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Discussion Paper/Document d'analyse
2009-3

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Bank of Canada Discussion Paper 2009-3

January 2009

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ISSN 1914-0568

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Acknowledgements

We thank Ryan Bruno and Stephen Snudden for research assistance, and Larry Schembri and Robert Lafrance for helpful comments.

Abstract

The authors explore the usefulness of macroeconomic models in analyzing global economic developments by examining movements in commodity prices between July 2007 and July 2008. They use the Bank of Canada's version of the Global Economy Model and investigate the longer-term outlook for commodity prices by constructing two different, globally consistent, scenarios for emerging Asia. In the first scenario, the authors assume that a persistent increase in emerging Asia's productivity underlies its sustained growth; in the second scenario, they assume that a combination of productivity increases and a temporary demand shock underlie its growth. The demand for commodities increases in both scenarios, but, by comparing the two, the authors reveal that each scenario has considerably different economic implications. Allowing for the possibility that a small share of emerging Asia's growth might be fuelled by a temporary demand shock generates a strong "boom-bust" outcome for emerging Asia, and amplifies the volatility in commodity markets. The authors also investigate the possibility that emerging markets react to inflation by revaluing their exchange rates by 10 per cent. This affects the outlook for commodities only marginally.

JEL classification: E30, E50, E58, E60
Bank classification: International topics; Recent economic and financial developments

Résumé

Les auteurs se proposent d'évaluer l'utilité des modèles macroéconomiques dans l'analyse de l'évolution de la conjoncture économique mondiale. Ils se penchent à cette fin sur les variations de prix qu'ont connues les produits de base entre juillet 2007 et juillet 2008. Pour examiner les perspectives d'évolution à long terme de ces prix, ils élaborent, dans le cadre du modèle de l'économie mondiale de la Banque du Canada (BOC-GEM), deux scénarios distincts, cohérents à l'échelle internationale, à propos des économies émergentes d'Asie. Le premier scénario postule qu'une hausse persistante de la productivité des pays considérés est à l'origine de leur croissance soutenue; dans le second scénario, des gains de productivité conjugués à un choc temporaire de la demande sont plutôt les facteurs sous-jacents avancés. Si dans les deux cas, la demande de matières premières progresse, chaque scénario apparaît, par comparaison, présenter des implications économiques très différentes. Le fait de supposer qu'un choc temporaire de la demande puisse contribuer dans une faible mesure à la croissance des économies émergentes d'Asie cause un fort cycle d'expansion et de contraction dans cette région du monde et amplifie la volatilité des marchés des produits de base. Les auteurs analysent aussi les conséquences d'une éventuelle décision de ces pays asiatiques de contrer l'inflation en réévaluant leur monnaie de

10 % : une telle mesure n’a que peu d’effets sur les perspectives d’évolution des cours des matières premières.

Classification JEL : E30, E50, E58, E60
Classification de la Banque : Questions internationales; Évolution économique et financière récente

1 Introduction

Monetary policy-makers face considerable challenges. First, data are typically not available in real time. Second, the source of economic developments – the underlying shock that drives, say, changes in oil prices – is typically not easily observable. And third, in many cases, macroeconomic outcomes are compatible with more than one hypothesis about the underlying shock, whereas the appropriate policy response to an economic development depends on the correct identification of the underlying shock. Policy-makers require tools to identify shocks and test hypotheses that underlie distinct macroeconomic developments.

In this paper, we show how macroeconomic models can provide a useful tool to interpret global economic developments. We consider the rapid acceleration in oil and food prices between July 2007 and July 2008. Previous studies have found that an important element driving the run-up in oil and food prices over this period is strong demand from emerging markets, particularly from emerging Asia (IMF 2008b; Elekdag et al. 2008). If this is correct, the question then arises: why is demand from emerging Asia so strong, and how sustainable is this high level of demand? In other words, to assess the medium-term outlook for commodity prices, assumptions about the sources of strong demand for commodities are required. Consider, for instance, that demand for commodities is driven by strong productivity growth in emerging Asia, possibly fuelled by an ongoing shift in labour from agriculture to the industrial sector. This transition in labour might continue for several years, and emerging Asia is likely to enjoy further productivity gains. Hence, under this assumption, commodity prices can be expected to stay at elevated levels over the medium to long term. An alternative assumption could be that strong demand for commodities is, at least in part, due to a temporary demand shock in emerging Asia ("overheating"). If this is correct, then we might expect a more rapid moderation in commodities prices when the demand shock unwinds.

To decide which of these two assumptions is more likely to reflect reality, macroeconomic models are used, because they help uncover important transmission channels. In the example analyzed here, one transmission channel is the price of tradable goods: higher-than-expected productivity growth in emerging Asia leads to an expansion of the global supply of tradable goods, which helps contain global inflation. If commodity prices are driven by a temporary demand shock, however, we would expect to see an increase in inflation that extends beyond the volatile food and energy components in

the consumption basket. This means that, by informing policy-makers about the possible consequences of different assumptions, macroeconomic models can help identify the source of the shock, and therefore help determine an appropriate policy response.

To illustrate these considerations in practice, we use the Bank of Canada's version of the Global Economy Model (BoC-GEM). We build two consistent scenarios, covering the period from July 2007 to July 2008. Both scenarios replicate key features of the global economy. In our first scenario, we assume that growth in emerging Asia is driven only by a persistent increase in its productivity. In our second scenario, we still assume that a large share of emerging Asia's growth is due to productivity gains, but we also allow for a temporary demand shock. We find that the two scenarios imply very different paths for inflation in tradable goods worldwide. Also, they imply different policy responses for central banks. Our model-based analysis thus provides guidance with regard to which variables might contain information to help identify the "correct" shock, and helps in determining the appropriate policy response. Lastly, we illustrate how our macroeconomic model can help evaluate possible domestic outcomes, if foreign countries were to adjust their policy stance. This is done by examining the consequences of a scenario in which emerging markets revalue their currencies against the U.S. dollar to avoid overheating their economies.

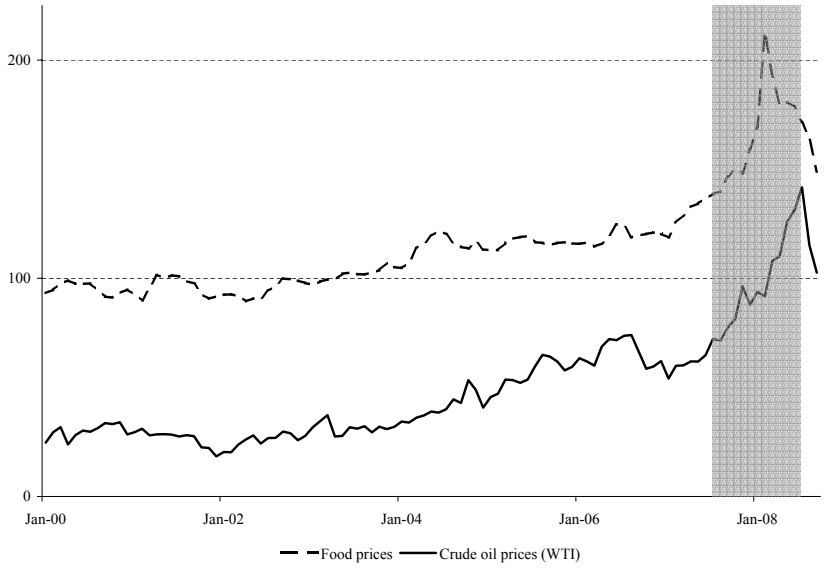
In section 2, we provide some economic background information, outline key features of the model we use, and explain our simulation strategy. Section 3 outlines our first scenario, in which high growth in emerging Asia is driven only by high productivity gains. The second scenario, in which high growth in emerging Asia results partly from a temporary demand shock, is described in section 4. Section 5 investigates the implications of emerging Asia revaluing their currencies as a way to contain inflation. Section 6 summarizes our main findings.

