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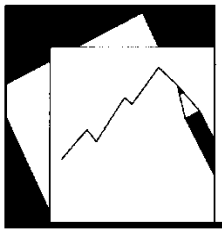

IMF Working Paper

Oil Shocks in a Global Perspective: Are they Really that Bad?

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Oil Shocks in a Global Perspective: Are they Really that Bad?

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Abstract

Using a comprehensive global dataset, we outline stylized facts characterizing relationships between crude oil prices and macroeconomic developments across the world. Approaching the data from several angles, we find that the impact of higher oil prices on oil-importing economies is generally small: a 25 percent increase in oil prices typically causes GDP to fall by about half of one percent or less. While cross-country differences in impact are found to depend mainly on the relative size of oil imports, we also show that oil price shocks are not always costly for oil-importing countries: although higher oil prices increase the import bill, there are partly offsetting increases in external receipts. We provide a small open economy model illustrating the main transmission channels of oil shocks, and show how the recycling of petrodollars may mitigate the impact.

JEL Classification Numbers: F00, F30, F41

Keywords: Oil prices; Oil importing economies; Oil shock episodes; Emerging and developing countries; Recycling of petrodollars

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I. INTRODUCTION

The manner in which oil prices affect emerging and developing economies has received surprisingly little attention, given the large body of literature on their effects in advanced economies. The aim of this paper is to help fill the gap in coverage by outlining stylized facts that characterize the relationship between oil prices and macroeconomic aggregates across the world. The results show that cross-country differences in this relationship can in large part be attributed to differences in the relative size of oil imports. At the same time, the negative impact of oil price shocks on oil-importing countries is partly offset by concurrent increases in exports and other income flows. These flows arise from high commodity prices being associated with good times for the world economy as well as from the recycling of petrodollars by oil-exporting economies. Both factors highlight the importance of viewing the impact of oil price developments from a global perspective.

The notion that oil prices can have a macroeconomic impact is generally well accepted and the debate has centered mainly on the magnitude and the channels of the effect. In a series of contributions, Hamilton (1983, 1996, 2005, 2009) has presented empirical evidence suggesting that oil price shocks have been one of the main causes of recessions in the United States. Others, including Barsky and Kilian (2004), argue that the effect is small and that oil shocks alone cannot explain the U.S. stagflation of the 1970s. Taking a more intermediate position, Bernanke et al. (1997) argue that an important part of the effect of oil price shocks on the U.S. economy results not from the change in oil prices per se, but from the resulting tightening of monetary policy. In the same line of research, Blanchard and Gali (2007) present evidence showing that the dynamic effect of oil shocks has decreased considerably over time, owing to a combination of improvements in monetary policy, more flexible labor markets, and a smaller share of oil in production. Their results indicate that a 10 percent increase in the price of oil would, prior to 1984, have reduced U.S. GDP by about 0.7 percent over a 2–3 year period, while after 1984 the loss would be only about 0.25 percent.

In contrast to the extensive literature on the impact of oil prices on the U.S. economy, there has been much less work on other countries and very little of that on developing economies. Outside the U.S., studies of the relationship between oil prices and the macroeconomy have almost exclusively been confined to other OECD members, with results suggesting that they tend to be affected in broadly the same way as the U.S. but less strongly.[2] We are only aware of a few papers analyzing the impact of oil price shocks on non-OECD countries, of which only three cover oil-importing countries while the others look at individual oil exporters. One of these three papers is by Berument et al. (2010), who apply structural VAR techniques to a number of

[2] For example, Jiménez-Rodriguez and Sánches (2004) find that a 100 percent increase in oil prices reduces GDP by between 1 and 5 percent in G-7 countries and the Eurozone, with the U.S. at the upper end of that range and no significant impact found for Japan. For Norway they find that the impact is positive at between 1 and 2 percent. Results from several other studies are reported in a survey by Jones et al. (2004).

countries in the Middle East and North Africa. They find that oil price increases have a positive impact on output in most of the region's oil-exporting economies, but, depending on whether the shock is due to demand or supply, either a positive or negative impact on the region's oil importers. Another paper is by Kilian et al. (2007) who also use a structural VAR but focus on the impact of oil price shocks on external balances and take a more global perspective. They find that the overall effect on the current account depends critically on the response of the non-oil trade balance, with oil-importing economies tending to experience an improvement in this balance and the opposite being the case for oil-exporting countries. Lastly, Mohaddes and Raissi (2011) provide evidence indicating that the price of oil, through its impact on external income and in turn on capital accumulation, has a positive impact on real output in Jordan.

In this paper, we provide a broad global perspective on the interaction between oil prices on the one side and, on the other, both economic output and international trade. We start by looking at correlations between the cyclical component of oil prices and the cyclical components of GDP, imports, and exports. The results show that these correlations have, across the world, usually been positive and increasing over the last forty years. This indicates that periods with high oil prices have generally coincided with good times for the world economy, especially in recent years. It also highlights the importance of disentangling the positive effect of oil prices increasing as a result of growing demand from more adverse effects resulting from spikes in oil prices due to reductions in supply as happened in the 1970s.

To analyze the impact of large oil price shocks on economic activity, we focus on the 12 episodes since 1970 in which oil prices have reached three-year highs. Even here we find no evidence of a widespread contemporaneous negative effect on economic output across oil-importing countries, but rather value and volume increases in both imports and exports. It is only in the year after the shock that we find a negative impact on output for a small majority of countries. These findings suggest that the higher import demand in oil-exporting economies resulting from oil price increases has an important and immediate offsetting effect on economic activity in the rest of the world, and that the adverse consequences are mostly relatively mild and occurring with a lag. We complement this analysis with dynamic panel regressions showing that the lagged negative impact of oil price increases on GDP in oil importing economies is statistically significant and depends on the size of oil imports relative to GDP. The results indicate that, after controlling for global economic conditions, a 25 percent increase in oil prices (roughly equal to the median price increase in our 12 oil shock episodes) causes the typical oil importer (where net oil imports have averaged between 3 and 4 percent of GDP) to experience a cumulative loss of output of around 0.3 percent of GDP over a 2–3 year period. For oil importers with oil imports greater than 5 percent of GDP the output loss increases to about 1 percent.

From these results we conclude that, across the world, the negative impact of oil price increases depends to a large extent on, first, how dependent countries are on oil imports, and, second, how strong are their links to oil exporters and the rest of the world. In this respect, the U.S. appears to be an outlier in that we, consistent with findings in the literature, see that its economy has been relatively hard hit by oil price shocks despite net oil imports averaging a relatively low

1.2 percent of GDP over the sample period (albeit increasing from 0.3 percent in 1970 to 2.3 percent in 2010). Across all oil-importing countries, we find that the high-income OECD economies, where the ratio of oil imports to GDP has averaged about 2 percent, are less sensitive to oil shocks than are other oil importers, where the ratio of oil imports to GDP has averaged about 4 percent.

We proceed as follows: Section II provides an overview of the data that we employ. Section III presents the big picture, stylized facts about co-movement of oil prices and other macroeconomic aggregates across the world over the last 40 years. Section IV documents stylized facts on economic developments during and after oil shock episodes. Section V presents results from dynamic panel regressions. Section VI presents a simple model consistent with the facts, and section VII concludes.

II. DATA OVERVIEW

To assess how the relationship between oil prices and macroeconomic aggregates varies across countries we apply an extensive dataset of annual data spanning from 1970–2010. Aside from global oil prices, our interest is primarily in just a few variables: GDP, and imports and exports of goods and services. This narrow focus allows us to cover a large majority of countries. Our data are all sourced from the IMF's World Economic Outlook database, and after dropping those missing complete series for GDP we are left with 144 countries (see Data Appendix). We divide these into four groups: oil exporters, and oil-importing OECD, middle-income, and low-income countries.[3]

Table 1. Summary Statistics, 1970-2010 Averages

	GDP per capita (US$)	Net oil exports (% of GDP)	Annual real GDP growth (%)	Standard deviation of GDP per capita growth (%)	Exports/GDP (%)	Imports/GDP (%)
Oil Exporters	10758	26.3	4.8	8.9	51	42
Oil-importing OECD	18296	-2.0	2.7	3.8	37	36
Oil-importing Middle-income	9044	-4.2	4.2	6.1	51	57
Oil-importing Low-income	1525	-3.8	3.6	5.4	27	40

Sources: IMF, *World Economic Outlook* database; and authors' calculations.

