

Oil Shocks and External Balances

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Abstract: This paper estimates the effects of demand and supply shocks in the global crude oil market on several measures of oil exporters' and oil importers' external balances, including the oil trade balance, the non-oil trade balance, the current account, capital gains, and changes in net foreign assets (NFA). First, we show that the effect of oil demand and supply shocks on the merchandise trade balance and the current account, which depending on the source of the shock can be large, depends critically on the response of the non-oil trade balance. Our results provide evidence of an intermediate degree of international financial integration. Second, we document the presence of large and systematic valuation effects in response to these shocks. Valuation effects overall tend to cushion the effect of oil demand and supply shocks on the NFA positions of oil exporters and oil importers. Third, we quantify the overall importance of oil-market specific demand and supply shocks for external balances.

JEL Codes: F32, F36, O16, O57, Q43

Key Words: Oil prices; external adjustment; oil demand; oil supply; international financial integration; valuation effects.

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1. Introduction

A large literature has investigated the macroeconomic impact of oil-price shocks, focusing in particular on the response of real economic growth and consumer price inflation in oil-importing countries (see, e.g., Barsky and Kilian 2004; Kilian 2008a; Hamilton 2008). A much smaller literature including, for example, Bruno and Sachs (1982), Ostry and Reinhart (1992), and Gavin (1990, 1992) has studied the impact of oil price shocks on external accounts. Recent developments in the crude oil market and the emergence of large global external imbalances have reignited the long-standing policy discussion about the role of oil prices in determining external balances (see, e.g., Rebucci and Spatafora 2006).

There is renewed interest in the question of how oil revenues will be recycled in the global economy, along with the recognition that the impact of oil price shocks may depend on their source. On the one hand, a concern in policy discussions is that oil price shocks have large and potentially harmful effects on external accounts, forcing countries to borrow from abroad to offset adverse terms-of-trade shocks. On the other hand, it is sometimes suggested that there is not enough international risk sharing. In that view, the ensuing imbalances may not be large enough to cushion the domestic impact of oil price shocks effectively. Thus, it is interesting from both a policy and a theoretical point of view to investigate and to quantify the impact of oil price shocks on external balances.

Our paper provides the most comprehensive analysis to date of the relationship between oil prices and external balances. We document the dynamic effects of oil demand and oil supply shocks on external balances of oil-exporting and oil-importing economies during 1975–2006. The paper also examines the changing importance of these shocks over time by means of historical decompositions, and it uses variance decompositions as a measure of the average importance of these shocks for external balances.

Our analysis departs from the existing literature in several dimensions. First, we not only control for reverse causality from global macroeconomic conditions to the real price of oil, but we also differentiate between alternative sources of the variation in the real price of oil. Our analysis illustrates the importance of distinguishing between oil price changes driven by crude oil supply shocks, by oil-market specific demand shocks and by innovations to the demand for all industrial commodities driven by the global business cycle.

Second, previous studies tended to focus exclusively on the trade balance and the current account. In this paper, we further differentiate between the effects of shocks in the crude oil market on the oil-trade balance and the non-oil trade balance, highlighting the role of the non-oil trade balance in offsetting oil trade deficits. Estimates of the response of the non-oil trade balance, to the extent that these shocks have purely transitory effects, shed light on the degree to which international financial markets are incomplete and thus provide a useful benchmark for the design of theoretical models of the transmission of oil demand and supply shocks under incomplete markets. We also consider the effects of such shocks on capital gains and losses on gross foreign assets and liabilities. The existence of such valuation effects in general has been documented by Gourinchas and Rey (2007a,b) for the United States and by Lane and Milesi-Ferretti (2007a) for other countries. In this paper, we address the complementary question of whether there are systematic valuation effects in response to oil demand and oil supply shocks that help financially integrated economies cope with oil trade imbalances.

Third, previous studies focused on selected oil-importing advanced economies. In contrast, we focus on broad aggregates of oil exporters and major oil importers. This approach allows us to interpret our empirical results in light of recent theoretical advances (i) in modeling oil demand and oil supply shocks in the two-country dynamic stochastic general equilibrium (DSGE) framework (see Bodenstein, Erceg, and Guerrieri 2008), and (ii) in modeling valuation effects in incomplete markets in the DSGE framework (see Ghironi, Lee and Rebucci 2007; Devereux and Sutherland 2008). Empirical evidence on the responses of external balances is especially important because theory puts few restrictions on these responses.

Our first result is that each of the three oil demand and oil supply shocks that we consider has different effects on external balances. For example, the effect of an oil supply disruption on the oil trade balance tends to be small, short-lived and statistically insignificant, consistent with the estimated response of the price of oil. In contrast, an unexpected increase in the demand for crude oil causes a persistent, large and statistically significant oil trade deficit. Similarly, the timing, magnitude, and even the direction of the response of other components of the current account may differ with the type of shock.

Our second result relates to the question of market completeness. Whereas the theoretical literature has tended to focus on the limiting cases of financial autarky or complete markets, our estimates of the responses of the non-oil trade balance provide evidence of considerable, but not

perfect international financial market integration.

The third set of results relates to the capital gains and losses triggered by oil demand and supply shocks. Using the Lane and Milesi-Ferretti (2007b) NFA data set, we document the presence of large and systematic valuation effects in response to these shocks for broad aggregates of oil importers and oil exporters. Valuation effects manifest themselves in capital gains or capital losses. Our analysis suggests that these capital gains and losses play an important role in explaining the dynamics of changes in NFA positions, making it necessary to consider the degree of international financial integration of a country and the composition of its foreign asset holdings and liabilities in predicting the effect of such shocks. We conclude that international financial integration has tended to cushion the effect of oil demand and supply shocks on the change in NFA positions of oil exporters and oil importers overall.

