CHAPTER II OIL PRICES AND GLOBAL IMBALANCES

Two developments have dominated the international economic landscape over the past several years. First, large global external imbalances have persisted, including a large current account deficit in the United States matched by surpluses in other advanced economies, in emerging Asia and—more recently—in fuel-exporting countries (Figure 2.1). These imbalances have been matched by corresponding shifts in net foreign asset positions, although—particularly for the United States—this has been partly offset by valuation changes, reflecting exchange rate movements in conjunction with changes in the relative price of U.S. financial assets. Second, energy prices have risen sharply since 2003 (Figure 2.2), driven both by strengthening global demand and most recently by concerns about future supply.[1] With limited excess capacity, the medium-term supply-demand balance is expected to remain very tight, and oil prices will persist near current levels.

This chapter seeks to examine the implications of the rise in oil prices for global imbalances and how these imbalances may evolve, focusing on three main questions:[2]

- What has been the impact of higher oil prices on global imbalances, and what are the key channels of transmission?

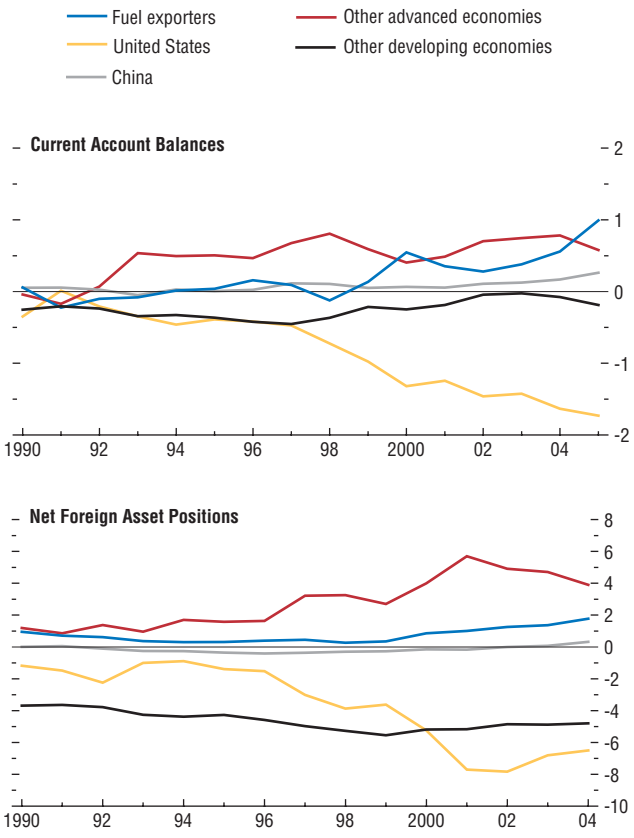
The main authors of this chapter are Alessandro Rebucci and Nikola Spatafora, with support from Lutz Kilian, Doug Laxton, Lars Pedersen, and M. Hashem Pesaran. Christian de Guzman and Ben Sutton provided research assistance.

[1]See the April 2005 *World Economic Outlook*, Chapter IV, as well as Hamilton (2005); and Kilian (2006).

[2]See previous issues of the *World Economic Outlook*, including in particular the April and September 2005 issues, for a detailed discussion of how and why global imbalances have emerged, the associated risks, and the appropriate policy response.

Figure 2.1. Current Account Balances and Net Foreign Asset Positions
(Percent of world GDP)

Large global external imbalances emerged starting around 1996. In particular, the United States is now running an unprecedented current account deficit, with fuel exporters emerging as the main counterparts. Also, the United States is by far the world's largest net debtor. As a group, other advanced economies remain the largest creditors; fuel exporters' net foreign assets, while growing, remain relatively small.



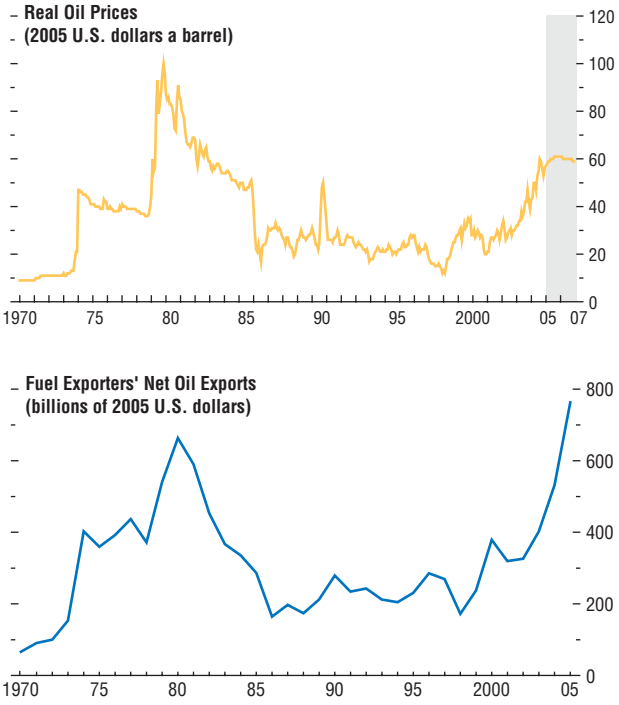
Sources: IMF staff calculations; and Lane and Milesi-Ferretti (2006).

- How has the recycling of oil export revenues, or "petrodollars," affected global and regional financial markets?
- How do policy responses—in particular the pace at which oil exporters spend additional revenues, and the extent to which oil importers allow pass-through of energy prices into core inflation—affect global and regional saving and investment, and hence the evolution of external imbalances?

Specifically, the next section documents key facts about the energy market, external imbalances, and their financing, contrasting the current oil price shock with previous episodes. The chapter then analyzes the likely impact of the current shock on imbalances and how the imbalances may evolve over time. In particular, it offers an econometric analysis of the historical impact of oil prices on external positions, the channels of transmission, and the associated adjustment process. It also investigates through simulations the impact of factors such as the speed with which oil exporters spend their additional revenues, and the extent to which oil prices are allowed to feed through into core inflation.

Figure 2.2. Real Oil Prices and Net Oil Exports

Energy prices started to increase in 1999, with a sharp rise since 2003. This upsurge is to a large extent driven by growing demand in advanced and emerging economies, as well as by expectations of future market tightness. However, current and expected future real oil prices are still significantly below their value in the late 1970s and early 1980s.



Sources: IMF, *International Financial Statistics;* and IMF staff estimates.

How Does the Current Oil Price Shock Compare with Previous Episodes?

As a result of the almost $30 per barrel increase in oil prices during 2002–05—and, to a much lesser extent, rising production—global oil exports have boomed. For a broad sample of fuel exporters,[3] the value of oil exports more

[3]This sample consists of Algeria, Angola, Azerbaijan, Bahrain, Brunei Darussalam, Republic of Congo, Equatorial Guinea, Gabon, Islamic Republic of Iran, Iraq, Kazakhstan, Kuwait, Libya, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, Sudan, Syrian Arab Republic, Trinidad and Tobago, Turkmenistan, United Arab Emirates, Venezuela, and Yemen. The sample includes all the countries in the *World Economic Outlook* "Fuel Exporters" analytical group as of February 2005, with the addition of Kazakhstan and Norway. The main criteria for selection were that, over the past five years, the average share of fuel exports in total exports exceeds 40 percent;

Table 2.1. Increase in Fuel Exporters' Net Oil Exports[1]
(Billions of constant 2005 U.S. dollars, unless otherwise noted)

	CPI-Deflated	Trade-Price-Deflated[2]	Percent of World GDP[3]	Percent of Own GDP[3]	Percent of World Private Capital Flows[3]	Percent of World Stock Market Capitalization[3]
1973–81	436	289	1.9	48.9	78.6	7.6
1973–76	239	139	1.1	27.8	58.4	5.5
1978–81	218	174	0.8	14.5	39.3	4.5
2002–05	437	382	1.2	33.2	37.3	1.6

Sources: IMF staff calculations, *World Economic Outlook, International Financial Statistics;* and World Bank, Financial Structure and Economic Development Database.
[1]All values deflated by the U.S. CPI, except where otherwise noted.
[2]Trade-price-deflated figure is calculated using a trade-weighted average of the G-7 non-oil export-price deflator.
[3]World GDP, own GDP, private capital flows, and stock market capitalization are all computed for the first year of the relevant period (except for private capital flows and stock market capitalization during 1973–76 and 1973–81, when the final year of the relevant period was used instead, reflecting limited data availability). Private capital flows are defined as the sum of net direct investment, portfolio investment, and other investment, from the balance of payments. Russia is excluded from all calculations in the "Percent of Own GDP" column, since it was not a market economy during 1973–81.

than doubled to nearly $800 billion in 2005 and in real terms is now well above the previous 1980 peak (Figure 2.2). For fuel exporters, the current shock is in real terms comparable to (or indeed slightly larger than) the shocks of the 1970s, although as a share of their GDP it is not quite as large (Table 2.1). Rising exports by fuel producers have, of course, been matched by rising imports elsewhere. The increase in the oil-import bill between 2002 and 2005 amounted to almost 4 percent of GDP for China, and over 1 percent of GDP for the United States, other advanced economies, and other developing countries (Table 2.2). From the perspective of the global economy, nevertheless, the current shock is smaller than in the 1970s, whether measured relative to world GDP, private capital flows, or the size of financial markets (Table 2.1). It is also worth noting that external imbalances were apparent well before oil prices started to edge upwards in 1999, and certainly before oil prices reached their current peaks (Figure 2.3). That said, over the past two years higher oil prices account for one-half of the deterioration in the U.S. current account deficit.

Since 2002, fuel exporters have spent a somewhat smaller share of their additional revenues than after the first oil price shock. Their imports over the past few years have remained broadly constant as a share of GDP; even in absolute terms, the increase in imports accounts for little more than one-half of the additional revenues (as opposed to the three-quarters share observed in the early 1970s). A more formal statistical analysis (see Box 2.1, "How Rapidly Are Oil Exporters Spending Their Revenue Gains?") confirms these broad conclusions, while finding

Table 2.2. Change in Net Oil Exports, 2002–05

	Billions of Constant 2005 U.S. Dollars[1]	Percent of World GDP[2]	Percent of Own GDP[2]
Fuel exporters[3]	437	1.24	33.2
United States	–124	–0.35	–1.1
Other advanced economies[4]	–198	–0.56	–1.3
China	–53	–0.15	–3.8
Other developing countries[5]	–53	–0.15	–1.2

