Did Easy Money in the Dollar Bloc Fuel the Oil Price Run-Up?*

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Among the various explanations for the run-up in oil prices that occurred through mid-2008, one story focuses on the role of monetary policy in the United States and in developing economies. In this view, developing countries that peg their currencies to the dollar were forced to ease their monetary policies in response to reductions in U.S. interest rates, leading to economic overheating and higher oil prices. We assess that hypothesis using simulations of SIGMA, a multi-country DSGE model. Even when the currencies of many developing countries are pegged to the dollar rigidly, an easing of U.S. monetary policy leads to only a transitory run-up in oil prices. Instead, strong economic growth in many developing economies, as well as shortfalls in oil production, better explain the sustained run-up in oil prices observed between 2004 and 2008.

JEL Codes: F41, F42.

1. Introduction

During the years preceding the world recession, the price of oil shot up dramatically. As shown in figure 1, crude oil prices more than tripled between the end of 2002 and the end of 2007, and then rose another 60 percent or so to their peak in early July 2008. Given

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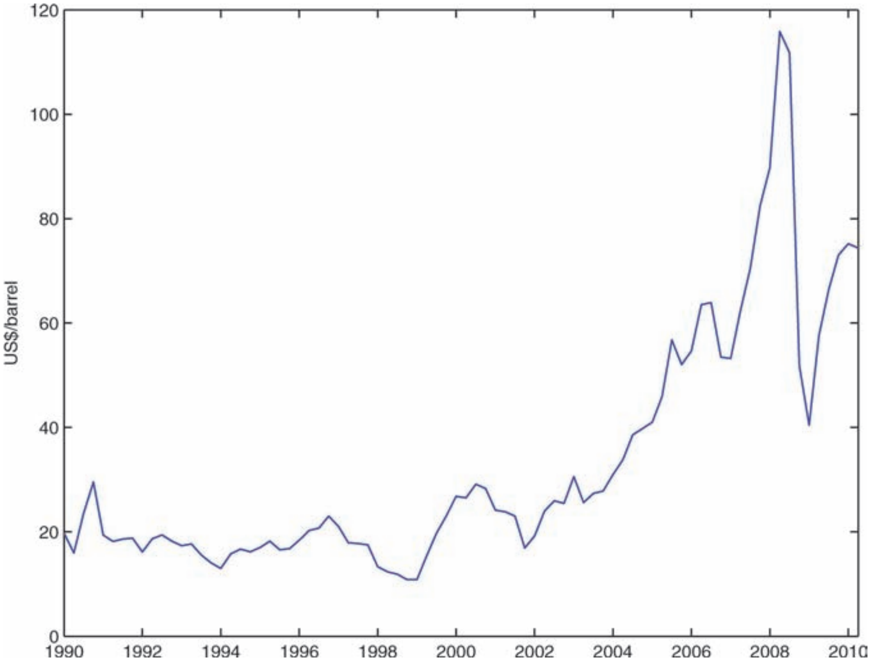
Figure 1. The Price of Oil (U.S. Refiners' Acquisition Cost for Imported Crude)



the consequences of these movements for global inflation, economic activity, and the pattern of external imbalances, it is not surprising that they garnered tremendous attention from analysts and policymakers alike. More recently, the global spotlight has shifted away from the price of oil, partly because it has come down considerably since its peak and also because of the subsequent financial crisis and recession around the world.

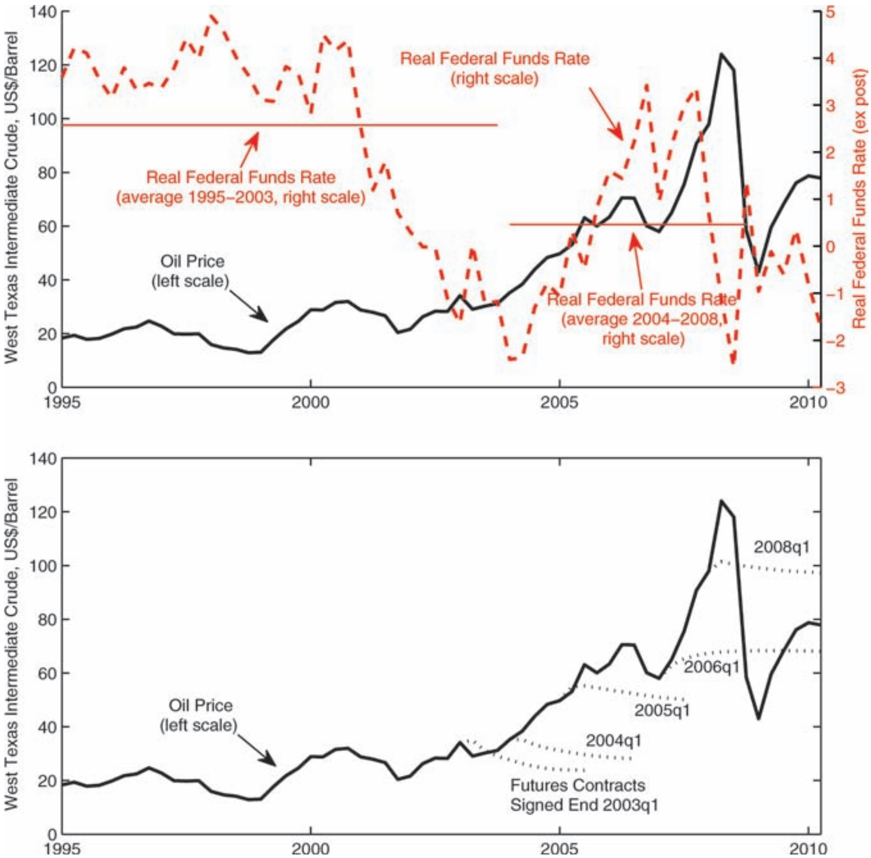
Yet, the behavior of oil prices remains an important issue for the global economy. First, the price of oil remains quite elevated relative to its level earlier in this decade. Second, its prior run-up exacerbated the effects of the financial turmoil: it reduced real disposable income in many commodity-importing countries, and its inflationary effects constrained some central banks from loosening monetary policy in response to financial strains. Finally, as global economic conditions improved, the price of oil has moved up from its recent lows, raising the question of where it will stabilize.

Accordingly, understanding the run-up in the price of oil prior to the global recession remains a high priority for analysts and policymakers. A plethora of explanations for the rise, many of them complementary, have been advanced. One group of these focuses on the fundamentals of supply and demand: industrialization in China and other developing countries substantially boosted the demand for oil, while a combination of slowly growing capacity, weather problems, and geopolitical concerns prevented the supply from keeping up. A second explanation focuses on the role of speculators in driving up commodity prices in general. According to a third explanation—advanced by Frankel (2008)—declines in interest rates caused by the Federal Reserve's monetary easing led to a run-up in the price of oil by depressing the dollar and by reducing the cost of holding inventories, thus diminishing the incentive to extract resources today rather than saving them for the future.

Finally, in the last couple of years, a fourth broad explanation for the run-up in the price of oil emerged which, intriguingly, married elements of the fundamentals-based explanation with the view that the run-up was caused by Federal Reserve loosening. This explanation, which for convenience we will call the "dollar bloc" story, starts with the premise that many developing economies have pegged their currencies to the U.S. dollar. When the Federal Reserve loosened monetary policies, these developing countries had to loosen their policies as well, even though such loosening was not appropriate to their economic circumstances. This led to an overheating of their economies, excess demand for commodities such as oil, and sharp increases in commodity prices. As shown in figure 2, U.S. real interest rates were lowered sharply during the 2001–02 recession and remained well below their historical average through the period between 2003 and mid-2006, and against this backdrop, oil prices rose markedly. The dollar bloc explanation was pithily summarized by Martin Wolf (2008):

> Today, the hapless Federal Reserve is trying to re-expand demand in a post-bubble U.S. economy. The principal impact of its monetary policy comes, however, via a weakening of the U.S. dollar and an expansion of those overheating economies linked to it. To simplify, Ben Bernanke is running the monetary policy of the People's Bank of China. But the policy appropriate to

Figure 2. U.S. Policy Rates and the Price of Oil



the U.S. is wildly inappropriate for China and indeed almost all the other countries tied together in the informal dollar zone or, as some economists call it, "Bretton Woods II."