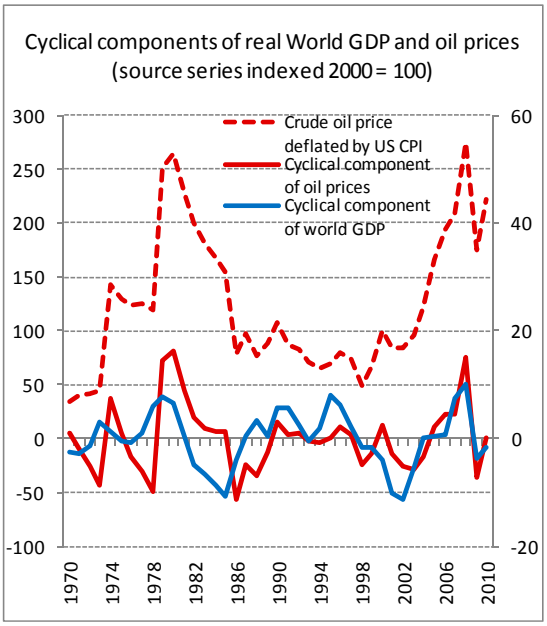
Table 1 shows summary statistics for the four groups. From these data, the oil-exporting countries stand out by virtue of their large positive ratio of net oil exports to GDP. Among the oil

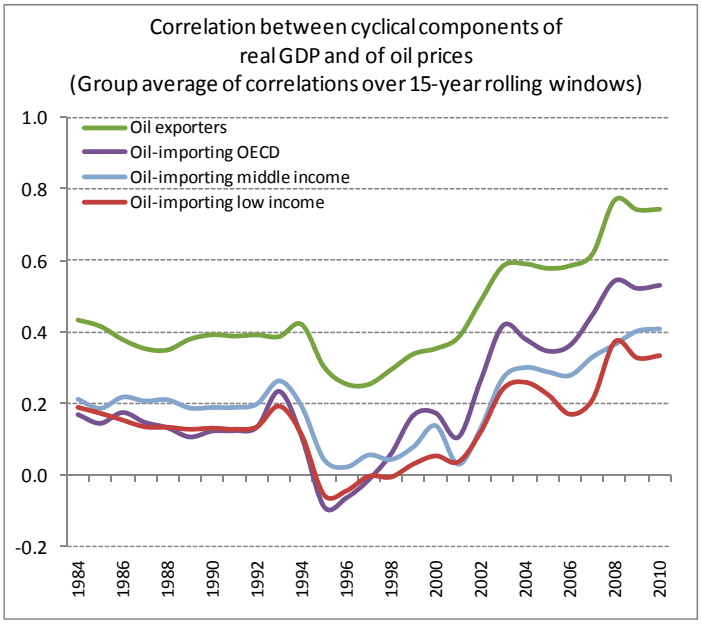
[3] We identify oil-exporting countries as those where the average share of net oil exports in total exports is at least 20 percent over 1970–2010. Among the other countries, we first identify OECD countries based on the membership in 1980, with Norway dropping out as the only oil exporter. We then divide the remaining countries based on average annual per capita income at purchasing power parity, with a cutoff level of $4000. In the following, we use the terms non-oil exporting and oil-importing interchangeably to ease the exposition, although some of the countries classified as oil-importing also export oil.

importers, in contrast, this ratio is negative, with non-OECD countries being about twice as oil-dependent as the OECD members. Non-OECD countries also are characterized by higher ratios of exports and imports to GDP than OECD countries. These data indicate that, on the whole, non-OECD countries, and oil exporters in particular, have greater exposure to oil-price determined movements in the terms of trade and also greater variation in output.

III. The Big Picture

In analyzing the impact of changes in oil prices, it is important to recognize that commodity prices can be influenced by global conditions. For example, oil prices can be high because of strong global aggregate demand or high because of low oil supply. Macroeconomic outcomes can be expected to vary accordingly. If oil prices are high due to demand, they are in any given country likely to be associated with above-trend levels of output and trade, while the opposite is likely to hold if the reason for high oil prices is low oil supply. The extent to which oil prices are associated with negative outcomes is therefore an empirical question.





We analyze the co-movements of oil prices with our core macro variables by looking at correlations of the cyclical component of real series.[4] The results are summarized in Table 2 and the following regularities emerge:

Stylized fact #1: Oil prices and GDP tend to move in the same direction. In each of the four groups, correlations are positive on average. This reflects that for a majority of countries, periods

[4] To construct the series used in this section we first deflate U.S. dollar values with the U.S. CPI to create indices set to 100 in year 2000. We then apply the HP filter, using $\lambda = 100$ and including the April 2011 *World Economic Outlook* projections to 2015 to enhance the robustness of the 2010 end-point estimates.

of above-trend oil prices have generally coincided with above-trend output. Moreover, with correlations in all cases substantially higher in the second half of the sample than in the first half, this positive association has increased over time. Among individual countries, oil exporters clearly exhibit the highest correlations. Still, it is striking that the correlations are also positive for a large majority of oil importers. Indeed, the U.S. and Japan stand out as being the only OECD countries displaying a negative correlation over 1970–2010 (Figure 1).[5]

Stylized fact #2: Oil prices and imports tend to move in the same direction. Correlations for all three groups of oil importers are substantially higher than those between oil prices and GDP. Only a handful of countries display a negative correlation (Figure 2).

Stylized fact #3: Oil prices and exports tend to move in the same direction. The correlations are strongest among oil exporters where they for all variables are the highest among all the country groups. For oil importers, in contrast, the correlations are somewhat smaller than for imports. Nevertheless, for all groups and sub-periods, the correlations are higher than for GDP, and negative for less than 1 in 10 countries (Figure 3).[6]

From these three stylized facts we conclude that oil prices tend to be positively associated with economic activity and also that the degree of co-movement has strengthened over time.[7] The relationship is strongest for oil exporters, as one would expect, but is also clearly present among the majority of OECD countries and—somewhat less strongly—in oil-importing developing economies. This suggests that, especially in the second half of our sample period, variation in oil prices has been driven more by variation in demand than by variation in supply. Accordingly, oil price increases during the past two decades appear to a large extent a reflection of good times for the global economy.

While these results suggest that oil prices on the whole should not be a major cause for concern in so far as they follow the pattern of recent history, they do not rule out the possibility that particularly large oil price increases can have more adverse consequences. Indeed, there is strong evidence of a non-linear relationship between oil prices and economic outcomes, where large

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[5] To account for possible lagged effects, we also calculated correlations of GDP with oil prices a year earlier instead of contemporaneously. In this specification, the correlations are positive for all oil exporters. The oil-importing countries, in contrast, show no clear pattern, with the group evenly split between those displaying a positive and those displaying a negative correlation. The U.S. still stands out, however, this time with the most negative correlation among all 144 countries.

[6] Available data on foreign direct investment and remittances inflows are not as comprehensive as for imports and exports, but they show a broadly similar pattern of positive correlations.

[7] Given that the presence of a trend in oil prices is debatable, we also calculated correlations without the cyclical adjustment of oil prices. This did not materially change the results.

upward price increases have a disproportionately negative impact.[8] In the next two sections we therefore examine how our four groups of countries fared during oil price spikes.

IV. Anatomy of Oil Shocks

The natural starting point to assess how damaging oil price shocks have been in different countries and groups of countries is to consider what actually happened during such episodes. In what has become a standard approach, we follow Hamilton (2003) in identifying oil price shocks as years when oil prices reach a three-year high. This approach identifies 12 shocks during our 1970–2010 sample, a period in which the median increase in oil prices was 27 percent. Following Kaminsky et al. (2004), we study the behavior of macroeconomic aggregates during these episodes by comparing the median annual change in a particular variable in the year of the event to the median annual change over the entire sample period. This tells us if the observed changes during these episodes were large or small in a given country. We perform these calculations for all countries and for variables expressed in both nominal and real terms and as a ratio to GDP, and we report the median values for each group in Table 3.[9] We identify the following patterns:

Stylized fact #4: Oil price shocks are generally associated with contemporaneous increases in imports. In each of the three groups of oil importers a large majority of countries experienced above-median changes in imports, whether defined as the nominal or real growth rate or as the change in the ratio to GDP. The largest increases are in nominal import growth, as could be expected given the higher oil prices. Changes in the growth rate of real imports and in the ratio of imports to GDP are smaller but still sizeable at around 1 percent or more in each of the three groups of oil importers. Compared to the oil importers, the oil exporters exhibit a significantly larger increase, 4.4 percent, in import volumes. In contrast to the oil importers, however, the oil exporters exhibit a decline in the ratio of imports to GDP, reflecting their high growth of nominal GDP in these episodes at 9.6 percent above the median rate.

Stylized fact #5: Oil price shocks are generally associated with contemporaneous increases in exports. Oil exporters exhibit a large increase in the growth rate of nominal exports of almost 25 percent, reflecting the large price increases, but a small decline in the volume growth rate. More surprising is the consistent pattern of increasing exports among the oil importers: they show increases in the growth of export volumes ranging between 0.7 percent for the middle-income countries and 1.3 percent in the low-income group and, in all cases, increases in the ratio

[8] See Hamilton (2005) and references therein.

[9] For real series we distinguish between two concepts. One is where U.S. dollar values are deflated by U.S. CPI, as in the previous section. The other is the conventional measure where nominal series are deflated by their respective deflators. The former is useful to gauge changes in international purchasing power. The latter concept, which we hereafter refer to as *volume*, measures the quantities involved. In the years with oil price shocks, as shown in Table 2, the former measure consistently increased by more than the latter, implying that the various price deflators all increased by more than U.S. CPI.

to GDP of close to 1 percent. In all three groups of oil importers, and by each of the four measures, exports increase in a sizeable majority of countries.

