes commodities and thus contains only a single tradable good and a nontradable good.

In the simpler two-good framework, the Balassa (1964)-Samuelson (1964) effect is driving the adjustment of exchange rates. As the top right-hand panel shows emerging Asia experiences a real effective appreciation and all other countries/blocks experience real effective depreciations. The bilateral exchange rates in the bottom three right-hand panels show that everyone experiences a large depreciation relative to emerging Asia. To maintain balance in the current account given the decline in the price of tradable goods from emerging Asia, these regions' exchange rates must depreciate to improve the competitiveness of domestically produced tradable goods. The extent of the depreciation reflects the relative importance of trade between emerging Asia and each of the regions. From emerging Asia's perspective, their currency needs to appreciate to improve the competitiveness of foreign-produced tradable goods.

In the version of the model that includes commodities, the magnitude of the real appreciation in the emerging Asia currency is reduced by more than 25 percent. The increase in the real price of commodities, which emerging Asia is a net importer of, contains the magnitude of the appreciation required to maintain external balance. After 10 years, emerging Asia's real effective exchange rate needs to appreciate by just under 7 percent in the version of the model that includes commodities compared to a real appreciation of over 9 percent in the version that excludes commodities. The presence of commodities reverses the sign of the required movement in Australia's real effective exchange rate, which appreciates by just under 4 percent compared to a small depreciation in the version of the model without commodities. Looking at the bilateral rate between Australia and emerging Asia, the standard Balassa-Samuelson effect is exerting depreciation pressure against the Asian currency due to the increase in imports of competitively priced manufactures from that region. The increase in real commodities prices on the other hand is exerting appreciation pressures. The Balassa-Samuelson effect dominates and Australia's real exchange rate relative to the Asian currency depreciates, but by roughly 75 percent less than in the model that excludes commodities. Including commodities also moderates the extent of the depreciation of the U.S. dollar and remaining countries currencies relative to the Asian currency, but by notably less than the moderation in the Australia-Asia bilateral rate. Consequently, the Australian real bilateral rate with the United States and with remaining countries appreciates by more which leads to the appreciation in Australia's real effective exchange rate.

Figure 3. The Impact on Real Exchange Rates of Faster Productivity Growth in Emerging Asia's Tradable Sector  
(Percent deviation from baseline)



Because the simulation analysis is conducted allowing real exchange rates to adjust to maintain external balance it can offer only limited insight on the issue of the global imbalances that have built up over the last decade. However, one factor often cited as underlying those imbalances is undervalued exchange rates in emerging Asia. This simulation suggests that, if the region was able to prevent its real effective exchange rate from adjusting, the tradable-sector productivity growth that fueled its growth over the period may have contributed less than is often assumed to undervaluation because of the regions imports of increasingly expensive commodities.