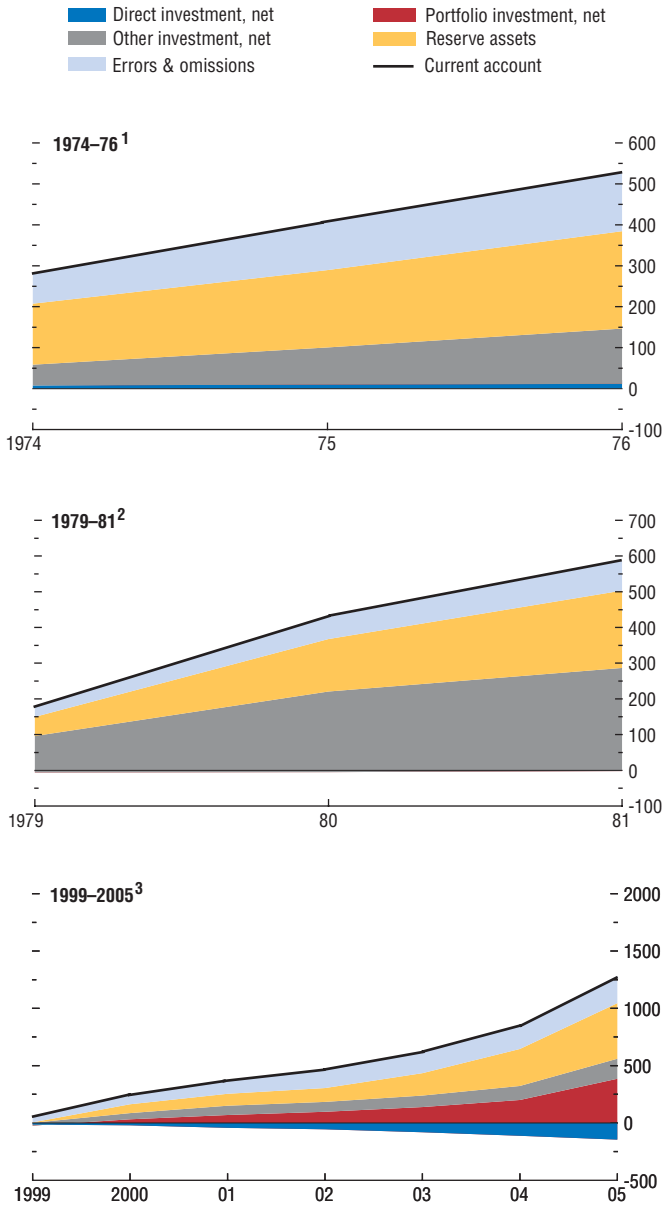
Source: IMF staff calculations.
[1]All values deflated by the U.S. CPI.
[2]Both world GDP and own GDP are computed for 2002.
[3]Includes all the countries in the *World Economic Outlook* group of fuel exporters, with the addition of Kazakhstan and Norway.
[4]Includes all the countries in the *World Economic Outlook* group of advanced economies, except for the United States.
[5]Includes all other countries.

and the average value of fuel exports exceeds $500 million. Kazakhstan was included even though data were not available to gauge whether the first criterion was met. The sample excludes large oil producers for which oil is not a key export earner, such as Canada, Ecuador, Mexico, and the United Kingdom.

Figure 2.3. Fuel Exporters' Cumulative Current Account Balances and Capital Flows

(Billions of 2005 U.S. dollars, cumulative)

Current account surpluses in the 1970s were associated with significant increases in official reserves and bank deposits. During the past few years, there has been relatively little accumulation of bank deposits, while portfolio investment flows have been sizable.



Source: IMF staff calculations.
[1]Cumulative, starting from 1974.
[2]Cumulative, starting from 1979.
[3]Cumulative, starting from 1999.

significant differences across countries (spending rates are relatively low in Cooperation Council of the Arab States of the Gulf, or GCC, countries, but considerably higher in the Islamic Republic of Iran). In particular, the public sector has been cautious about rapidly ramping up spending: between 2002 and 2005, government budget surpluses in fuel exporters increased on average by 11 percentage points of GDP. This appears to reflect concerns, fueled by past experience, about whether such large amounts can be spent effectively within a short period, and whether the current oil price shock may prove transitory (see also IMF, 2005).

Will the shock in fact persist? From a historical perspective, about one-half of the 1973–74 oil price shock proved enduring, while the 1979–81 shock was eventually completely reversed. While any long-run oil price forecast is subject to enormous uncertainty, both market expectations and an assessment of medium-term oil market fundamentals suggest that a considerable proportion of the recent shock will be permanent in nature (see Chapter IV of the April 2005 *World Economic Outlook*). Examining this issue from a different perspective, the shock has changed not just current income, but also wealth: the value of fuel exporters' petroleum reserves increased by more than $40 trillion between 1999 and 2005 (Table 2.3). If two-thirds of this were to prove permanent in nature, broadly consistent with the estimates in the April 2005 *World Economic Outlook*, it would imply an $850 billion increase in permanent income,[4] almost three times the observed increase in aggregate imports to date. That said, the increase in wealth has been spread very unevenly across fuel exporters; in some, such as Norway and Bahrain, the value of total petroleum reserves is equivalent to current GDP or less.

Fuel exporters' spending patterns are likely to affect the relative demand for goods from

[4]Assuming a U.S. long-term real interest rate of 3 percent, roughly the average value observed over the past 30 years.

Table 2.3. Petroleum Reserves

	Percent of World Reserves	Value of Reserves in Percent of 2005 GDP[1]	Change in Value of Reserves, 1999–2005		Percent of World Crude Oil Production
			Percent of 2005 GDP	Percent of 2005 world GDP	
Sample of selected fuel exporters	**88.2**	**2,156**	**1,763**	**98.3**	**62.4**
Kuwait	8.3	8,178	6,708	10.5	3.0
Libya	3.3	5,847	5,034	4.3	2.0
Saudi Arabia	22.1	4,722	3,856	27.6	13.2
Kazakhstan	3.3	4,145	3,663	4.5	1.6
United Arab Emirates	8.2	4,129	3,368	10.3	3.3
Iran, I. R. of	11.1	3,679	3,199	14.8	5.1
Venezuela	6.5	3,329	2,724	8.1	3.7
Azerbaijan	0.6	3,276	2,672	0.7	0.4
Qatar	1.3	2,244	2,143	1.9	1.2
Nigeria	3.0	2,111	1,862	4.0	3.1
Angola	0.7	1,826	1,672	1.0	1.2
Congo, Rep. of	0.2	1,729	1,425	0.2	0.3
Gabon	0.2	1,416	1,123	0.2	0.3
Sudan	0.5	1,290	1,280	0.8	0.4
Equatorial Guinea	0.1	1,133	1,042	0.2	0.4
Oman	0.5	1,033	849	0.6	1.0
Yemen	0.2	1,010	995	0.4	0.5
Brunei Darussalam	0.1	927	761	0.1	0.3
Syrian Arab Republic	0.3	661	572	0.4	0.7
Algeria	1.0	635	522	1.3	2.4
Russia	6.0	529	454	8.0	11.6
Trinidad and Tobago	0.1	399	354	0.1	0.2
Norway	0.8	185	144	1.0	4.0
Turkmenistan	—	175	142	0.1	0.3
Bahrain	—	53	36	—	0.1
Iraq[2]	9.7	—	—	12.1	2.5
OPEC	**74.9**	**3,601**	**2,997**	**95.3**	**41.0**
World	**100.0**	**153**	**128**	**128.0**	**100.0**

Sources: BP, *Statistical Review of World Energy 2005;* Energy Information Administration; and IMF staff calculations.

Note: Estimates of reserves refer to end-2004 and of crude oil production to 2004 (except for Bahrain, where production estimates refer to 2003).

[1]Total value of stock of reserves calculated using average petroleum spot price for December 2005.

[2]No GDP data available.

different regions. In particular, fuel exporters are importing fewer goods, measured as a share of their total merchandise imports, from the United States today than they were in the 1970s. In terms of market share of imports, the United States ranks well below either advanced economies or most developing economies (Table 2.4).[5] Hence, as the shock redistributes income from advanced economies and other developing countries toward fuel exporters, relative demand for U.S. goods declines. Even assuming that fuel exporters spend all their incremental revenues, this "third-country" effect would still act to increase the U.S. current account deficit by a further $25 billion, or 0.2 percent of GDP.

For now, however, oil exporters are saving a considerable share of their income. This raises the question of how the surplus funds are being recycled and how they are affecting global financing conditions, including the extent to which they are contributing to low global interest rates. At a broad level, the current account surpluses of the 1970s and early 1980s were

[5]As a caveat, the data reflect the composition of merchandise trade alone. However, there is anecdotal evidence that fuel exporters may be relatively large consumers of U.S. financial services.

Table 2.4. Composition of Merchandise Imports

(Percent of imports of given importing region sourced from given exporting region)

	Exporting Region					
	Fuel exporters[1]	United States	Other advanced economies[2]	China	Other developing countries[3]	Total
Importing Region—2004						
Fuel exporters[1]	—	8.4	59.0	7.6	25.0	100
United States	8.3	—	54.0	13.8	23.9	100
Other advanced economies[2]	19.5	25.8	—	21.3	33.4	100
China	9.2	8.6	65.3	—	17.0	100
Other developing countries[3]	13.3	19.5	59.3	8.0	—	100
Importing Region—Change Between 1981 and 2004[4]						
Fuel exporters[1]	—	–5.7	–9.0	6.6	8.0	. . .
United States	–11.4	—	–4.9	13.0	3.2	. . .
Other advanced economies[2]	–19.6	–8.7	—	18.1	10.1	. . .
China	8.5	2.6	–14.7	—	3.6	. . .
Other developing countries[3]	–9.2	–4.8	7.8	6.3	—	. . .

Source: IMF, *Direction of Trade Statistics*.
[1]This group is as defined in the text.
[2]This group included all the countries in the *World Economic Outlook* group of advanced economies, except for the United States.
[3]This group includes all other countries.
[4]Percentage point difference in the share of imports between 1981 and 2004 (i.e., a positive number indicates an increase since 1981). The year 1981 is the earliest date available with data coverage comparable to 2004.

almost entirely associated with increases in official reserves and bank deposits (Figure 2.4); much of this was on-lent to emerging market countries, particularly in Latin America, setting the stage for the 1981–82 debt crisis (see Box 2.2, "Recycling Petrodollars in the 1970s"). During the past few years, in contrast, there has been relatively little accumulation of bank deposits, whereas portfolio investment flows have been sizable. However, given the limitations of published data, it is difficult to be more precise regarding the current allocation of oil money by asset, currency, or region. Fuel exporters' recorded deposits in BIS-reporting banks, together with their identified purchases of U.S. securities, amount to less than one-third of the cumulative current account surpluses (Figure 2.5; see also BIS, 2005). In some countries, prepayment of external debt accounts for an important share of the difference.[6] Anecdotal evidence also suggests other possible explanations. Purchases of U.S. securities may be booked largely through intermediaries based in London or offshore financial centers. Again, fuel exporters may be investing in more diversified portfolios—for instance, real estate, private equity, and hedge funds. They may also be investing relatively more in non-U.S. and, perhaps, non-G-7 securities, not least because of the reporting requirements of the post-9/11 Patriot Act. For instance, some of the savings may have been invested in regional equity and real estate, whose price is booming throughout the Middle East, and in emerging markets more generally. However, IMF staff estimates of the currency composition of fuel exporters' official reserves indicate that the share held in dollar-denominated assets, at about 60 percent of all identified assets, has not changed significantly since 2002.[7]

Given the limited hard data available, any impact of the recycling of oil revenues on financial market conditions must be estimated indirectly. To the extent that petrodollars are currently being recycled through market-based instruments, rather than bank-based lending,

[6]IMF staff estimates indicate that as much as 10 percent of fuel exporters' total 2005 hydrocarbon revenues were allocated to debt prepayments.
[7]See IMF (2006), Box 1.6, for a more detailed discussion.

any effect on financing should be concentrated on market-based financial systems and on traded assets. Box 2.3 ("The Impact of Petrodollars on U.S. and Emerging Market Bond Yields") analyzes whether the recycling of petrodollars has helped lower either U.S. long-term interest rates or emerging market spreads. There is indeed strong evidence that capital inflows from abroad have helped reduce yields on U.S. bonds. The precise impact of oil-related flows is more difficult to disentangle, although its magnitude is likely to be relatively modest (at most a ⅓ percentage point reduction in U.S. nominal yields in 2005), possibly reflecting the diminished importance of fuel exporters in the international financial system.[8]

Finally, it is worth underscoring that the current increase in oil prices is taking place in a very different global environment from the past. In particular, the pattern of external imbalances has changed markedly since the 1970s. Then, large external deficits were concentrated in oil-importing developing countries (Figure 2.3). Now, it is the United States that is running a large external deficit, aggravated by high oil prices; given the central role of the United States in the world economy, this must heighten concerns. Set against this, the nature of the international financial system has been transformed over time, with bank-based lending being largely replaced by intermediation through financial markets. Now that the recycling of petrodollars is market-based and less driven by a few large intermediaries, it may well prove more sustainable than in earlier episodes.