Stylized fact #6: Oil price shocks are generally associated with contemporaneous increases in GDP. The results dispel any notion of oil shocks always having an immediate and widespread negative impact on output. On the contrary: these episodes have generally been associated with GDP growth increasing in the same year, with the median volume increase ranging from 0.2 percentage points for oil-importing OECD countries to 1.5 percentage points for the oil exporters. This positive impact is seen in a majority of cases, with the share of episodes with above-median GDP volume growth ranging from 58 percent for oil-importing OECD countries to 63 percent for middle-income oil importers. Within the groups, the impact varies across countries (Figures 4 and 5), but it is notable that the U.S. is very much at the low end of the distribution. Indeed, median U.S. GDP volume growth during the oil shock episodes was 0.4 percent lower than median growth over the entire sample period and above the median in only 5 of the 12 episodes. On both counts, these are the lowest figures among all the OECD countries, possibly reflecting relatively low fuel taxes and higher energy intensity in the U.S. [10]
From these results, we conclude that oil shock episodes have typically been associated with widespread contemporaneous increases in international trade and, surprisingly, in economic output as well. The increases in trade likely reflect that the oil exporters' higher export earnings during periods with large oil price increases are partially recycled as higher imports from the rest of the world. With petrodollars also creating activity in other countries via the flow of remittances and investments, these offsetting effects help explain the lack of a negative GDP impact.[11] Surprising as it is, it is important to stress that these are only the contemporaneous effects in the year of the oil price shock. Indeed, results in the literature suggest that the negative impact on output for advanced economies only really materializes after four quarters (see, e.g., Hamilton, 2005, and Jiménez-Rodriguez, 2004).

To evaluate lagged effects, Table 4 considers what happens to imports, exports, and GDP in the year after the oil shocks. The results indicate that some negative effects tend to occur with a lag. One year after an oil shock, OECD oil-importers' rate of GDP volume growth typically fell by 0.7 percent compared to the median (1.8 percent in the U.S.) and only a third of these countries

[10] Even in 1974 and 1979, when oil prices increased by some 220 and 110 percent—the two largest such increases in our sample period—same-year GDP growth increased relative to the median for all four of our groups. In the year after the shock, however, the negative impact was more pronounced, with growth declining (although still positive for all but the OECD) for all groups of oil importers in both years except middle-income countries in 1980. In 1975, GDP volume growth fell by 3 percentage points for the group of OECD countries and 1.3 percentage points for the other two groups of oil importers. In 1980, the declines were less than 1 percentage point for all groups.

[11] Available data on remittances and foreign direct investment are not as comprehensive as those for imports and exports. While the results are consequently more tentative, applying the methods in this section to these data indicates that the growth rate of oil importing countries' receipts from remittances and foreign direct investment typically increased during oil shock episodes in much the same way as for exports. On average, however, these flows are smaller than those of exports and the macroeconomic effects are therefore likely to be smaller too.

experienced an increase (Figure 6 and Table 4). The impact on other oil-importing countries has been less pronounced, however, perhaps reflecting a greater share of primary goods in their exports and a positive correlation between the price of oil and prices of other commodities, and the oil exporters posted an increase in the growth rate of GDP volume. Export volume growth was more consistently negative, declining by between around 0.5 percent for middle-income oil importers and 1.5 percent for oil-importing OECD countries. Imports show a more mixed picture, with volume growth increasing further for all groups, except OECD oil importers.

V. DYNAMIC PANEL ESTIMATION

In this section we adapt the basic autoregressive model of Hamilton (2003, 2005) based on quarterly data for the U.S. to annual data and extend it to analyze multiple countries and at the same time also control for global conditions. Our dynamic panel model takes the following form:

$$y_{i,t} = a_0 + \sum_{l=1}^{p} a_l y_{i,t-l} + b x_t + \sum_{l=0}^{n} c_l op_{t-l} + \varepsilon_{i,t},$$

where $y_{i,t}$ is output in country i at time t, x_t is an indicator of global economic conditions, and op_t reflects the extent of an oil price shock.

Table 5 reports results from our preferred specification of this model. We measure home country output as the same cyclical component of GDP volume used in the previous section. To control for global economic conditions, we use world GDP volume (again measured as the cyclical component) as well as the level of oil prices (deflated by U.S. CPI), reflecting the association established in Section III. For the measure of oil price shocks, op_t, we use the percentage change in the price of oil in the years where it reaches a three-year high, with this variable otherwise taking a value of zero. We find that the coefficients on lagged home-country output are typically strongly significant with up to three lags and with broadly similar magnitudes across different country groups. The coefficient on world GDP volume is positive and strongly significant for all countries and more so than that on the oil price level, with the magnitudes indicating that oil-exporting and oil-importing middle-income economies are more influenced by global conditions than oil-importing OECD and, in particular, low-income countries.[12]

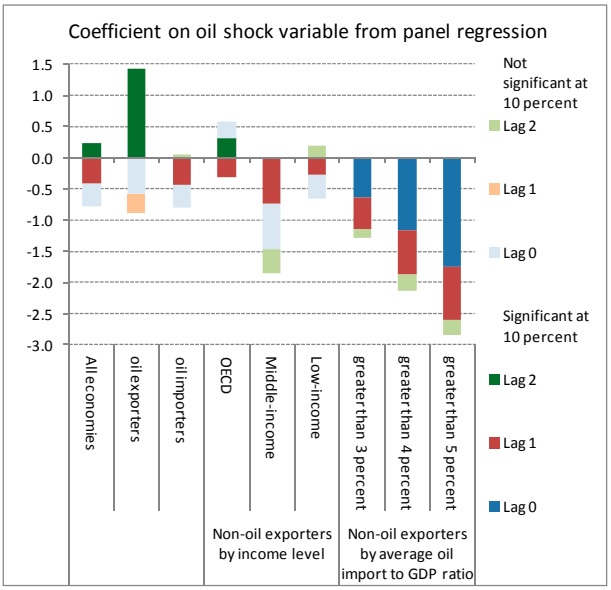
Our main interest, however, is in the coefficients on the oil price shock variable, which capture the average effect of an oil shock on the domestic economy. The results show that even when controlling for global economic conditions and thus abstracting from the generally positive association between oil prices and global demand, the contemporaneous oil shock coefficient is statistically insignificant for the world as a whole and also separately for each of the four groups

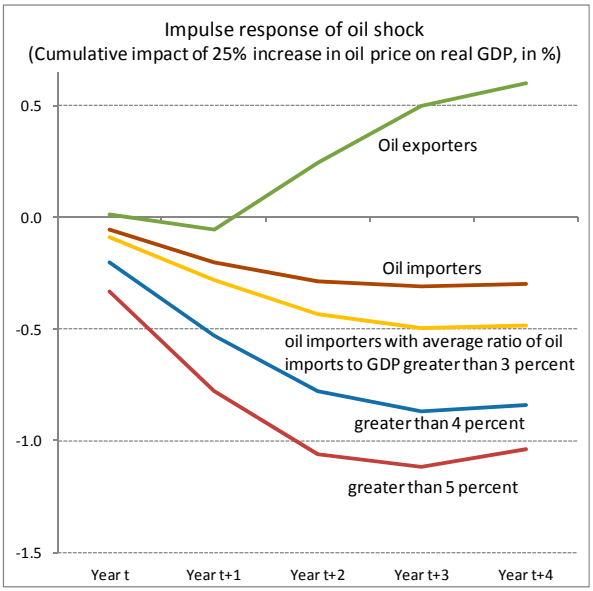
[12] Given the possibility that the regression results are unduly influenced by countries where output could influence world GDP or oil prices, we tried excluding from the regression the U.S. and Saudi Arabia—the two prime candidates for such causality. This has an almost imperceptibly small impact on the results.

of countries that we have used so far. Nevertheless, if we instead sort oil importers by their average ratio of oil imports to GDP, we find that the effect becomes larger and more significant as the ratio of oil imports to GDP increases. For countries with an average ratio of oil imports to GDP of 4 percent or more, the results indicate that a 25 percent increase in oil prices will reduce real GDP that year by 0.3 percent (-1.170/4).

In line with the findings in the previous section, the results in Table 5 also point to the presence of lagged effects. Indeed, by controlling for global economic conditions, the regressions make these effects more clearly visible, especially for oil exporters and oil-importing middle-income economies. At lag 1, the coefficient on the oil price shock is negative and statistically significant at 10 percent for all the country groups under consideration except for oil exporters, indicating that oil shocks do have important lagged effects on output in oil-importing countries. And, again, the coefficient becomes more negative the higher the ratio of oil imports to GDP. At lag 2, by contrast, the coefficient is strongly positive for the oil exporters and somewhat less so for the group of non-oil exporting OECD countries.

To trace out the full impact of an oil shock, taking into account the fact that higher oil prices are generally positively associated with good global conditions as well as the dynamic effects, we calculate impulse responses for a 25 percent increase in oil prices as implied by the coefficients in Table 5. The results indicate that the typical oil importer can expect a cumulative GDP loss of about 0.3 percent over the first two years with little subsequent impact. For countries with oil imports of more than 4 percent of GDP (i.e., at or above the average for middle- and low-income oil importers), however, the loss increases to about 0.8 percent—and this loss increases further for those with oil imports above 5 percent of GDP. In contrast to the oil importers, oil exporters show little impact on GDP in the first two years but then a substantial increase consistent with the positive income effect, with real GDP 0.6 percent higher in year *t*+3.





To put these numbers in perspective, it is useful to think of an economy where oil accounts for

4 percent of total expenditure and where aggregate spending is determined entirely by demand. If the quantity of oil consumption remains unchanged, then a 25 percent increase in the price of oil will cause spending on other items, and hence real GDP, to contract by 1 percent of the total. From this reference point, one would expect the possibility of substituting away from oil to reduce the overall impact on GDP. At the same time, there could also be factors working in the opposite direction, via, for example, confidence effects, market frictions, or changes in monetary policy. With our estimates of the GDP loss at only about half the level implied by the direct price effect on the import bill, the results presented here suggest the size of any such magnifying effects, if present, is not substantial across countries.