### **Impact on Australia**

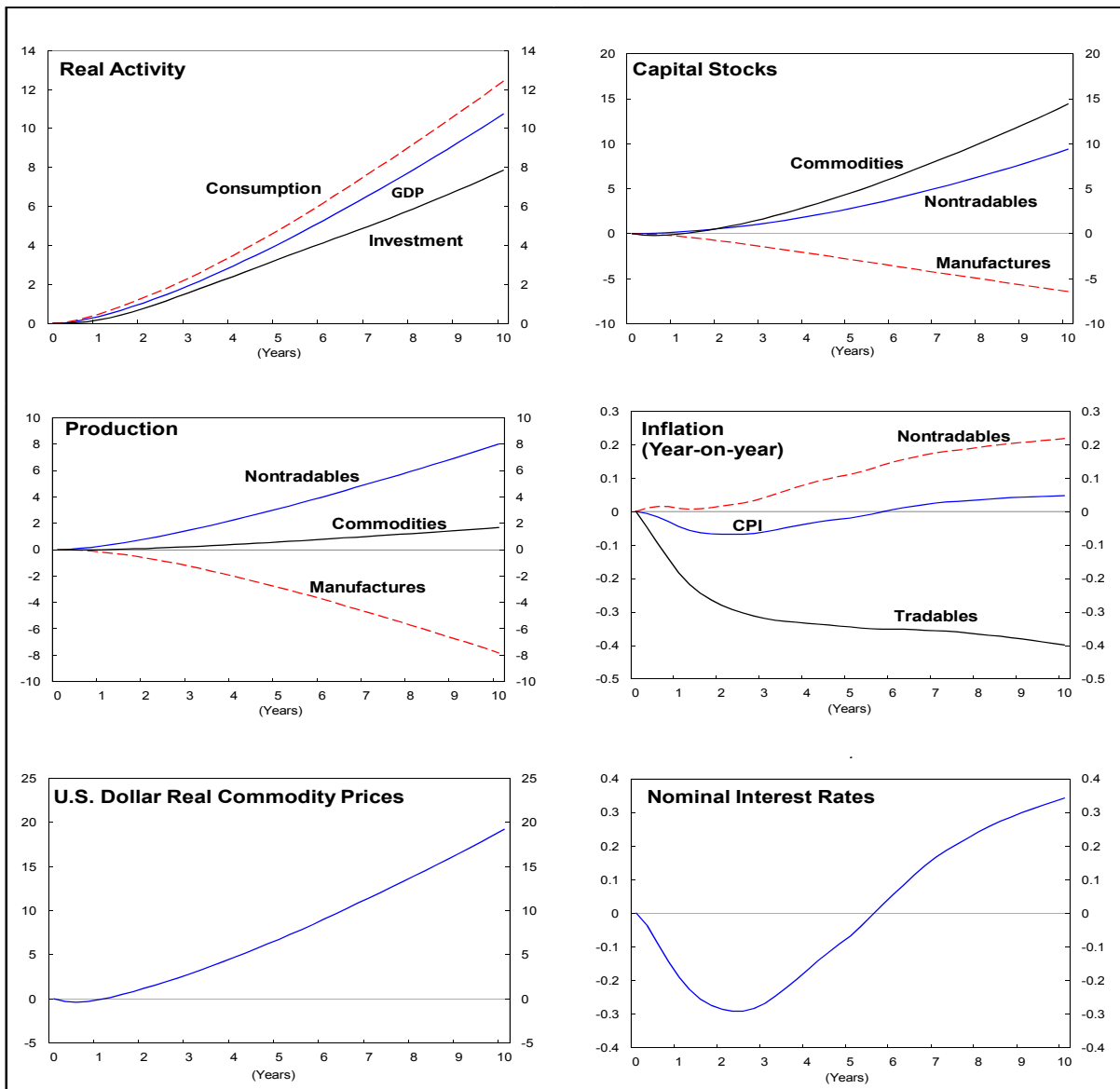
Rapid growth in emerging Asia raises both consumption and investment in Australia and leads to considerable reallocation of resources across sectors. With tradable goods prices declining, household real wages rise, which in turn raises labor supply. Household returns from the ownership of the commodity sector also increase substantially. Both these factors help fuel the increase in consumption. Investment also rises given increased returns to capital. However, a larger decline in the relative price of investment goods, owing to their higher import content, moderates the increase in real investment relative to the rise in GDP. Increased investment is directed to the nontradable and commodity sectors as the capital stock in the manufactured goods sector declines. Although not shown, changes in labor inputs closely mirror the changes in the sectors' capital stocks. Although the changes in production in nontradables and manufactured goods closely matches the changes in their capital stocks, the increase in commodity production is notably lower than the increase in factor inputs, reflecting the importance of land in commodity production.

An interesting aspect of this simulation is that the increase in Australian GDP that arises from its integration with fast growing emerging Asia is driven by factor accumulation, both capital and labor. That factor accumulation, rather than being motivated by rising marginal products associated with productivity growth, is driven by increasing returns. For capital it is from the rise in real commodity prices and nontradable goods prices as demand for nontradables increases along with rising household wealth. For labor it is because of rising real wages owing to declines in tradable goods prices and increased labor demand given capital accumulation. This provides some insight into the characteristics of Australian growth over the last decade. During this period, GDP growth in Australia has remained robust while the estimated contribution of productivity to that growth has declined relative to earlier periods as outlined in Rahman, Stephan, and Tunny (2009) and Sun (2010). This simulation suggests that rising returns to both capital and labor encouraged factor accumulation resulting in robust output growth even though productivity growth slowed.

Although the model captures some of the broad features seen in the CPI data, it does not capture the magnitude of the inflation pressures witnessed in Australia at the height of the recent commodity boom. The competitively priced tradable manufactured goods from emerging Asia put significant downward pressure on tradable goods prices, which initially drives CPI inflation below baseline. However, as households learn more about the

persistence of the increase in productivity in emerging Asia, and thus form better expectations of it implications for their wealth, demand for nontradable goods accelerates. The resulting pickup in nontradable goods inflation eventually drives CPI inflation above baseline. However, CPI inflation does not increase much above baseline and this probably reflects two factors. First, commodities do not feed directly into the CPI basket in the model. Commodities are only used as intermediate inputs and costly adjustment slows the pass-through of higher commodity prices into final goods prices. Second, there is no fixed factor in nontradable goods production and this is likely leading to an understatement of the impact on inflation of the increased demand for nontradables.