How Will the Current Oil Price Shock Affect Global Imbalances?

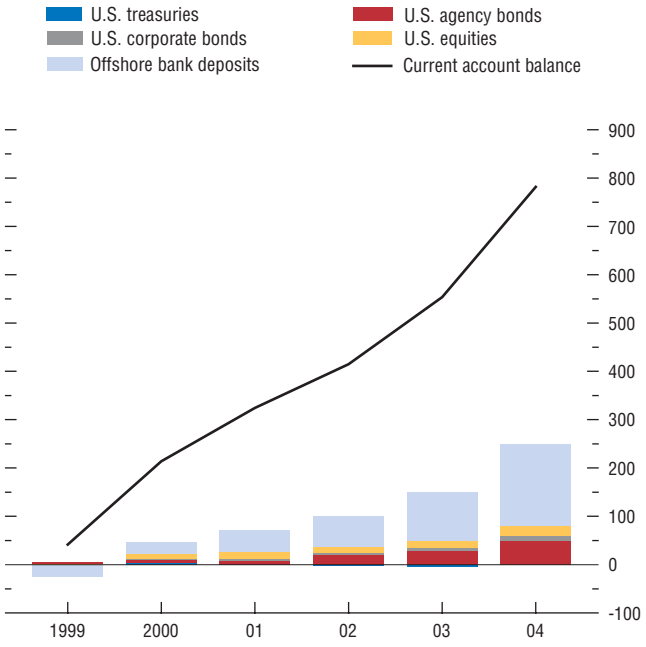
The previous section sought to place the recent oil shock in context. This section looks in

[8]Their gross external assets as of end-2004 accounted for less than 4 percent of the world total, while their share of official reserves was about 10 percent.

Figure 2.4. Fuel Exporters' Cumulative Current Account Balances and Identified Asset Purchases

(Billions of U.S. dollars, cumulative since 1999)

In contrast to the 1970s, tracking the precise assets and countries into which oil revenues have been invested over the past few years is difficult. Identified purchases only account for a small share of current account surpluses.

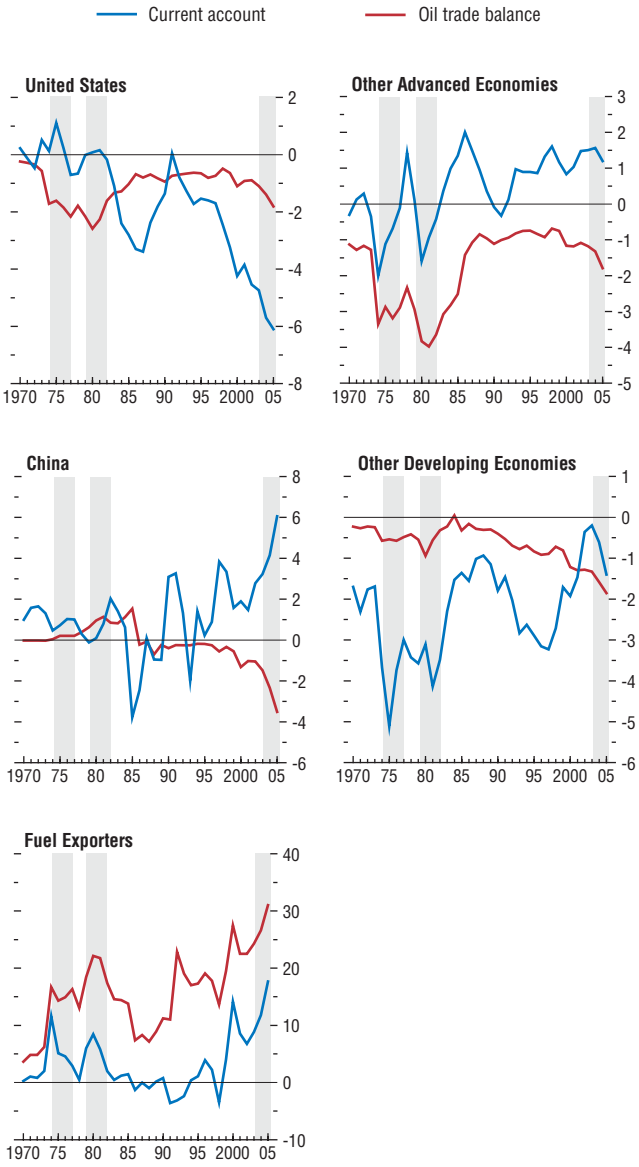


Sources: Bank for International Settlements; Treasury International Capital System; and IMF staff calculations.

Figure 2.5. Current Account and Oil Trade Balances

(Percent of GDP)

In the 1970s, large external deficits, financed by the recycling of petrodollars, were concentrated in oil-importing developing countries. In recent years, the oil price shock has instead contributed to a widening U.S. current account deficit and has redistributed current account surpluses from other advanced economies and emerging Asia toward fuel exporters.



Source: IMF staff calculations.

more detail at how the global economy—and particularly global imbalances—are likely to adjust. Following the initial oil price shock, adjustment takes place broadly as follows.[9]

- In *fuel importers*, the rise in world oil prices worsens the trade balance, leading to a higher current account deficit and a deteriorating net foreign asset position. At the same time, higher oil prices tend to decrease private disposable income and corporate profitability, reducing domestic demand; along with a depreciation of the exchange rate, this acts to bring the current account back into equilibrium over time. The speed and output cost of adjustment depends on factors such as the degree of trade openness, structural flexibility,[10] and central bank credibility, as well as the shock's expected persistence and the speed with which it is allowed to feed through into domestic fuel prices. Among other things, these determine the extent to which rising oil prices raise inflationary pressures, necessitating a monetary tightening that could lead to a more pronounced slowing in growth.
- In *fuel exporters*, the process works broadly in reverse: trade surpluses are offset by stronger growth and, over time, real exchange rate appreciation. One important difference, however, is that fuel exporters may take longer than fuel importers to adjust to the increase in fuel prices.[11] Hence, their savings may remain at high levels for extended periods.
- Consequently, *aggregate global demand* is likely to fall. In turn, this sets in train a process of multilateral adjustment, driven by interest and exchange rate changes, as well as growth

[9]See Ostry and Reinhart (1992) and Cashin and McDermott (2003) for a detailed discussion of the international transmission of terms-of-trade shocks.

[10]See the April 2005 *World Economic Outlook*, Chapter III.

[11]The rise in oil exporters' revenues is often very large as a share of own GDP, and cyclical and/or structural and institutional constraints can make it very difficult to expand demand quickly and efficiently. In contrast, no such constraints prevent demand from rapidly adjusting downward in fuel importers.

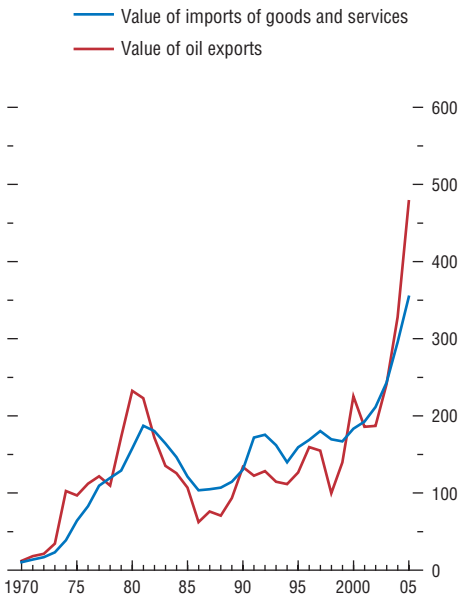
Box 2.1. How Rapidly Are Oil Exporters Spending Their Revenue Gains?

Oil-exporting countries' export revenues have increased significantly over the past two years, with Organization of the Petroleum Exporting Countries (OPEC) revenues estimated at about $500 billion in 2005, twice that in 2003, but lower as a share of world GDP (1.1 percent) than both in 1974 and in 1979 (around 2 percent). Oil exporters' response to higher revenues has an important bearing on the evolution of global imbalances, as well as their domestic economic developments. This box assesses the response of major oil-exporting countries' imports to higher oil revenues and compares it with their past behavior, in particular with the 1970s' episodes of sharp increases in oil prices. To this end, it augments the use of the simple marginal propensities to import by a more formal estimation of import functions.

One might expect that after years of low oil prices and limited social expenditures in many oil-exporting countries, spending would adjust rapidly to higher prices, especially in countries with large populations (relative to their oil income) and sizable development needs. In the 1970s, however, oil exporters took time to respond to higher revenues, but once spending took off, it gradually rose to unsustainable levels, with the average propensity to import surpassing one by the late 1980s—reflecting in large part badly planned or wasteful projects and declining oil prices. Spending was finally curtailed (with the average propensity to import falling below one) by the mid-1990s, after years of low oil prices, suggesting that oil exporters must have initially assumed a higher permanent component in the price hikes than was justified ex post. The experience with the resulting fiscal deficits, therefore, could result in a more cautious use of higher oil revenues this time around, especially in countries where the ability to absorb the increased revenues is limited.

Note: The main authors of this box are Pelin Berkmen and Hossein Samiei.

OPEC Imports and Oil Exports [1]
(Billions of U.S. dollars)



Sources: World Integrated Trade Solution; Source OECD; and IMF staff calculations.
[1]OPEC-9, excluding Iraq and Indonesia; data for United Arab Emirates start from 1971.

A quantitative analysis and comparison of spending patterns across the three episodes is not straightforward in part because much depends on the time periods used and definitions of spending out of oil revenues. For example, a casual examination of the first figure—which depicts nominal imports and oil exports of OPEC countries—suggests that spending out of oil revenues has been larger in the current episode than in the past. Specifically, in 2004 imports constituted about 90 percent of oil exports, in contrast to 38 percent in 1974 and 75 percent in 1979.

However, more meaningful than these simple ratios is the behavior of the marginal propensity to import out of oil revenues over the shock periods. There is no single correct way of defining this propensity. One possible definition is

Box 2.1 *(concluded)*

Marginal Propensity to Import Out of Oil Revenues[1]

	1973–1974	1973–1975	1978–1980	1978–1981	2003–2005
GCC[2]	0.08	0.34	0.18	0.25	0.15
OPEC[3]	0.14	0.52	0.24	0.42	0.24
Iran, I.R. of	0.17	0.68	0.35	0.24	0.37
Saudi Arabia	0.01	0.32	0.27	0.39	0.26
Venezuela	0.18	0.65	–0.15	0.01	0.46
Major non-OPEC[4]	. . .	. . .	. . .	. . .	0.31
Russia	0.77	1.37	0.76	1.08	0.20
Norway	. . .	. . .	0.18	–0.30	–0.13
Mexico	. . .	. . .	. . .	. . .	0.78

Sources: World Integrated Trade Solution; OECD; *World Economic Outlook*; and IMF staff calculations.

[1]Defined as (change in imports net of non-oil exports, investment income, and transfers)/(change in oil exports).

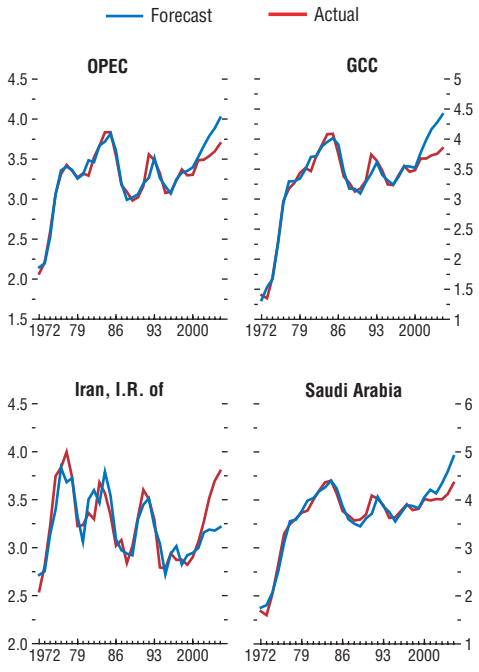
[2]The Cooperation Council of the Arab States of the Gulf (GCC) includes Bahrain, Kuwait, Oman, Qatar, Saudi Arabia, and the United Arab Emirates.