VI. Modeling The Macroeconomic Effects of Oil Price Shocks

We now develop a simple model of the macroeconomic effects of oil price shocks. Our focus is on explaining the response of a small open economy to oil price shocks according to the strength of links to the rest of the world. The model has three non-storable goods: exportables, importables, and non-tradables; we select the exportable good as the numeraire. There is a given and constant endowment path of exportables and non-tradables. In contrast, the economy consumes, but is not endowed with importables.

A. Consumer's Problem

Consumer's lifetime utility is given by

$$\int_0^\infty u(c_t^I, c_t^N) e^{-\beta t}\, dt, \tag{1}$$

where β is the subjective discount rate, and c_t^I and c_t^N denote consumption of importables and non-tradable goods. We correspondingly denote the price of importables and non-tradeables by p_t^I and p_t^N, with the ratio p^N/p^I being the real exchange rate and p_t^I being the inverse of the terms of trade.

The flow constraint is given by

$$\dot{b}_t = r b_t + y^E + p_t^N y^N + \Phi_t - p_t^I c_t^I - p_t^N c_t^N, \tag{2}$$

where b denotes the stock of net foreign assets, y^E and y^N are the endowments of exportable and non-tradable goods, and Φ is non-interest income from the rest of the world. We assume

$$\Phi_t = \alpha f(p_t^I), \qquad where \qquad f'(p_t^I) > 0$$

where this income flow can be interpreted as exports or other forms of external receipts arising from the recycling of oil revenue, with the magnitude depending on the degree of economic integration, α. By substitution and forward integration we get

$$\dot{b}_t = rb_t + y^E + p_t^N y^N + \alpha f(p_t^I) - p_t^I c_t^I - p_t^N c_t^N \tag{3}$$

$$b_0 + \int_0^\infty [y^E + p_t^N y^N + \alpha f(p_t^I)] e^{-rt}\, dt = \int_0^\infty (p_t^I c_t^I + p_t^N c_t^N) e^{-rt}\, dt \tag{4}$$

Formally, the economy's problem consists in maximizing (1) subject to (4), and the first-order conditions are given by

$$u_{c^I}(c_t^I, c_t^N) = \lambda p_t^I \tag{5}$$

$$u_{c^N}(c_t^I, c_t^N) = \lambda p_t^N \tag{6}$$

Combining these two,

$$\frac{p_t^N}{p_t^I} = \frac{u_{c^N}(c_t^I, c_t^N)}{u_{c^I}(c_t^I, c_t^N)} \tag{7}$$

B. Equilibrium Conditions

The non-tradable goods market must clear.

$$c_t^N = y^N \tag{8}$$

Imposing condition (8) on (4) yields the economy's resource constraint.

$$b_0 + \int_0^\infty [y^E + \alpha f(p_t^I)] e^{-rt}\, dt = \int_0^\infty p_t^I c_t^I e^{-rt}\, dt \tag{9}$$

C. Perfect Foresight Equilibrium

The perfect foresight equilibrium path (PFEP) for this economy, along which p_t^I is constant, is characterized by consumption of importables, consumption of non-tradables, and the real exchange rate. From (5) is is clear that consumption of importables will be constant along a PFEP. Then, using the resource constraint (9), the level of consumption of importables is given by

$$c^I = \frac{rb_0 + y^E + \alpha f(p^I)}{p^I} \tag{10}$$

Consumption of non-tradables, along a PFEP, will be equal to the endowment.

$$c^N = y^N \tag{11}$$

The real exchange rate is obtained by substituting (10) and (11) in (7).

$$\frac{p^N}{p^I} = \frac{u_{c^N}(c^I, y^N)}{u_{c^I}(c^I, y^N)} \tag{12}$$

D. Oil Shock

Suppose that there is an unanticipated permanent increase in the price of oil, i.e. the importable goods. This implies deterioration in the terms of trade. Since the shock is unanticipated, consumers re-optimize at the moment of the shock. Along the new perfect foresight equilibrium, p^I will still be constant and from (10) we get that c^I can increase or decrease, depending on whether the negative terms of trade effect that results from the loss of purchasing power is smaller or greater than the positive "recycling" effect resulting from the positive correlation between income flows and the price of oil.

$$\frac{dc^I}{dp^I} = \underbrace{-\frac{rb_0 + y^E + \alpha f(p^I)}{{p^I}^2}}_{terms\ of\ trade\ effect} + \underbrace{\frac{\alpha f'(p^I)}{p^I}}_{recycling\ effect} \gtreqless 0$$

In practice, which effect is larger is an open empirical question. Notice that in this simple model, the parameter α is capturing the degree of integration to the rest of the world and/or the oil exporters.

E. Competitiveness

What is the effect of an oil price shock on the real exchange rate? To answer this question, we totally differentiate (13) and obtain

$$\frac{d(\frac{p^N}{p^I})}{dp^I} = \frac{dc^I}{dp^I}\left[\frac{u_{c^I}u_{c^Ic^N} - u_{c^N}u_{c^Ic^I}}{{u_{c^I}}^2}\right] \gtreqless 0$$

Notice that for normal goods, the term in brackets is positive (see Vegh, forthcoming). This result implies that an adverse oil price shock (an increase in p^I) can lead to an increase (appreciation) or decrease (depreciation) in the real exchange rate p^N/p^I. Again, the effect will depend on the relative strength of the terms of trade effect vis-à-vis the recycling effect.

Intuitively, a deterioration in the terms of trade (e.g., from an increase in the price of oil) can make the consumer wealthier or poorer depending on the strength of the recycling effect. If the consumer is poorer, then, at pre-shock relative prices, he would like to consume less of both importables and non-tradable goods. Since non-tradables are in fixed supply, this implies that at pre-shock relative prices there is excess supply of non-tradable goods, which will further decrease the real exchange rate. The opposite happens if the consumer is wealthier after the shock. In other words, if a decline in the terms of trade does not lead to a loss of income, the real exchange rate may not depreciate.

F. Lessons Learned

The main lesson to be drawn from this model is that negative terms of trade shocks can be associated with positive and offsetting effects that help mitigate the direct impact on the domestic economy. The intuition is simple: a loss in the terms of trade is a gain to someone else and, depending on the degree of interlinkages, some of that gain will be shared. The net wealth effect is in principle ambiguous; it depends on the relative strength of the negative and positive effects.

VII. Conclusion

Conventional wisdom has it that oil shocks are bad for oil-importing countries. This is grounded in the experience of slumps in many advanced economies during the 1970s. It is also consistent with the large body of research on the impact of higher oil prices on the U.S. economy, although the magnitude and channels of the effect are still being debated. In this paper, we offer a global perspective on the macroeconomic impact of oil prices. In doing so, we are filling a void of research on the effects of oil prices on developing economies.

Our findings indicate that oil prices tend to be surprisingly closely associated with good times for the global economy. Indeed, we find that the United States has been somewhat of an outlier in the way that it has been negatively affected by oil price increases. Across the world, oil price shock episodes have generally not been associated with a contemporaneous decline in output but, rather, with increases in both imports and exports. There is evidence of lagged negative effects on output, particularly for OECD economies, but the magnitude has typically been small.

Controlling for global economic conditions, and thus abstracting from our finding that oil price increases generally appear to be demand-driven, makes the impact of higher oil prices stand out more clearly. For a given level of world GDP, we do find that oil prices have a negative effect on oil-importing countries and also that cross-country differences in the magnitude of the impact depend to a large extent on the relative magnitude of oil imports. The effect is still not particularly large, however, with our estimates suggesting that a 25 percent increase in oil prices will cause a loss of real GDP in oil-importing countries of less than half of one percent, spread over 2–3 years. One likely explanation for this relatively modest impact is that part of the greater revenue accruing to oil exporters will be recycled in the form of imports or other international flows, thus contributing to keep up demand in oil-importing economies. We provide a model illustrating this effect and find supporting empirical evidence.

The finding that the negative impact of higher oil prices has generally been quite small does not mean that the effect can be ignored. Some countries have clearly been negatively affected by high oil prices. Moreover, our results do not rule out more adverse effects from a future shock that is driven largely by lower oil supply than the more demand-driven increases in oil prices that have been the norm in the last two decades. In terms of policy lessons, our findings suggest that efforts

to reduce dependence on oil could help reduce the exposure to oil price shocks and hence costs associated with macroeconomic volatility.[13] At the same time, given a certain level of oil imports, developing economic linkages to oil exporters could also work as a natural shock absorber.

[13] See Ramey and Ramey (1995).