Figure 4. The Impact of Emerging Asia Growth on Australia  
(Percent or Percentage Point Deviation from Baseline)



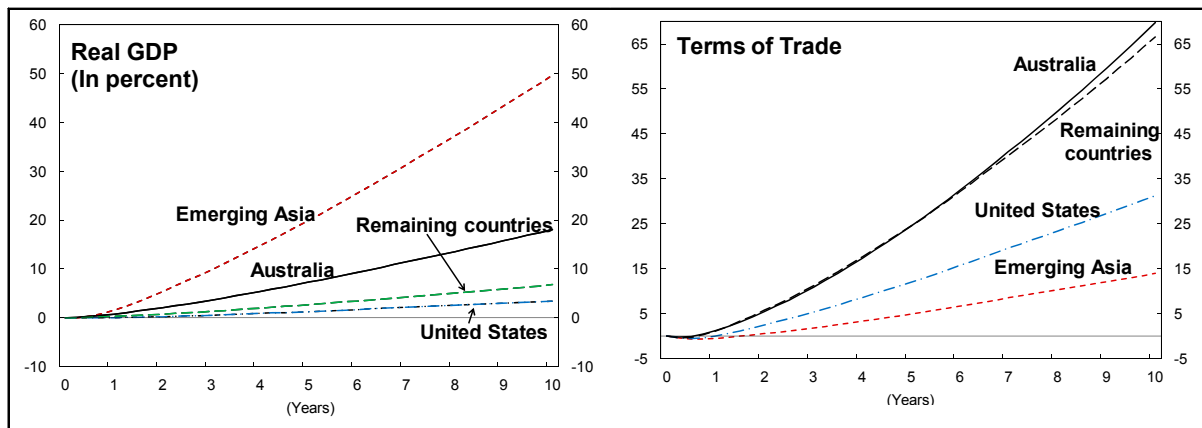


## B. Estimating the Future Impact: Continued Tradable-Sector-Driven Growth

### Real Activity

If the next decade evolves just as the previous decade, faster growth in emerging Asia will increase growth in the rest of the world by more than the estimated impact over the last decade. The outcomes for some key macro variables from the simulation analysis of what might occur over the coming decade are presented in Figures 5, 6, and 7. Increasing emerging Asia's GDP by 50 percent over 10 years with an increase in the manufactured goods sector productivity and replicating the increase in the share of imports from emerging Asia in Australia, raises Australian GDP by 18 percent after 10 years. GDP in the block of remaining countries increases by roughly 7 percent, with U.S. GDP rising by roughly 3½ percent. Part of the reason for the better performance of the United States is that the remaining countries share of imports from emerging Asia was not increased beyond what the model's properties delivered. The share of imports from emerging Asia in the block of remaining countries import bundle increased by 10 percentage points in the simulation, bringing it close to 75 percent. Having it increase further seems implausible. Increasing it further would have lowered imports from the United States and thus U.S. GDP. Overall, the larger impact on GDP in this simulation compared to the simulation that estimates the historical impact arises because of the increased size of emerging Asia and its greater share in other countries' import bundles.

Figure 5. GDP Impact of Productivity Growth Gap in Emerging Asia's Tradable Sector  
(Percent deviation from baseline)



### Real Exchange Rates

The movements in real effective exchange rates required to maintain external balance once again reflect the importance of commodities. In the previous simulation, emerging Asia's real effective exchange rate needed to appreciate by roughly 7 percent at the end of the 10-year period. In this simulation the required appreciation is about 1 percent.<sup>7</sup> Commodities prices in

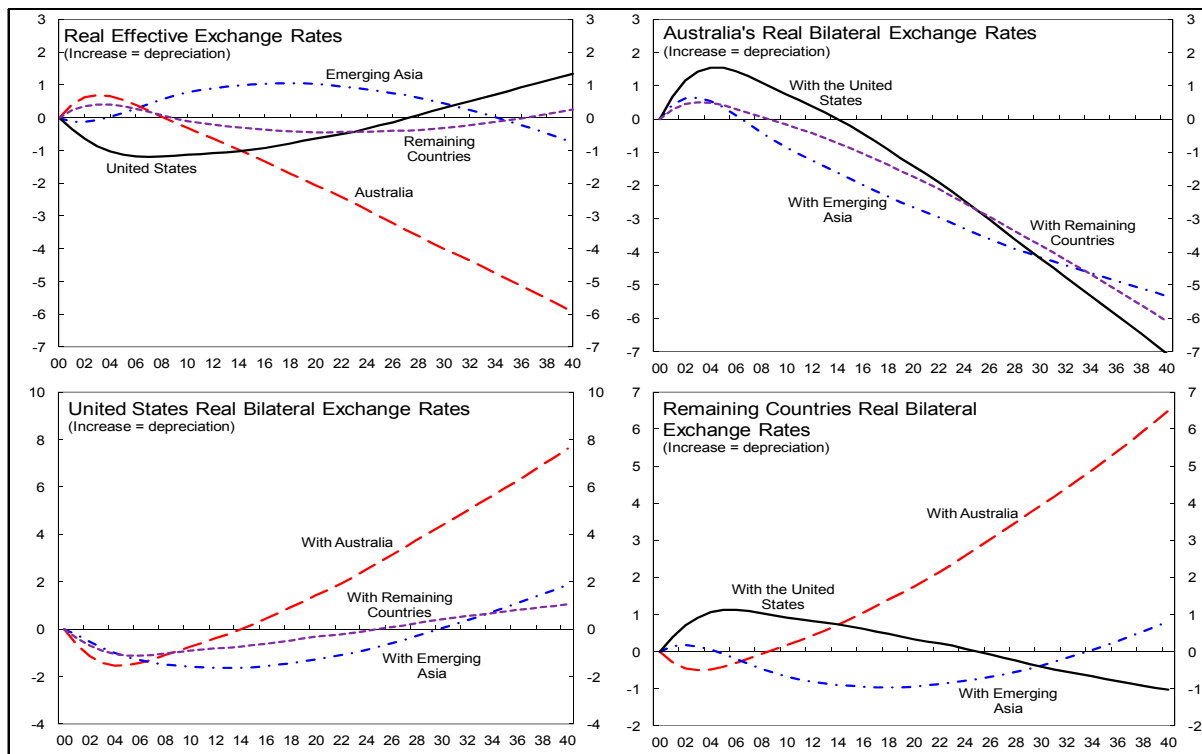
<sup>7</sup> In the very long run, the required appreciation to the 50 percent increase in emerging Asia's real GDP is 6 percent in this simulation and 12 percent in the previous simulation. If demand for emerging Asia's