2 Simulating Global Economic Developments

2.1 The economic backdrop

Over the past decade, emerging markets have been performing very well. Fuelled by higher terms of trade and improvements in monetary and fiscal policy, growth in emerging markets has averaged between 7 and 8 per cent in 2007 and the first half of 2008 (IMF 2008b). As a consequence of their strong growth, demand from emerging

Figure 1: Food and Oil Prices



markets for many commodities has risen substantially (Cheung and Morin 2007). We focus on explaining the rapid increase in food and oil prices between July 2007 and July 2008. During this period, food and oil prices rose by 17 and 82 per cent, respectively (Figure 1, shaded area).

An acceleration of commodity prices of this magnitude poses considerable challenges for policy-makers in commodity-exporting and commodity-importing countries. First, while the run-up in commodity prices seems to reflect both supply restrictions and strong demand, the relative contribution of the two factors is not clear. Second, to assess the medium-term outlook for commodity prices, assumptions are required about the persistence of supply restrictions, as well as about the source of strong demand for commodities. Commodity prices can be expected to stay at elevated levels over the medium to long term if the shock driving high demand is persistent. If, however, the strong demand for commodities is, at least in part, due to temporary economic developments, we might expect a rapid deceleration in commodities prices, once the shock unwinds. These two interpretations have different implications for the outlook for commodity prices, as well as for the world economy, including Canada.

2.2 The model

To assess the developments in commodity prices between July 2007 and July 2008, we use the Bank of Canada's version of the Global Economy Model (BoC-GEM). The BoC-GEM is a non-linear, dynamic stochastic general-equilibrium (DSGE) model with highly developed theoretical and microeconomic foundations. An advantage of using a global DSGE model over a partial-equilibrium model is that, by construction, all scenarios are globally consistent; i.e., the developments of all economies in the models, as well as the evolution of commodity prices, are fully compatible.

The model has been documented extensively (Faruqee et al. 2006; Lalonde and Muir 2007), so we keep the description of BoC-GEM relatively short. BoC-GEM has five "country blocks," representing Canada, the United States, emerging Asia, commodity-exporting countries (mainly OPEC countries), and the remaining countries (mostly comprising Europe and Japan).[1] It is a five-sector model, featuring tradable goods, non-tradable goods, energy, gasoline and retail fuels, and food. Each region features firms, households, and the government.

Firms: A continuum of firms combine capital and labour to produce raw materials, intermediate goods, and final goods. The production structure is as follows: capital, labour, food, and oil are used to produce tradable and non-tradable goods, and capital, labour, and land[2] are combined to produce oil and food. Then, tradable goods, non-tradable goods, and gasoline are combined to produce a final consumption good; tradable and non-tradable goods are required for the investment good. Frictions include adjustment costs for capital, investment, the share of imported goods, and the production and use of oil. The market structure is characterized by monopolistic competition.

Households: Two types of consumers exist: the first class owns all of the firms and has access to capital markets; the second class is liquidity constrained and can consume only out of their labour income. All consumers have habit persistence in consumption and labour supply, and there are nominal rigidities in wages.

Government: Governments consume non-tradables, financed by taxes or borrowing. Their consumption does not enter the utility function of households. Fiscal policy targets a long-run debt-to-GDP ratio. The most important sources of revenues

[1] To save space, we do not discuss the results for the "remaining countries" block in this study. Detailed results are available upon request.

[2] One can also think of land as reserves; e.g., oil reserves.

are taxes on labour and capital. Monetary authorities control a short-term interest rate. They implement an inflation-forecast-based monetary rule, except for emerging Asia, which targets the nominal exchange rate.

An important feature of oil and food production is that producers respond to changes with a time lag. This reflects the fact that changes to production typically require a (costly) adjustment of the capital stock and labour. Note also that the time lag is higher for the production of oil than for food, simply because oil production requires much more expensive and complicated capital outlays. This has two important implications: first, shocks to oil and food of the same magnitude will lead to hump-shaped price responses for both types of commodities, but because the adjustment is more sluggish for the oil sector, the initial increase in oil prices is higher than the initial increase in food prices. Second, if a shock is short lived, the supply response for oil is smaller, simply because oil producers realize that, by the time their new supply becomes available, the shock might have already ended.

BoC-GEM features international trade in oil, food, and tradable goods for consumption and investment (including intra-industry trade). Trade flows are calibrated on a bilateral basis for all tradable goods, to be consistent with actual trade flows, as reported by the COMTRADE database of the United Nations.

Note that, while BoC-GEM is calibrated to replicate evolutions in the real economy, it is not a forecasting tool. The purpose of this study is not to make the most accurate projection about the exact level of commodity prices over, say, the next five years. Instead, we use BoC-GEM to evaluate the consequences of different assumptions regarding the underlying source of strong demand for commodities, notably from emerging Asia.

2.3 Why are commodity prices rising?

Our simulation strategy is to construct different scenarios in which we approximate qualitatively the global economic conditions between July 2007 and July 2008. A remarkable feature of this period is that not only were oil and food prices at high levels at the outset, but they kept rising over time. From a modelling perspective, this ongoing price increase is important, because a one-time jump in prices to a new level is conceptually very different from an ongoing price increase.

To perceive this, note that in a perfect, frictionless flex-price equilibrium, absent shocks to the commodity supply, fully anticipated demand developments should not systematically affect prices. For example, suppose that commodity producers anticipate that growth in emerging Asia will accelerate over the next months. If goods producers know in advance that the demand for their product will change, they will adjust their production schedule accordingly. Hence, abstracting from unanticipated supply restrictions, a one-time upward shift in the demand for oil or food may cause a jump to a new steady-state price level, but should not cause ongoing increases in prices (i.e., an upward-sloping price path), if producers are forward looking. Ongoing price increases imply that producers are repeatedly surprised by strong demand, or, put differently, that demand has to exceed expectations repeatedly.[3] The same logic holds for restrictions in the oil and food supply: if anticipated, prices will jump to the new steady-state level, rather than move up continuously. Hence, sustained upward movements in commodity prices can reflect either *ongoing* cuts in supply, or *ongoing* positive surprises to commodity demand.

2.4 Broad economic trends between July 2007 and July 2008

Given that strong economic growth, if anticipated, does not create ongoing price increases in oil and food prices, we have to assume that ongoing positive surprises occur to demand between July 2007 and July 2008 to generate sustained commodity price increases. Is this realistic?