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DATA APPENDIX

Oil-exporting countries (19)	Algeria, Angola, Cameroon, Congo, Ecuador, Equatorial Guinea, Gabon, Indonesia, Iran, Kuwait, Nigeria, Norway, Oman, Qatar, Saudi Arabia, Syria, Trinidad, UAE, Venezuela.
Oil-importing countries (125)	
OECD based on membership in 1980 (23)	Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, Netherlands, New Zealand, Portugal, Spain, Sweden, Switzerland, Turkey, UK, USA.
Middle-income countries (36)	Antigua, Argentina, Bahamas, Bahrain, Barbados, Botswana, Brazil, Bulgaria, Chile, Colombia, Costa Rica, Cyprus, Dominica, Grenada, Hong Kong, Hungary, Israel, Jamaica, Korea, Lebanon, Malaysia, Mauritius, Mexico, Panama, Peru, Poland, Romania, Seychelles, Singapore, South Africa, St. Kitts, St. Lucia, St. Vincent, Suriname, Taiwan, Uruguay
Low-income countries (66)	Albania, Bangladesh, Belize, Benin, Bhutan, Bolivia, Burkina, Burundi, Cape Verde, CAR, CDR, Chad, China, Comoros, Côte d'Ivore, DR, Egypt, El Salvador, Ethiopia, Fiji, Gambia, Ghana, Guatemala, Guinea, Guyana, Haiti, Honduras, India, Jordan, Kenya, Kiribati, Lao, Lesotho, Madagascar, Malawi, Maldives, Mali, Mauritania, Mongolia, Morocco, Mozambique, Myanmar, Nepal, Nicaragua, Niger, Pakistan, Paraguay, Philippines, PNG, Rwanda, Samoa, Sao Tome, Senegal, Sierra Leone, Solomon Islands, Sri Lanka, Sudan, Swaziland, Tanzania, Thailand, Togo, Tunisia, Uganda, Vanuatu, Vietnam.

Data series used—all from the April 2011 vintage of the World Economic outlook database—are:

Oil Prices	W001POILAPSP	Crude Oil (petroleum), simple average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh, US$ per barrel
U.S. CPI	W111PCPI	Consumer price index, period average
Imports	W…BM	Imports of goods and services
Import deflator	W…TM_D	Price deflator for imports goods & services
Oil imports	W…TMGO	Value of oil imports
Exports	W…BX	Exports of goods and services
Export deflator	W…TX_D	Price deflator for exports goods & services
Oil exports	W…TXGO	Value of oil exports
GDP per capita	W…PPPPC	PPP per capita
World nominal GDP	W001NGDPD	Gross domestic product, current prices, U.S. dollars
World real GDP	W001NGDP_R	Gross domestic product, constant prices
Nominal GDP	W…NGDPD	Gross domestic product, current prices, U.S. dollars
Real GDP	W…NGDP_R	Gross domestic product, constant prices
GDP per capita	W…PPPGDP	PPP valuation of country GDP, U.S. dollars

Table 2. Correlation between Oil Prices and Macroeconomic Aggregates

Correlation between the cyclical component of real GDP and the cyclical component of real oil prices

	1970-2010	1970-90	1991-2010
Oil exporters	0.48	0.36	0.70
Oil-importing OECD	0.26	0.11	0.49
Oil-importing Middle Income	0.24	0.17	0.36
Oil-importing Low Income	0.18	0.14	0.28

Correlation between the cyclical component of real imports and the cyclical component of real oil prices

	1970-2010	1970-90	1991-2010
Oil exporters	0.39	0.30	0.59
Oil-importing OECD	0.47	0.30	0.75
Oil-importing Middle Income	0.42	0.38	0.64
Oil-importing Low Income	0.38	0.33	0.50

Correlation between the cyclical component of real exports and the cyclical component of real oil prices

	1970-2010	1970-90	1991-2010
Oil exporters	0.65	0.62	0.84
Oil-importing OECD	0.42	0.24	0.69
Oil-importing Middle Income	0.32	0.24	0.56
Oil-importing Low Income	0.29	0.28	0.38

Sources: IMF, *World Economic Outlook* database; and authors' calculations.
Note: Real variables constructed by deflating U.S. dollar values with U.S. CPI.

Table 3. Economic Developments during Oil Shocks, 1970-2010
(12 shocks, median outcomes by country group)

	Oil exporters	Non-oil exporters		
		OECD	Middle-income	Low-income
(episode value less median value, in percent)				
Imports				
Nominal annual growth rate	10.5	9.2	7.7	9.4
Real annual growth rate				
Nominal in US$ deflated by US CPI	7.7	6.2	7.6	7.6
Volume	4.5	1.3	3.3	1.1
Ratio to GDP annual change	-0.8	1.1	1.3	0.7
Exports				
Nominal annual growth rate	24.6	7.7	4.2	7.6
Real annual growth rate				
Nominal in US$ deflated by US CPI	21.6	5.8	3.2	7.4
Volume	-0.2	1.0	0.5	2.1
Ratio to GDP annual change	2.7	0.8	1.2	0.7
GDP				
Nominal annual growth rate	11.7	5.7	2.6	5.8
Real annual growth rate				
Nominal in US$ deflated by US CPI	9.3	2.3	2.1	2.5
Volume	1.4	0.3	1.0	1.1
(share of episodes with value greater than median value, in percent)				
Imports				
Nominal annual growth rate	83	83	92	83
Real annual growth rate				
Nominal in US$ deflated by US CPI	75	83	75	83
Volume	75	75	100	58
Ratio to GDP annual change	33	92	100	92
Exports				
Nominal annual growth rate	100	75	75	83
Real annual growth rate				
Nominal in US$ deflated by US CPI	100	67	75	75
Volume	50	67	75	67
Ratio to GDP annual change	83	92	67	83
GDP				
Nominal annual growth rate	100	67	83	83
Real annual growth rate				
Nominal in US$ deflated by US CPI	100	58	75	67
Volume	92	67	75	75

Sources: IMF, *World Economic Outlook database*; and authors' calculations.
Note: Oil price shocks identified as years when the nominal U.S. dollar price of crude oil reaches a 3-year high. There have been 12 such years since 1970: 1973, 74, 79, 80, 90, 96, 2000, 04, 05, 06, 07, 08, during which real oil prices increased by an average of 46 percent. Volumes are computed as nominal variables deflated by the corresponding deflator (exports and imports deflator for exports and imports and GDP deflator for GDP).

Table 4. Economic Developments in Year after Oil Shocks, 1970-2010
(12 shocks, median outcomes by country group)

		Non-oil exporters		
	Oil exporters	OECD	Middle-income	Low-income
(episode value less median value, in percent)				
Imports				
Nominal annual growth rate	8.5	-1.8	3.5	5.3
Real annual growth rate				
Nominal in US$ deflated by US CPI	5.8	-2.8	3.0	0.3
Volume	6.9	-3.6	2.2	-0.1
Ratio to GDP annual change	1.0	0.7	1.2	0.1
Exports				
Nominal annual growth rate	-0.8	-2.4	-1.0	1.0
Real annual growth rate				
Nominal in US$ deflated by US CPI	0.3	-4.9	-1.4	-1.9
Volume	-4.1	-2.1	-2.4	-0.6
Ratio to GDP annual change	-0.6	0.7	0.0	-0.1
GDP				
Nominal annual growth rate	6.9	-2.3	0.8	2.7
Real annual growth rate				
Nominal in US$ deflated by US CPI	7.6	-2.6	-0.3	-0.7
Volume	1.1	-0.8	-0.1	0.2
(share of episodes with value greater than median value, in percent)				
Imports				
Nominal annual growth rate	67	50	58	58
Real annual growth rate				
Nominal in US$ deflated by US CPI	67	50	58	50
Volume	83	42	67	50
Ratio to GDP annual change	67	67	58	50
Exports				
Nominal annual growth rate	50	42	50	50
Real annual growth rate				
Nominal in US$ deflated by US CPI	50	33	42	42
Volume	17	33	42	50
Ratio to GDP annual change	42	67	42	50
GDP				
Nominal annual growth rate	58	42	67	58
Real annual growth rate				
Nominal in US$ deflated by US CPI	58	33	50	50
Volume	67	33	50	50

Sources: IMF, *World Economic Outlook database*; and authors' calculations.
Note: Oil price shocks identified as years when the nominal U.S. dollar price of crude oil reaches a 3-year high. There have been 12 such years since 1970: 1973, 74, 79, 80, 90, 96, 2000, 04, 05, 06, 07, 08, during which real oil prices increased by an average of 46 percent. Volumes are computed as nominal variables deflated by the corresponding deflator (exports and imports deflator for exports and imports and GDP deflator for GDP).