Similarly, in 2008, an article in the *Economist* entitled "A Tale of Two Worlds" observed:

Apart from the Gulf States, few countries still peg their currencies to the dollar, but most try to limit the amount of appreciation. This means that as the Fed cuts rates there is pressure on emerging economies to do the same, to prevent capital inflows pushing up their exchange rates. In the face of rising

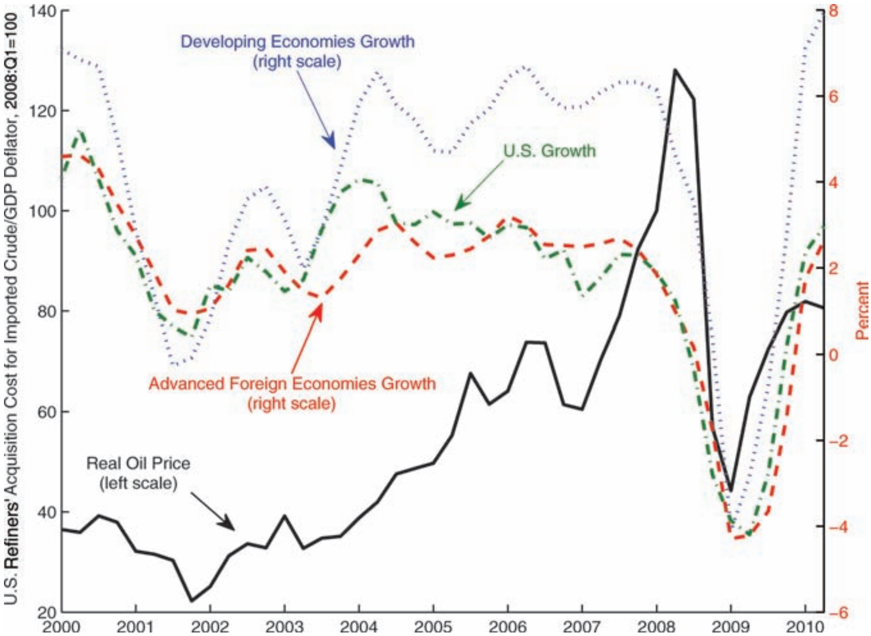
> inflation, emerging economies should be lifting interest rates, not cutting them, but their rigid currency policies makes this hard. In turn, continued surging demand in emerging economies boosts commodity prices, which reduces Americans' spending power and so encourages the Fed to cut rates further. The more the Fed cuts, the bigger the risk of inflation in emerging markets.

This paper assesses the plausibility of the dollar bloc explanation for the run-up in the price of oil using SIGMA, a forward-looking dynamic general equilibrium model comprised of three country blocks. Our model simulations indicate that, in a world where an appreciable portion of the global economy (20 percent) is assumed to be pegged to the dollar, a loosening of U.S. monetary policy on the order of what occurred in recent years—with the real federal funds rate falling some 2 percentage points below its historical average in 2004 through 2007—can indeed cause a sharp spike in oil prices. This occurs because the economies pegged to the dollar receive stimulus (both as their currencies follow the dollar downward and as they loosen their own monetary policies) and this boosts their GDP and thus their demand for oil. However, the spike in oil prices is short lived. As the pegged economies overheat, their GDPs return to trend, oil demand softens, and oil prices retrace their earlier rise.

The transient nature of the oil price hike implied by our model simulations seems at odds with historical experience. In particular, the dramatic oil price increases that occurred over 2004–08 have been highly persistent and appear to have been perceived as such by financial markets. As seen in the lower panel of figure 2, rising oil spot prices over that period—the solid line—were associated with a similar-sized shift in the oil futures path—the dotted lines. Thus, our model suggests that U.S. monetary policy easing is not a good candidate for explaining the large and durable run-up in oil prices that occurred between 2003 and 2008. As an important corollary, the channels through which U.S. monetary policy changes affect U.S. output and core inflation are not much affected by the presence of a dollar bloc.

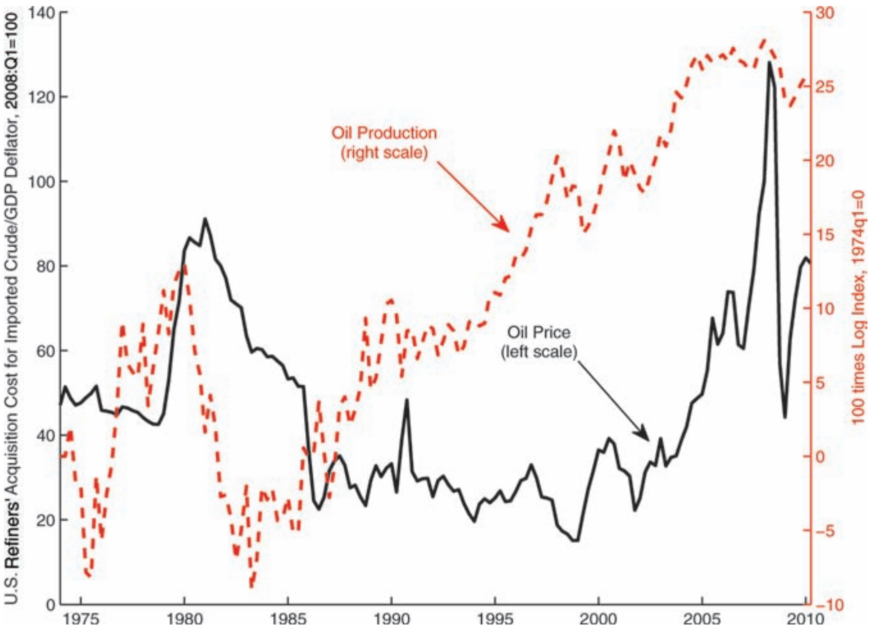
If U.S. monetary easing does not explain the run-up in oil prices, what does? We performed a number of simulations to assess the

Figure 3. Recent Global GDP Growth and Real Oil Prices



plausibility of the most prominent "fundamentals"-based explanations for the surge in oil prices. To begin with, we analyzed the effects of an acceleration of productivity growth sufficient to boost world GDP growth by about 1 percentage point; this increase is comparable to the run-up in global growth seen earlier this decade compared with its historical average (see figure 3). Our model simulation suggests that such an increase in economic growth, because it is sustained, could lead to a similarly sustained rise in oil prices in the neighborhood of 70 percent above their baseline level. We then evaluated the impact of a sustained reduction in the growth of global oil production of 1.5 percentage points, comparable to the reduction in oil supply growth that actually occurred in recent years (as seen in figure 4, global oil production has essentially stalled since 2004). Such a shock would boost the price of oil persistently more than 30 percent above its baseline level. Combining both simulation experiments, we find that the higher global GDP growth and the reduction in oil supply would together lead to a sustained doubling of the oil

Figure 4. World Oil Production and Real Oil Prices



price, roughly comparable to the increase in oil prices between 2004 and the fall of 2010.

In sum, the fundamentals-based explanation for the run-up in oil prices appears more plausible than the "dollar bloc" story, and this holds true even under the somewhat heroic assumption that a fifth of the global economy (including most developing economies) is rigidly pegged to the dollar.

2. Model Description

SIGMA is a multi-country, multi-sector dynamic general equilibrium model used for policy analysis by Federal Reserve staff. The model structure builds heavily on Erceg, Guerrieri, and Gust (2006) and Bodenstein, Erceg, and Guerrieri (2011). We conduct our simulations in a three-country version of the model that includes the United States, a group of "dollar bloc" countries that maintain fixed exchange rates against the U.S. dollar, and an aggregate "rest of the world" (ROW) bloc comprised of all other foreign countries.[1] Monetary policy in both the United States and the ROW bloc is assumed to follow a modified Taylor rule that reacts to inflation and output growth (rather than the output gap), and which allows for a modest degree of interest rate smoothing.

SIGMA has a high degree of formal similarity in the structure of key behavioral equations across the three country blocs. The core of the model has its antecedents in the seminal open-economy modeling framework of Obstfeld and Rogoff (1995), but it embeds a wide array of nominal and real rigidities that have been identified by the literature as important empirically. Thus, consumption behavior is consistent with the permanent income hypothesis in the longer term, though our model incorporates habit persistence, which effectively makes consumption more inertial in the short run. Investment depends on Tobin's Q, though we follow Christiano, Eichenbaum, and Evans (2005) in assuming that investment adjustment costs depend on the change in investment rather than in the capital stock. This increases the persistence in the investment response relative to the standard Q-theory approach. Government spending evolves exogenously (as a share of GDP), and the fiscal authority is assumed to adjust lump-sum taxes in a manner that enables the government to satisfy its intertemporal solvency constraint.

On the aggregate supply side, inflation is determined by a fairly conventional New Keynesian Phillips curve that allows for some intrinsic persistence: thus, inflation depends partly on its own lag but also on marginal cost and the inflation rate expected to prevail in the future. Marginal costs rise when output exceeds potential or when real wages rise above the level that would prevail if wages were completely flexible (in which case wages would immediately adjust to changes in fundamentals, such as higher oil prices). Nominal wages change sluggishly given that they are set in long-term staggered contracts. This contributes to some additional inertia in prices given the substantial influence of wages on marginal cost.

[1] A more complete description of the model and its calibration is provided in a technical appendix to this paper that is available on the Federal Reserve Board's web site as supplementary material to International Finance Discussion Paper No. 979.

Each country or country bloc in our model is regarded as producing a basket of non-oil goods that it can either export or use to satisfy domestic demand. Because each country's basket is an imperfect substitute with the basket produced by other countries, the demand curve for its export basket is downward sloping in its relative price. Producers in each country are assumed to set prices in the buyers' currency (following a Calvo-style timing assumption for price setting). This is consistent with the "local currency pricing" assumption embedded in many open-economy macro models (e.g., Betts and Devereux 1996) and implies gradual adjustment of trade prices to exchange rate movements. Moreover, our model incorporates adjustment costs that penalize rapid changes in bilateral trade shares. This specification captures the idea that it may be costly for households and firms to vary the composition of their import basket in the short run in response to relative price changes, even while allowing aggregate imports to respond rapidly to changes in real activity.