Between 2007 and 2008, economic forecasters underpredicted the strength in global economic activity; growth in emerging markets – particularly in emerging Asia – has turned out to be stronger than anticipated. Table 1 shows the growth forecasts for the global economy for 2007 from the International Monetary Fund's World Economic Outlook for two consecutive years (April 2007 and April 2008), and compares it to actual values. Note, in particular, the deviation of the April 2007 forecasts from the actual outcomes for 2007 (last column). This is a proxy for the difference between the expected and realized economic developments. We see that economic developments were either more vigorous than anticipated (emerging Asia, but also to some extent commodity exporters), or less favourable than anticipated (United States). Also note that the IMF's estimate of emerging Asia's output gap (to the extent available) is very

[3]The initial price increase is exacerbated if there are lags until new production capacity becomes available.

Table 1: Differences between Expected and Actual Economic Developments, 2007–2008

	Forecasted values		Actual values
	April 2007	April 2008	for 2007
Canada			
Real GDP	2.4	2.7	2.7
Inflation	1.7	2.1	2.1
Output gap	-0.2	0.2	0.6
United States			
Real GDP	2.2	2.2	2.0
Inflation	1.9	2.9	2.9
Output gap	-0.6	0.1	1.2
Emerging Asia			
Real GDP	8.4	9.7	10.0
Inflation	3.7	5.3	5.4
Output gap	-	-1.1	1.2
Commodity exporters			
Real GDP	5.3	5.8	5.9
Inflation	10.4	10.4	10.6
Output gap	-	-	-
Commodity prices			
Oil	-5.5	7.6	10.7
Food	4.4	12.0	15.2

Note: All data are taken from the World Economic Outlook of the IMF. Commodity exporters are proxied by the IMF group "Middle East Oil Exporters."

small. This indicates a view that strong economic growth in emerging Asia is not driven by a temporary demand shock.

Our model-based analysis does not attempt to replicate exactly the economic developments of all countries or regions in Table 1. Instead, we assume that global economic conditions are matched *qualitatively* by generating scenarios for the period between July 2007 and July 2008 with the following features:

- Over the entire period, real global GDP remains broadly unchanged.
- Global demand rotates: economic growth is higher than expected in emerging Asia and lower than expected in the United States (low growth in the United States is driven by difficulties in the housing sector and turmoil in credit markets). For simplicity, we assume that growth in emerging Asia exceeds expecta-

tions by about 2 per cent, and is about 0.5 per cent weaker than expected in the United States.

- Prices for food and oil increase by 40 and 120 per cent, respectively.

Note that our simulations do not attempt to simulate the actual "total" level of growth in emerging Asia. We model the share in emerging Asia's growth that was not expected in July 2007 (we set this share to be 2 per cent). As an illustration, suppose that emerging Asia's expected growth rate was 8 per cent between July 2007 and July 2008, and that its actual growth rate was 10 per cent. We focus on this deviation between the expected and the actual growth rate, because growth that is 2 per cent stronger than expected is likely to cause the movements in oil and food prices that we are interested in.

Generating weaker-than-expected growth for the United States is relatively straightforward. A shock to the corporate risk premium and a negative consumption shock capture the global financial market turbulence and the contracting housing sector, respectively. They lead to a contraction of real U.S. GDP.

The paths for growth in emerging Asia and oil and food prices are more challenging, because they are the result of a potentially complex mix of economic shocks (IMF 2008a). Consider oil and food prices. Although local prices might be affected by local subsidies or price controls, on a global scale they are determined by supply and demand. We proceed as follows:

1. We first model high demand for oil and food, strong growth in emerging Asia, and economic weakness in the United States. This generates a demand-driven increase in food and oil prices. The rotation of global demand drives up oil and food prices, because growth in emerging Asia is more commodity-intensive than growth in the United States.[4]

2. While the rotation in demand *contributes* to the run-up in prices, it does not account for the full increase. To generate the remaining price increases, we add supply restrictions to food and energy.

[4]This corresponds with the IMF's assessment that the current run-up in commodity prices "seems largely associated with increased demand for commodities on the part of China and other fast-growing economies in Asia" (IMF 2008b). Note that the current commodity price boom is broadly based, since it includes oil, metals, and many agricultural products. While supply restrictions such as bad harvests can account for a substantial increase in *some* commodities, they cannot explain why such a broad range of prices have increased at the same time. This suggests that the current commodity boom has a strong demand element.

- For oil, the remaining price increases are generated by a negative oil supply shock in the commodity-exporting region.[5]
- To match the price increases for food, we impose a negative food supply shock in emerging Asia and the commodity-exporting region,[6] and a negative food supply shock in the United States to account for the increasing production of biofuels.

All shocks for oil and food have both permanent and temporary components. However, the temporary element is relatively stronger for food, because it includes bad harvests, which are presumably a short-lived phenomenon.

3. Lastly, the supply restrictions, which capture price increases above the ones implied by strong demand, remain unchanged across simulations.

Keeping the oil and food supply shocks constant for the different scenarios is admittedly a strong assumption, but by keeping the supply side constant, the transmission of the different assumptions with regard to demand is exposed more clearly. This facilitates a comparison between scenarios to determine which is more likely to be an accurate description of the world economy.

Having determined the mix between demand and supply shocks, the main question is: what is driving the high demand for oil and food from emerging Asia? Here we explore two possibilities: a permanent productivity shock, and a temporary demand shock. Both are modelled as separate scenarios.

3 Scenario 1: A Persistent Increase in Potential Output in Emerging Asia

3.1 Transmission channels

Table 1 suggests that growth in emerging Asia is unexpectedly strong, but that the output gap is small. The uncertainty surrounding estimates for output gaps is high,

[5]This can be interpreted as OPEC restricting output (relative to the growth in demand), a fall in oil production in Mexico, or continuing supply problems in Nigeria (political unrest) and Russia (poor oil infrastructure).

[6]These two shocks capture the negative consequences of price controls in countries such as Malaysia or Thailand on the supply of food and the severe drought in Australia, respectively.

but, taken at face value, this suggests that growth in the region is strong because of a positive shock to potential output. This is the starting point for our first scenario, in which we assume that the positive surprise to growth in emerging Asia is driven *entirely* by productivity gains. One explanation for the strong productivity gains is ongoing structural changes in emerging Asia, particularly the shift of relatively unproductive labour out of agriculture and into the manufacturing sector.