Our fourth set of results is about quantifying the importance of global business cycle demand shocks as well as oil-specific demand and supply shocks for external balances. We provide evidence, for example, that these shocks jointly account for 82% of the variation in oil exporters' changes in NFA (expressed as a share of GDP). Oil-market specific demand and supply shocks jointly account for about half of the variation, whereas demand shocks associated with the global business cycle account for an additional one third. For an aggregate of major oil importers the corresponding shares are lower, but still large.

The remainder of the paper is organized as follows. Section 2 motivates our focus on demand and supply shocks in the crude oil market and describes the econometric methodology used in this study. Section 3 discusses the data. Section 4 reviews the mechanisms by which shocks to oil demand and oil supply are expected to drive external balances. Section 5 reports the estimation results. Section 6 contains our conclusions.

2. Empirical Methodology

Theoretical models of the effect of oil price shocks on the economy in general (and on external accounts in particular) have typically been constructed under the premise that one can think of varying the price of crude oil, while holding all other variables in the model constant. In other words, oil prices are treated as exogenous with respect to the global economy. This premise is not credible (see, e.g., Barsky and Kilian 2002, 2004; Hamilton 2003). There are good theoretical reasons and there is strong empirical evidence that global macroeconomic fluctuations influence

the real price of crude oil (see Kilian 2008b,c,d). For example, it is widely accepted that a global business cycle expansion (as in recent years) tends to raise the real price of oil.¹ The fact that the same economic shocks that drive macroeconomic aggregates (and thus external accounts) also may drive the price of crude oil makes it impossible to separate cause and effect in studying the effect of higher oil prices on external accounts without a structural model of oil prices.

A second limitation of standard theoretical models is the implicit premise that the effect of an exogenous change in the price of crude oil will be the same, regardless of which demand or supply shocks in the oil market are responsible for this change. This premise is questionable. Since oil price shocks historically have been driven by varying combinations of oil demand and oil supply shocks, their effect on external aggregates is bound to be different from one period to the next. Indeed, this fact helps account for the apparent instability in the reduced form relationship between oil prices and the macroeconomy. Recent work by Kilian (2008d) and Kilian and Park (2008) has shown that the effects of demand and supply shocks in the crude oil market on U.S. macroeconomic aggregates are qualitatively and quantitatively different, depending on whether the oil price increase is driven by a booming world economy (resulting in high demand for all industrial commodities including crude oil), by a disruption of global crude oil production, or by shifts in precautionary demand for crude oil that reflect increased concerns about future oil supply shortfalls (also see Alquist and Kilian 2008). It is quite natural to expect similar differences in the effect of these shocks on external accounts. In this section, we outline an empirical methodology that addresses both of these concerns and allows us to assess empirically the effect of oil demand and oil supply shocks on external balances.

Our empirical approach involves two main steps. The first step is to trace fluctuations in the real price of crude oil to the underlying demand and supply shocks in the crude oil market. The second step is to assess empirically the responses of external accounts of selected countries and country groups to the demand and supply shocks in the crude oil market identified in the first step. To the extent that the latter shocks are predetermined with respect to macroeconomic aggregates and external accounts, standard regression methods can be used to estimate the responses of external accounts by country or region and to determine the extent to which historical fluctuations in external accounts were driven by the cumulative effect of specific

¹ As noted by Hamilton (2008), “it is clear ... that demand increases rather than supply reductions have been the primary factor driving oil prices over the last several years.”

demand and supply shocks in the crude oil market.

2.1. Construction of the Demand and Supply Shocks in the Crude Oil Market

Our approach closely follows the identification strategy of Kilian (2008d).² We estimate a structural VAR model based on monthly data for the vector time series z_t , consisting of the percent change in global crude oil production, a (suitably detrended) measure of global real economic activity in industrial commodity markets, and the real price of crude oil.³ The VAR model allows for two years worth of lags. The structural VAR representation of the model is

$$(1) \quad A_0 z_t = \alpha + \sum_{i=1}^{24} A_i z_{t-i} + \varepsilon_t,$$

where ε_t denotes the vector of serially and mutually uncorrelated structural innovations. The structural innovations are derived by imposing exclusion restrictions on A_0^{-1} in $e_t = A_0^{-1} \varepsilon_t$. We attribute fluctuations in the real price of oil to three structural shocks: ε_{1t} denotes shocks to the global supply of crude oil (henceforth “oil supply shock”); ε_{2t} captures shocks to the global demand for all industrial commodities (including crude oil) that are driven by global real economic activity (“aggregate demand shock”)⁴; and ε_{3t} denotes an oil-market specific demand shock. The latter shock is designed to capture shifts in precautionary demand for crude oil that reflect increased concerns about future oil supply shortfalls that are by construction orthogonal to the other shocks (“oil-specific demand shock”), although there are other possible interpretations (see Kilian 2008d).

We assume that (1) oil producers are free to respond to lagged values of oil prices, real activity, and oil production in setting oil supply, but will not respond to oil demand shocks

² Analogous approaches have been employed in Kilian and Park (2008) for studying the effect of oil demand and oil supply shocks on U.S. stock markets and in Kilian (2008e) for studying the relationship between the U.S. retail gasoline market and the global crude oil market.

³ The term real economic activity in this paper is understood to refer to real economic activity that affects industrial commodity markets rather than the usual broader concept of real economic activity underlying world real GDP or industrial output. This distinction is necessary because an increase in value added in the service sector, for example, is likely to have a very different effect on global demand for industrial commodities than an increase in manufacturing. The index of global real economic activity in industrial commodity markets is constructed from representative single voyage freight rates collected by Drewry Shipping Consultants Ltd. for various bulk dry cargoes such as coal, iron ore, fertilizer, and scrap metal. For a full discussion of the rationale and construction of this index see Kilian (2008d). Unlike alternative measures of monthly global real activity such as indices of OECD industrial production, this index captures the recent surge in demand for industrial commodities from emerging economies such as China and India.