Table 5. Dynamic Panel Regressions: Main Results

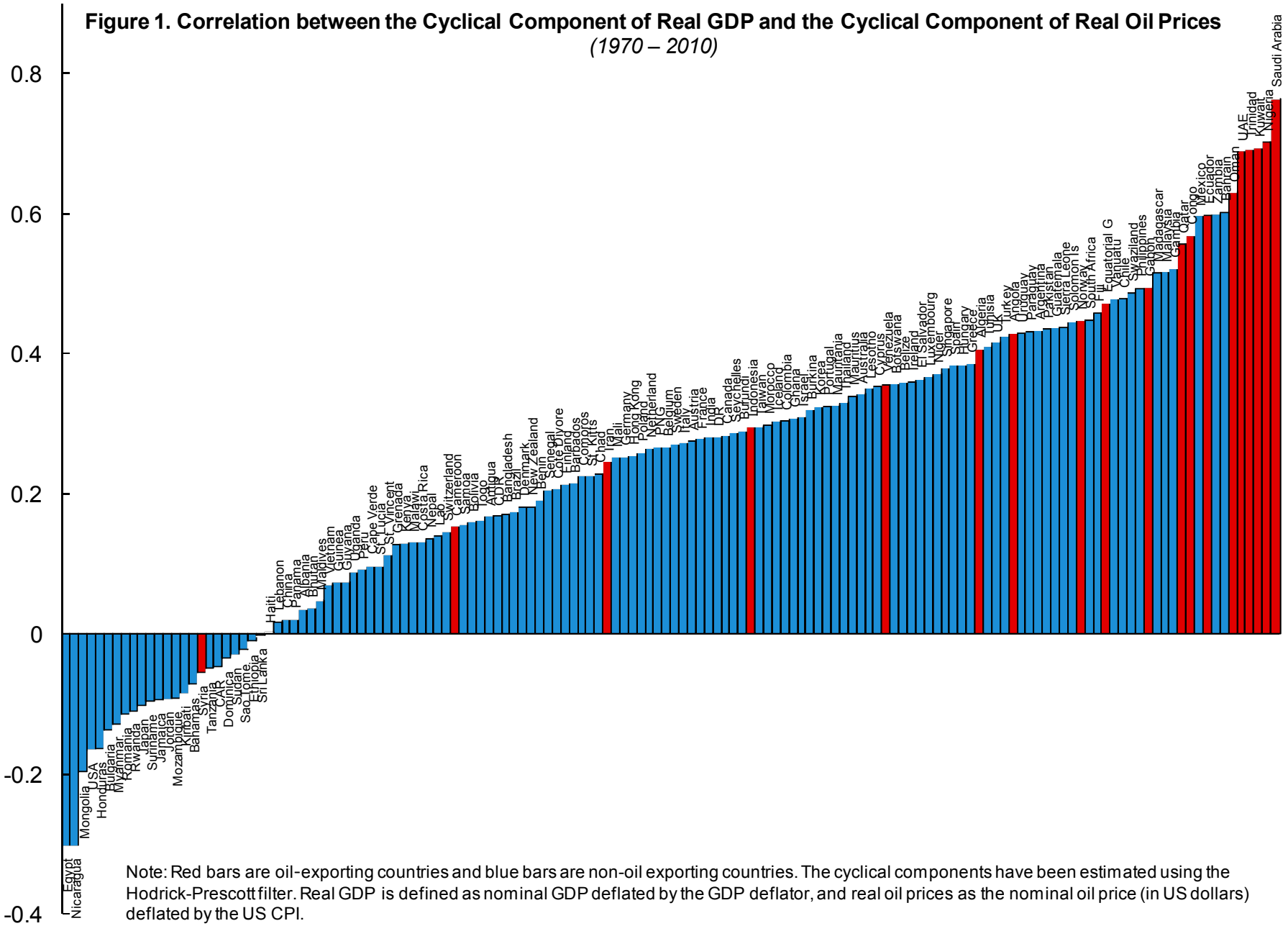
(Dependent variable: Real GDP)

			Oil importers						
							Average oil import to GDP ratio (in percent)		
	All countries	Oil exporters	All	OECD	Middle-income	Low-income	greater than 3 percent	greater than 4 percent	greater than 5 percent
Constant	-0.218 *	-0.877 *	-0.109	-0.216 *	-0.302	0.012	-0.210	-0.237	-0.215
	(0.112)	(0.477)	(0.106)	(0.118)	(0.231)	(0.150)	(0.146)	(0.209)	(0.290)
Dependent variable lagged									
Lag 1	0.746 ***	0.774 ***	0.731 ***	0.636 ***	0.694 ***	0.754 ***	0.727 ***	0.734 ***	0.686 ***
	(0.014)	(0.038)	(0.015)	(0.034)	(0.027)	(0.020)	(0.019)	(0.023)	(0.030)
Lag 2	-0.243 ***	-0.313 ***	-0.208 ***	-0.127 ***	-0.264 ***	-0.155 ***	-0.230 ***	-0.245 ***	-0.244 ***
	(0.017)	(0.047)	(0.019)	(0.048)	(0.033)	(0.026)	(0.024)	(0.029)	(0.037)
Lag 3	-0.066 ***	0.029	-0.108 ***	-0.162 ***	-0.102 ***	-0.120 ***	-0.095 ***	-0.091 ***	-0.102 ***
	(0.014)	(0.040)	(0.015)	(0.040)	(0.027)	(0.021)	(0.019)	(0.024)	(0.030)
World real GDP	0.580 ***	0.781 ***	0.546 ***	0.685 ***	0.702 ***	0.422 ***	0.564 ***	0.590 ***	0.625 ***
	(0.039)	(0.166)	(0.038)	(0.045)	(0.082)	(0.053)	(0.052)	(0.074)	(0.102)
Oil price	0.209 **	0.620 *	0.144 *	0.201 **	0.410 **	-0.005	0.277 **	0.362 **	0.400 *
	(0.086)	(0.366)	(0.082)	(0.091)	(0.177)	(0.115)	(0.112)	(0.160)	(0.222)
Oil price shock									
Lag 0	-0.359	-0.570	-0.358	0.275	-0.724	-0.389	-0.631 *	-1.170 **	-1.740 **
	(0.263)	(1.119)	(0.249)	(0.267)	(0.542)	(0.352)	(0.343)	(0.490)	(0.681)
Lag 1	-0.409 ***	-0.305	-0.433 ***	-0.306 **	-0.745 ***	-0.274 *	-0.517 ***	-0.710 ***	-0.850 ***
	(0.120)	(0.511)	(0.114)	(0.124)	(0.249)	(0.162)	(0.157)	(0.224)	(0.312)
Lag 2	0.229 *	1.420 ***	0.045	0.310 **	-0.383	0.187	-0.131	-0.254	-0.259
	(0.121)	(0.513)	(0.115)	(0.124)	(0.250)	(0.162)	(0.158)	(0.226)	(0.314)
Cross-sections	144	19	125	23	36	66	75	48	29
Total observations	5184	684	828	828	1296	2376	2700	1728	1044
R-squared	0.46	0.44	0.47	0.65	0.47	0.47	0.46	0.46	0.43

Sources: IMF, World Economic Outlook database; and authors' calculations.

Note: Unbalanced panel of annual data 1970-2010. Real GDP measured as cyclical component of series indexed to 100 in year 2000. Oil price is average price of crude deflated by U.S. CPI and indexed to 1 in year 2000. Oil price shock is the annual change in oil prices in years where oil prices reach a three-year high, expressed as a fraction. Figures show coefficients, with standard errors in parenthesis and "***", "**", and "*" indicating significance at, respectively, the 1, 5, and 10 percent level.

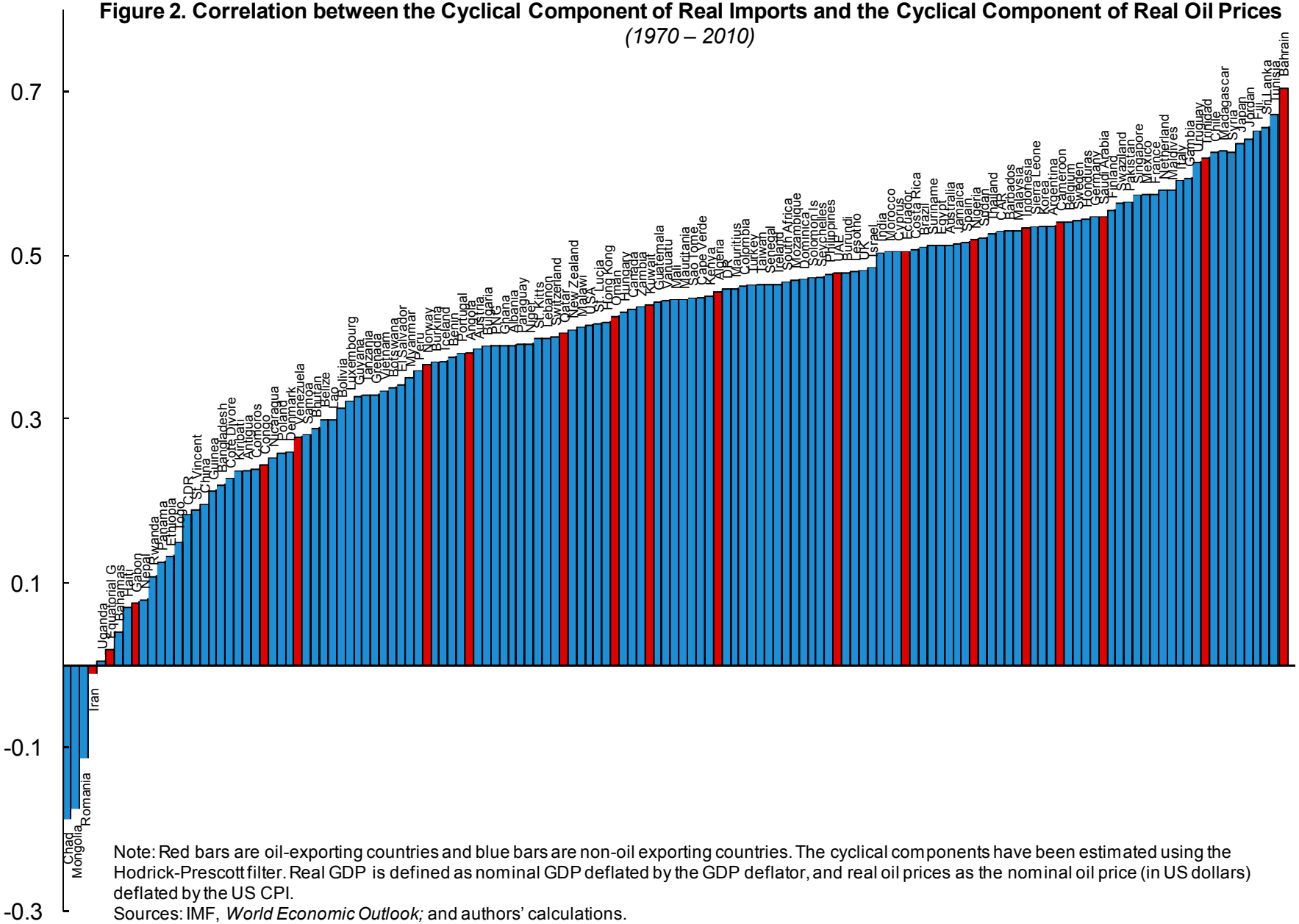
Figure 1. Correlation between the Cyclical Component of Real GDP and the Cyclical Component of Real Oil Prices
(1970 – 2010)



Note: Red bars are oil-exporting countries and blue bars are non-oil exporting countries. The cyclical components have been estimated using the Hodrick-Prescott filter. Real GDP is defined as nominal GDP deflated by the GDP deflator, and real oil prices as the nominal oil price (in US dollars) deflated by the US CPI.
Sources: IMF, *World Economic Outlook;* and authors' calculations.