[3]OPEC-9, excluding Iraq and Indonesia. Data for the United Arab Emirates start from 1971.

[4]Major non-OPEC includes Angola, Canada, Kazakhstan, Mexico, Norway, Oman, and Russia.

Dynamic Forecasts for Real Imports

(Log of billions of 2000 U.S. dollars)



Source: IMF staff estimates.

the change in the current account over the change in oil revenues.[1] The results, shown in the table, suggest that OPEC is currently spending 24 percent of its additional oil revenues on imports. The figure is 31 percent for major non-OPEC countries and 15 percent for the Cooperation Council of the Arab States of the Gulf (GCC). The latter group also appears to be spending less rapidly than in most past episodes, while for OPEC the picture is less clear-cut. These results, however, could underestimate spending propensities if, in particular, additions to non-oil export revenues are also mostly oil-related (e.g., natural gas and oil products—as in many OPEC countries), although the extent that this may be the case is difficult to know given data deficiencies. If the above definition is modified to incorporate the change in non-oil revenues too, then the marginal propensity to spend in the recent period will be higher (and less different from past episodes). The figure for the GCC (34 percent) is also now close to that for OPEC (36 percent). These aggregate trends also mask important differences across countries. In particular, countries with larger populations and/or expenditure needs, such as the Islamic Republic of Iran, Mexico, and Venezuela have higher propensities to import than Saudi Arabia and most other GCC members.

The above analysis, while informative, does not capture the impact of other variables on imports. As an alternative—and more formal—statistical analysis, we estimate import functions for the 1970–2001 period and examine the out-of-sample forecasts for the recent period. This procedure does not distinguish shock episodes from other periods and focuses on testing whether current performance is similar to the

[1]Or equivalently: (change in imports net of non-oil exports, investment income, and transfers)/(change in oil exports). This definition assumes that the increase in oil income is the only "shock" to external revenues and that additions to other revenues are fully spent on imports.

average of the past. We use an error-correction formulation, with real GDP and the terms of trade as explanatory variables.[2] The estimation is done for oil-exporting countries individually, the GCC, and OPEC (for which comparison with the past is possible). The results (second figure) suggest that OPEC's spending is only slightly lower than that implied by its past behavior while the GCC's spending behavior is clearly more conservative. Most of the individual countries' responses (e.g., the Islamic Republic of Iran and Saudi Arabia) are also consistent with their spending needs and with the trends in the marginal propensity to import discussed above.

On balance, these findings suggest that average spending so far has been gradual, especially for most GCC exporters. But expenditure needs are great in many countries and, based on the 1970s experience, it is not at all certain that the current trend will continue. The outcome will also depend on perceptions about the magnitude of the permanent component in higher prices. Higher spending, when prudent and on projects with high returns, would help promote domestic growth in these countries and contribute to reducing global imbalances.

[2]The logarithmic change in real imports is regressed on its lagged values, current and lagged values of logarithmic changes in GDP and the terms of trade, and an error correction term. The estimation is carried out using an autoregressive distributed lag model, and employs the Schwarz-Bayesian criterion for lag selection.

differentials. The incipient excess of global saving over investment puts downward pressure on real interest rates, which supports investment demand in fuel importers and weakens incentives to save in fuel exporters. At the same time, exchange rate changes and growth differentials shift aggregate demand from importers to exporters.

- Adjustment is also influenced importantly by *financial market developments*. Higher oil prices will tend to reduce asset prices—including equities and exchange rates[12]—in oil-importing countries and to raise them in oil-exporting countries. This will tend to reinforce the adjustment process, particularly in countries—such as the United States—where wealth effects are large. In addition, changes in asset prices have important valuation effects.[13] For example, if oil exporters hold equities or bonds in oil-importing countries, their gains from higher oil prices may be partly offset by capital losses on their asset holdings, as stock markets in oil importers fall or their exchange rates depreciate.

To investigate the adjustment process in more detail, IMF staff used two separate but consistent vector autoregressions (VARs).[14] The first of these, a standard VAR, investigates the link between real oil prices and external positions (measured using both current accounts and net foreign assets) in the United States and in selected other country groups. The second, a Global VAR (GVAR),[15] looks in more detail at the link between oil prices, growth, inflation, and asset prices, to shed more light on how the adjustment takes place. Starting with the broad implications of oil prices for external positions, the VARs suggest that:

[12]Bond prices will also fall, as long as *nominal* interest rates increase.

[13]See the April 2005 *World Economic Outlook*, Chapter III, for a detailed discussion of valuation effects.

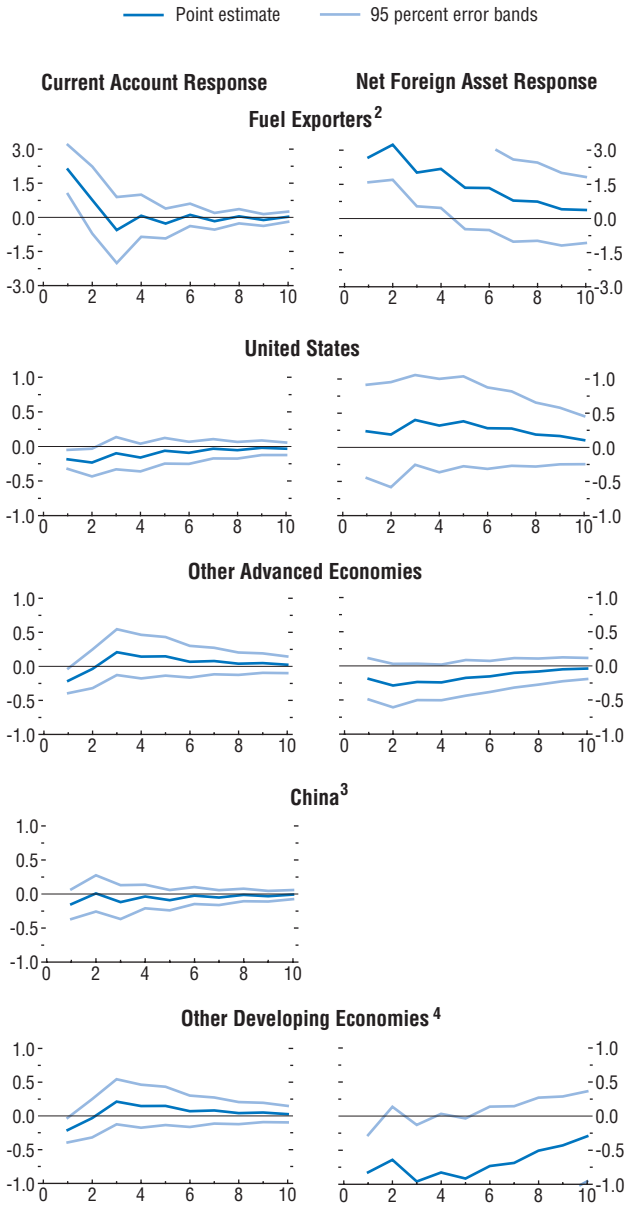
[14]Adopting two separate but consistent models allows for more parsimonious specifications. The results are consistent with those obtained combining the two models within a single GVAR.

[15]As estimated by Dees and others (forthcoming); see Appendix 2.1 for details.

Figure 2.6. Impact of Oil Price Shocks on External Imbalances, 1972–2004[1]

(Percent of GDP, x-axis in years)

In the short term, oil price shocks lead to external imbalances. However, the impact on net foreign assets has historically proved transitory.



Source: IMF staff calculations.

[1]Response to a permanent $10 a barrel annual average increase in oil prices (measured in constant 2005 U.S. dollars).

[2]Fuel exporters' response presented on a wider scale.

[3]Net foreign asset data available only after 1980.

[4]Error bands partially out of scale.

- Oil price shocks have a marked but relatively short-lived impact on current accounts (Figure 2.6).[16] A permanent increase in real oil prices of $10 per barrel was on average associated with an increase in fuel exporters' current account surplus of about 2 percent of own GDP, with the effect dying out within three years. This was matched by higher deficits in the United States (about ¼ percent of GDP), other advanced economies, and developing economies other than China.[17] Among these, the impact on the United States was statistically the most significant as well as persistent (with a half-life of about three years).
- Oil price shocks also have a noticeable—and predictable—effect on the net foreign asset position of all regions, except the United States (see Figure 2.6). A permanent $10 per barrel oil price shock boosts the net foreign asset position of oil exporters by about 2 percent of GDP, in line with the increase in the current account; the increase has a half-life of about five years. More surprisingly, the estimated change in U.S. net foreign assets was positive (although statistically insignificant), while other countries experienced a larger and more persistent reduction in net foreign assets than implied by the (cumulative) impact on the current account.[18] This may reflect the valuation effects described above, with declines in asset prices in the United States reducing wealth in the rest of the world.

Against this background, how does the underlying adjustment to an oil shock occur, and are there significant differences across countries and regions? Figure 2.7 compares the adjustment process across regions in response to a perma-

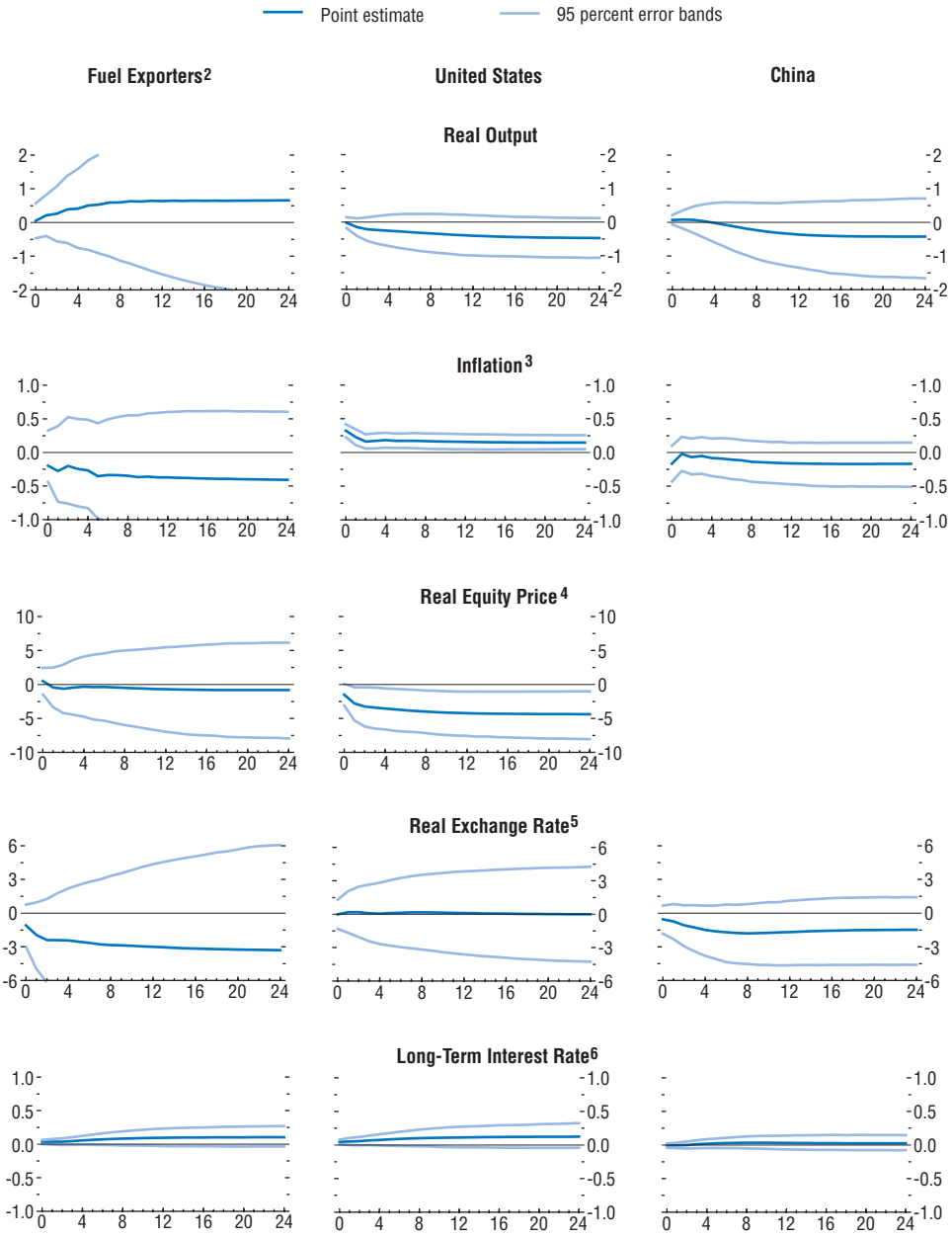
[16]See Appendix 2.1 for a fuller discussion of the identification and interpretation of the oil price shock.