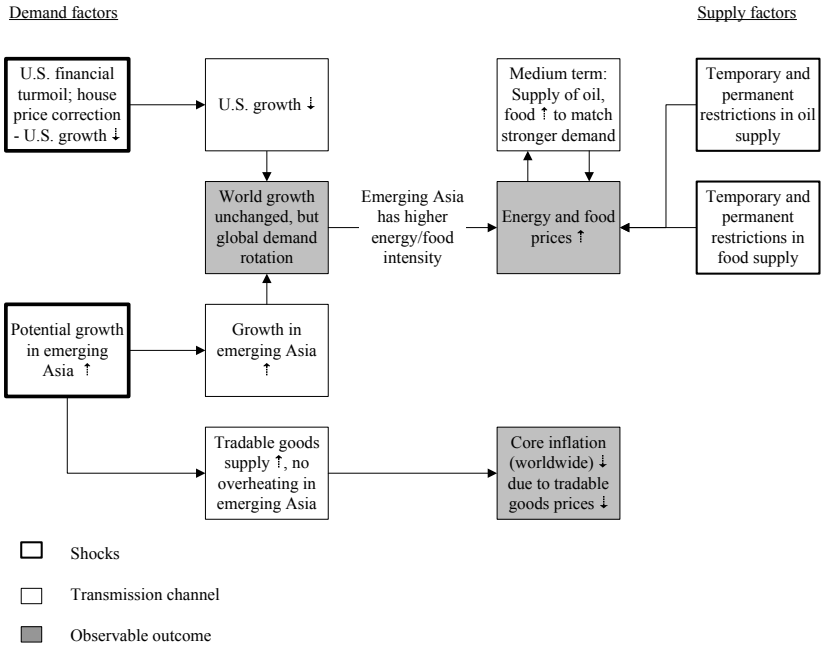
Figure 2 provides an overview of the main transmission channels of this scenario. The negative commodity supply shocks (right side) drive up the prices for food and energy directly. The demand shocks (left side) yield unchanged world growth, but the higher commodity intensity of emerging Asia drives up the demand for commodities. This leads to higher prices, but because commodity producers realize that demand has permanently increased, they will expand their supply over the medium term. Although prices for commodities and food will adjust to a permanently higher level, they come off their peaks once the supply has adjusted to the new steady state. Price increases for commodities drive up headline inflation, but, because the global supply of tradable goods expands due to the positive productivity shock in emerging Asia, core inflation can be expected to drop.

3.2 Results of scenario 1

Figures 3 and 4 show the first set of simulations. The outcome of the scenario in terms of commodity prices and economic growth in the United States and emerging Asia is consistent with the paths set out in section 2.4. Prices for oil and food in real terms increase sharply, and, in line with the continuing increase of economic potential in emerging Asia, prices are projected to remain strong. They come off their peaks, though, towards the end of the projection horizon, as (i) the supply of oil and food responds positively to the higher prices, (ii) the temporary supply restrictions run off, and (iii) demand weakens over the medium to long term. This is driven by rising inflation, which eventually reduces economic growth below potential.

To illustrate this point, consider emerging Asia. The region experiences a sustained positive productivity shock – i.e., a rise in potential output – that generates stronger-than-anticipated growth of roughly 2 per cent until mid-2008. The expanding supply leads initially to lower prices, but, as the positive supply shock fades away, inflation becomes a major issue. Given that emerging Asia maintains a fixed exchange rate vis-à-vis the U.S. dollar, the region's central banks cannot raise interest rates enough

Figure 2: Scenario 1: Commodity Prices Are Driven by a Positive Productivity Shock in Emerging Asia



to maintain price stability. Consequently, inflation rates increase, visible in headline inflation (which is dominated by higher energy prices) and core inflation. Over time, as the rising costs of living outpace wage growth, they act as a drag on consumption and, consequently, real growth.

Regarding the economic outlook for other countries, the United States is dominated by the shocks to the housing sector and its financial system. U.S. growth is initially weaker than expected, but it returns to potential as the temporary shocks slowly run off. Owing to rising food and energy prices, headline inflation increases, but note that, despite an expansive monetary policy response to the weak economy, core inflation does not rise. Inflationary pressures in the United States are low because of the weak economy, but also because prices for imported goods are low, given the expanding supply in emerging Asia.

Canada is affected through the following three channels. First, low U.S. growth hurts Canadian exports. Second, as a producer of commodities, Canada benefits from higher oil and food prices (wealth effects). Consequently, Canada's real exchange rate appreciates, which helps contain core inflation. Third, falling prices for imported goods

Figure 3: Scenario 1: Oil and Food Prices; Rest of the World (deviation from control)

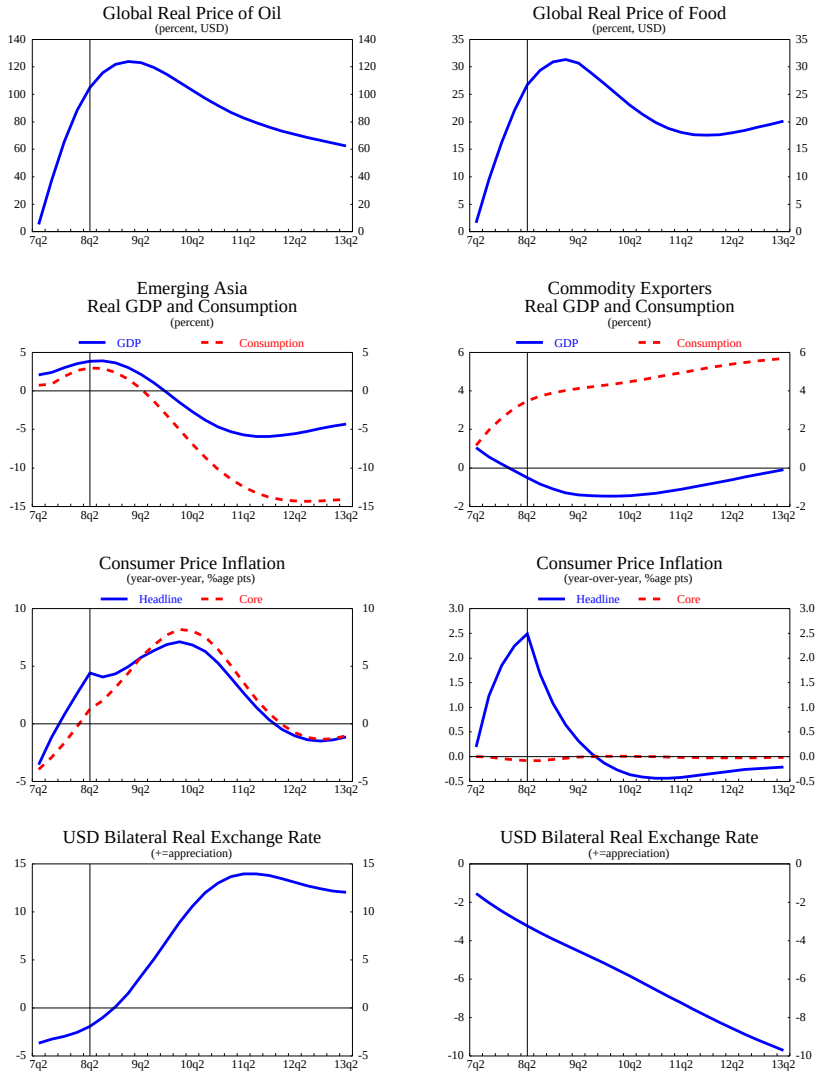
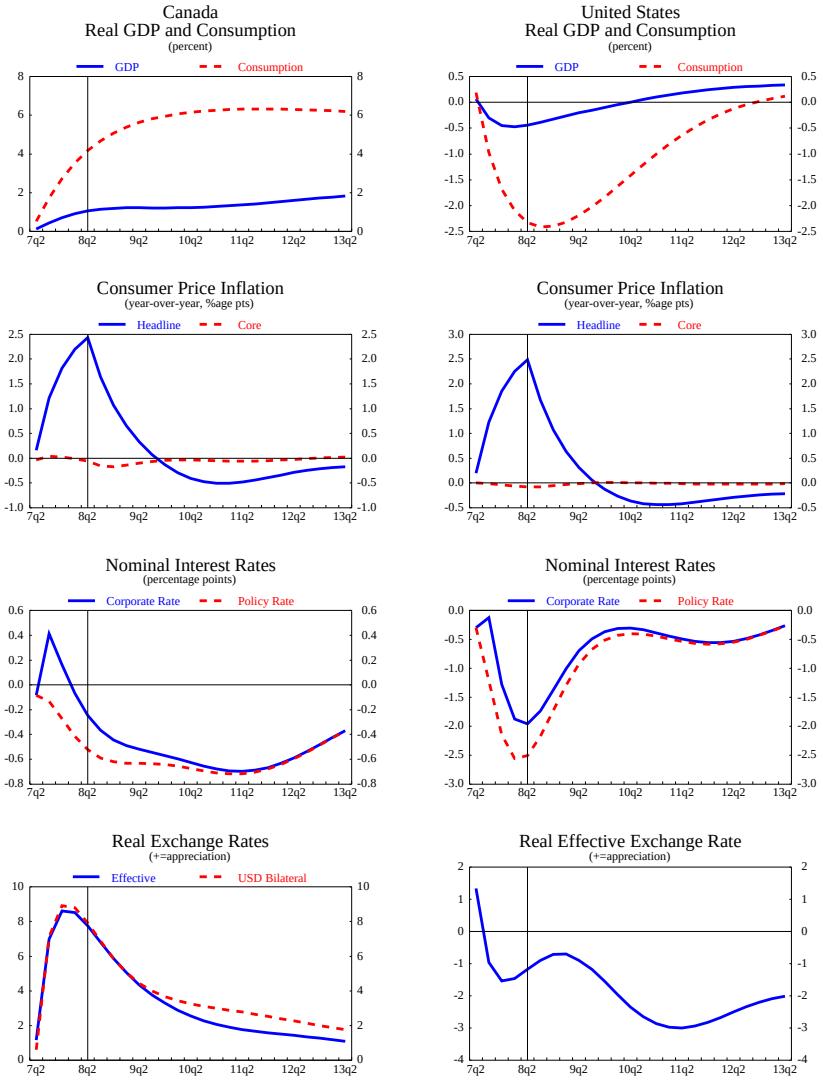