Figure 2. Correlation between the Cyclical Component of Real Imports and the Cyclical Component of Real Oil Prices

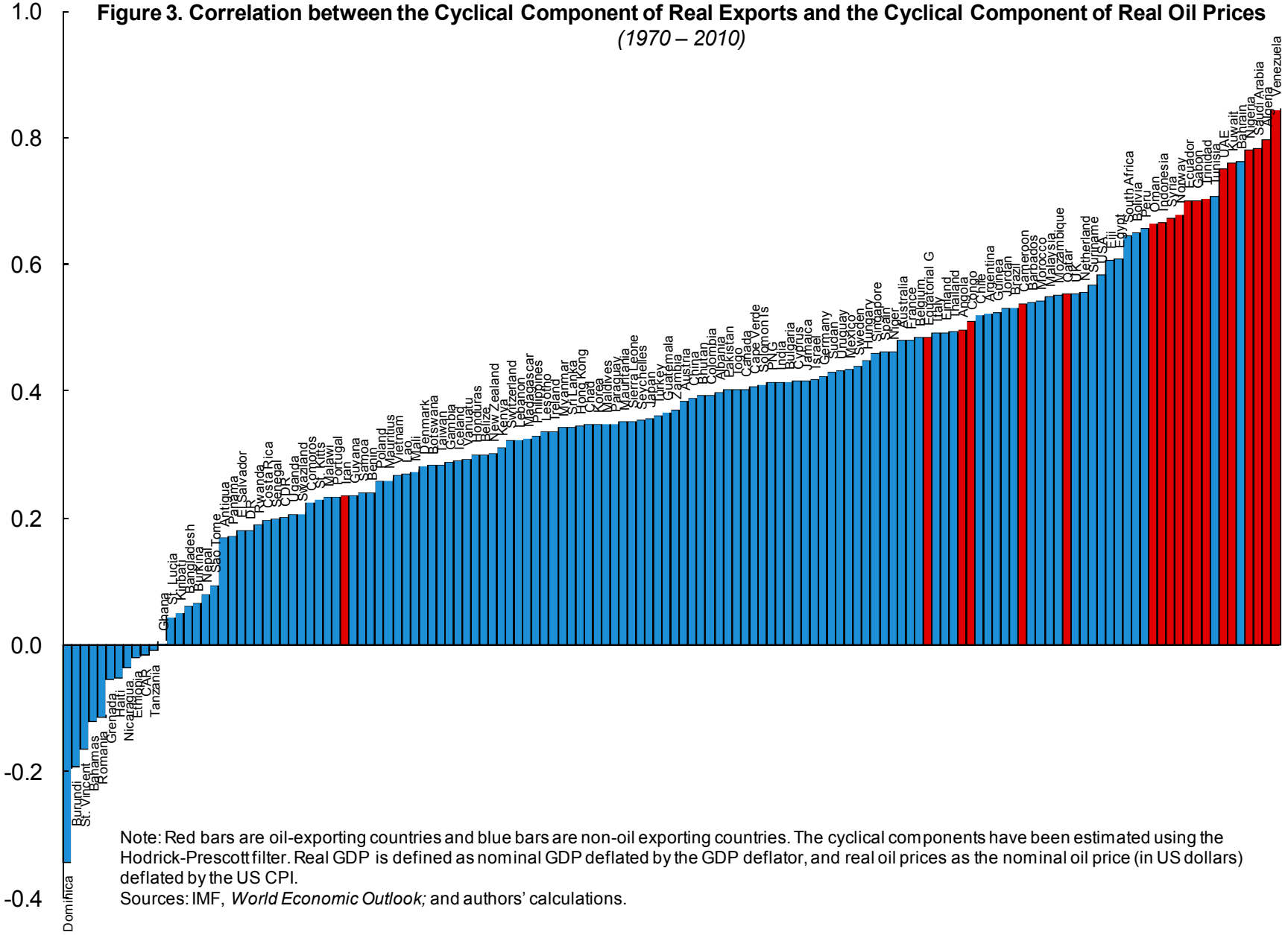
(1970 – 2010)



Note: Red bars are oil-exporting countries and blue bars are non-oil exporting countries. The cyclical components have been estimated using the Hodrick-Prescott filter. Real GDP is defined as nominal GDP deflated by the GDP deflator, and real oil prices as the nominal oil price (in US dollars) deflated by the US CPI.

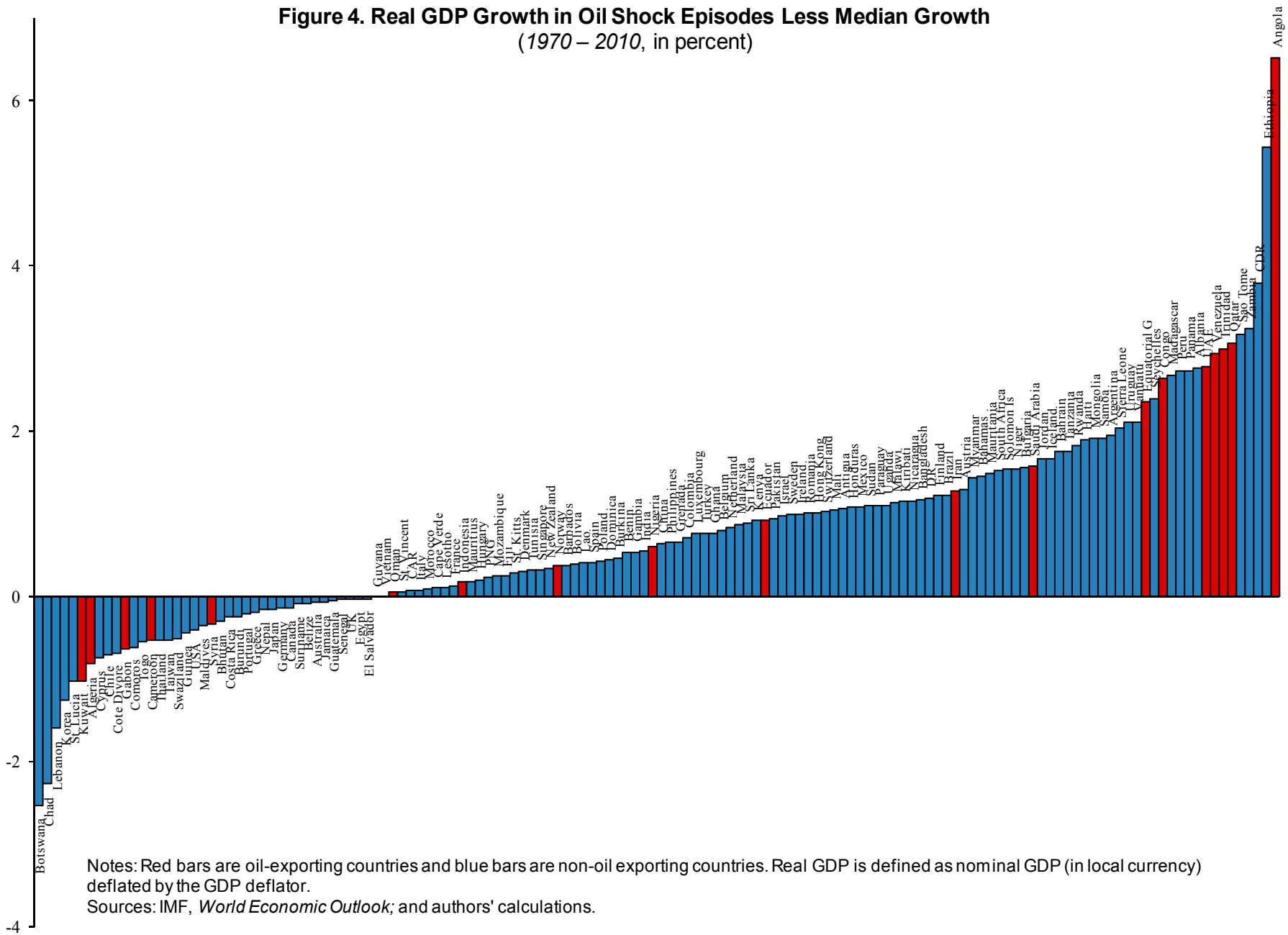
Sources: IMF, *World Economic Outlook;* and authors' calculations.