[17]China was a net oil exporter during the first half of the sample period.

[18]For many fuel exporters, complete data on foreign asset positions are not available. This may explain the similarity between the cumulative current account response and the estimated change in net foreign assets.

Figure 2.7. Adjustment to Oil Price Shocks, 1979:Q2–2003:Q4[1]

(Percent unless otherwise indicated, x-axis in quarters)



Source: IMF staff calculations, based on Dees and others (forthcoming).

[1]Response to a permanent $10 a barrel annual average increase in oil prices (measured in constant 2005 U.S. dollars).

[2]Groups described in Appendix 2.1.

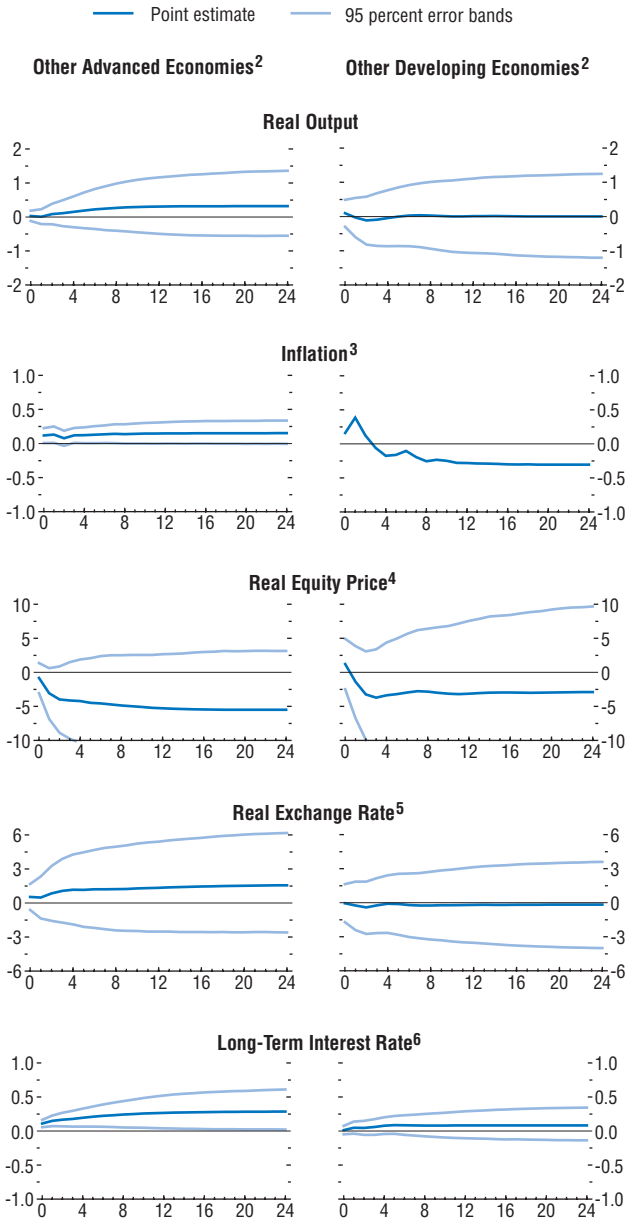
[3]*Y*-axis in percentage points at a quarterly rate. For other developing countries, error bands out of scale.

[4]For fuel exporters, data only available for Canada, Norway, and the United Kingdom. For other developing countries, confidence intervals partially out of scale. For China, insufficient data available.

[5]Error bands partially out of scale. For the United States, real effective exchange rate vis-à-vis other groups shown. For all other groups, CPI-based real bilateral exchange rate vis-à-vis the United States shown.

[6]*Y*-axis in percentage points at a quarterly rate; multiply by four to annualize. For other developing countries, only Korea and South Africa shown. For China, short-term interest rates shown.

Figure 2.7 *(concluded)*[1]



[1]Response to a permanent $10 a barrel annual average increase in oil prices (measured in constant 2005 U.S. dollars).

[2]Groups described in Appendix 2.1.

[3]*Y*-axis in percentage points at a quarterly rate. For other developing countries, error bands out of scale.

[4]For fuel exporters, data only available for Canada, Norway, and the United Kingdom. For other developing countries, confidence intervals partially out of scale. For China, insufficient data available.

[5]Error bands partially out of scale. For the United States, real effective exchange rate vis-à-vis other groups shown. For all other groups, CPI-based real bilateral exchange rate vis-à-vis the United States shown.

[6]*Y*-axis in percentage points at a quarterly rate; multiply by four to annualize. For other developing countries, only Korea and South Africa shown. For China, short-term interest rates shown.

nent oil price shock (again, of $10 per barrel).[19] The key points are as follows.

- The basic adjustment channels work broadly as described above, with slowing growth and real depreciation supporting the trade adjustment in oil importers, while fuel exporters experience real appreciation and output growth. In particular, in the United States, the real effective exchange rate depreciates, and output declines by up to ½ percent, although this decrease is statistically weak. In other advanced economies, the exchange rate also depreciates, but any output declines are smaller than in the United States (especially in Japan).[20]
- Inflation in advanced economies rises after one year by an annualized ¾ percentage point in the United States, and somewhat less elsewhere.[21] This has historically been accompanied by an increase in both short- and long-term nominal interest rates. Long-term real rates, however, fall temporarily in response to the shock. This helps support demand in fuel importers and maintain the global saving-investment balance, until exchange rate changes and growth differentials work their way through the adjustment process. In developing countries, the response of inflation cannot be estimated precisely, reflecting strong heterogeneity within this group.[22]

[19]These results are based on the estimates of Dees and others (forthcoming). For this exercise, both the sample period (1979:Q2–2003:Q4) and the list of countries included (see Appendix 2.1) are slightly different from what was previously used. This reflects the limited availability of the quarterly data needed to estimate the underlying GVAR model.

[20]In Japan, there is a marked depreciation. In the euro area, in contrast, the real exchange rate does not respond (see Appendix 2.1).

[21]For this sample, which includes the second oil price shock and the associated delayed policy response, the hypothesis that inflation is affected even in the long run cannot be rejected.

[22]These results, while based on a different methodology, are broadly consistent with earlier IMF staff estimates of the impact of an oil price shock. For instance, the calculations in IMF (2000) suggest that a $10 per barrel increase in oil prices would reduce real GDP in the United States and euro area by about ½ percent, and increase inflation after one year by 1 percentage point.

Box 2.2. Recycling Petrodollars in the 1970s

The first "oil shock" began in the fall of 1973. The sudden tripling of world oil prices resulted in a large windfall gain for oil-exporting countries at the expense of oil importers. It also led to a major financial shock, since most exporting countries spent only a small portion of the increased revenues. In 1974, the first full year after the initial shock, the aggregate current account surplus of major oil-exporting countries amounted to $68 billion (one-third of their GDP). The major counterparts were the deficits of industrial countries ($31 billion, 0.8 percent of GDP) and of oil-importing developing countries, or OIDC ($34 billion, 10½ percent of GDP). Although these shifts moderated over time as oil exporters adjusted to the new market situation with increased spending, the general pattern persisted through the rest of the decade.[1]

Oil exporters faced the question of how to use their sizable current account surplus. Data on identified investments, which account for almost the entire surplus, indicate that most of the money was channeled into a few well-established markets. In 1974, more than half was placed in bank deposits and money market instruments (including short-term treasury securities) in advanced economies (see the first table). Of the liquid investments in the United States, treasury securities accounted for less than a sixth of the total, with the rest placed mostly with commercial banks. About $25 billion was channeled into long-term investments, such as loans to national governments and international agencies, as well as government bonds in the United States and the United Kingdom. Broadly speaking, the pattern persisted throughout the rest of the 1970s.

The financial shock from the oil price increases of the 1970s came at a time when the potential for large private international capital flows was just beginning to be realized. The first relevant development, which began in the late 1960s, was the deregulation and consequent innovative evolution of Eurocurrency markets. The oil shock of 1973–74 reinforced this development, providing new fuel for these markets by making large sums of liquid assets available for investment. By then, banks in Europe and in less regulated "offshore" financial centers were much better prepared than they would have been even a few years earlier to accept and invest dollar-denominated deposits and other liquid liabilities. A third factor was weak aggre-

Note: The main authors of this box are James M. Boughton and Suchitra Kumarapathy.

[1]The current account balance of industrial countries swung from a cumulative surplus of $23 billion in 1968–73 to a deficit of $44 billion in 1974–79, while the cumulative deficit of OIDC doubled to $139 billion.

Fuel Exporters' Deployment of Current Account Surpluses

(Billions of U.S. dollars; by type of financial investment)

	1974	1975	1976	1977	1978	1979
Bank deposits and money market investments						
Dollar deposits in the United States	1.9	1.1	1.8	0.4	0.8	4.9
Sterling deposits in the United Kingdom	1.7	0.2	–1.4	0.3	0.2	1.4
Deposits in foreign currency markets	22.8	9.1	12.1	10.6	3.0	31.2
Treasury bills in the United Kingdom and the United States	4.8	0.6	–1.0	–1.1	–0.8	3.4
Total	**31.2**	**11.0**	**11.5**	**10.2**	**3.2**	**40.9**
Long-term investments						
Special bilateral arrangements	11.9	12.4	12.2	12.7	8.7	11.8
Loans to international agencies	3.5	4.0	2.0	0.3	0.1	–0.4
Government securities in the United Kingdom and the United States	1.1	2.2	4.1	4.5	–1.8	–0.9
Other[1]	9.7	6.1	8.5	5.8	3.3	2.4
Total	**25.1**	**24.7**	**26.8**	**23.3**	**10.3**	**12.9**
Total new investments	**56.3**	**35.7**	**38.3**	**33.5**	**13.5**	**53.8**

Source: Bank for International Settlements.

[1]Including equity and property investments in the United Kingdom and the United States, and foreign currency lending.

Box 2.2 *(concluded)*

gate demand in industrial countries, which meant that banks in those countries had to find other profitable outlets for the "petrodollars" that oil exporters were investing with them. For many banks, meeting this challenge meant moving into new markets where loan demand was stronger, including Latin America and other developing countries.

A large part of the initial response to the oil shocks took the form of official "recycling" of petrodollars, in which the IMF and other official creditors provided fast-disbursing loans to OIDC. The main vehicle for the IMF was an "Oil Facility," newly established in 1974, through which $2.4 billion were lent to 45 developing countries from 1974 to 1976. Because the shock was thought to be temporary, this financing was provided with only token conditionality. Overall, in 1974–76, official recycling from multilateral and bilateral creditors and donors amounted to $48 billion, two-thirds of which was bilateral.