Our model also includes a world oil market in which the price of oil is determined to equate world demand and supply. In each country, oil is demanded by firms as an input into production and by households as a component of their consumption bundle (which also includes imports and domestically produced goods). In line with our specification of non-oil trade, our model incorporates adjustment costs that penalize rapid changes in the share of oil used in production and consumption. As a result, the short-run price elasticity of demand for oil is much lower than the long-run elasticity of demand, consistent both with empirical and anecdotal evidence. Oil supply is assumed to be exogenously fixed in each country bloc, though the initial endowment is much larger relative to per capita output in the ROW bloc; accordingly, the latter is a net exporter of oil, while the United States and the dollar bloc countries are importers.

Turning to the calibration, the relative population size parameters are chosen so that the United States comprises about 25 percent of world output. The dollar bloc is assumed to include most major developing economies in both developing Asia and Latin America (referred to as the DA-LA bloc below) and accounts for 20 percent of world GDP. Even though some countries that are admittedly dollar peggers are omitted from the dollar bloc due to data limitations—notably some Middle East oil exporters—this omission is more than counterbalanced by the inclusion of a broad set of major developing countries that allow their currencies to vary substantially against the dollar. Thus, we interpret the 20 percent share of world output as an upper bound on the importance of the dollar bloc. The ROW accounts for the remainder of world GDP (55 percent). We use national accounts data to calibrate expenditure shares for each of the three country blocs in our model. Model parameters determining bilateral trade flows for non-oil goods are derived using nominal trade shares from the International Monetary Fund's (IMF's) *Direction of Trade Statistics.*

Using 2007 data from the British Petroleum *Statistical Review*, we calibrate oil imports for the United States to 67 percent of total demand in the non-stochastic steady state, implying that 33 percent of oil demand is satisfied by domestic production. Similarly, for the dollar bloc, we calibrate oil imports to 40 percent of total oil demand. We use data on oil use from British Petroleum and the International Energy Agency (IEA) to calibrate the energy intensity of each country bloc. The share of energy in consumption is set to 1.9 percent for the United States, 3.7 percent for the DA-LA bloc, and 1.6 for the ROW; the share of energy in production is set to 2.7 percent for the United States, 4.4 percent for the DA-LA, and 3.4 for the ROW. Finally, the adjustment cost parameters on oil use in production and consumption imply a half life of the response of oil expenditure to a permanent oil price change of ten years.

3. Simulation Results

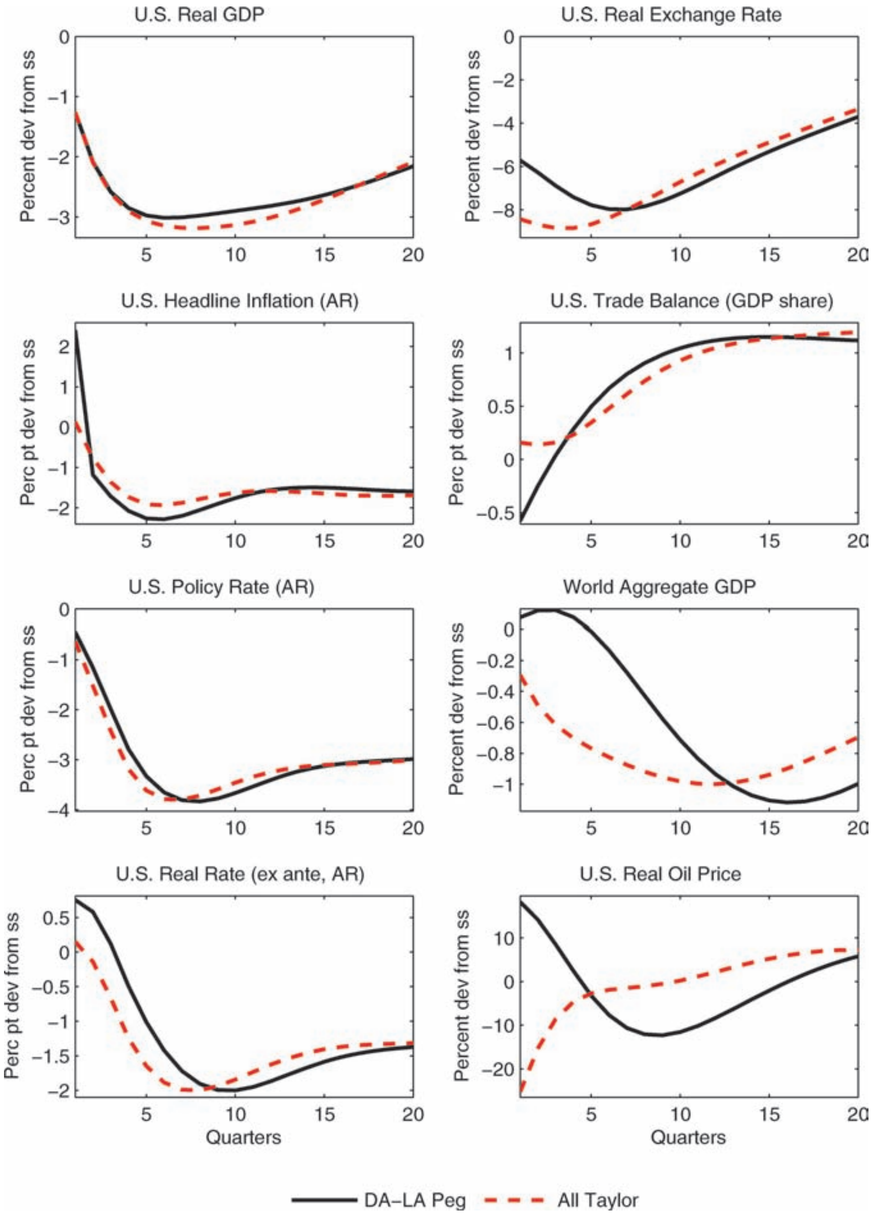
A key objective of our simulations is to evaluate the hypothesis that accommodative U.S. monetary policy in response to adverse shocks originating in the United States generated a boom in emerging market countries through the mechanism of fixed exchange rates, thus helping to fuel a run-up in oil prices. Of course, some have argued that during the 2000s, U.S. monetary policy loosened by more than was consistent with a systematic response to cyclical economic conditions, and it was this excessive loosening that led to undesirable outcomes (see Taylor 2000). Disentangling how much of the movement in the federal funds rate was attributable to the systematic component of the monetary policy rule and how much was due to monetary policy innovations is a complicated task. To simplify, we consider two extreme cases. In the first case, we attribute all of the observed fall in the U.S. real interest rate to the systematic component of policy: rates drop because a shock to U.S. consumption demand causes a large drop in U.S. activity. In the second case, all of the movement in the U.S. real rate is due to unforeseen monetary policy innovations. Given the model's linearity, the effects in intermediate cases may be viewed as a convex combination of these extremes.

3.1 U.S. Aggregate Demand Shock

We begin by analyzing the effects of a country-specific decline in the exogenous component of consumption demand in the United States. As seen in figure 5 (lower-left panel), the shock is scaled so that the U.S. real interest rate falls 2 percentage points below baseline, which is roughly the average amount by which the real federal funds rate over the 2004–08 period dipped below its corresponding average over the 1990–2003 period (recalling figure 2). The shock is assumed to follow an AR(1) process, with a persistence parameter of 0.975.

In order to assess the impact of monetary policy in the dollar bloc countries, we contrast our benchmark calibration in which the dollar bloc countries maintain pegged exchange rates ("DA-LA Peg") to an alternative in which all countries, including those in the dollar bloc, follow the Taylor rule ("All Taylor"). As seen in figure 5, the U.S. aggregate demand contraction has quite similar effects on output, inflation, and interest rates in the United States irrespective of the particular assumption about foreign monetary policy. U.S. output falls persistently, headline price inflation falls below baseline in response to the negative output gap (notwithstanding a transient initial rise due to higher oil prices), and U.S. policy rates decline as implied by the Taylor rule. Because U.S. real short-term interest rates fall much more sharply than interest rates abroad, the U.S. real exchange rate depreciates. This stimulates U.S. real net exports and helps cushion the impact of the domestic spending decline on U.S. GDP. As expected, the size of the real dollar depreciation is somewhat smaller in the benchmark case in which 20 percent of the world pegs than if all countries followed a Taylor rule. Although this implies that the stimulus to U.S. exports arising from a relative price channel is smaller in the benchmark case, foreign activity shows a

Figure 5. U.S. Aggregate Demand Shock



much larger expansion (as shown below). As a result, the stimulus to U.S. real exports turns out to be fairly similar irrespective of the assumption about monetary and exchange rate policy in the dollar bloc. This implication and the relatively low degree of openness of the U.S. economy help explain why U.S. output appears nearly invariant to the assumption about foreign monetary policy.

By contrast, the effects of the U.S. aggregate demand contraction on foreign economies depend starkly on the monetary and exchange rate policy pursued by the dollar bloc countries. Focusing initially on the case in which all countries follow the Taylor rule—the dashed lines—output and inflation in both the dollar bloc countries (shown in figure 6) and in the ROW (figure 7) are basically insulated from the effects of the U.S. shock. Although their real net exports decline due to exchange rate appreciation and the fall in U.S. activity, the contractionary effect on GDP is more than offset by higher domestic demand as monetary authorities abroad cut interest rates. Moreover, real exchange rate appreciation depresses the price of imported capital goods, which also boosts investment (in both the DA-LA and ROW economies).