⁴ The term “aggregate demand” as used here differs from the concept of aggregate demand in macroeconomics textbooks. Rather it refers to shifts in the demand for *all* industrial commodities reflecting the global business cycle.

within the same month, given the costs of adjusting oil production and the uncertainty about the state of the crude oil market; (2) that increases in the real price of oil driven by demand shocks that are specific to the oil market will not lower global real economic activity in industrial commodity markets within the month; and (3) that innovations to the real price of oil that cannot be explained by oil supply shocks or aggregate demand shocks must be demand shocks that are specific to the oil market. These assumptions imply a recursively identified model of the form:

$$e_t \equiv \begin{pmatrix} e_{1t}^{\Delta prod} \\ e_{2t}^{rea} \\ e_{3t}^{rpo} \end{pmatrix} = \begin{bmatrix} a_{11} & 0 & 0 \\ a_{21} & a_{22} & 0 \\ a_{31} & a_{32} & a_{33} \end{bmatrix} \begin{pmatrix} \varepsilon_{1t}^{oil\ supply\ shock} \\ \varepsilon_{2t}^{aggregate\ demand\ shock} \\ \varepsilon_{3t}^{oil-specific\ demand\ shock} \end{pmatrix}.$$

This structural model postulates that that real price of oil (conditional on lagged values of all variables) is determined by the intersection of the demand curve for crude oil and the supply curve of crude oil. Oil demand shocks do not shift the oil supply curve, but move the demand curve along the supply curve, causing the real price of oil to change. The model also allows for oil supply shocks (say an unexpected oil supply disruption caused by a war or driven by an exogenous political decision) to move the vertical supply curve along the downward sloping demand curve, again causing the price of oil to change. Thus, all three shocks are allowed to affect the real price of oil within a given month. The model further imposes that the shifts in the real price of oil triggered by oil-market specific demand shocks will not affect global aggregate demand within the same month. This assumption is consistent with the sluggish response of real aggregates to shocks in oil markets documented in the related literature.

The assumption of a vertical short-run supply curve of crude oil is consistent with anecdotal evidence. Global oil supply undoubtedly responds to oil demand shocks. The assumption of a one-month delay in that response is consistent with the observation that oil producers only infrequently update forecasts of oil demand. The reason for the slow response of oil supply to oil demand shocks is that changing oil supply is costly. Oil producers will respond to a change in trend demand, once recognized, but, in practice, determining a change in trend requires a long time span of data. When in doubt, oil producers will wait until enough information has accumulated rather than rush to changing supply immediately in response to

news about the economy.⁵

The response of the real price of oil to the three structural shocks ε_{jt} , $j = 1, 2, 3$, is reported in Figure 1. There are striking differences in the timing, persistence, and magnitude of the responses depending on the source of the shock, although all three responses are ultimately transitory. An unanticipated increase in oil-market specific demand (such as an increase in precautionary demand for oil) causes an immediate and persistent increase in the real price of oil characterized by overshooting; an unanticipated increase in aggregate demand for all industrial commodities causes a delayed, but sustained increase in the real price of oil; and an unanticipated oil supply disruption causes a short-lived increase in the real price of oil within the first year.

In this paper, we are interested in assessing the effect of these crude oil demand and crude oil supply shocks on external accounts. Whereas the shocks implied by the VAR model are measured at monthly frequency, international data on external accounts for most countries are available only at annual frequency. Following a similar procedure in Kilian (2008d), we deal with this problem by constructing measures of the annual shocks as averages of the monthly structural innovations for each year:

$$\hat{\zeta}_{jt} = \frac{1}{12} \sum_{i=1}^{12} \hat{\varepsilon}_{j,t,i}, \quad j = 1, \dots, 3,$$

where $\hat{\varepsilon}_{j,t,i}$ refers to the estimated residual for the j th structural shock in the i th month of the t th year of the sample. Although data for z_t are available as far back as 1973, we lose two years worth of observations in estimating the VAR model. Thus, the resulting annual shock series extends back only as far as 1975. Figure 2 plots $\hat{\zeta}_{jt}$, $j = 1, 2, 3$. The pattern of shocks in the late 1970s and in the 1980s is consistent with additional evidence about the genesis of the second oil crisis presented in Barsky and Kilian (2002, 2004). Figure 2 illustrates that oil price shocks are best thought of as composites of underlying demand and supply shocks. For example, the oil price shock of 1979/80 is the result of the superimposition of three large positive aggregate

⁵ This assumption is consistent with anecdotal evidence from the early 1980s that Saudi Arabia was slow to adjust to the realities of reduced demand during the Volcker recession. Moreover, there is no evidence that oil producers are adjusting supply within the same month in response to announcements about global macro developments. The few historical instances in which countries such as Saudi Arabia moved quickly in response to news events were reactions to adverse oil supply shocks (such as the Iranian Revolution), not examples of responses to shifts in the demand for oil.

demand shocks in 1978, 1979, and 1980, a one-time spike in oil-specific demand in 1979 (at the time of the Iranian Revolution, the Iranian hostage crisis and the Soviet invasion of Afghanistan) and an oil supply shock in 1980 (but interestingly not in 1979, as discussed in Kilian 2008c,d).