Over time, international private banks took over much of the financing role. In 1975, long-term official loans and grants to OIDC amounted to about $18 billion, and private financing was estimated at roughly the same amount, most of it channeled through commercial banks. But cross-border private flows, especially through banks, then increased sharply. For instance, the external foreign currency assets reported by banks in eight European countries, Canada, Japan, the United States, and offshore branches of U.S. banks quadrupled to almost $1 trillion between 1973 and 1980.[2] The

[2]Since the lion's share of the recycling in the 1970s passed through the banking systems or securities markets of industrial countries, the Bank for International Settlements (BIS) was able to estimate the composition and direction of financial flows, using data obtained largely from its participating central banks. Subsequently, financial markets continued to globalize and diversify into new and more complex instruments, and a variety of nonbank financial institutions became major intermediaries for cross-border flows. Since the mid-1990s the BIS has ceased reporting cross-border banking claims on a basis comparable to earlier years, and tracking the course of overall flows has become much more difficult.

Financial Inflows for Selected OECD Economies in 1974

(Billions of U.S. dollars)

	Financial Inflows			
	Traditional capital inflows	Compensatory foreign borrowing[1]	Official inflows[2]	Total
United Kingdom	2.2	4.1[3]	3.2[4]	9.5
Italy	1.0	2.1	5.3	8.4
France	3.8	1.7	0.5	6.0

Source: OECD, *Economic Outlook*, 1975.

[1]Official or semi-official borrowing from foreign private institutions.

[2]Private and official borrowing from foreign official institutions.

[3]Of which, $2.6 billion representing foreign currency borrowing by the public sector under the exchange cover scheme, and $1.5 billion drawing on the government Euro-loan.

[4]Including an increase of $5.3 billion in sterling-denominated exchange reserves by oil-exporting countries.

Eurobond market also expanded considerably, with the total value of international and foreign bond issues growing from $12 billion in 1974 to $38 billion in 1980.

A portion of the recycled funds went to industrial countries with large current account deficits, including France, Italy, and the United Kingdom, which relied on a combination of official and private external financing (see the second table). In 1974, for instance, the United Kingdom financed its $7.5 billion current account deficit by means of compensatory foreign borrowing and direct inflows of funds from oil-exporting countries (at the time, the United Kingdom was still developing the North Sea oil fields and was a major oil importer). The IMF also provided financing to several industrial countries, including large Stand-By Arrangements for Italy and the United Kingdom, in part because of the failure of these countries to adjust policies and aggregate demand fully to the oil shock.

An even greater share of the recycled petrodollars went to developing countries, many of which had initially faced difficulties financing their increased current account deficits. Weak overall aggregate demand and a big unanticipated jump in price inflation kept world interest rates low in nominal terms and substantially

negative in real terms throughout the 1970s, encouraging developing countries to take on loans. For many developing countries that were exporters of primary commodities, a commodity-price boom in the mid-1970s made their borrowing terms look even more attractive. For instance, in 1973–78 low-income countries as a group paid an average nominal interest rate of just over 3 percent on their external debt, while their export prices—measured in the depreciating U.S. dollar—rose at an average annual rate of 18 percent. Latin America emerged as the largest borrowing region, accounting for two-thirds of total credits issued by reporting banks to OIDC—a development that laid the basis for the debt crises of the 1980s.

- There also appears to be an active valuation channel. Equity prices fall by 2–4 percentage points in major advanced economies, which—along with the depreciation of the U.S. dollar—results in a wealth transfer to the United States from other economies.

The analysis so far describes the average impact of oil price shocks in the past. However, the effects of the current shock, including the speed and nature of the future adjustment process, may be different, and in particular will depend on two policy-related factors. First, as noted above, oil producers appear to be increasing their spending in response to higher revenues more slowly than in the past. In addition, as discussed in Chapter I, the impact of oil prices on core inflation to date has been surprisingly mild relative to previous experience, so that central banks have not had to raise short-term interest rates to reduce inflationary pressures. Partly as a result, growth in oil-importing countries has been relatively unaffected, implying that trade balances may take longer to adjust; set against this, for net debtors, relatively lower interest payments on external debt have reduced any negative impact on current accounts.[23]

To examine the potential impact of these various factors on the adjustment of global imbalances, IMF staff undertook two simulations using the IMF's MULTIMOD model.[24] The first scenario assumes rapid adjustment in oil exporters, as compared to the WEO baseline where their existing current account surpluses continue into the medium term. Specifically, the scenario assumes that imports by oil exporters increase by $150 billion in 2006 (about ⅓ of their aggregate 2005 current account surplus, or ⅓ percent of world GDP), and $350 billion (about ¾ of their current surplus) by 2010. This more rapid pace of expenditure shrinks the U.S. current account deficit, by almost ¾ percent of GDP by 2010, and also leads to some real dollar appreciation (Table 2.5). The decline in global savings results in an increase in real and nominal interest rates in oil importers, amounting to up to 40 basis points. There is little net impact on growth in advanced economies.

In the second scenario, it is assumed that the low level of pass-through into core inflation cannot be sustained and that pass-through picks up in 2006, although its magnitude is still only half of what would have been expected based on his-

[23]In addition, historical experience may prove misleading in illustrating the potential impact of any large future oil price shock, if there are important nonlinearities in the effects of such shocks.

[24]For a description of MULTIMOD, see Laxton and others (1998); see Hunt, Isard, and Laxton (2001) for the specific version employed here. MULTIMOD does not have a separate "oil exporters" group. The estimates reported aggregate all those countries whose trade surplus increases in response to an oil price increase. This includes Canada, the United Kingdom, the "small industrial economies" group, and a group of high-income developing economies that are mainly oil exporters.

Table 2.5. Impact of Oil Price Shock: Greater Spending by Fuel Exporters

(Relative to baseline)

	2006	2007	2008	2009	2010
Current account balance (in percent of GDP)					
United States	0.4	0.4	0.5	0.6	0.7
Japan	0.5	0.7	0.9	1.0	1.1
Euro area	0.5	0.7	0.9	1.0	1.1
Core inflation (in percentage points)					
United States	0.1	0.1	—	—	0.1
Japan	0.1	0.1	0.1	0.1	0.1
Euro area	0.2	0.2	0.1	—	0.1
Real short-term interest rate (in percentage points)					
United States	0.3	0.3	0.3	0.3	0.3
Japan	0.4	0.4	0.3	0.3	0.4
Euro area	0.5	0.5	0.3	0.3	0.4
Nominal short-term interest rate (in percentage points)					
United States	0.4	0.4	0.4	0.3	0.4
Japan	0.5	0.5	0.4	0.4	0.4
Euro area	0.6	0.6	0.4	0.4	0.4
GDP (in percent)					
United States	0.5	0.1	−0.4	−0.2	−0.1
Japan	0.5	0.2	−0.4	−0.3	−0.1
Euro area	0.7	0.2	−0.5	−0.3	−0.1
Real effective exchange rate (in percent)					
United States	−0.8	−0.7	−0.6	−0.6	−0.6
Japan	0.7	0.7	0.7	0.6	0.6
Euro area	−0.3	−0.3	−0.4	−0.4	−0.4

Source: IMF staff calculations.

Table 2.6. Impact of Oil Price Shock: Delayed Pass-Through to Core Inflation

(Relative to baseline)

	2006	2007	2008	2009	2010
Current account balance (in percent of GDP)					
United States	—	—	−0.1	−0.1	−0.1
Japan	—	0.1	0.2	0.2	0.1
Euro area	—	—	—	—	—
Core inflation (in percentage points)					
United States	0.1	0.3	0.1	0.1	—
Japan	0.1	0.3	0.1	—	—
Euro area	0.1	0.2	0.1	—	—
Real short-term interest rate (in percentage points)					
United States	0.2	0.6	0.4	0.3	0.2
Japan	0.2	0.5	0.3	0.2	0.1
Euro area	0.2	0.5	0.2	0.1	—
Nominal short-term interest rate (in percentage points)					
United States	0.3	0.7	0.6	0.3	0.2
Japan	0.3	0.6	0.4	0.2	0.1
Euro area	0.2	0.6	0.3	0.1	—
GDP (in percent)					
United States	−0.3	−0.8	−0.7	−0.5	−0.4
Japan	−0.2	−0.6	−0.6	−0.4	−0.3
Euro area	−0.2	−0.5	−0.5	−0.3	−0.2
Real effective exchange rate (in percent)					
United States	0.1	0.3	0.3	0.2	0.1
Japan	—	0.1	—	0.1	0.1
Euro area	−0.1	−0.4	−0.3	−0.2	−0.2

Source: IMF staff calculations.

torical experience through 2003. As core inflation increases, central banks respond by increasing nominal interest rates significantly (by about 70 basis points for the United States in 2007, relative to the baseline), so as to contain the inflationary impact of the increase in energy prices (Table 2.6). In turn, higher interest rates act to depress demand and output, with some positive effects on the trade balance. Higher interest rates also increase the interest burden on the U.S. stock of net foreign liabilities, which tends to raise both the U.S. current account deficit and the Japanese current account surplus.[25] Nevertheless, as long as monetary policy responds promptly to the inflationary pressures, the effects on both output and, especially, the current account are relatively mild. If the monetary policy response were instead delayed, the eventual effects would prove much more sizable.[26]

[25]The impact on net foreign assets, however, would be mitigated by valuation effects working in favor of the United States but not present in the model.

[26]For technical reasons, all scenarios assume that the oil price is driven only by oil supply shocks. This tends to overestimate the positive impact of lower oil prices on real GDP in oil-consuming countries. However, there is no a priori reason why the assumption should affect results for either scenario relative to the baseline. In addition, all scenarios assume full and immediate pass-through of the world oil price into domestic oil prices. Incomplete pass-through would result in slower adjustment.

Box 2.3. The Impact of Petrodollars on U.S. and Emerging Market Bond Yields

How does the recycling of oil-export revenues affect global financial markets? To the extent that higher oil prices increase world net savings, and that saved petrodollars are used to purchase given securities, the outcome would be an increase in the price of (or, equivalently, a lower interest rate on) such securities. In turn, this could lead to a second-round effect on the price of other, similar securities. This box analyzes the issue by focusing on the link between oil prices and interest rates on U.S. and emerging market bonds.

Examining first the United States, direct evidence of a link between petrodollars, capital inflows, and interest rates is not available, in large part because many oil exporters tend to purchase U.S. securities through third-country intermediaries. Such third-country trades confound the country attribution of U.S. capital flows data. The estimation here therefore proceeds more indirectly. As a first step, following Warnock and Warnock (2006), there is evidence that capital flows to the United States do put downward pressure on U.S. interest rates (see the first table, column 1). Foreign flows into U.S. government securities in the 12-month period through May 2005 depressed U.S. 10-year yields by 86 basis points,[1] controlling for factors such as inflation expectations and the federal funds rate. On this basis, if one assumed that fuel exporters used one half of their current account surplus to finance investments in the United States, the increase in oil prices over the last two years would have reduced U.S. yields by about ⅓ percentage point (holding constant all other capital flows).