The solid lines in figure 6 show the effects of the U.S. demand shock on the DA-LA bloc under our benchmark case in which 20 percent of the world economy consists of countries that peg to the dollar. Policy rates in the DA-LA bloc (lower-left panel of figure 6) decline in lockstep with U.S. nominal interest rates, exerting a highly expansionary effect on domestic absorption in the DA-LA bloc. The stimulus from lower policy rates is reinforced by a sharp depreciation of the DA-LA multi-lateral real exchange rate, which mainly reflects nominal depreciation against the ROW currencies. DA-LA real GDP rises substantially, with real exports expanding despite the fall in U.S. activity. As seen in figure 7, output in the ROW rises modestly, notwithstanding the contractionary impact of exchange rate appreciation on real net exports. The output expansion mainly reflects that investment rises as real exchange rate appreciation lowers the cost of capital goods.

Returning to figure 5, the different foreign output responses associated with alternative assumptions about monetary policy in the dollar bloc countries translate into a sizable disparity in the initial response of the oil price in our model. In the case in which all countries follow the Taylor rule, lower world output (mainly because of

Figure 6. U.S. Aggregate Demand Shock (Responses of DA-LA Bloc)

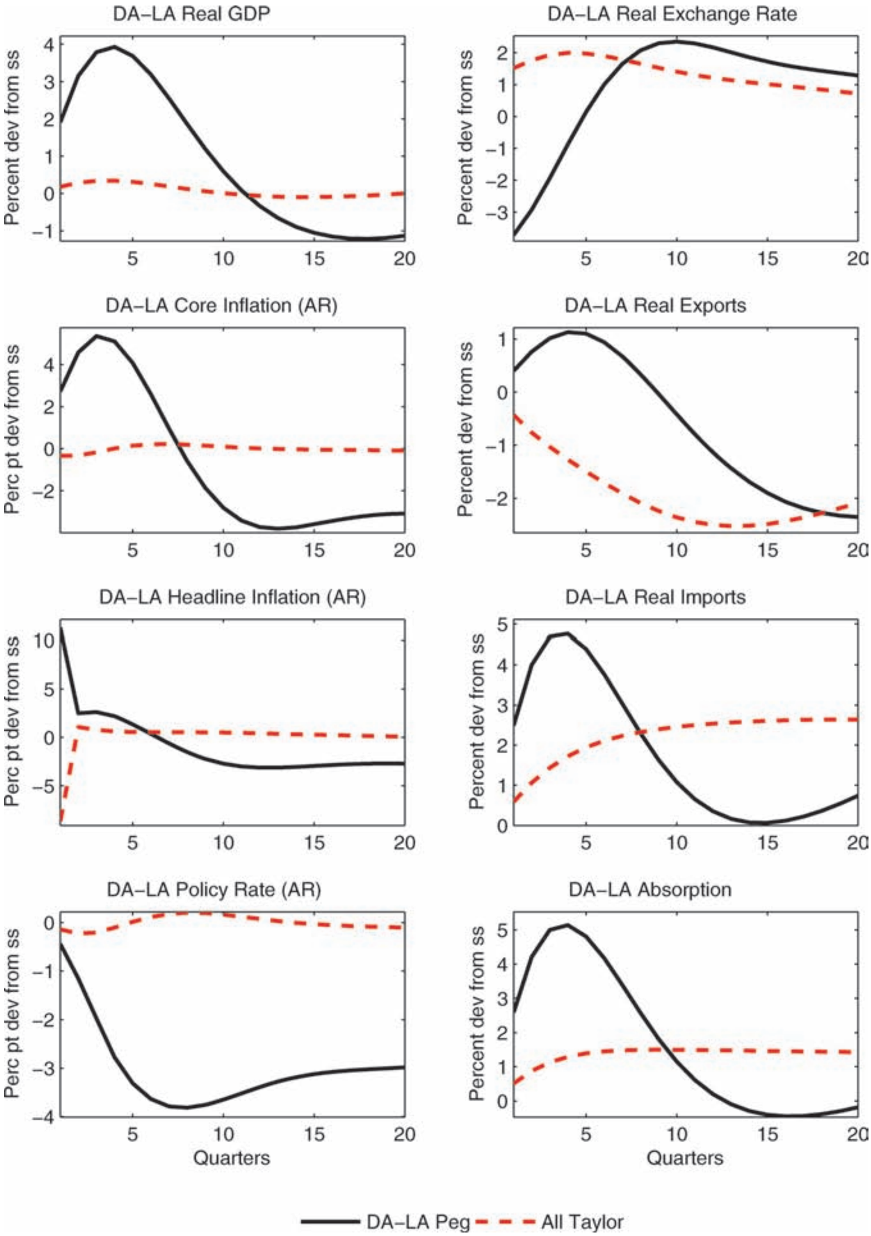
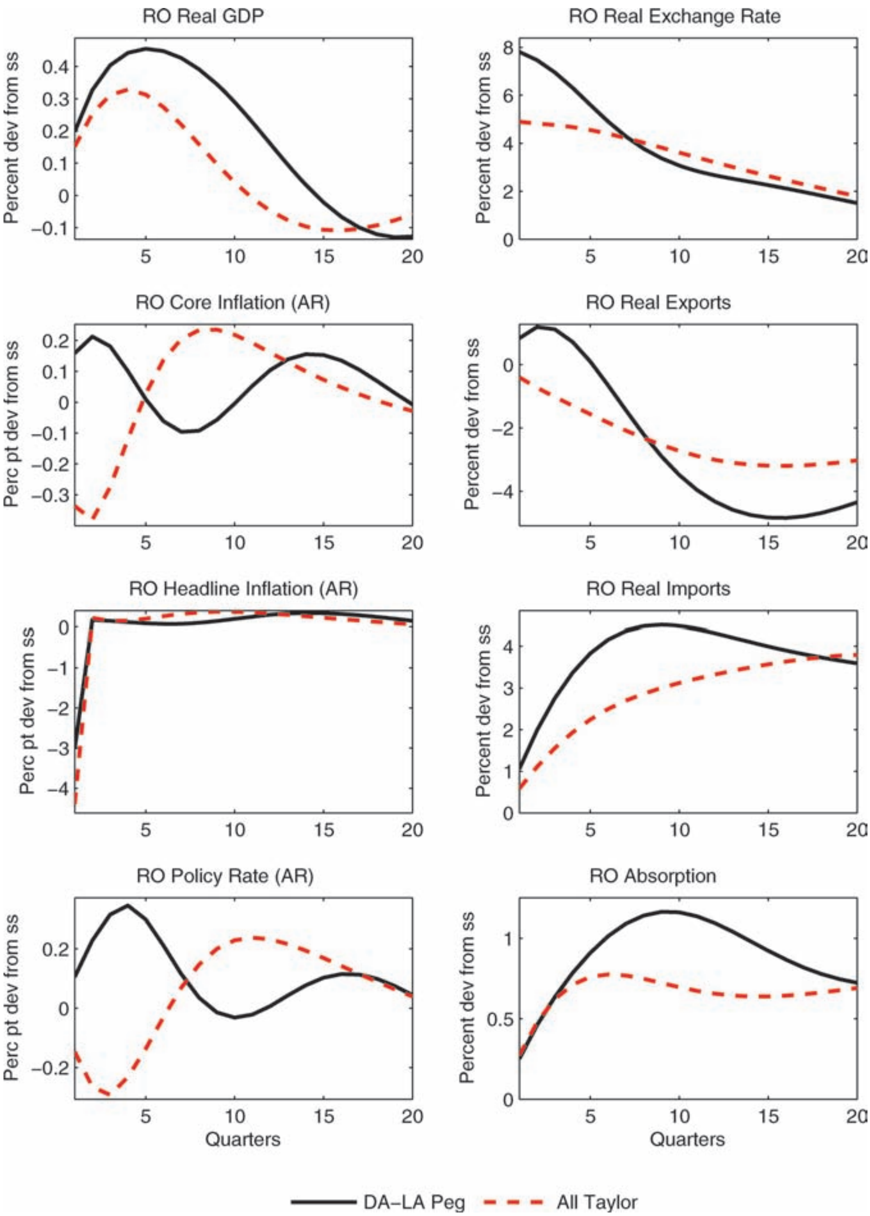


Figure 7. U.S. Aggregate Demand Shock (Responses of ROW Bloc)



the large contraction in the United States) causes the oil price to fall almost 25 percent below baseline in the impact period, and roughly 5 percent after one year. By contrast, the oil price rises by around 15 percent initially in the benchmark case in which dollar bloc countries peg. The disparity in the oil price responses in the face of fairly modest differences in the response of world GDP reflects that the oil price elasticity of demand is extremely low in the short run in our model, in the neighborhood of only 0.01 percent in the impact quarter of the shock (consistent with a half life of adjustment to a relative price change of ten years).

But even if pegged exchange rates in some trading partners induced an initial rise in oil prices by as much as suggested in our model simulation, a key implication of our model is that this channel cannot account for permanent or even persistent increases in the oil price in response to accommodative U.S. monetary policy. The oil price rise under our benchmark case is wholly attributable to a temporary (even if somewhat persistent) rise in foreign output gaps. After an initial spike, oil prices in the simulation rapidly decline toward the steady state. This evidently contrasts with the nature of the actual run-up in oil prices in the years before the global financial crisis.