2.2. Estimation of the Dynamic Effects

Let y_t denote a stationary macroeconomic aggregate of interest such as the share of the trade balance in GDP. We are interested in estimating the response of y_t to demand and supply shocks in the crude oil market. We treat the shocks $\hat{\zeta}_{jt}$, $j = 1, \dots, 3$, as predetermined with respect to y_t . Predeterminedness rules out feedback from y_t to the shocks $\hat{\zeta}_{jt}$, $j = 1, \dots, 3$, within a given year t .⁶ This assumption allows us to examine their dynamic effects on the dependent variable based on regressions of the form:

$$(2) \quad y_t = \delta_j + \sum_{i=0}^h \psi_{ij} \hat{\zeta}_{j,t-i} + u_{jt}, \quad j = 1, \dots, 3$$

where u_{jt} is a potentially serially correlated error, and $\hat{\zeta}_{jt}$ is a serially uncorrelated shock. The parameter h is chosen to coincide with the maximum horizon of the impulse response function to be computed. In practice, we set the maximum horizon of the impulse responses to five years.⁷ By definition the impulse response is $dy_{t+1}/d\hat{\zeta}_{j,t}$. Differentiation yields that $dy_t/d\hat{\zeta}_{j,t-i} = \psi_{ij}$. Under stationarity, it follows that $dy_t/d\hat{\zeta}_{j,t-i} = dy_{t+i}/d\hat{\zeta}_{j,t} = \psi_{ij}$.

Regression model (2) allows consistent estimation of the impulse responses under minimal assumptions. Our equation-by-equation approach is built on the premise that the shock series $\hat{\zeta}_{jt}$, $j = 1, \dots, 3$, are mutually uncorrelated. Whereas the structural VAR residuals $\hat{\varepsilon}_{jt}$, $j = 1, \dots, 3$, are orthogonal by construction, the annual shocks $\hat{\zeta}_{jt}$, $j = 1, \dots, 3$, which have been obtained by aggregating over time, need not be orthogonal, but their correlation is very low in our application below, ranging from -0.11 to 0.07, so not much is lost by treating these shocks as orthogonal.

⁶ In contrast, strict exogeneity imposes in addition Granger non-causality from y_t to $\hat{\zeta}_{jt}$. For further discussion see Cooley and LeRoy (1985). Pre-determinedness and strict exogeneity in our regression framework correspond to the notion of weak and strong exogeneity.

⁷ Given that oil demand may adjust very slowly to higher oil prices, It would be desirable to know how much external balances adjust at much longer horizons, but econometric answers to that question are not feasible on the basis of the short time span of data currently available.

We also investigated some alternative regression approaches. One alternative approach would have been to estimate model (2) including current and lagged values of all shocks. That approach uses the same identifying assumptions as model (2), but would have been far less parsimonious. Another approach would have been to fit a recursively identified VAR model to $(\hat{\zeta}_{1t} \hat{\zeta}_{2t} \hat{\zeta}_{3t} y_t)'$ with a sufficiently high lag order. That more restrictive regression approach is practically feasible, but many of the response estimates are strongly counterintuitive and the estimation results are highly sensitive to the lag structure, suggesting that the model structure is rejected by the data or – more likely – that there is a serious overfitting problem. A third alternative would have been to add lagged dependent variables as regressors in the model (2). The latter specification would have required strict exogeneity of $\hat{\zeta}_{jt}$ with respect to y_t , which is not a viable assumption in our context (see Kilian 2008b,c,d). For these reasons, we report results based on the parsimonious equation-by-equation approach based on model (2).

3. Data

Our analysis focuses on two broad aggregates of countries: *oil exporters* and *major oil importers*. A country is classified as an *oil exporter* if its average share of fuel exports in total exports during 1970-2005 is at least 20 percent. Fuel exports include petroleum products, natural gas and coal.⁸ We exclude Canada and the U.K. because these countries are likely to behave differently from both oil-importing advanced economies and from major oil exporters. Both countries have diversified export structures with fuel shares of less than 20 percent, but their oil exports are large in absolute value during the sample period. In contrast, the oil export share of Norway is high enough for the country to qualify as a major oil exporter. *Major oil importers* include the United States, Japan and the Euro area. The Euro area for the purpose of the paper includes 12 high-income oil-importing European countries.⁹ In additional sensitivity analysis we extended the sample of oil importing economies to include middle-income countries. The results are very similar and are omitted to conserve space.

⁸ The list of major oil exporters includes Algeria, Angola, Azerbaijan, Bahrain, Brunei, Congo (Rep. of), Ecuador, Gabon, Indonesia, Iran, Kazakhstan, Kuwait, Libya, Mexico, Nigeria, Norway, Oman, Qatar, Russia, Saudi Arabia, Syria, Trinidad and Tobago, Turkmenistan, the United Arab Emirates, Venezuela, and Yemen.

⁹ The Euro area includes Austria, Belgium, Finland, France, Germany, Greece, Ireland, Italy, Luxembourg, the Netherlands, Portugal, and Spain.

In the empirical analysis we consider six different measures of external balance. The specific measures of external balance used are:

- Change in Net Foreign Assets \equiv Current Account + Capital Gains
- Current Account \equiv Merchandise Trade Balance + Service Trade Balance + Income Balance
 - Merchandise Trade Balance \equiv Oil Trade Balance + Non-Oil Merchandise Trade Balance
 - Oil Trade Balance
 - Non-Oil Merchandise Trade Balance
 - Capital Gains on Gross Foreign Assets and Liabilities.

In what follows, the *trade balance* should be understood to refer to the merchandise trade balance. The trade balance does not include trade in services because of data availability and concerns about the poor quality of trade data on services. For the same reasons, we also exclude the income balance, whose response, in any case, would be difficult to interpret without further knowledge of countries' asset and liability positions. A more detailed description of these aggregates is provided in the data appendix of our working paper. The NFA data are from Lane and Milesi-Ferretti (2007b). All other data (including the trade balance, current account, and GDP data) are from the IMF's *World Economic Outlook* database.