Figure 4: Scenario 1: United States and Canada (deviation from control)



from emerging Asia allow monetary policy to lower interest rates. Taken together, Canadian real GDP and consumption expand permanently.

4 Scenario 2: A Temporary Demand Shock in Emerging Asia

4.1 Transmission channels

In the second scenario, we vary the source of the stronger-than-expected growth in emerging Asia. We keep the supply restrictions for food and commodities unchanged, but change the assumption that the growth in emerging Asia is entirely due to higher potential output. Instead, we assume that the stronger-than-expected growth is due to a combination of productivity increases and a positive, temporary domestic demand shock in emerging Asia.[7] This temporary demand shock, which runs off during 2009, creates a temporary overheating of emerging Asia's economy.

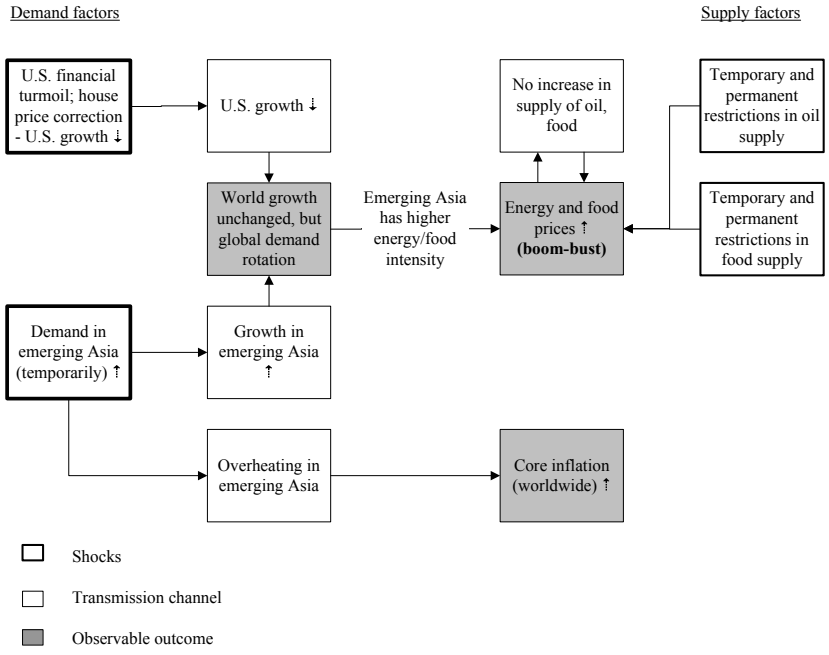
In terms of the transmission of the shocks, there are several differences between the first and the second scenarios (see Figure 5). First, while core inflation is contained in the first scenario due to the expanding supply of tradable goods from emerging Asia, this disinflationary effect is replaced by rising core inflation in scenario 2. The second difference is the supply response of commodity production, which affects commodity prices in the short and long term. In the second scenario, the supply of commodities expands by 25-30 per cent less than in the first scenario. Intuitively, in the second scenario, commodity producers realize that a relatively larger share of the rise in commodity demand is temporary. Hence, given the large adjustment costs and delays required to put new investment in place to expand oil and food production, commodity producers do not expand their supply as much as in a case where demand is structurally higher because of a positive shock to potential in emerging Asia.

4.2 Results of scenario 2

The effects of the second scenario are shown in Figures 6 and 7. We describe our main findings by comparing the two scenarios region by region.

[7] One possible explanation for the demand shock could be the 2008 Summer Olympics in Beijing, which could have had temporary effects on demand.

Figure 5: Scenario 2: Commodity Prices Are Driven by a Temporary Demand Shock in Emerging Asia



The second scenario, compared to the first, generates a strong "boom-bust" behaviour in emerging Asia. In the first scenario, emerging Asia's real GDP is 2.0 per cent stronger than expected; in the second scenario, real GDP peaks at 2.6 per cent higher than expected (i.e., real GDP is 0.6 per cent higher than in the first scenario). Note, however, that this growth rate is associated with growth being substantially above potential: in scenario 2, emerging Asia's economic potential has not expanded, so the increase in real GDP translates to an overheating of emerging Asia's economy. This fuels inflationary pressures: relative to the first scenario, headline inflation rates in emerging Asia increase in scenario 2 by an additional 6.3 per cent by 2008Q2, and core inflation rates increase by an additional 5.4 per cent. These are the highest inflation rates of all regions, because emerging Asia maintains a fixed exchange rate against the U.S. dollar, and cannot increase interest rates enough to fight inflation. Inflation and the associated increase in the cost of living prompt a fall in consumption, which is about 3.1 per cent stronger than in the first scenario, once the positive demand shock has been run off. This amplifies the boom-bust behaviour in emerging Asia, and, during the bust, real output in the region contracts sharply.