(continued...)

this simulation increase by 50 percent more than in the previous simulation leading to a roughly 50 percent larger improvement in the terms of trade for Australia and the block of remaining countries. With emerging Asia even more dependent on commodity imports from the rest of the world and given the larger increase in real commodity prices, maintaining external balance in the current account requires even less real effective exchange rate appreciation. Australia's real effective exchange rate, however, needs to appreciate by 6 percent, almost twice the appreciation in the previous simulation. This appreciation reflects the rising importance of commodities in Australia's export bundle, which more than offsets the depreciation pressures coming from the typical Balassa-Samuelson effect given imports of competitively priced manufactured goods from emerging Asia.

The appreciation pressure on the Australian dollar is evident in all the real bilateral rates. After 10 years, the Australian dollar appreciates in real terms by roughly 5 percent against the Asian currency, by 6 percent against the block of remaining countries currency, and by more than 7 percent against the U.S. dollar. The U.S. dollar depreciates against all currencies in real terms, in part reflecting its position as a net commodity importer.

Figure 6. The Impact on Real Exchange Rates of Faster Productivity Growth in Emerging Asia's Tradable Sector  
(Percent deviation from baseline)

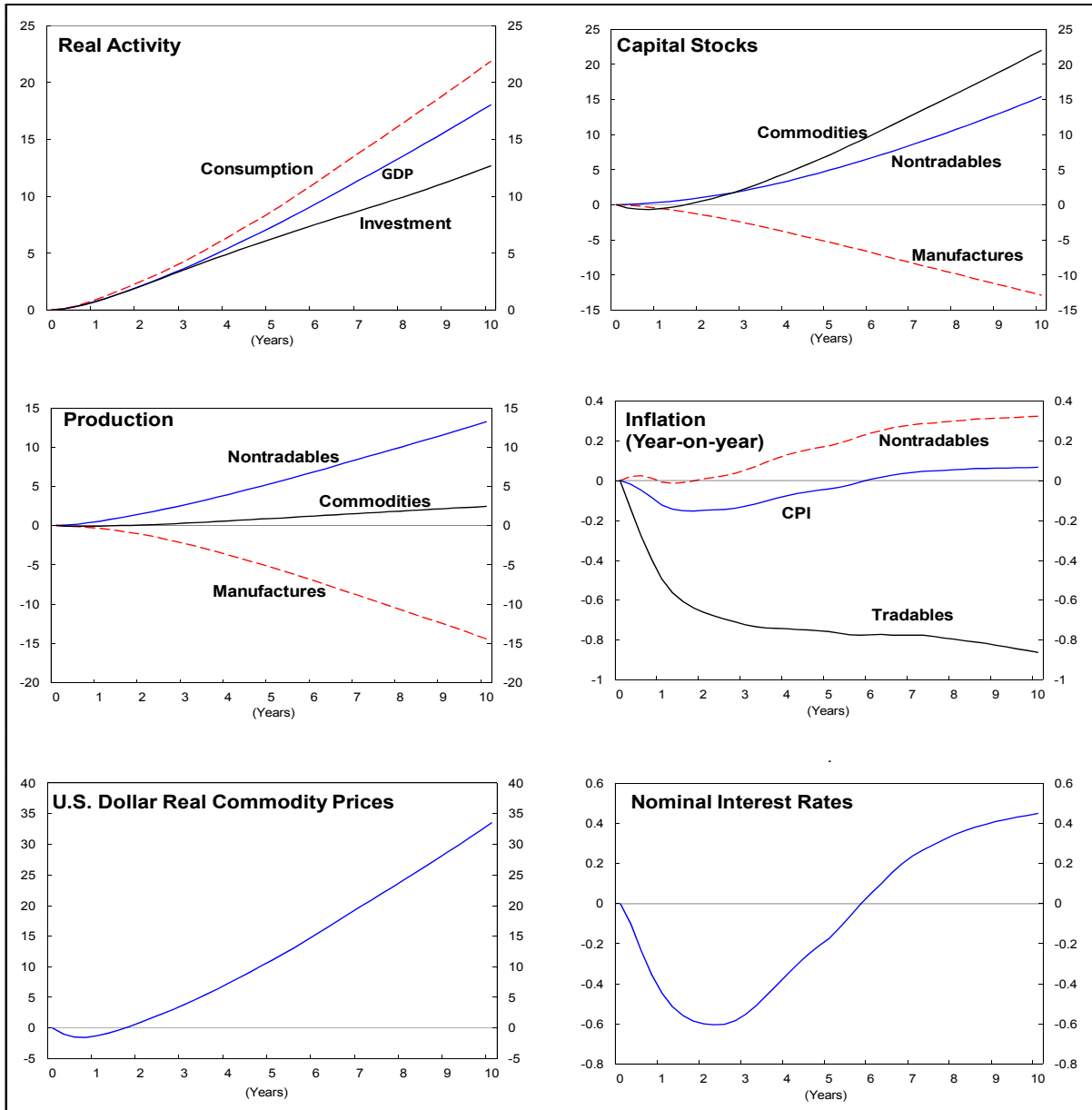


manufactured export good was also exogenously increased in the block of remaining countries, as was done in the previous simulation, the required appreciation would be a little larger than 6 percent in the long run.

### Impact on Australia

Relative to the previous simulation, the characteristics of the adjustment in Australia are similar; however, the magnitudes are larger. Consumption increases more than GDP with investment growing less. Significant resource reallocation occurs.