All external accounts are expressed in current dollars. As is conventional, all external accounts are normalized by nominal GDP for the empirical analysis. Shares in GDP for the groups are not computed by averaging shares across countries, but by adding external accounts across countries and normalizing them by the sum of GDP in current dollars of the same countries. This procedure has the advantage of netting out intra-group imbalances.

4. Theoretical Background

A number of theoretical studies have examined the impact of oil price shocks on external accounts, holding everything else constant.¹⁰ While this earlier literature provides a useful framework for thinking about the effects of an exogenous shift in oil prices, it is of limited use for our purposes because (1) it does not allow for endogenous responses of the real price of oil to the global economy, (2) because it does not distinguish between demand and supply shocks in

¹⁰ Sen (1994) provides an overview of various channels of transmission.

the crude oil market, and (3) because it does not take into account the degree of international financial integration and the international portfolio structure of oil importing and oil exporting economies.

In this paper, we build on recent advances in the theoretical literature that incorporate the distinction between demand and supply shocks in the global crude oil market that is central to our analysis. The theoretical analysis of the trade account most closely related to our empirical analysis is Bodenstein et al. (2008), who in turn build on the open economy model of Backus and Crucini (1998). Our analysis also is guided by recent empirical and theoretical work that stresses the role of valuation effects in the external adjustment of economies (see, e.g., Lane and Milesi-Ferretti 2007a; Gourinchas and Rey 2007a,b; Ghironi et al. 2007; Devereux and Sutherland 2008). Whereas the traditional “trade” (or macroeconomic) channel of adjustment to external shocks works through changes in the quantities and prices of goods exported and imported and is reflected in the response of the trade accounts, the “financial” (or valuation) channel of adjustment stressed in the recent literature works through changes in total asset return differentials and is reflected in income flows and in valuation changes, conditional on an economy’s initial gross foreign asset and foreign liability position. Because of the limitations of the income data discussed above, we concentrate on the capital gains and losses in this paper.

4.1. The Trade Channel

Economic theory suggests that the three demand and supply shocks in the global crude oil market have different effects on the oil trade balance and the non-oil trade balance.

Oil supply shocks

Bodenstein et al. model suggests that an exogenous oil supply disruption causes a temporary increase in the real price of oil, consistent with the estimated response of the real price of oil in Figure 1. For a given oil supply shock, the smaller the oil share in production and the larger the elasticity of substitution between oil and other factors of production, the flatter the overall response of the real price of oil will be. Under incomplete markets, an oil supply disruption generates an oil trade deficit in the oil-importing country, the magnitude and persistence of which depends on the response of the real price of oil. An oil supply disruption also generates a non-oil trade surplus, the magnitude of which depends on the extent to which markets are incomplete. In contrast, under complete markets, the non-oil trade balance of oil importers

should remain unaffected by oil supply disruptions. The response of the oil-exporting economy will be the exact mirror image of that of the oil-importing economy by construction.

Oil-market specific demand shocks

The effects of oil-market specific demand shocks (such as a precautionary demand shock) on the real price of oil and on trade flows are qualitatively the same as in the case of oil supply shocks. The key difference is that such shocks may have more immediate, larger and more persistent effects on the real price of oil, as shown in Figure 1, and therefore are associated with larger and more persistent oil trade and non-oil trade responses.

Aggregate demand shocks

Aggregate demand shocks are defined as demand shocks that affect all industrial commodities across the board. For example, a productivity shock in oil-importing countries would raise demand not only for crude oil, but for all other industrial commodities. Such aggregate demand shocks in the data are associated with a hump-shaped response of the real price of oil (see Figure 1). Aggregate demand shocks are different from other oil demand or oil supply shocks from a theoretical perspective. The response of the non-oil trade balance to an unanticipated increase in global aggregate demand depends on two opposing effects. On the one hand, such a shock represents a short-run stimulus for the oil-importing economy (independently of the oil share), which will tend to cause a non-oil trade deficit. On the other hand, it has adverse consequences for oil-importing economies in that it raises the price of oil, causing an oil trade deficit and hence a non-oil trade surplus under incomplete markets. Which of these two effects dominates is an empirical question. Related research by Kilian (2008d) and Kilian and Park (2008) suggests that within the first year of such a shock, the stimulating effect on the U.S. economy dominates, whereas subsequently the adverse effect associated with higher oil prices does. Thus, theory predicts an oil trade deficit, but is consistent with either a non-oil trade surplus or a non-oil trade deficit. Hence, the response of the non-oil trade balance to an aggregate demand shock has no immediate implications for the debate over incomplete versus complete markets.

4.2. The Valuation Channel

The valuation channel of adjustment relies on changes in asset prices in response to oil demand and oil supply shocks. The magnitude and the nature of these capital gains and losses depends on the size of the initial gross foreign asset holdings and liabilities of oil importers and exporters, as

well as their precise composition by financial instrument and currency.¹¹ Standard diversification arguments suggest that oil exporters should hold some of their wealth in the form of assets in oil importing economies (and vice versa). This diversification of asset holdings plays an important role. Under the additional assumption that an increase in the price of oil all else equal will cause profits and asset prices to increase in the oil-exporting economy (and to fall in the oil-importing economy), some of the increased wealth associated with higher oil prices will be transferred from oil exporters to oil importers. Thus, positive oil-specific demand shocks and negative oil supply shocks should be associated with a temporary capital loss in oil exporting countries (and a corresponding capital gain in the rest of the world). In the long-run, asset prices return to their steady state level and the valuation channel vanishes. Of course, as discussed earlier, aggregate demand shocks have additional effects not operating through the real price of oil, which may temper or reverse the ensuing capital gains and losses.