Figure 6: Scenario 2: Oil and Food Prices; Rest of the World (deviation from control)

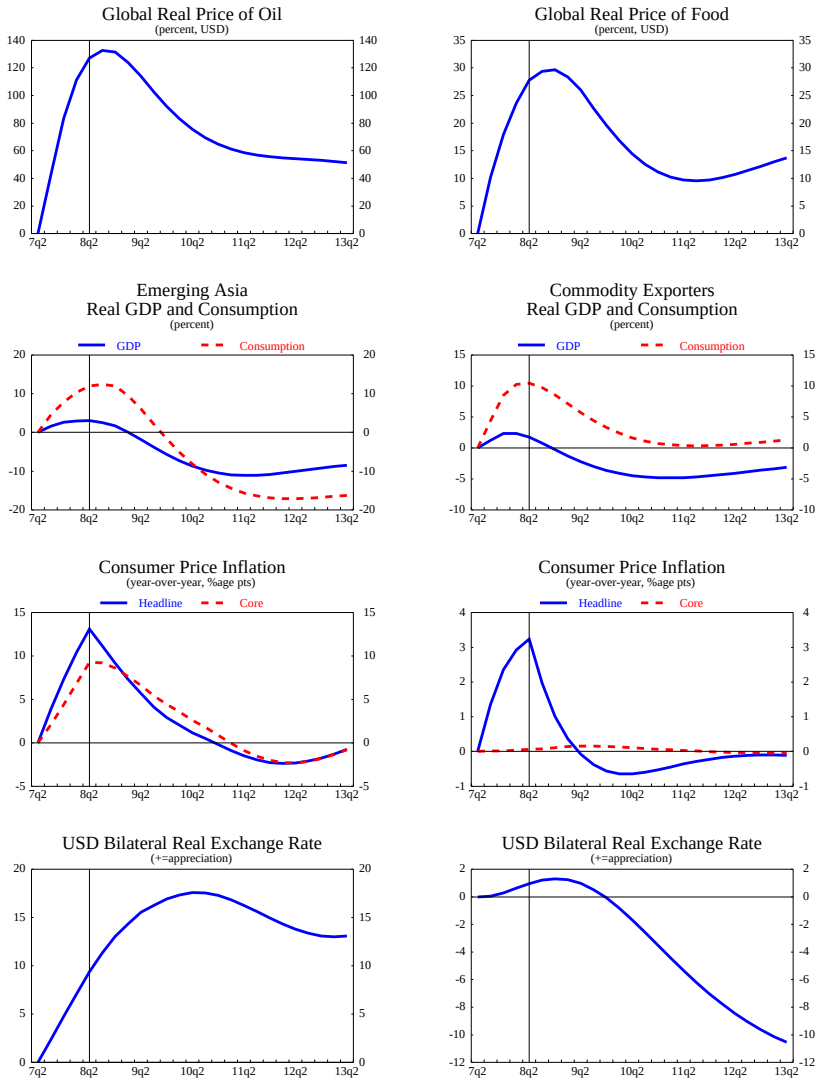
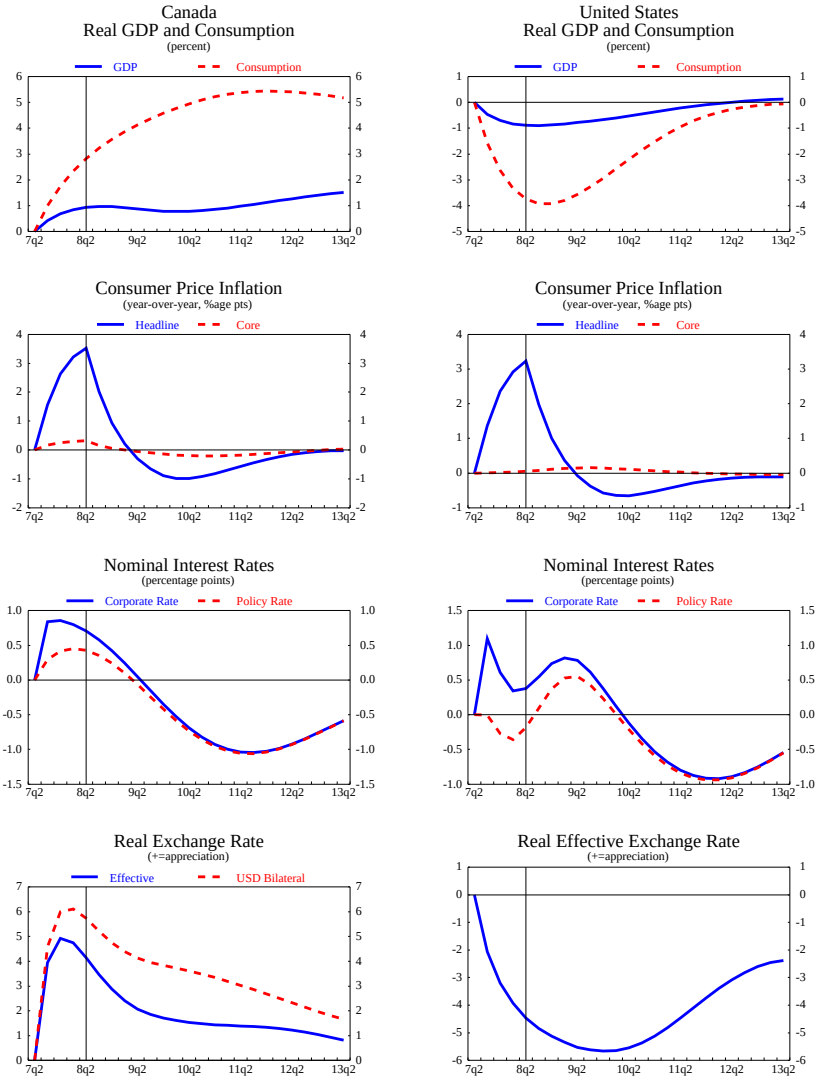


Figure 7: Scenario 2: United States and Canada (deviation from control)



As before, an important transmission channel to the rest of the world is commodity prices. Prices peak at levels that are 18.6 per cent higher for oil, and 3.1 per cent higher for food, than in the first scenario. Moreover, the price increases are more front-loaded (i.e., a larger share occurrs in 2008), and the supply responses from commodity producers are more muted, because they realize that demand for commodities increases only temporarily. The fall in economic activity after the bust in emerging Asia reduces the demand for oil and food (in value terms, the demand for oil from emerging Asia, relative to the first scenario, is 15 per cent lower by 2010). Taken together, prices for oil and food are much more volatile in scenario 2 than in scenario 1.