The implications of these model simulations for agents' expectations about the future path of oil prices also appears inconsistent with historical experience. Agents in the model forecast that most of the oil price increase will be reversed within a couple of years. However, the oil price hikes that occurred over the 2003–08 period appear to have been perceived as largely permanent, recalling our discussion of the oil futures path in the lower panel of figure 2. This casts doubt on the hypothesis that a loosening of U.S. monetary policy in response to the weakening economy contributed markedly to the run-up in oil prices.

3.2 U.S. Monetary Policy Shocks

Figures 8 and 9 show the effects of an alternative cause of the loosening of U.S. policy—namely, a series of unforeseen i.i.d. monetary policy innovations that lowers the real interest rate (based on core inflation) by 2 percentage points over a four-year period. Thus, in contrast to the simulations above, all of the drop in the real policy rate in the 2004–08 period relative to the average over the 1990–2003

Figure 8. U.S. Monetary Policy Shock

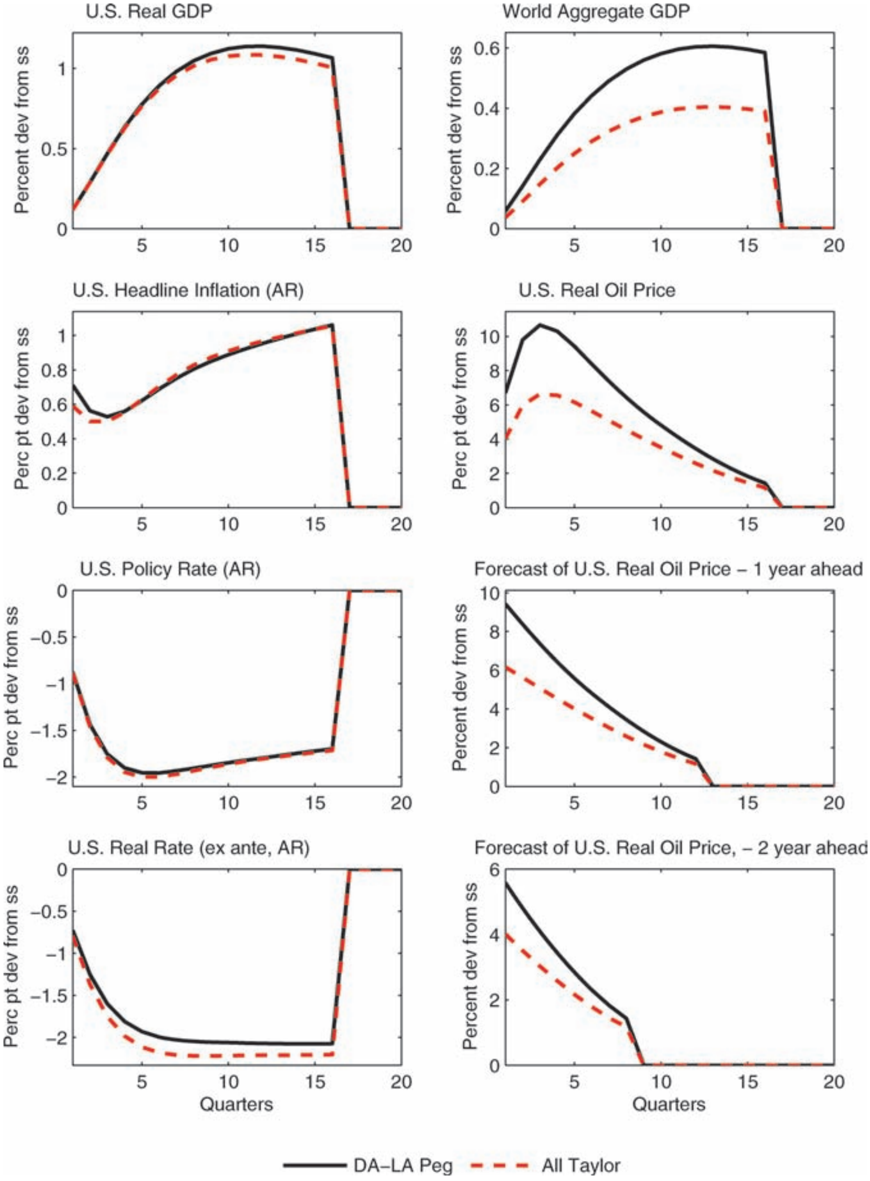
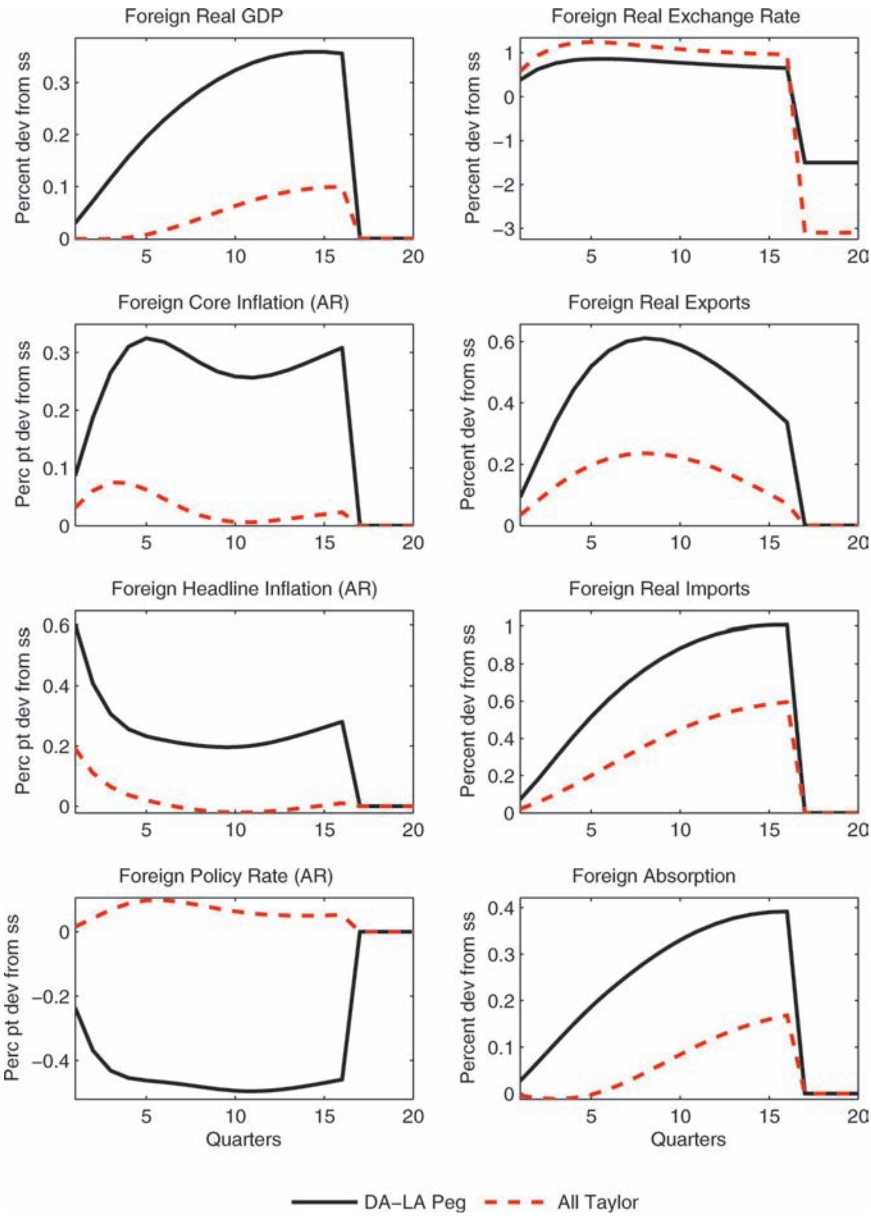


Figure 9. U.S. Monetary Policy Shock (Aggregate Foreign Responses)



period is attributed to the unsystematic component of the policy rule. The average fall in the nominal policy rate over the first four years of the simulation—of around 175 basis points—turns out to be very close to the upper range of "Taylor-rule deviations" reported by Dokko et al. (2009). In particular, Dokko et al. (2009) report an average deviation of around 200 basis points over 2003 to mid-2006 when the inflation measure in the Taylor rule is taken to be headline inflation, and when the output gap is based on the current vintage of revised data. However, those authors emphasize that the Taylor-rule deviations are much smaller and less persistent under alternative inflation measures, including core PCE inflation, and when the output-gap measure is based on real-time data. Accordingly, we interpret our results as indicating an upper range of the effects on output and inflation that might be associated with departures from a Taylor rule in our model.

As before, we contrast our benchmark calibration in which the dollar bloc countries maintain pegged exchange rates ("DA-LA Peg") to an alternative in which all countries, including those in the dollar bloc, follow the Taylor rule ("All Taylor"). U.S. GDP (figure 8) rises under either assumption about monetary policy abroad, as lower interest rates stimulate the interest-sensitive components of domestic spending, and as dollar depreciation boosts real net exports. Turning to figure 9, aggregate foreign output is nearly unaffected by the U.S. monetary policy shock under the "All Taylor" case, reflecting that the stimulus from higher U.S. activity is offset by exchange rate appreciation (n.b., the foreign variables in figure 9 are averages of the DA-LA and ROW responses computed using U.S. trade weights). By contrast, aggregate foreign output rises much more under the DA-LA peg, almost wholly due to a substantial expansion of DA-LA output as interest rates fall.