Figure 7. The Impact of Emerging Asia Growth on Australia  
(Percent or percentage point deviation from baseline)



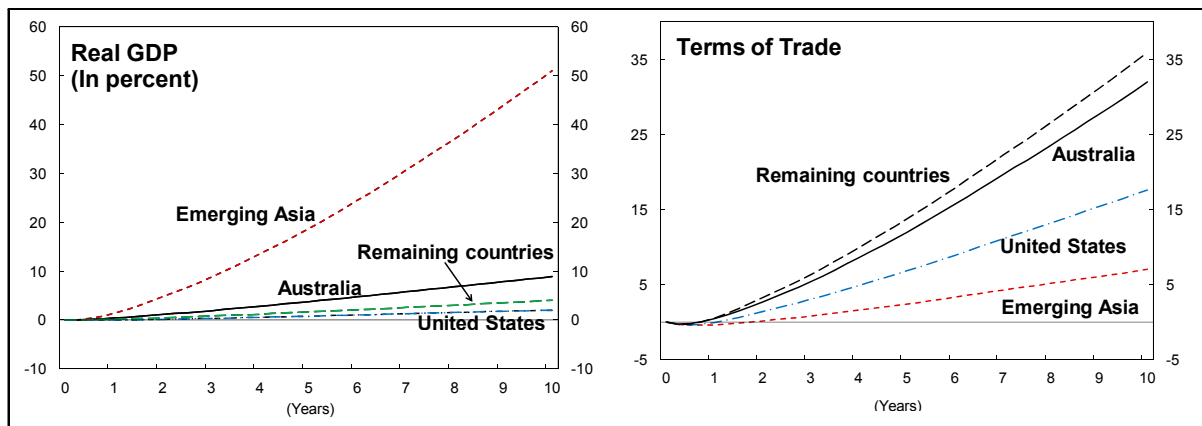
### C. Estimating the Future Impact: Nontradable- and Tradable-Sector-Driven Growth

#### Real Activity

The simulations up to this point have illustrated the benefits to Australia and other regions of the world arising from emerging Asia's export-led growth. However, the sustainability of this growth model has been questioned and significant policy debate has occurred on the need for the region to pursue more balanced growth as outlined in Prasad (2009a, b). To examine the implications of growth in emerging Asia becoming more balanced, the simulation in this section assumes that emerging Asia's real growth continues to outperform, but is driven by productivity in growth in both the tradable and nontradable sectors. In this simulation, productivity in the manufactures and nontradable sectors increase equally, raising emerging Asia's GDP by 50 percent over a 10-year period. The simulation results for some key macro variables are presented in Figures 8, 9, and 10.

A key implication of emerging Asia achieving more balanced growth is that the growth dividend for the rest of the world declines. Australian GDP increases by 9 percent compared to increases of 4 percent in the block of remaining countries and 2 percent in the United States. The more modest improvements in the terms of trade for Australia and the block of remaining countries help explain the difference. With emerging Asian growth now having a larger nontradables component, commodity demand and thus commodity export prices do not accelerate as much. Further, with less improvement in the competitiveness of imports from emerging Asia, import prices decline by a little less.