This simple prediction of a capital loss at least in response to negative oil supply shocks and positive oil-specific demand shocks ignores likely asymmetries in oil exporters' and oil importers' gross asset and liability positions. Given the relative weight of oil exporters and oil importers in world GDP (about 10% and 90%, respectively, in PPP terms), one would expect that the share of oil exporters' asset holdings in the total asset holdings of oil importing economies must be rather small, whereas that of oil importers in the total asset holdings of oil exporting economies may be much larger. This reasoning suggests that the valuation effect should be larger for oil exporters than for oil importers, all else equal.¹² Even this prediction, however, ignores the important role of relative exchange rate adjustments triggered by oil demand and oil supply shock (also see the related evidence in Lane and Milesi-Ferretti 2007a). Thus, one would not

¹¹ Ghironi et al. (2007) and Devereux and Sutherland (2008) illustrate the workings of the valuation channel in a standard two-country DSGE model with incomplete financial markets and a symmetric configuration of gross foreign assets and liabilities.

¹² In the absence of detailed portfolio data for oil exporting economies it is difficult to assess the empirical content of this statement. If, however, we are willing to assume that oil exporters do not hold foreign assets in other oil exporting economies (because those assets do not allow diversification), we can compute aggregate gross foreign asset and liabilities for the aggregate of oil exporters defined earlier based on the data set of Lane and Milesi-Ferretti (2007b). These data show that oil exporters on average held foreign assets valued at about 60% of their GDP over the sample period, compared with foreign liabilities of about 50% of GDP. For individual countries, we find greater disparities. The data show that Saudi Arabia, for example, has foreign assets amounting to 101% of Saudi GDP on average over the sample period, but Saudi foreign liabilities are only 26% of GDP on average. These patterns are consistent with widespread anecdotal evidence of the recycling of oil revenues in the form of foreign asset acquisitions and support the hypothesis that oil importers' capital gains should be smaller than oil exporters' capital losses.

expect the stylized bilateral and symmetric model to generate accurate predictions for specific oil-importing economies..

5. Estimation Results

5.1. Impulse responses

The responses of external balances to oil demand and supply shocks can be constructed from regression model (2).¹³ Figures 3 and 4 show the estimated responses of each measure of external balance by type of shock. All responses have been normalized such that a given shock will imply an increase in the real price of oil. The external balances are expressed as a share of GDP. The one-standard error bands for the impulse responses based on model (2) are constructed using a block bootstrap method that allows for serially correlated error terms (see Berkowitz, Birgean and Kilian 1999).

5.1.1. Oil Exporters

The aggregate of oil exporters in Figure 3 is of particular interest because the external accounts for the aggregate of oil exporters by construction are the mirror image of the external accounts of the rest of the world. For example, a surplus for oil exporters in Figure 3 is indicative of a deficit for the rest of the world by construction. Thus, the results in Figure 3 lend themselves to being interpreted in light of the predictions of two-country DSGE models. As predicted by theory, oil demand and oil supply shocks have different implications for the timing, magnitude and sign of the response of external balances.¹⁴

¹³ That model treats $\hat{\zeta}_{jt}$, $j = 1, \dots, 3$, as predetermined with respect to the dependent variable. Although the assumption of predeterminedness is not testable, its plausibility may be judged based on the correlation of $\hat{\zeta}_{jt}$, $j = 1, 2$, with autoregressive innovations for U.S. external balances (expressed as a share of GDP). Clearly, the United States is the economy for which the assumption of predetermined external shocks is most likely to be invalid, given the overall size of the U.S. economy and its disproportionate contribution to the world economy. It can be shown, however, that innovations to the U.S. dependent variables are not very highly correlated with demand and supply shocks in the crude oil market at annual frequency, with the exception of the oil trade balance (which is highly negatively correlated with oil-specific demand shocks for the obvious reason that oil-market specific demand shocks raise the price of oil immediately causing the oil trade balance to deteriorate on impact). The low correlation with the global aggregate demand shock, in particular, dispels concerns that positive innovations to domestic real economic activity (reflected in a deterioration of the current account as a share of GDP) may drive aggregate demand innovations in global commodity markets. If there were such a causal link within the year, one would expect to see a large negative correlation instead. Similarly, oil supply disruptions would be associated with large positive correlations. The actual correlations are quite small in most cases and often of the opposite sign. While not dispositive, these results are consistent with the maintained assumption of predeterminedness.

¹⁴ In the interest of conserving space we only report results for a broadly defined set of oil exporting economies. Qualitatively similar results were obtained for the subset of OPEC oil exporters.

Oil supply shock

Figure 3 shows an immediate, but short-lived and statistically insignificant oil trade surplus in oil-exporting countries. Consistent with the evidence in Figure 1, the oil trade surplus is largest on impact (defined as year 0 in Figure 3). The non-oil trade balances shows little response initially followed by a marginally significant surplus three years later that is not predicted by the Bodenstein et al. model. The net effect on the merchandise trade balance and current account is an initial statistically insignificant surplus driven by the oil trade balance, followed by a return to balance in year 1 and 2. The statistically significant trade surplus in year 4 is driven by the unexpected response of the non-oil trade balance described above.

The last two columns of Figure 3 focus on the capital account.¹⁵ Oil exporters as a group experience a statistically significant short-run capital loss, consistent with the implications of the theoretical analysis in Ghironi et al. (2007) and Devereux and Sutherland (2007). The capital loss within the first year offsets the current account surplus. As a result, there is no change in NFA positions. Subsequent capital losses are only partially statistically significant (for example at horizons 3 and 4, but not at horizon 5), while changes in NFA are generally not statistically significant.