Returning to figure 8, world GDP rises under either assumption about foreign monetary policy, and given a fixed oil supply, oil prices must rise. However, given that the output boost is transient, the oil price rise also shows little persistence. Accordingly, even if monetary policy had been looser than needed to respond to economic conditions, our model results suggest that such loosening could not explain the sustained run-up in oil prices prior to the global recession.

Insofar as our model implies that oil price movements must be highly persistent to exert much effect on U.S. core inflation and output, the oil price hikes induced by the policy response abroad have relatively little impact on U.S. output and core inflation. Moreover, certain features of our simulations may exaggerate the actual short-term impact of monetary policy loosenings on oil prices (and hence headline inflation). First, some of the sizable quantitative effects shown in figures 5 and 8 simply reflect that the shock to the United States is both large in magnitude and occurs very rapidly: for example, U.S. GDP contracts a full 3 percent in a period of one year in response to the negative aggregate demand shock. With a more gradual phasing-in of the shock, the initial effects on oil prices would differ less across the alternative specifications of DA-LA monetary policy. Second, our model does not allow for oil inventories or variable capacity utilization. In the presence of these features, the perception that the oil price would fall in the future (due, say, to a winnowing of the foreign output gap) would create an incentive to sell inventories and boost current production. Thus, the initial rise in the oil price would be attenuated compared with that shown in figures 5 and 8. Finally, our calibration that imposes a ten-year half life of adjustment contributes to a much larger oil price rise after an increase in world GDP than suggested by some empirical estimates. In particular, while our calibration suggests that a 1 percent rise in world GDP would push up the real price of oil by over 50 percent on impact, this is roughly ten times as large as estimated by Kilian (2009) using a structural VAR framework to identify various shocks affecting oil prices.

To sum up, our model results indicate that even in the presence of a substantial dollar bloc abroad, a loosening in U.S. monetary policy can generate only a transient increase in global output and hence in oil prices, and this result obtains irrespective of whether the monetary loosening is in response to weakening activity or to the unsystematic component of policy. Accordingly, the channels through which U.S. monetary policy changes affect U.S. GDP and core inflation—and forecasts of headline inflation at a horizon beyond a year—are not materially affected by the presence of a dollar bloc. Moreover, although our model implies sizable movements in headline inflation in the short run, it probably overstates such fluctuations insofar as it abstracts from empirically realistic features that would allow greater intertemporal smoothing in oil production and oil demand.

Of course, it is possible that U.S. monetary loosening may impact oil prices in a more persistent manner than captured by our model. For instance, if the monetary shocks considered in figure 8 were more persistent, U.S. output would show a somewhat larger and persistent rise, and oil prices would be affected in a commensurate manner. A problem with this explanation, however, is that more persistent innovations tend to boost expected inflation at horizons beyond a year substantially; but in reality, inflation expectations (except at very short horizons) remained remarkably well anchored at around 2 percent throughout the 2003–06 period.

More plausibly, a potential limitation of our modeling framework is that agents are assumed to have perfect foresight about the underlying sources of all movements in real activity and inflation. In particular, in our simulations agents can immediately recognize that the source of the initially faster foreign GDP growth is accommodative U.S. monetary policy, and hence that any associated boom in oil prices must be transient. But to the extent that it is difficult in practice to disentangle shocks, it is plausible that a boom in fast-growing regions of the world—such as the DA-LA bloc—might be interpreted as driven exclusively by faster productivity growth, when in fact some of the boom was due to monetary stimulus. Accordingly, in a richer modeling environment that allowed for imperfect information about shocks, U.S. monetary policy could possibly exert somewhat larger and more persistent effects on oil prices than implied by our simulations.

3.3 Other Explanations for the Run-Up in Oil Prices

We now turn to using our model to consider the quantitative effects of other shocks that may have exerted a pronounced effect in driving up world oil prices during the past few years. It seems reasonable to focus attention on two particular explanations. First, it seems plausible that faster-than-expected growth in world output—especially in developing economies such as China and India—may have made an important contribution to driving up oil prices. Second, growth in world oil supply has slowed markedly, and projections for the future level of oil production have been revised downward dramatically since the early years of this decade.

Figures 10 and 11 report the effects of a SIGMA simulation in which foreign real GDP growth initially rises about 1.5

Figure 10. Foreign Technology Growth Shock

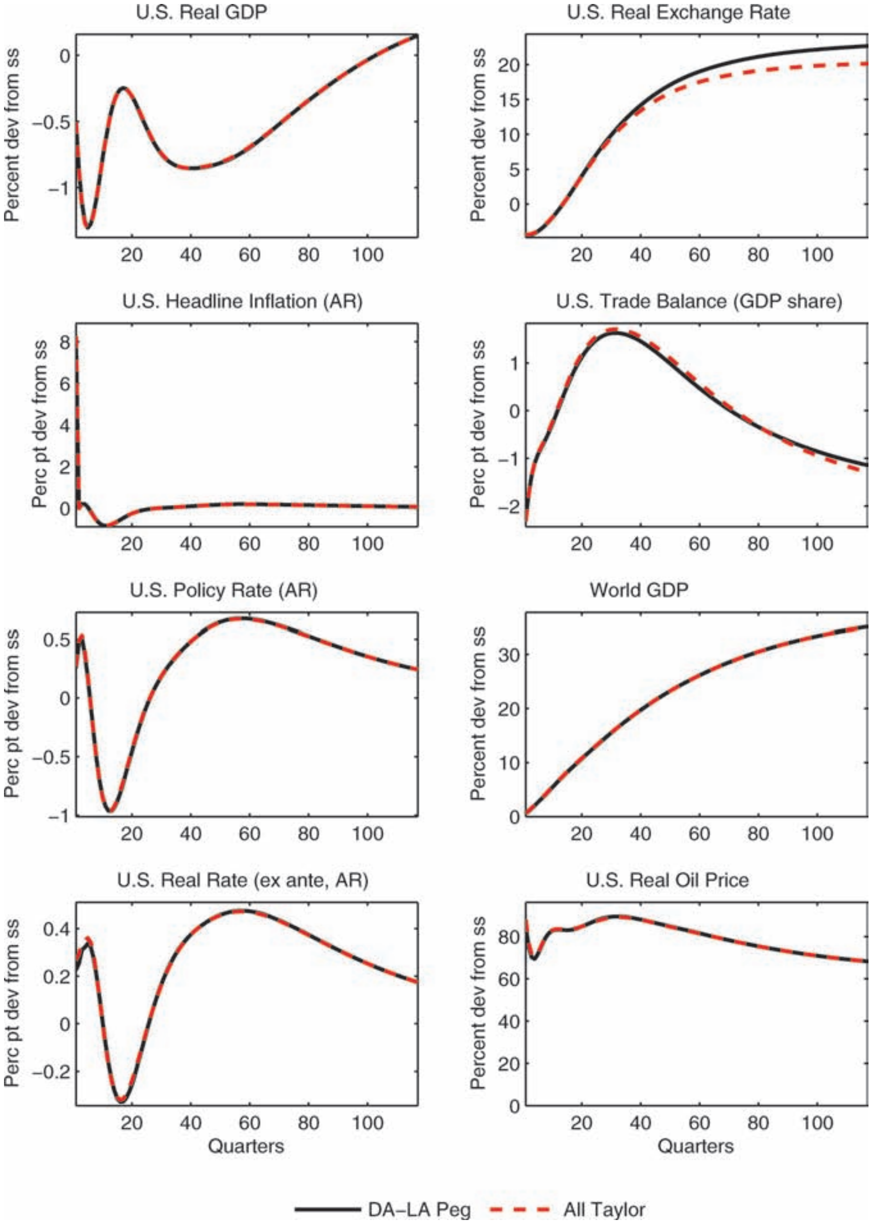
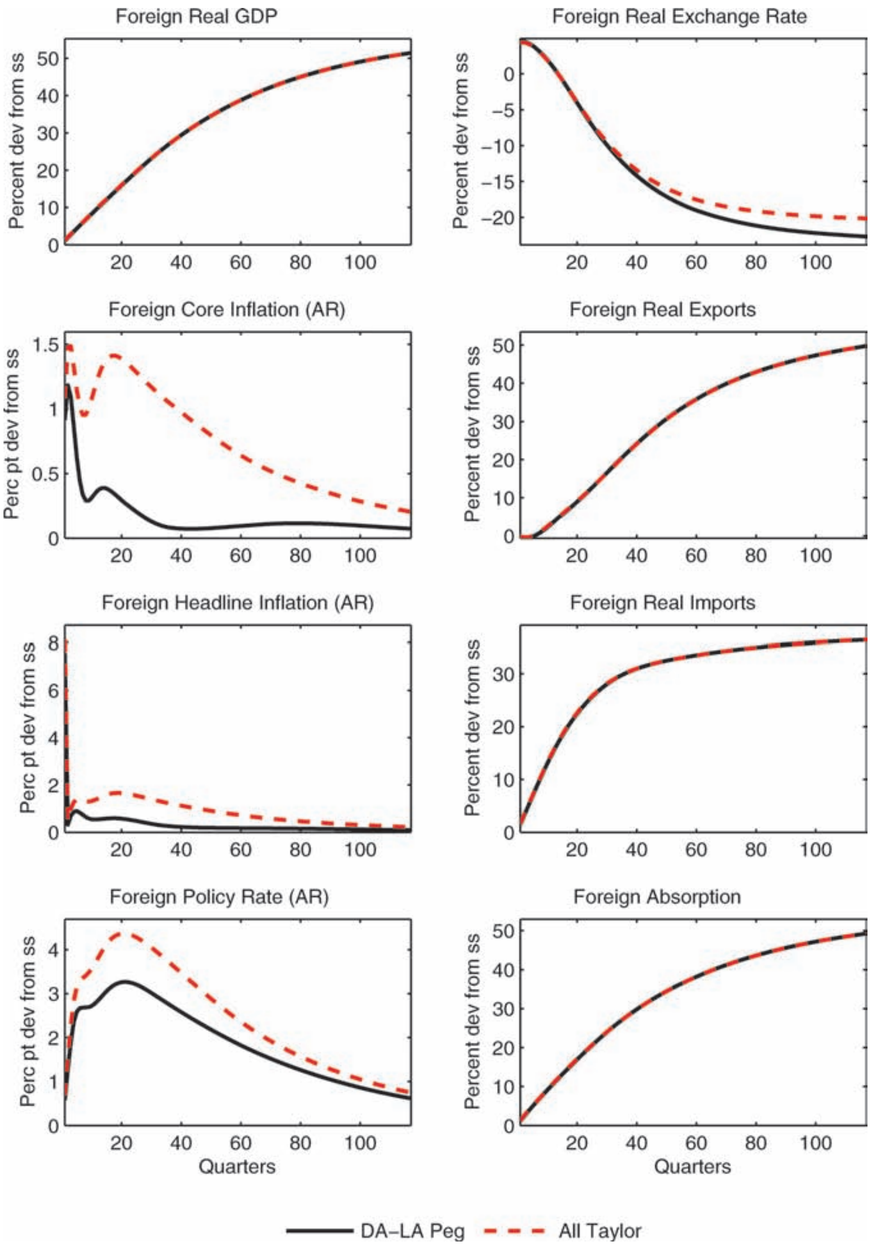