The United States experiences stagflation for almost two years in both scenarios, but core inflation is marginally higher in the second scenario. Also, relative to the first scenario, the second induces additional volatility, as the unravelling of the demand shock in emerging Asia deepens the U.S. recession. Relative to the first scenario, headline inflation increases by an additional 0.9 per cent in 2008Q2, and core inflation is 0.2 per cent higher by 2008Q3, because import prices for tradable goods from emerging Asia are higher in scenario 2. Reflecting the stronger rise in commodity and tradable goods prices in scenario 2, the U.S. Federal Reserve tightens monetary policy to contain inflation. This amplifies the negative effect on real GDP. Lastly, the rise in prices for imported goods leads to a real depreciation of the U.S. dollar relative to scenario 1. Over time, as prices for imports (oil and food) come off their peaks, the depreciation of the U.S. dollar is partly reversed.

For Canada, scenario 2 increases economic volatility. The more rapid increases in oil and food prices are positive terms-of-trade shocks, and lead to positive wealth effects. This results in higher consumption and higher investment, as the relative prices of imported investment goods fall due to a stronger Canadian dollar. A major difference between the scenarios for Canada in the short term is the monetary policy response: in scenario 2, the more volatile commodity prices and the rising tradable-goods prices lead to rapid increases in headline and core inflation measures. While monetary policy is easing in scenario 1, the second scenario experiences a temporary monetary tightening (the difference between the scenarios peaks at almost 100 basis points).

When the bust in emerging Asia occurs, Canada does not fully escape the ensuing economic turmoil. This is clearly visible in Canada's real exchange rate: the fall in economic activity in emerging Asia results in lower food and energy prices. Consequently, some of the appreciation of the Canadian real effective exchange rate is reversed, and monetary policy reacts by lowering interest rates.

4.3 Evaluation

The purpose of this model-based analysis is to simulate different assumptions that potentially underlie broad economic developments. By comparing the economic implications of these assumptions, insights can be derived about the source of the shock and possible policy responses. In this case, the following insights emerge.

First, the broad picture generated by the first scenario has difficulties reconciling the rise in inflation in tradable goods observed in many countries in the summer of 2007. Hence, the assumption of a permanent productivity shock – underlying scenario 1 – is not in line with actual economic outcomes between July 2007 and July 2008. Second, scenario 2 seems more in line with the broad economic trends over this period: the overheating in emerging Asia, as well as the strong performance in several commodity-exporting countries, is compatible with resource utilization being at peak levels in many emerging economies.[8] Also, core inflation in many emerging markets has been rising. This suggests that the current period of strong growth in emerging Asia might exhibit an element similar to scenario 2. And third, an implication of the second scenario is that commodity prices might exhibit a boom-bust behaviour, once the temporary demand shock in emerging Asia is run off.

5 Emerging Asia Revalues

As we have seen, a model-based analysis can help identify the sources of broad trends in the global economy. In addition, it is possible to simulate the qualitative effects of changes in domestic or foreign economic policy. In this section, we assume that the second scenario provides a reasonably accurate description of the global economy between July 2007 and July 2008. To evaluate policy options in emerging Asia, we introduce the possibility of changing the value of the exchange rate.

So far in this study, emerging Asia has maintained a fixed exchange rate. This limits its ability to change interest rates to fight inflation. In this situation, a straightforward policy option is for emerging Asia to revalue its currency. A one-off revaluation is consistent with a monetary policy strategy aimed at limiting nominal exchange rate volatility; yet, by making exports to the rest of the world more costly, a revaluation

[8] While we caution against making direct comparisons between model-generated numbers and actual data, note that, for example, JP Morgan Chase Bank (2008) shows that unemployment in emerging markets has fallen rapidly and that unit labour costs have accelerated.

might provide a quick way to cool off an overheating economy. We take scenario 2 as a starting point, and ask the following two questions:

- First, would a revaluation be an appropriate monetary policy response for emerging Asia?
- Second, how would a revaluation of emerging Asia affect the outlook for the rest of the world?

In seeking to answer these questions, we add to the second scenario a 10 per cent nominal revaluation of emerging Asia's exchange rate against the U.S. dollar, which occurs in 2008Q3.[9] Figures 8 and 9 each plot the effects of scenario 2 and "scenario 2 including revaluation." In emerging Asia, a 10 per cent revaluation makes its consumers richer by lowering the relative prices of imported goods. This gives a boost to domestic consumption. At the same time, the rise in the exchange rate dampens exports. Given the size of emerging Asia's export sector, the negative effect through lower exports dominates the positive effect on consumption. Hence, the revaluation cools down the economy. Also, headline and core inflation fall quickly, given that the prices of imported goods fall. These effects occur very quickly, almost cutting in half the time before inflation returns to zero.

Lower inflation in emerging Asia lowers the prices of tradable goods worldwide, but only marginally. The largest effects occur in the United States: given emerging Asia's revaluation against the U.S. dollar, the prices of tradable goods from emerging Asia increase (due to the higher exchange rate), but, at the same time, inflation declines in the imported-goods sector, because of lower inflation in emerging Asia. This enables U.S. monetary policy to be more expansionary. Consequently, U.S. GDP is slightly higher than in the second scenario. The effects of the revaluation on the rest of the world are relatively small: the outlook for oil and food prices is hardly affected, and Canada's economic outlook remains virtually unchanged.

A revaluation of emerging Asia's exchange rate, then, is an effective means to reduce inflation in emerging Asia. It has minor effects on the rest of the world – clearly visible in the virtually unchanged prices for oil and food – but it does allow U.S. monetary policy to be slightly looser, which helps shorten the period of negative economic growth in the United States.

[9] We also analyzed a nominal revaluation of 20 per cent against the U.S. dollar. A revaluation of this magnitude would deepen emerging Asia's recession. We therefore conclude that such a revaluation is not very likely.

Figure 8: Emerging Asia Revalues by 10 Per Cent against the U.S. Dollar: Oil and Food Prices, Emerging Asia and Commodity Exporters (dashed line: scenario 2; solid line: scenario 2 including revaluation)