Figure 3. Correlation between the Cyclical Component of Real Exports and the Cyclical Component of Real Oil Prices
(1970 – 2010)



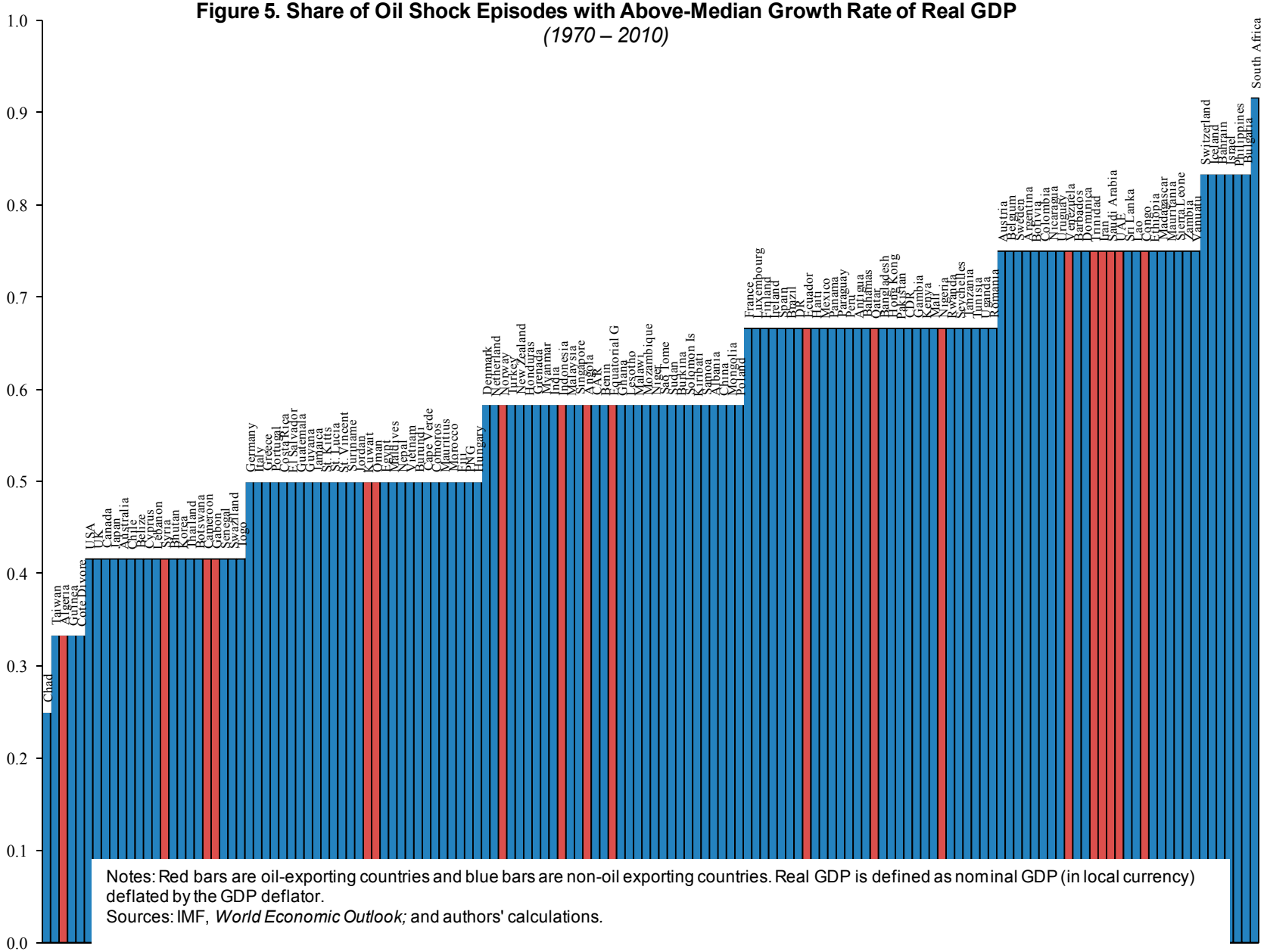
Note: Red bars are oil-exporting countries and blue bars are non-oil exporting countries. The cyclical components have been estimated using the Hodrick-Prescott filter. Real GDP is defined as nominal GDP deflated by the GDP deflator, and real oil prices as the nominal oil price (in US dollars) deflated by the US CPI.
Sources: IMF, *World Economic Outlook;* and authors' calculations.

Figure 4. Real GDP Growth in Oil Shock Episodes Less Median Growth
(*1970 – 2010*, in percent)



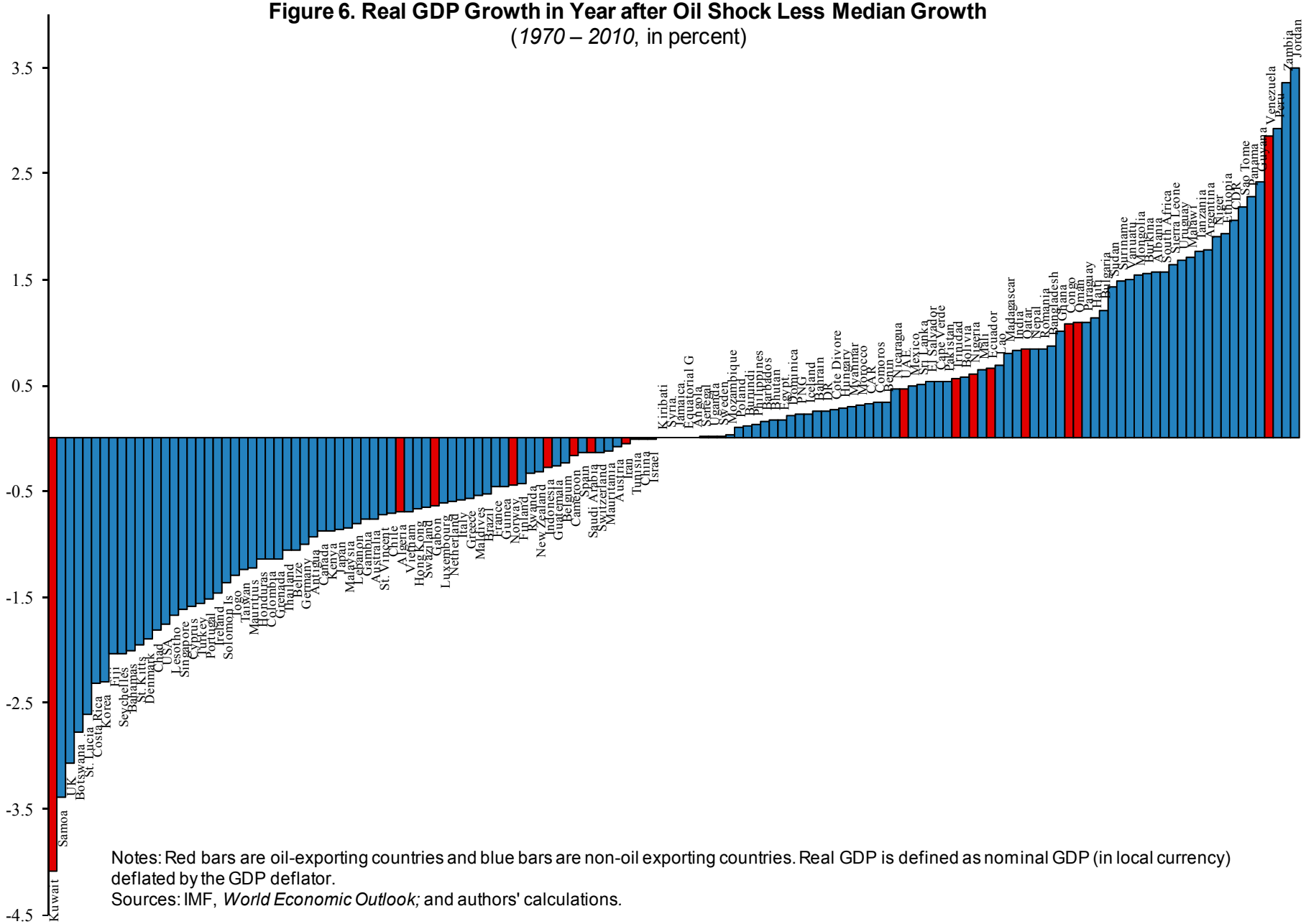
Notes: Red bars are oil-exporting countries and blue bars are non-oil exporting countries. Real GDP is defined as nominal GDP (in local currency) deflated by the GDP deflator.
Sources: IMF, *World Economic Outlook;* and authors' calculations.

Figure 5. Share of Oil Shock Episodes with Above-Median Growth Rate of Real GDP
(1970 – 2010)



Notes: Red bars are oil-exporting countries and blue bars are non-oil exporting countries. Real GDP is defined as nominal GDP (in local currency) deflated by the GDP deflator.
Sources: IMF, *World Economic Outlook;* and authors' calculations.

Figure 6. Real GDP Growth in Year after Oil Shock Less Median Growth
(*1970 – 2010*, in percent)



Notes: Red bars are oil-exporting countries and blue bars are non-oil exporting countries. Real GDP is defined as nominal GDP (in local currency) deflated by the GDP deflator.
Sources: IMF, *World Economic Outlook;* and authors' calculations.