Figure 11. Foreign Technology Growth Shock (Aggregate Foreign Responses)



percentage points relative to baseline due to faster growth in technological progress abroad.[2] Given that the technology improvement occurs only in the foreign countries, this is consistent with a rise in world GDP growth of a little more than 1 percentage point. The size of the shock seems plausible in light of the surprisingly fast world GDP growth that occurred earlier in this decade. For instance, world GDP growth as estimated by the IMF's World Economic Outlook (WEO) rose from about 4 percent per year in 2003, roughly its historical average over the preceding two decades, to an average pace of over 5 percent per year in the 2004–08 period. Although explicit longer-term forecasts for world growth are not provided in the WEO, our reading of the evolution of short-term world growth forecasts and the associated commentary in successive editions of the WEO over the 2003–08 period is that much of the faster growth was a surprise and was eventually reflected in upward revisions to projections for potential growth in China and some other key economies.

Figure 10 shows that the shock eventually pushes up the level of world GDP by a little more than 30 percent over the thirty-year simulation horizon depicted (even though U.S. GDP actually declines a bit, as the stimulative effect of an improvement in real net exports is offset by higher real interest rates and oil prices, which depress U.S. investment for a prolonged period). The higher level of world GDP in turn causes oil prices to rise both persistently and by a large amount. By the end of the simulation horizon, the oil price remains nearly 70 percent above its baseline value. The magnitude of the increase reflects our assumption of a long-run demand elasticity of 0.5 for oil and the rise in world GDP of over 35 percent. The responses in the figure are virtually indistinguishable whether or not the dollar bloc pegs to the U.S. dollar or follows an independent Taylor rule. This reflects that the two alternative policies imply very similar paths for the real interest rate in the dollar bloc.

Although the initial rise in the oil price is a bit larger than the long-term response, overall the projected trajectory is reasonably flat. The growth rate shock produces a persistently elevated level path precisely because substitution away from oil associated with higher prices is almost completely offset by increased demand

[2]The shock to the growth rate of technology in each of the foreign country blocs follows an AR(1) with persistence of 0.95.

stemming from the increase in activity. With agents in the model expecting this flat trajectory, this scenario appears consistent with market expectations for oil prices actually observed during much of the 2004–08 period (as proxied by futures prices).

Our analysis also suggests that adverse shocks to the supply of oil may work in a parallel fashion to generate a highly persistent rise in oil prices, provided these shocks are sustained. Recalling figure 4, world oil production grew at a historical rate of roughly 1–1/2 to 2 percent per year through the first few years of this decade, but has subsequently declined in absolute terms due to particularly disappointing supply responses in non-OPEC countries. Moreover, while the limited forecasts of long-term oil supply available from the early part of this decade seemed consistent with a projection that oil supply would continue to expand roughly in line with its historical average, recent projections (including qualitative assessments) suggest a dismal outlook for growth in global supply. Notwithstanding that oil prices in late 2010 remained more than double their level of a few years ago, many analysts now project that the poor growth performance of the past few years will continue in the longer term. The IEA's 2008 *World Energy Outlook* projected that world crude oil output would be 75 million barrels per day in 2030, only a marginal increase from the local peak of 70 million barrel per day produced in 2007.

Accordingly, figures 12 and 13 investigate the implications of a persistent decline in the growth rate of world oil production of about 1–1/2 percentage points (that dies away very gradually, similarly to the productivity growth shock).[3] The contraction in world supply of over 20 percent after thirty years causes the oil price to rise nearly 40 percent by the end of the simulation horizon. The path of the oil price is relatively flat, as substitution away from oil due to higher prices is roughly counterbalanced by continued falls in supply. The results are little changed even if the dollar bloc follows a Taylor rule instead of pegging to the U.S. dollar.

Finally, it is interesting to consider the combined effects of faster-than-expected world GDP growth and weaker-than-expected growth in oil supply. This simulation is presented in figure 14. The

[3]The shock to the growth rate of oil supply follows an AR(1) with persistence of 0.98.

Figure 12. Oil Supply Shock in ROW Bloc

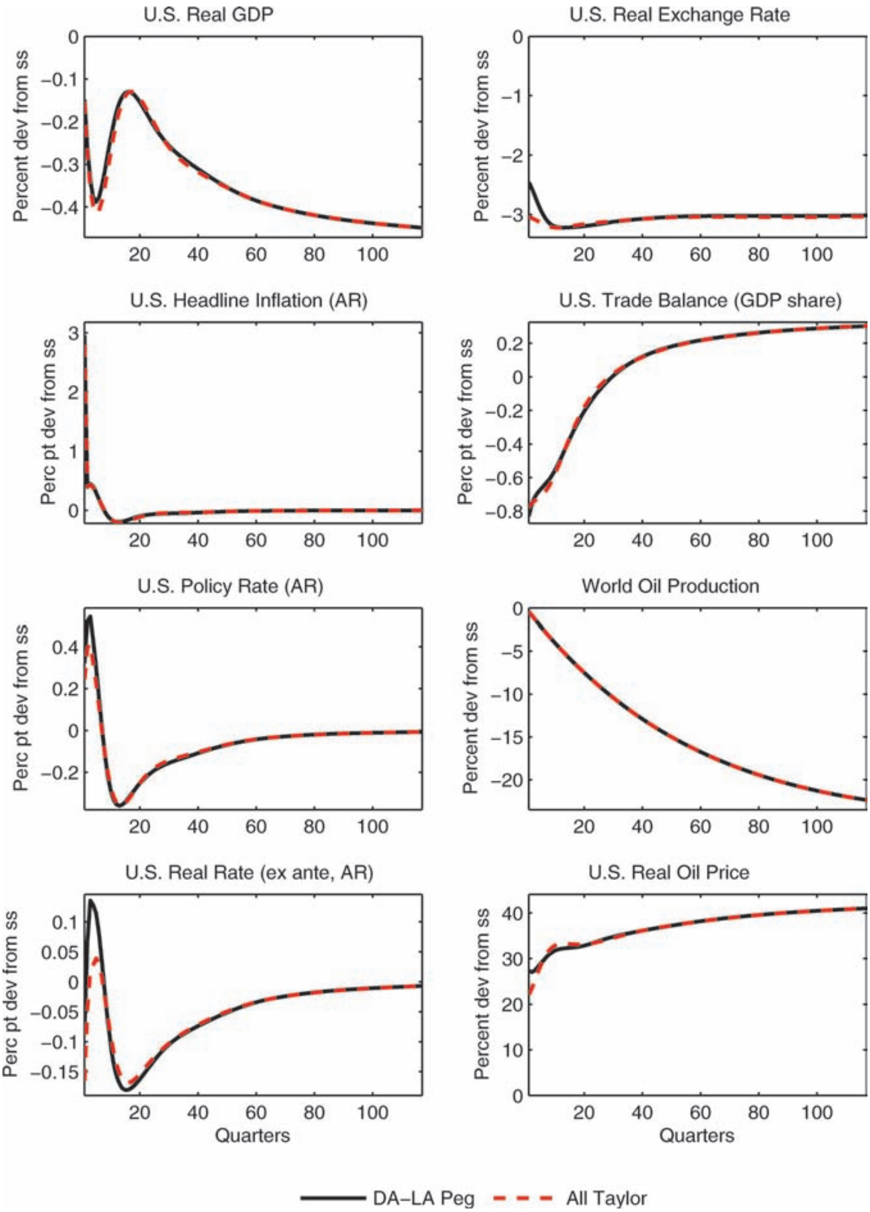


Figure 13. Oil Supply Shock in ROW Bloc (Aggregate Foreign Responses)