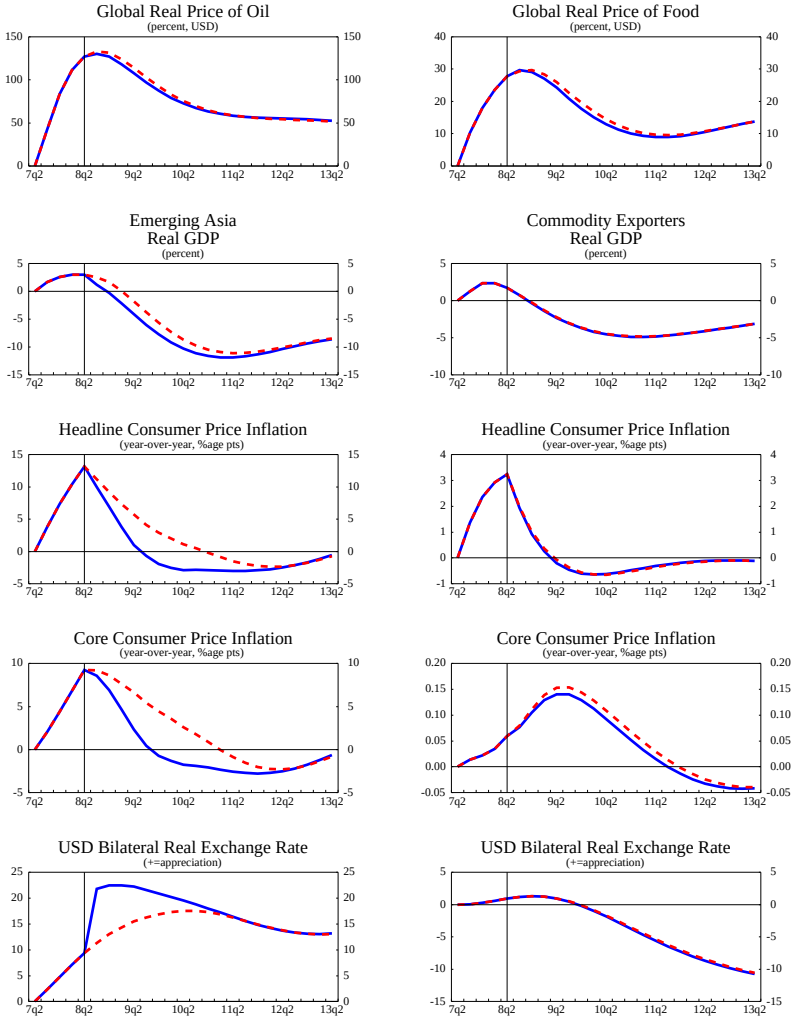
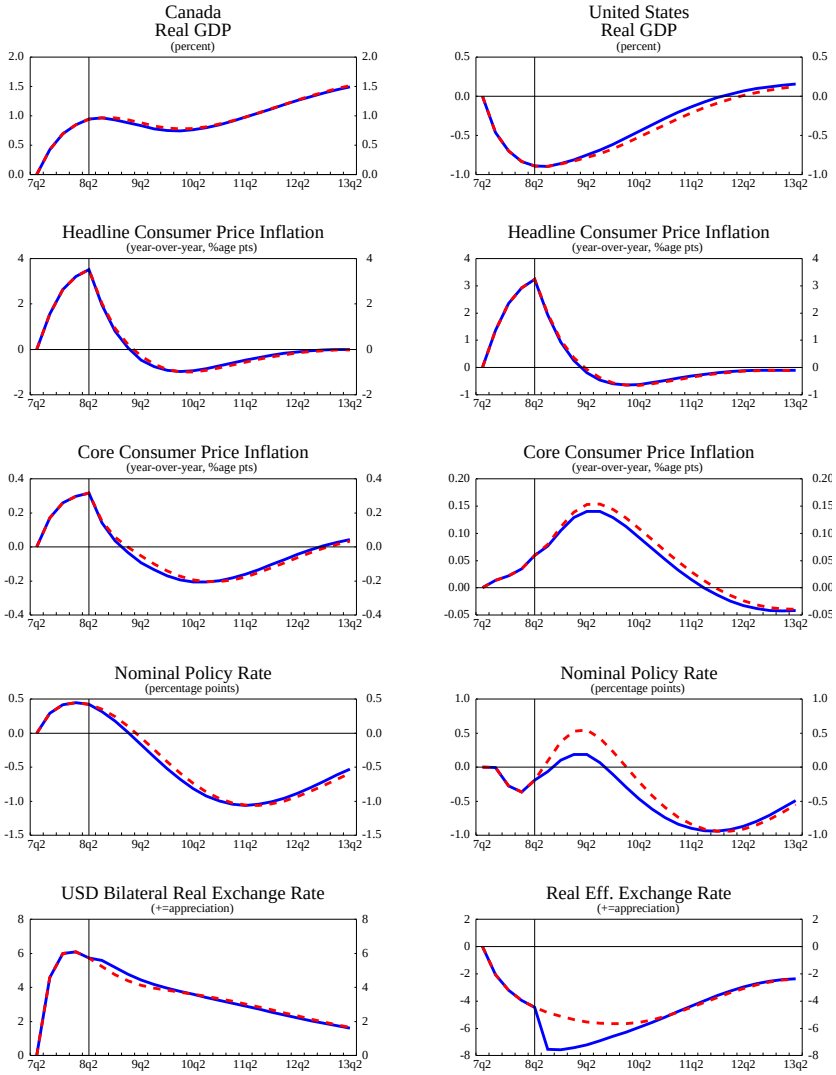


Figure 9: Emerging Asia Revalues by 10 Per Cent against the U.S. Dollar: United States and Canada (dashed line: scenario 2; solid line: scenario 2 including revaluation)



6 Conclusion and Policy Implications

Policy-makers face considerable uncertainty about the forces driving the global economy. In this regard, macroeconomic models can be useful tools to help identify the shocks underlying broad economic trends. As an illustration, we use the Bank of Canada's version of the Global Economy Model to investigate the causes and consequences of the recent run-up in oil and food prices. A combination of demand and supply shocks replicates the broad features of the global economy between July 2007 and July 2008. We investigate how different assumptions underlying the strong growth in emerging Asia over this period might affect the medium- to long-term outlook for the prices of commodities and tradable goods, as well as the global economic outlook. Several conclusions can be drawn.

In the short term, our findings indicate that the source of the shock in emerging Asia matters for monetary policy. Under a positive productivity shock, monetary policy in Canada and the United States lowers interest rates, because of negative pressure on core inflation due to cheap imports from emerging Asia. If demand in emerging Asia is strong because of a temporary demand shock (overheating), this disinflationary effect is replaced by rising tradable-goods prices, because the global supply of tradable goods does not expand. Consequently, monetary policy in Canada and the United States is considerably tighter.

In the long term, our findings show that, in both scenarios, commodity prices stay at high levels, but the second scenario increases the volatility of commodity prices substantially. A larger share of the price increases witnessed in the first half of 2008 is reversed quickly, if the source of strong growth in emerging Asia is a temporary demand shock. This also means that the medium- to long-term outlook for commodity-exporting countries is weaker in scenario 2.

Lastly, if emerging Asia were to revalue its currency by 10 per cent to cool off its overheating economy, its economic volatility would be reduced. Through falling inflation for imported tradable goods, a revaluation of emerging Asia's currency allows U.S. monetary policy to be more accommodative. This shortens the negative effect of emerging Asia's economic cycle on U.S. GDP. A revaluation of emerging Asia's exchange rate hardly affects the outlook for commodity prices, though, and it also hardly changes the outlook for Canada.

While this study has emphasized the usefulness of macroeconomic models to identify the forces underlying broad economic trends, an important caveat is that the results are sensitive to the assumptions behind the scenarios. First, we are admittedly considering two polar opposites – a persistent shock to potential growth in emerging Asia versus a temporary demand shock. In reality, strong growth in emerging Asia is likely to be a combination of both factors. This means that our boom-bust scenario is likely to overstate the negative effects, but it also means that our first scenario might be too optimistic. These two extreme cases provide an upper and lower bound for possible outcomes, but the most likely scenario is probably somewhere in between.

A second caveat is that, when we vary the source of the shock for emerging Asia, we keep the shocks regarding commodity supply constant. This helps expose the different transmission channels more clearly. In reality, however, it is not inconceivable that a true representation of the two scenarios would require a different mix of a commodity supply shock and a shock to emerging Asia's growth. Future research should address these issues.

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