Oil-market specific demand shock

Oil-specific demand shocks cause an immediate, highly significant and persistent oil trade surplus. The oil trade surplus peaks in year 1 and declines only slowly over time. It coincides with a persistent and partially significant non-oil trade deficit, suggesting a considerable degree of international financial integration. The net effect on the merchandise trade balance and current account is a highly significant temporary surplus. At the same time, oil exporters experience persistent and partially statistically significant capital losses in the first four years, resulting in a statistically significant accumulation of net foreign assets in years 0 and 1. The NFA accumulation is smaller than the current account surplus. Thereafter, the change in NFA is statistically indistinguishable from zero. As in the case of oil supply shocks, the capital gains response cushions the effect of the current account on the change in NFA, consistent with the predictions of the symmetric DSGE model of valuation effects under incomplete markets.

¹⁵ Although capital gains may be inferred from comparing the responses of the current account and of changes in NFA, we compute separate responses for capital gains. This facilitates the construction of confidence intervals for the response of capital gains.

Aggregate demand shock

The analysis of the responses to aggregate demand shocks is complicated by the fact that we cannot think of the change in the real price of oil as occurring in isolation. Hence, economic theory has no clear implications for the response of the non-oil trade balance in general. Figure 3 shows that a positive aggregate-demand shock causes a highly significant oil trade surplus in oil-exporting economies. The response is hump-shaped and peaks in year 2. At the same time, the non-oil trade balances goes into deficit starting in year 1, but the non-oil trade deficit is only partially statistically significant. The net effect on the merchandise trade balance and current account is a temporary surplus that is statistically significant in years 2 and 3. The non-oil trade deficit is associated with persistent, although mostly statistically insignificant, capital losses. Although the pattern of net foreign asset accumulation largely mirrors the current account, the capital losses systematically reduce the accumulation of net foreign assets.

Implications

Since the responses in Figure 3 by construction are measured with respect to the rest of the world, any deficit (surplus) in the response of oil exporters may be interpreted as surplus (deficit) from the point of the view of the rest of the world. This allows us to relate our empirical findings to the predictions of two-country DSGE models. Figure 3 provides two main insights. First, we consistently find that the trade channel of the transmission of these shocks, as reflected in the non-oil trade balance, plays an important role, suggesting that international financial markets are incomplete. The limiting case of financial autarky is clearly at odds with this evidence, as is the case of complete markets. In the former case, we would expect the oil trade deficit to be exactly offset by a non-oil trade surplus such that the trade balance is zero. In the latter case, we would expect no response of the non-oil trade balance. Both implications are rejected by the data.

Second, in addition to the trade channel, valuation effects in the form of capital gains and losses on gross foreign assets and liabilities constitute another important channel of transmission. Valuation effects dampen, in particular, the impact of oil demand shocks on NFA positions. This result is consistent with the theoretical analysis of valuation effects under incomplete markets in Ghironi et al. (2007) and in Devereux and Sutherland (2008) which suggests that valuation effects facilitate risk sharing between oil exporters and oil importers.

Documenting the existence of a valuation channel of the transmission of oil demand and oil supply shocks also is important for the policy debate regarding the harmfulness of the current

account imbalances caused by oil demand and supply shocks. To the extent that part of the external adjustment to these shocks operates through valuation effects, there is less need for short-run domestic macroeconomic adjustments. The reason is that international financial integration allows risk sharing between oil exporters and oil importers. Ownership of oil assets by residents of oil-importing countries provides some insurance against oil price increases. In turn, ownership of foreign assets by oil producers provides some insurance against falling oil prices for oil-exporting economies. Thus international portfolio diversification helps cushion the impact of oil demand and oil supply shocks. The extent to which this cushion is effective is evident in Figure 3. Although the magnitude, timing and statistical significance of the responses differs, any shock that raises (lowers) the real price of oil is associated with a capital loss (gain) for oil exporters. Moreover, since the external balance of oil exporters is computed with respect to the rest of the world, we know that by construction there must be valuation effects of the opposite sign in the rest of the world.

5.1.2. Major Oil Importers

While the results in Figure 3 lend themselves to interpretations in light of economic theory, it is of interest to look at the same problem from the point of view of major oil-importing economies. Constructing a comprehensive set of oil importers is difficult, given the data limitations of many oil importing countries including, for example, China. Figure 4 focuses on an aggregate of advanced oil-importing economies consisting of the United States, Japan, and the Euro area. While these economies represent only a subset of oil importers, their data are of high quality and they jointly represent a large share of world GDP. We have to keep in mind, however, that this aggregate of oil importers is not the complement to the aggregate of oil exporters considered in Figure 3.

Oil supply shock

Figure 4 shows that an oil supply shock causes an immediate oil trade deficit in oil importing countries, but the deficit is small, short-lived and statistically insignificant. This result is consistent with the small response of the real price of oil documented in Figure 1. The fact that the oil trade deficit is only short-lived is consistent with the short-lived oil trade surplus in oil-exporting economies documented in Figure 3. Under incomplete markets, one would expect oil-importing countries to generate a non-oil trade surplus. Indeed, the non-oil trade balance in Figure 4 is in surplus for the first few years, although not significantly so. As a result, within the

first three years neither the trade balance nor the current account is statistically different from zero. There is, however, a highly significant short-run capital loss, followed by largely insignificant capital gains in years 3 and 4. The capital loss causes an overall loss of net foreign assets that is especially pronounced on impact and one year after the supply shock. Unlike the corresponding capital loss in Figure 3, this capital loss is not consistent with the stylized bilateral theoretical models of the valuation effect discussed in section 4.4. We will return to this point below.