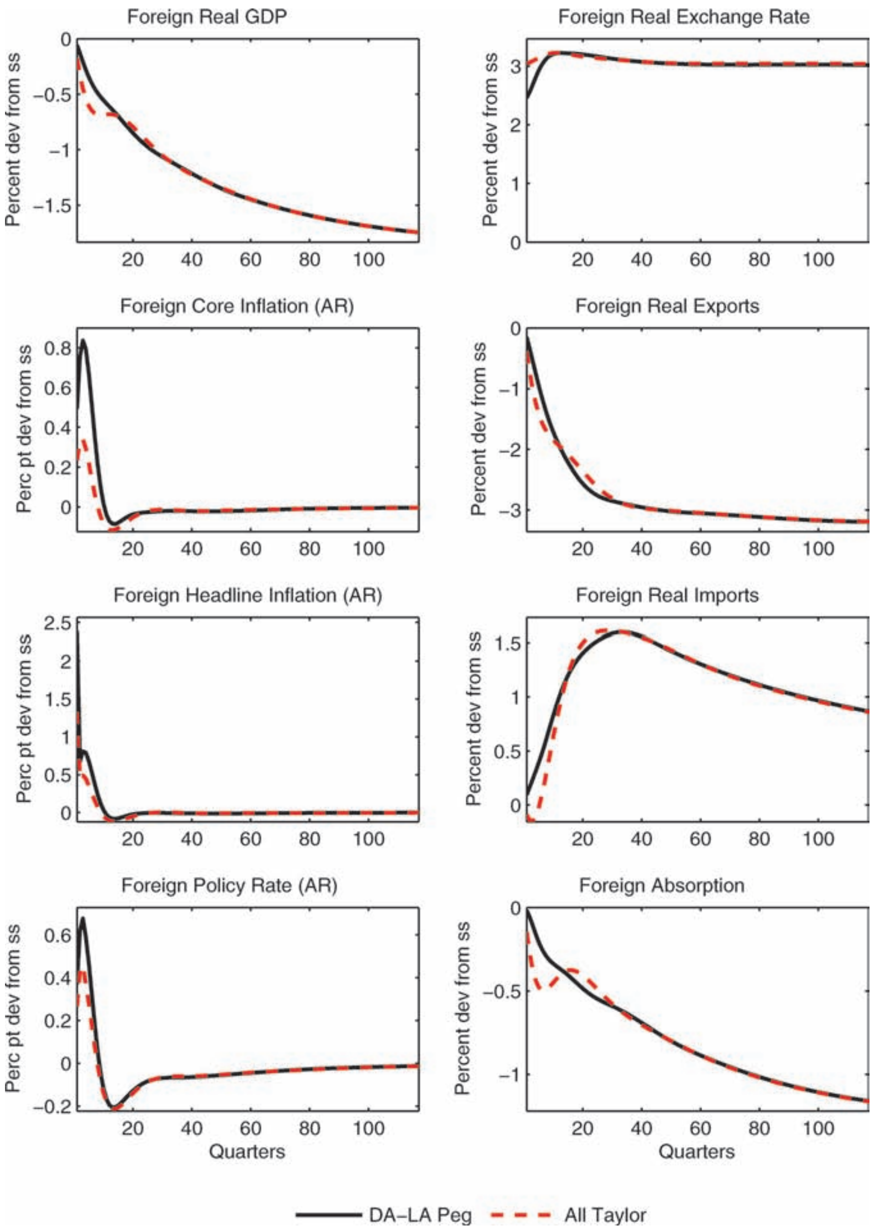
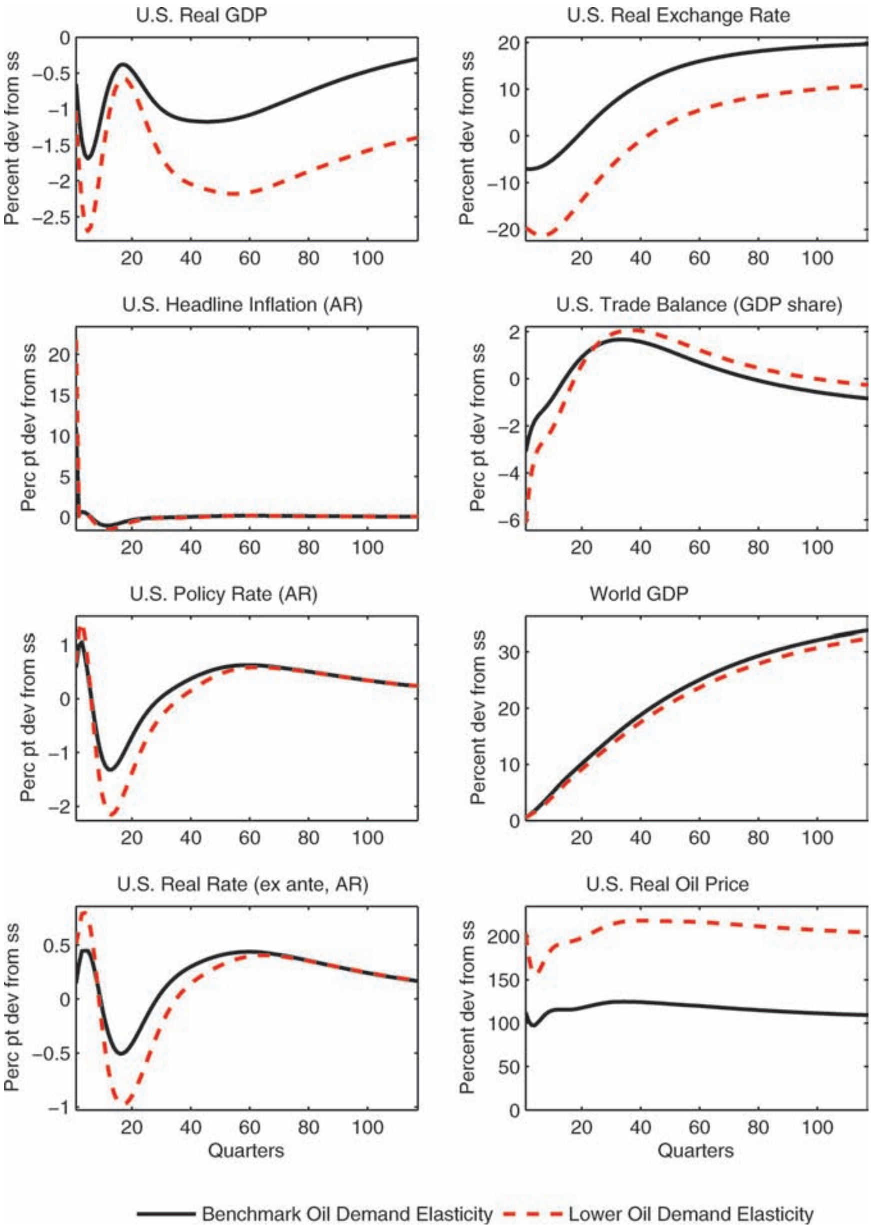


Figure 14. Foreign Technolgoy Shocks and Oil Supply Shock in ROW Bloc



simulation indicates that the combined shocks can account for more than a 100 percent rise in the oil price in the long run. The simulation reported by the dashed lines in figure 14 considers the effects of the same shocks but assuming a lower long-run price elasticity of demand for oil, equal to 0.3 (still in the range of empirical estimates). In that case, the oil price rises as much as 200 percent in the long run.

As highlighted above, our modeling framework lacks certain realistic features such as oil inventories and variable capacity utilization in oil supply. However, these features should not influence the long-run oil price response to persistent shocks. The main message is that faster-than-expected world GDP growth and weaker-than-expected growth in oil supply appear to offer a plausible rationale for much of the large and apparently permanent increase in oil prices that has occurred since 2003.

4. Conclusion

In this paper, we assessed the view that because many developing countries peg their currencies to the dollar, earlier this decade they were forced to loosen monetary policies in line with that in the United States, leading to economic overheating, increases in the demand for oil, and thus sustained rises in oil prices. Using the multi-country SIGMA model, we found that even if many developing country currencies were indeed pegged to the dollar, an easing of U.S. monetary policy would lead to only a transitory run-up in oil prices. The effect on oil prices is short lived both because loose monetary policy can keep output above its equilibrium level for only a limited period of time, and also because the run-up in oil prices induces demand adjustments that subsequently allow prices to come down.

A key lesson of our analysis is that it would take sustained and fundamental shocks to the demand and supply of oil to explain the persistent rise in its price through much of the decade. The more persistent responses of the price of oil to these shocks makes them more plausible candidates to explain the run-up in oil prices than the "dollar bloc" hypothesis.

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