Figure 8. GDP Impact of Productivity Growth Gap in Emerging Asia's Tradable and Nontradable Sectors  
(Percent deviation from baseline)



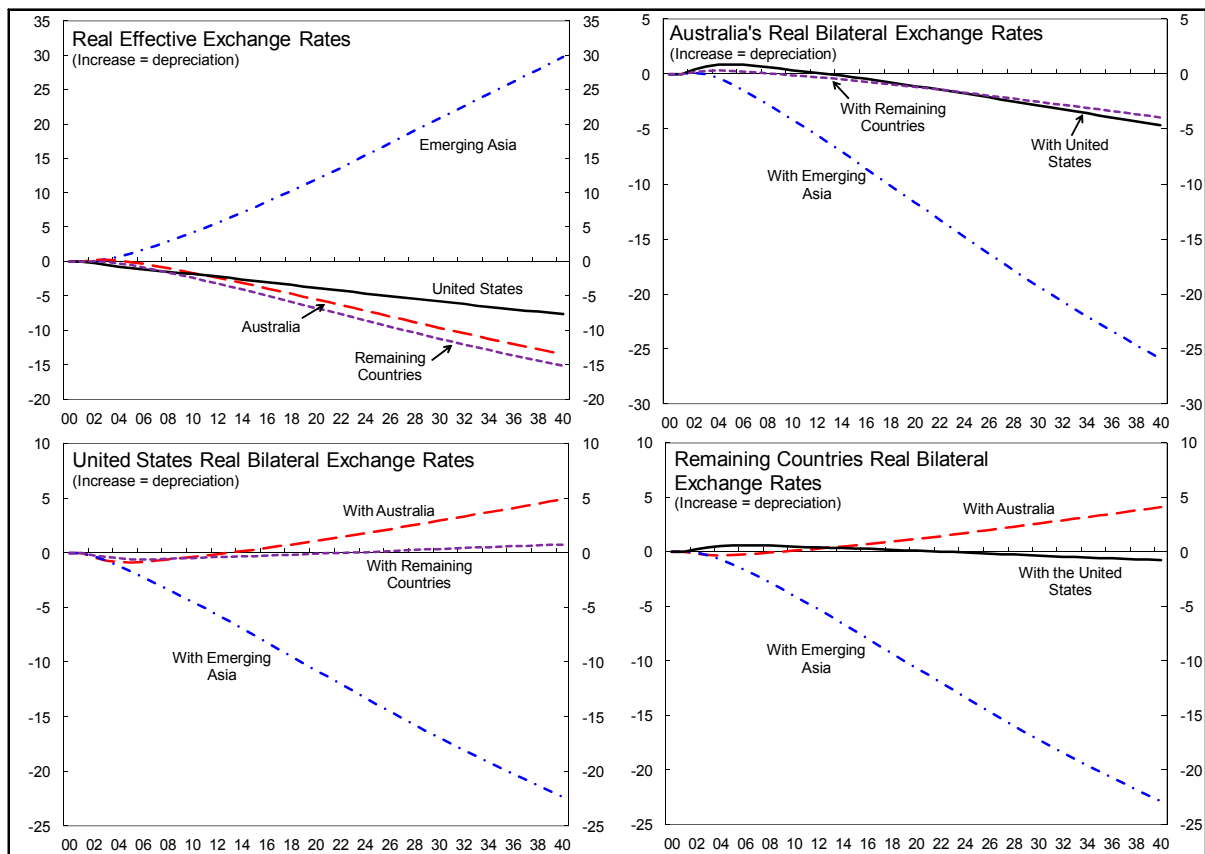
#### Real Exchange Rates

With emerging Asia's growth balanced between the manufactures and nontradable sectors, its real effective exchange rate must depreciate significantly. When productivity growth occurs in the tradable manufactures and nontradable sectors, the relative price of emerging

Asia's tradable goods does not decline. To sell the increased output to its trading partners, emerging Asia's real effective exchange rate must depreciate.<sup>8</sup> Compounding this is the depreciation pressure coming from rising imports of more expensive commodities. This simulation illustrates that if growth in the region remains stronger than most other regions of the world but becomes more balanced, underlying equilibrium exchange rates will decline. Consequently, if there are undervalued exchange rates in the region, exchange rate disequilibria could be partially resolved under more balanced growth in the region.

The real value of Australia's currency rises on all cross rates. The appreciation against the U.S. dollar and the block of remaining countries' currency reflects the importance of commodities in Australia's export bundle.