To investigate the issue further, the Warnock and Warnock regression analysis was extended by disaggregating total capital flows into the United States into two components: those attributable to East Asian countries, which are unlikely to directly reflect oil-export revenues; and all others ("Other Flows").[2] Perhaps surprisingly, East Asian inflows were found to have a relatively greater dollar-for-dollar impact on U.S. yields, although Other Flows have recently been somewhat larger in absolute terms (see the first table, column 2). Among possible explanations, East Asian purchases may have been concentrated on more thinly traded, longer-maturity portions of the yield curve, where purchases have a greater impact. In addition, interventions by Asian central banks may have been interpreted as a signal that they were likely to continue buying dollars in the future.[3] Overall, the regression attributes 52 basis points of the total

The Impact of Oil Revenues on U.S. Interest Rates[1]

	Nominal 10-Year Treasury Yield		
	(1)	(2)	(3)
Foreign capital inflows[2,3]	–0.24*	. . .	. . .
East Asian flows	. . .	–0.42*	–0.35*
Other flows	. . .	–0.14*	. . .
Oil-related	. . .	. . .	–0.12
Residual	. . .	. . .	–0.13*
Inflation expectations, 10-year ahead	0.63*	0.67*	0.65*
Interest rate risk premium	1.88*	3.16*	0.90*
Federal funds rate	0.36*	0.33*	0.35*
Structural budget deficit[2]	0.25*	0.23*	0.22*
R^2	0.90	0.90	0.85

Source: Authors' calculations.

[1]The sample is monthly, from August 1987 to May 2005. Yields are measured in percentage points. Asterisks denote statistical significance at the 1 percent level. The following variables are included but not reported: expected real GDP growth; the difference between 1-year ahead and 10-year ahead inflation expectations; and a constant.

[2]Scaled by lagged GDP.

[3]Twelve-month benchmark-consistent foreign official flows into U.S. treasury and agency bonds.

Note: The main authors of this box are Laura Kodres and Frank Warnock.

[1]Calculated as 12-month inflows, amounting to 3.65 (percent of lagged GDP), times the estimated coefficient, –0.236.

[2]For the purpose of this box, East Asia consists of China, Hong Kong SAR, Japan, Korea, and Taiwan Province of China—countries and territories whose governments have recently accumulated substantial positions in U.S. government securities.

[3]On a more technical note, "Other Flows" may also contain private flows that are related to other variables in the regression. In contrast, East Asian flows are primarily official flows, and may more reasonably be treated as exogenous.

Box 2.3 *(concluded)*

yield reduction between June 2004 and May 2005 to East Asian flows, but only 34 basis points to Other Flows.

Of course, Other Flows cannot be entirely assumed to reflect oil-export revenues—they have many potential sources. To isolate the effect of oil revenues, Other Flows were explicitly regressed on oil prices.[4] In this regression, however, oil prices have very little explanatory power. Further, the part of Other Flows that is related to oil prices does not help explain lower U.S. rates, even though non-oil-related Other Flows do have a statistically significant impact (see the first table, column 3).[5]

Summing up, while one might expect higher oil prices and the consequent recycling of petrodollars to exert downward pressure on U.S. interest rates, such an effect is hard to detect statistically among all the competing influences on U.S. yields. This may well reflect the relatively limited magnitude of petrodollar flows. Two caveats should, however, be stressed. First, these negative findings in part likely reflect the lack of direct data on capital inflows from fuel-exporting countries. Second, the above analysis treats U.S. interest rates as being determined separately from global interest rates. In an integrated world capital market, oil prices may also affect U.S. rates indirectly, through the impact of recycled petrodollars on interest rates in other countries. That said, the regressions failed to find a statistically significant impact of interest rate differentials or exchange rates on U.S. yields.[6]

[4]Allowing for 24 monthly lags, and deflating by nominal GDP. An alternative specification also included oil-export revenues, as proxied by oil prices times fuel exporters' total petroleum output, but these did not prove significant.

[5]Over selected subperiods (e.g., starting in January 1999), there is a relationship between Other Flows and oil prices. However, the portion of Other Flows attributable to oil prices over such subperiods still does not help explain U.S. rates.

[6]Their effect may already be picked up through other included variables, such as inflationary expectations or output. In a similar vein, purchases of U.S. corporate securities by oil exporters might impact U.S. interest rates; this effect is again not explicitly modeled.

Determinants of Emerging Market Bond Spreads

Explanatory Variable	Coefficient[1]
Oil price[2]	0.005
Non-fuel commodity prices[2]	–1.096*
World industrial production[2]	–1.173
Predicted credit ratings and outlooks[3]	0.237*
Federal funds three-month future rate	0.076*
R^2	Within = 0.49; Between = 0.73; Overall = 0.64

Sources: Bloomberg, L.P.; The PRS Group; J.P. Morgan; Bloomberg; and authors' calculations.

[1]Fixed-effects panel regression using 2,345 monthly observations on 29 countries, from January 1991 to May 2005. The dependent variable is the log of Emerging Market Bond Spreads, measured in basis points, using the J.P. Morgan Emerging Market Bond Indices (EMBI) relative to the U.S. 10-year treasury bond. All countries for which EMBI are available are included, except that Algeria and Côte d'Ivoire are excluded owing to lack of other data; Russia and Venezuela are excluded owing to significant oil exports; Nigeria is excluded on both grounds; and Argentina is excluded owing to its crisis-related spreads in 2001. Asterisks denote statistical significance at the 1 percent level. The following variables are included but not reported: expectations of federal funds rate (FF) increase; expectations of FF decrease; volatility of FF futures; volatility of FF futures × expectations of FF increase; volatility of FF futures × expectations of FF decrease; volatility of S&P 500 options; a constant; and a time trend.

[2]In logs.

[3]Predicted value for default risk, from a separate first-stage regression.

Even if petrodollars have only a limited effect on the large U.S. bond market, they might have a more sizable impact on the smaller market for emerging market debt. This hypothesis is explored next, using a model of emerging market bond spreads that controls for the impact of country-specific and global macroeconomic fundamentals and of variables related to U.S. financial markets. Specifically, the model recognizes that oil prices (as well as nonfuel commodity prices, global industrial production, and U.S. interest rates) influence emerging market bond spreads through two separate channels. First, oil prices affect emerging market "fundamentals," as proxied by their credit ratings and outlooks, which in turn affect their spreads. In particular, for oil importers, higher oil prices may negatively affect the cur-

rent account, one of the variables used to establish credit ratings.

Second, as discussed above, if a significant share of oil exporters' revenues is used to purchase emerging market debt , then higher oil prices may be associated with lower emerging market spreads. However, even after controlling for fundamentals, estimates suggest that any link between higher oil prices and lower emerging market spreads becomes statistically insignificant when industrial production is also included in the regressions (see the second table). Oil prices and industrial production both move in sync with the global economic cycle, making their independent influence on spreads difficult to disentangle. Interestingly, nonfuel commodity prices do have a statistically significant, negative impact on spreads. Either their positive influence on fundamentals in those nonfuel commodity exporters included in the sample (such as Chile) is not sufficiently captured by credit ratings, or the associated export revenues are being used to purchase emerging market debt.

Conclusions

Global imbalances had emerged long before the current oil price shock began. Nevertheless, some of these imbalances have clearly been exacerbated by higher energy prices. In particular, the increase in oil prices since 2003 has directly worsened the U.S. current account deficit by over 1 percent of GDP; at the same time, higher oil prices have tended to reduce surpluses in non-oil-exporting developing countries, notably in Asia. To the extent that higher net savings by oil exporters have driven down global interest rates, and that these lower rates have boosted demand in economies with market-based financial systems, such as the United States, the oil price shock may also have had an additional indirect negative effect on the U.S. external position. Since it is neither feasible nor desirable for oil exporters to spend their newfound revenues immediately, global current account imbalances are likely to remain at elevated levels for longer than would otherwise have been the case, heightening the risk of a sudden, disorderly adjustment.

In the past, current accounts have tended to adjust relatively quickly to oil shocks, as higher energy prices led to a rise in interest rates, a slowdown in growth and domestic demand, and changes in exchange rates and asset prices. This time, in part because of improved monetary frameworks and credibility, the impact on short-term interest rates, growth, and inflation has been smaller than before, while deeper financial integration may facilitate the persistence of deficits. Further, authorities in fuel-exporting countries are being somewhat more cautious in increasing spending, even though market expectations indicate that the current energy price shock is likely to prove more persistent than in the 1970s. All this suggests that current accounts may adjust more slowly now than in the past.

As with any terms-of-trade shock, much of the adjustment must take place in the private sector, but policies can also play an important supporting role. For consuming countries, this requires full pass-through of world oil prices into domestic energy prices, accompanied by a monetary stance that guards against potential spillovers into core inflation. For producers, most of which are developing countries, the rise in oil revenues represents a major development opportunity. While the pace at which oil earnings can be usefully spent will vary by country, measures to boost expenditures in areas where returns are high (as well as structural reforms to boost domestic supply, particularly of nontradables) would be highly desirable both from a domestic perspective and to help reduce global imbalances.

Appendix 2.1. Oil Prices and Global Imbalances: Methodology, Data, and Further Results

The authors of this appendix are Alessandro Rebucci and Nikola Spatafora.

This appendix describes more fully the empirical evidence, presented earlier in this chapter, regarding the effects of oil price shocks on external imbalances and the associated adjustment process. Specifically, the appendix describes the econometric models and data used and the identification of the oil price shocks. It also reports additional results underlying the aggregate responses depicted in Figure 2.7.

The Econometric Models

The econometric models used to analyze the response to oil price shocks of the current account or net foreign assets (NFA) are standard VARs, which include one lag of the following endogenous variables:[27]

- The real oil price, defined as the average annual nominal oil price deflated by the U.S. CPI, in first-difference form; and
- The current account (in the first VAR), or NFA as estimated by Lane and Milesi-Ferretti (2006) (in the second VAR), both as a share of world GDP.

The model also includes the following exogenous variables (as well as a constant and a time trend):

- World growth and world consumer price inflation.[28]
- A measure of the change in world oil supply due to events that are exogenous to the oil market, from Kilian (2006).

The model is estimated for the following countries and country groups: the United States; fuel exporters, as defined earlier; China; other advanced economies;[29] and other developing economies.[30] The current account and NFA of each country group are constructed as the sum of the values for individual countries.[31]

The econometric model used to analyze the broader macroeconomic adjustment process is instead the global, multiregion VAR (GVAR) estimated by Dees and others (forthcoming).[32] In this GVAR, country-specific VARs are first estimated for 33 countries (see below for model details and sample), under the assumption that foreign variables are weakly exogenous. Then, the country-specific VARs are combined to solve for a global model in which world variables and country-specific variables are jointly determined. Each country-specific model embeds a set of co-integrating relations derived from a standard, New-Keynesian small open economy model.[33] Hence, the GVAR may be interpreted as the empirical counterpart to a simplified, global, dynamic general equilibrium model.[34]

Each of the underlying country-specific VARs incorporates the following variables, subject to data availability: the level of real GDP; consumer price inflation; the real bilateral exchange rate versus the U.S. dollar; short and long nominal interest rates; real equity prices; and the foreign counterparts of these variables. The (nominal) oil price is endogenous in the VAR for the

[27]Data frequency is annual, and the sample period is 1972–2004.

[28]We treat these variables as exogenous because, while they are likely to affect oil prices quickly, it may take significant time for oil prices to affect them; and endogenizing world growth and inflation would use up a needed degree of freedom.

[29]Consisting of Australia, Canada, Cyprus, Denmark, euro area, Iceland, Israel, Japan, New Zealand, Sweden, Switzerland, and the United Kingdom.

[30]Consisting of all other countries in the Lane and Milesi-Ferretti (2006) data set.

[31]Inclusion of the global discrepancy in the empirical analysis does not change the results.

[32]Data frequency is quarterly, and the sample period is 1979:Q2–2003:Q4. On GVAR modeling, see also Pesaran, Schuermann, and Weiner (2004).

[33]For each country, these restrictions are first tested using an unrestricted model; if not rejected, they are then imposed on the data.

[34]Technically, it may also be seen as an approximation to a global common factor model.

United States and hence in the GVAR, but weakly exogenous in all other country-specific VARs (see Dees and others, forthcoming, for more details on all these variables). Lag length is selected at the level of the country-specific VARs, using standard selection criteria.

After estimating the responses of individual countries, weighted averages of these individual responses (with weights given by PPP-adjusted GDP) are used to construct aggregate responses for the following country groups: fuel exporters, both advanced and developing;[35] other advanced economies, consisting of Japan, available euro area economies[36] and other small advanced economies;[37] and other developing economies, consisting of East Asia,[38] Latin America,[39] and others.[40]

Description and Identification of Oil Price Shocks

Figure 2.6 reports the generalized impulse responses (GIRs) to a permanent shock to the real oil price.[41] The magnitude of the shock is normalized to $10 per barrel at constant 2005 prices. The GIRs are rescaled to show the impact on current account and NFA in terms of own GDP, although the models are estimated using current account and NFA as a share of *world* GDP.

The VARs for external positions control separately for those changes in world oil supply that are due to exogenous events, such as wars, domestic political instability, or other geopolitical events. Hence, the oil price shock should be viewed as that part of the change in real oil prices that is *not* due to such geopolitical events. The rationale for discarding such events is that, while wars, revolutions, and the consequent disruption of economic activity will undoubtedly be associated with changes in current accounts and NFA, the relevant channels (at least in the case of the directly affected countries) may go well beyond changes in oil prices, and hence have little to do with those economic mechanisms that are the focus of this chapter.

As a result, the oil price shock being analyzed embodies a mixture of demand and supply factors (for instance, expected future market tightness, long production lags, or discoveries of new oil reserves). And there is no a priori reason to expect that the responses to pure demand and supply shocks would be the same. No attempt is made to separate demand from supply shocks, since no generally accepted procedure for doing so exists.

Figure 2.7 reports the GIR to a permanent shock to the nominal oil price. The magnitude of the shock is again normalized to $10 per barrel at constant 2005 prices, for greater ease of comparison.[42]

Additional Details on GVAR Results

Figure 2.7 only reports the GIR to a permanent oil price shock for selected countries and country groups—specifically, the United States, China, all fuel exporters, all other advanced economies, and all other developing economies. Figure 2.8 presents more disaggregated

[35]Advanced economy fuel exporters are Canada, Norway, and the United Kingdom. Developing economy fuel exporters are Indonesia, Mexico, and Saudi Arabia.

[36]Austria, Belgium, Finland, France, Germany, Italy, the Netherlands, and Spain.

[37]Australia, New Zealand, Sweden, and Switzerland.

[38]Korea, Malaysia, the Philippines, Singapore, and Thailand.

[39]Argentina, Brazil, Chile, and Peru.

[40]India, South Africa, and Turkey.

[41]Also shown are two-standard-deviation error bands, computed analytically. GIRs illustrate the effects of changes in observed variables (such as oil prices) on the evolution of other variables in the system, taking into account the historical correlations between shocks to all variables in the system. The use of GIRs allows the computation of impulse responses without the large number of arguably arbitrary identification assumptions typically needed to orthogonalize shocks. The disadvantage is that the shocks are not structural and are therefore harder to interpret as supply or demand shocks.

[42]Since the GVAR is estimated using quarterly data, the distinction between real and nominal oil prices makes little difference to the results. Also shown are error bands, computed using bootstrap simulation, which contain 95 percent of the simulated distribution.

Figure 2.8. Additional Results: Adjustment to Oil Price Shocks, 1979:Q2–2003:Q4[1]

(Percent unless otherwise indicated, x-axis in quarters)

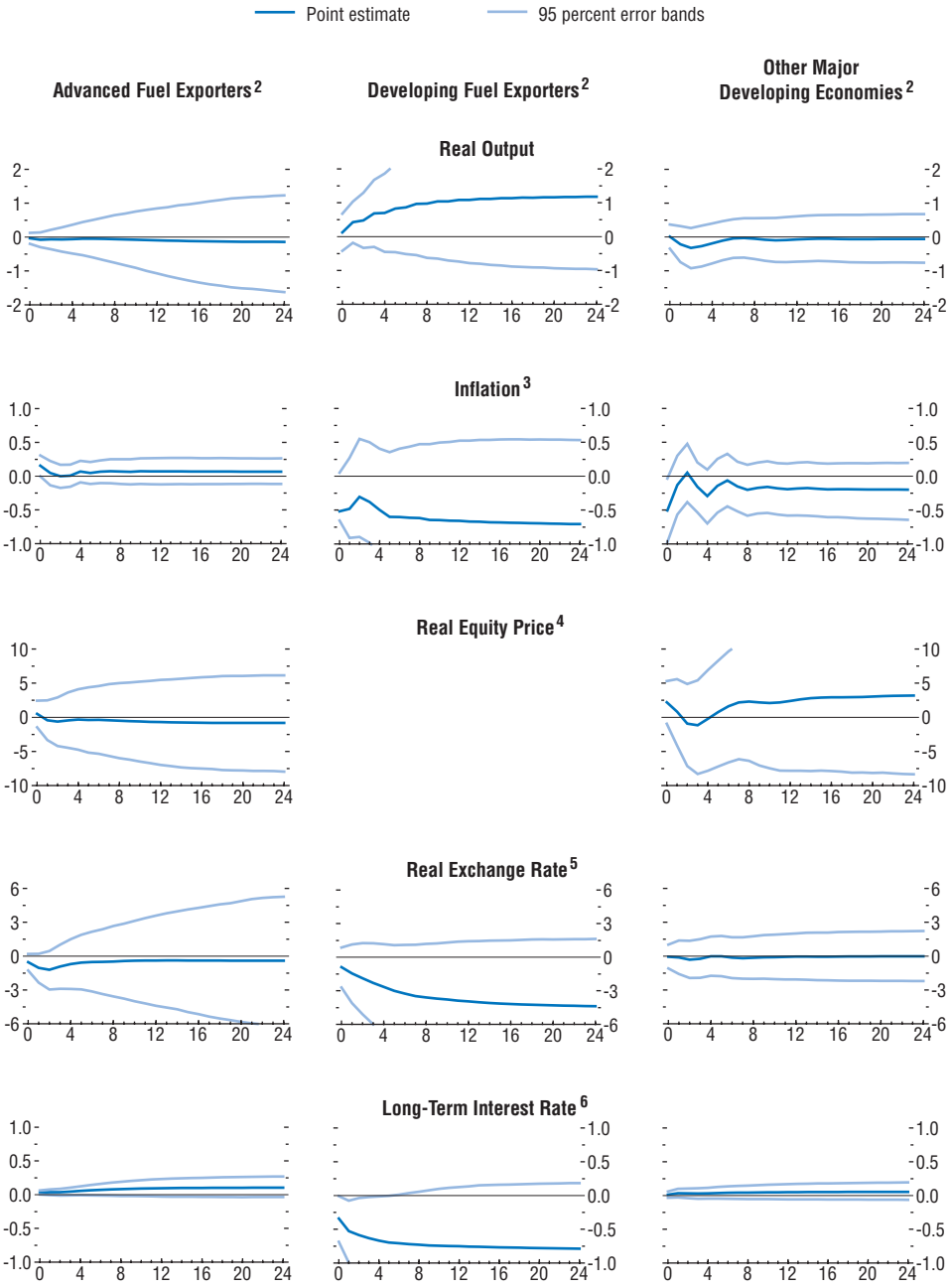
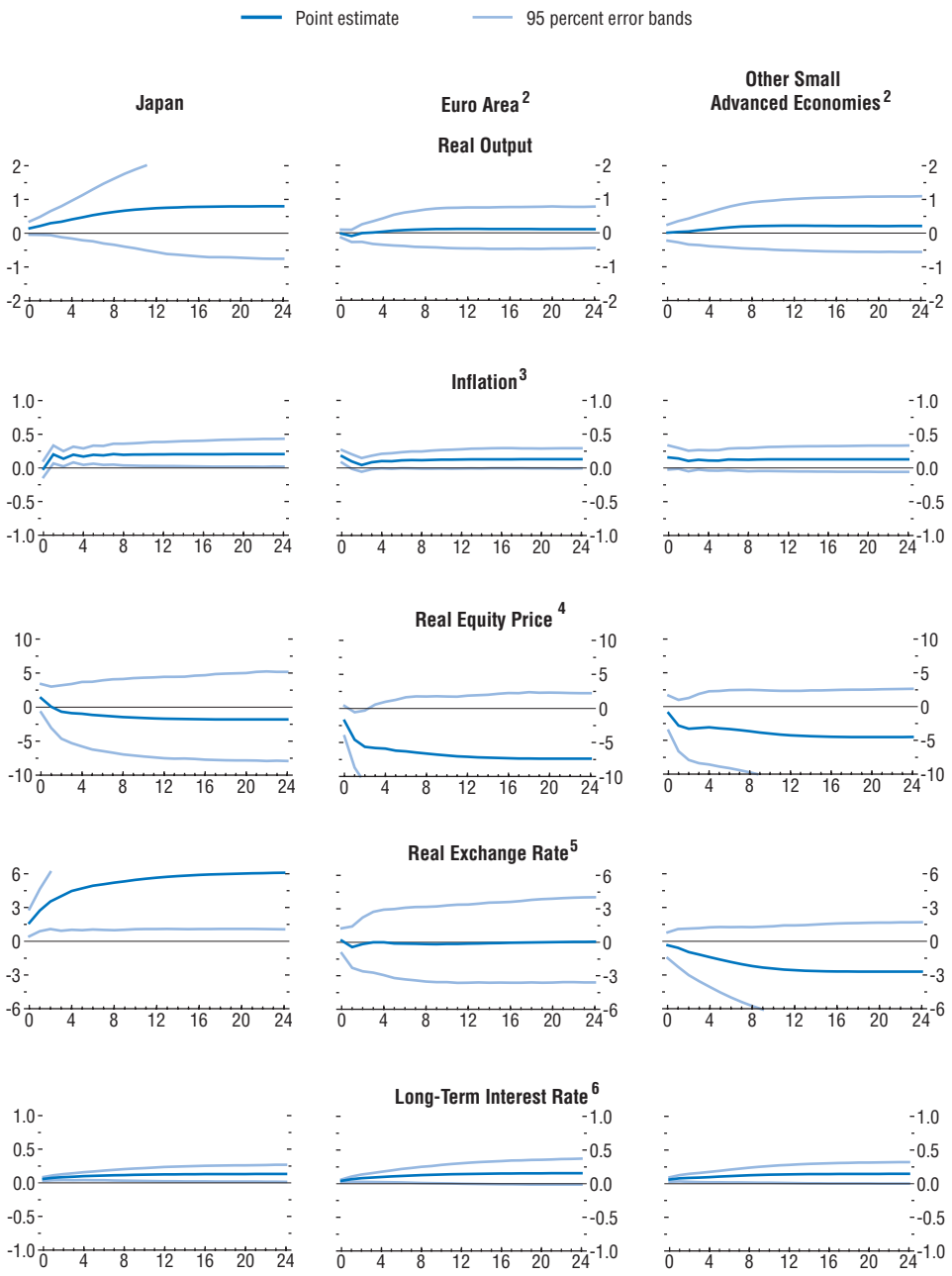


Figure 2.8 *(concluded)*



Source: IMF staff calculations, based on Dees and others (forthcoming).

[1]Response to a $10 a barrel annual average increase in oil prices (measured in constant 2005 U.S. dollars).

[2]Groups described in Appendix 2.1.

[3]*Y*-axis in percentage points at a quarterly rate. Developing fuel exporters and Turkey partially out of scale.

[4]Insufficient data available for developing fuel exporters. For other major developing countries, only India and South Africa shown. Euro area and other major developing countries partially out of scale.

[5]CPI-based real bilateral exchange vis-à-vis the United States shown. Developing fuel exporters and Japan partially out of scale.

[6]*Y*-axis in percentage points at a quarterly rate. For developing fuel exporters, short-term interest rates for Indonesia and Mexico shown. For other major developing countries, only South Africa shown.

responses; all groups referenced therein are defined as discussed above. Estimated responses for short-term interest rates are also available, although not reported.

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