Figure 9. The Impact on Real Exchange Rates of Faster Productivity Growth in Emerging Asia's Tradable and Nontradable Sectors  
(Percent deviation from baseline)

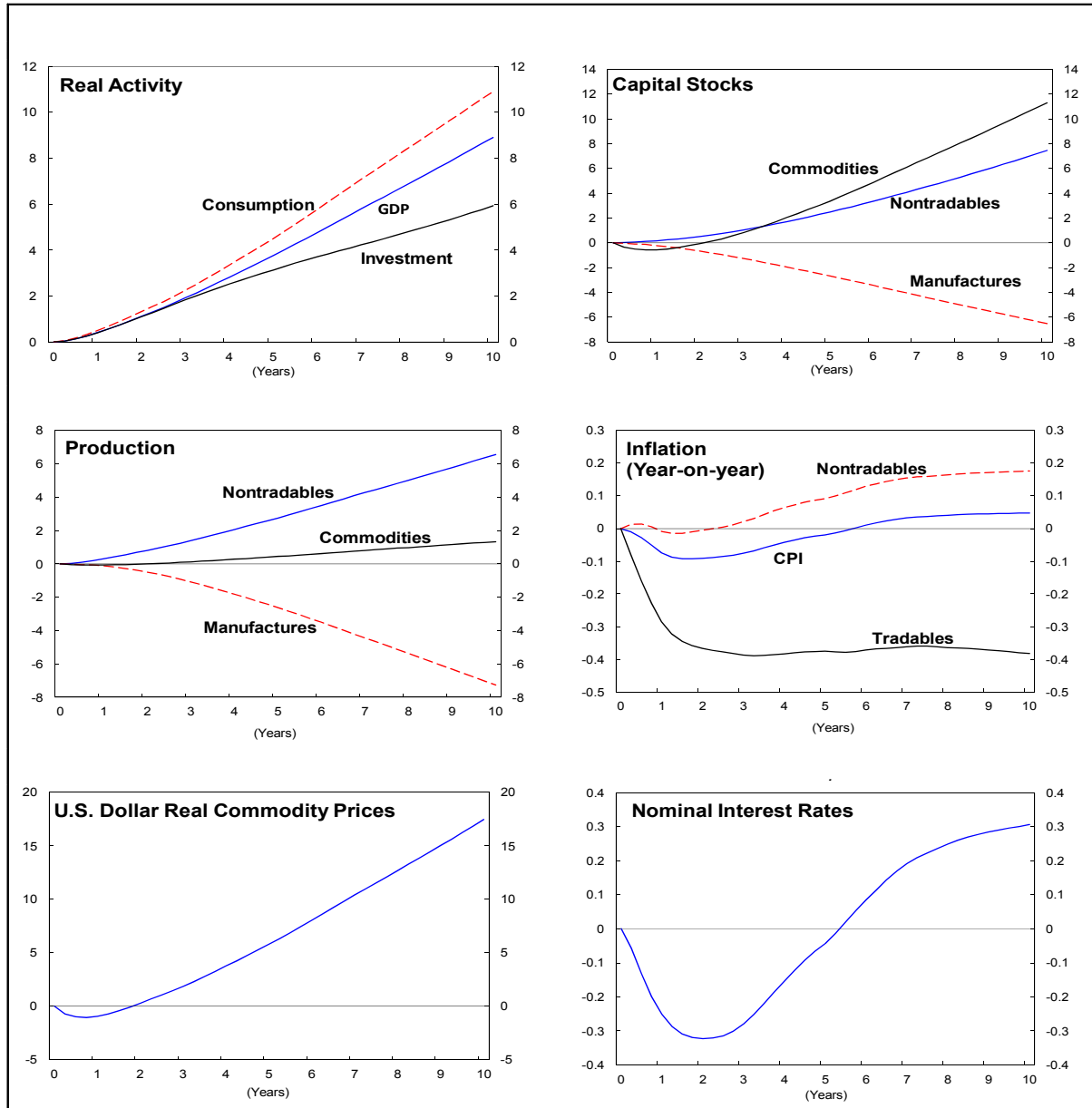


<sup>8</sup> One factor that could moderate the required depreciation would be if emerging Asia's exports continued to gain market share beyond that given by the model's properties, as was implemented in the two previous unbalanced growth simulations. However, preliminary analysis suggests that this would modestly reduce the magnitude of the required real effective exchange rate adjustment, not reverse the sign.

### Impact on Australia

When emerging Asia's growth becomes more balanced, the magnitude of the impact on Australia is reduced, but adjustment dynamics remain similar to the previous scenarios.

Figure 10. Faster Productivity Growth in Emerging Asia's Tradable and Nontradable Sectors  
(Percent or percentage point deviations from baseline)



## V. CONCLUSIONS

These simulations have illustrated how important emerging Asia has become for Australian growth. Over the last decade the analysis suggests that roughly 25 percent of GDP expansion in Australia was due to emerging Asia's growth differential. An interesting point about this Australian growth is that it arises from factor accumulation. That factor accumulation, rather than being driven by rising marginal products associated with productivity growth, is driven by increasing returns. The simulations looking ahead suggest that the component of Australian growth not related to rising productivity could increase. Australia could see continued strong growth, but relatively low measured productivity growth. Policymakers should be cognizant of this fact when assessing productivity growth. Policymakers should also be cautious about assuming that increases in factor accumulation will necessarily lead to a burst in productivity in the future.

With Australian growth becoming so closely tied with emerging Asia and commodities, one obvious area of policy focus should be facilitating the shift of resources across sectors. In the analysis presented, it was assumed that Australia had a slightly better ability than other regions of the world to increase commodity production by shifting capital and labor to the commodity sector. Given the abundant reserves of key commodities in Australia this is a plausible assumption. Past structural reforms aimed at improving flexibility in product and labor markets will undoubtedly prove beneficial for facilitating the reallocation of resources. However, additional public measures such as improved infrastructure and harmonization of state and federal regulation could further enhance Australia's ability to shift resources across sectors and increase the benefits from emerging Asian growth. The simulations also suggest that in addition to increasing capital and labor in the commodity sector, resources will also need to shift from tradable manufactured goods to nontradables to fully benefit from the improved terms of trade. Policymakers should therefore be cautious about implementing measures to maintain employment in manufacturing which could slow the movement of labor and capital to the commodity and nontradables sectors.

The growing dependence on emerging Asian growth will present challenges for longer-term projections of Australia's potential growth rate. Unlike other countries that are less open or less integrated with emerging Asia, Australian potential growth will have an important exogenous component. Basing projections on historical trends could lead to large errors, in either direction, depending on the economic performance of emerging Asia. The rate of growth in emerging Asia's GDP and the sectors in which it occurs will both matter.

Becoming more dependent on emerging Asian growth also means that Australia is likely to become exposed to larger exogenous shocks. The simulation analysis assumes that emerging Asian growth unfolds smoothly. However, this is unlikely to be the case and volatility in emerging Asia will imply larger shocks in Australia, probably through the terms of trade. To maintain macroeconomic stability going forward, policy is likely to have to work harder in Australia than it has in the past.

Looking to future work, there are a number of areas in which the analysis presented here could be extended. First, the speed of learning was assumed to be identical in the simulation estimating the historical impact of emerging Asian growth and those considering the

potential future impact. Although this was done to maintain comparability across the simulations, it is quite likely that people will learn more quickly moving forward. Examining the implications of faster learning could offer some useful insights on future policy challenges. Similarly, it might be insightful to consider more fully the implications of uncertainty and the possibility that people over estimate emerging Asia's future growth and the resulting impact on commodity prices and Australia's terms of trade. In addition it would be useful to consider the sensitivity of the results to different assumptions about the supply elasticities in the commodity sector as a significant portion of the benefits to Australia arise from higher prices for commodities, Australia's key export to emerging Asia.



### APPENDIX: INCORPORATING UNCERTAINTY

The analysis presented in the paper incorporates uncertainty about the persistence of the shocks. Under long-lived, perfect-foresight shocks that have significant implications for wealth, rational expectations models can produce adjustment dynamics unlike that seen in actual data (see for example Hunt and Rebucci (2005)). To address this and generate closer-to-real-world adjustment dynamics, the shocks are implemented assuming that each period, agents must generate forecasts of the shocks' persistence. To implement this, the following signal extraction problem is integrated into the simulation analysis:

$$\begin{aligned}\Delta O_t &= P_t + T_t, \\ P_t &= \rho \cdot P_{t-1} + \varepsilon_t, \\ T_t &= 0 \cdot T_{t-1} + v_t,\end{aligned}$$

where  $\Delta O_t$  is the change in the observed variable for which an expectation must be formed,  $P_t$  is the unobserved persistent component,  $T_t$  is the unobserved temporary component,  $\rho$  is the autoregressive coefficient on the persistent component,  $\varepsilon_t \sim N(0, \sigma^2)$ , and  $v_t \sim N(0, \sigma^2)$ .

Given the model and the observed change in period  $t$ , the Kalman filter generates optimal estimates of the persistent and temporary components for period  $t$ . These estimates are then used along with the model to generate forecasts for the variable in question beyond period  $t$ . At period  $t+1$ , a new observation is received and estimates of the persistent and temporary components for period  $t+1$  are generated. These in turn are used to generate new forecasts and so on.

In this simple model, the speed with which agents learn about the persistent component of the shock depends on their view of the relative magnitude of the variances of the persistent and temporary components. If agents use a model in which they expect the variance of the persistent component to be high relative to that of the temporary component, then they will learn quickly about persistent shocks. If, on the other hand, this relative variance is expected to be low, they will learn rather slowly. The relative variance can be time invariant or time varying, depending on what is required to deliver the desired speed of learning. (Ideally one would attempt to match the historical evolution of expectations when they can be extracted from available data.)

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