Oil-market specific demand shock

The last row of Figure 4 shows that a much larger, persistent and statistically significant oil trade deficit arises in response to an oil-specific demand shock. In this case as well, major oil importers generate a non-oil trade surplus, consistent with the incomplete markets model, but the response is small and not statistically significant, resulting in a statistically significant overall merchandise trade deficit and (to a lesser extent) current account deficit. Compared with the current account surplus of oil-exporters, not surprisingly, the response is much smaller in magnitude as a share of GDP. There is also evidence of partially statistically significant capital gains in response to oil-specific demand shocks that allow oil importers to run a smaller non-oil trade surplus. These gains mirror in part the capital losses of oil exporting economies, and largely offset the current account deficit. The resulting loss of net foreign assets initially is quite limited as a share of GDP and typically not statistically significant. In years 3 through 5, the capital gains more than offset the current account deficit.

Aggregate demand shock

In response to a positive aggregate demand shock, a statistically significant oil trade deficit as well as a largely statistically insignificant non-oil trade surplus arises in oil importing countries. The net effect is a marginally statistically significant merchandise trade deficit and a partially statistically insignificant current account deficit. There also is evidence of partially statistically significant capital gains in oil importing countries (mirroring the capital losses in oil exporting economies). These capital gains cause a statistically insignificant accumulation of net foreign assets, as one would expect given that capital gains and the trade balance offset one another.

Implications

The trade responses in Figure 4 are broadly consistent with those in Figure 3, although the

responses of the non-oil trade balance to demand shocks are small and less precisely estimated, given the smaller share of oil in the trade of major oil importers. Moreover, the results in Figure 4 leaves no doubt that oil demand and oil supply shocks trigger large and systematic valuation effects, the existence of which is important for policy analysis.

The valuation effects of individual oil-importing countries (or more generally of subsets of oil-importing economies as in Figure 4) are more difficult to predict because they depend on the cross-ownership of assets among oil-importing economies and on the relative responses of oil-importing countries' currencies and asset prices. In particular, the capital gains and losses of the aggregate of the major oil importers depends on the asset price differential between oil exporters and major oil importers as an aggregate, the differential among major oil importers (e.g., the differential between Japan and the United States and between the Euro area and the United States), and the differential between the major oil importers and other oil importers not included in our aggregate (such as China). In the absence of detailed information on international asset positions and a multilateral open economy model of asset flows and exchange rates, there are no testable implications of economic theory for how the burden of adjustment should be distributed across oil importers. Nevertheless, the large and systematic capital gains experienced by the major oil importers in Figure 4 in response to positive oil demand shocks are consistent with a simple bilateral risk sharing interpretation.

In contrast, in response to an oil supply disruption, in the short run, major oil importers experience a capital loss rather than the capital gain suggested by the bilateral model. Since we know from Figure 3 that oil exporters in the aggregate are experiencing a short-run capital loss (and hence the rest of the world must be experiencing a capital gain), the likely explanation is that the simple bilateral framework is too simplistic for predicting the valuation effect on the three major oil importers.

Even when the capital gain responses in Figure 4 have the sign predicted by the bilateral model, as in the case of the other two shocks, the model's prediction that the capital gains in oil importing countries should be smaller in magnitude than the capital losses in oil exporting countries is not supported by the data. Again, this result is not surprising as the theoretical model does not incorporate information about the composition of different countries' portfolios by currency and about the implied multilateral real exchange rate adjustments nor does it allow for the special role of the U.S. dollar as a reserve currency and the flight to quality in times of

geopolitical uncertainty. Our results are consistent with the view that international financial integration plays an important role not only in allowing risk sharing between oil exporters and the rest of the world, as shown in Figure 3, but also in affecting how the burden of adjustment is distributed across oil-importing economies.

5.2. Variance Decompositions

The impulse responses in Figures 3 and 4 illustrate the impact of a one-time demand or supply shock on external balances. A related and equally important question is how important each shock has been on average during our sample period in determining fluctuations in external balances. Table 1 summarizes the results of this variance decomposition for the broad aggregates of oil exporters and oil importers. Not surprisingly, the combined effect of the three shocks explains almost 96% of the fluctuations in the oil trade balance of oil exporters and almost 89% of their current account fluctuations. Whereas only 66% of capital gains are explained, 82% of the variation in NFA positions of oil exporters is accounted for based on these shocks. For the major oil importers, these shocks also account for 92% of the oil trade balance, but are considerably less important for the non-oil trade balance (47%), trade balance (75%), and current account (57%), reflecting the lesser dependence of these economies on global commodity markets. Nevertheless, the shocks in question account for about 75% of the variation in oil importers' capital gains and NFA positions.

Table 1: Variance Decompositions for External Balances as a Share of GDP

	External Account	Oil Supply Shock	Aggregate Demand Shock	Oil-Specific Demand Shock	Total
Oil Exporters	Oil Trade	7.2	39.3	49.4	95.9
	Non-Oil Trade	23.7	20.4	29.1	73.2
	Trade	8.8	35.2	44.4	88.5
	Current Account	12.0	34.4	39.3	85.7
	Capital Gains	25.4	15.8	25.3	66.5
	Change in NFA	10.2	31.7	40.1	82.0
Major Oil Importers	Oil Trade	6.9	29.8	55.4	92.1
	Non-Oil Trade	18.4	15.9	12.8	47.2
	Trade	7.2	27.4	40.4	75.1
	Current Account	9.9	22.7	24.8	57.4
	Capital Gains	22.3	32.1	22.4	76.8
	Change in NFA	32.8	16.9	25.0	74.8

NOTES: All results are based on the R^2 estimates implied by model (2), suitably scaled to match the total R^2 from an analogous regression of the dependent variable on current and lagged values of all three shocks, and expressed in percentage terms.

It is important to keep in mind that this result does not mean that oil price shocks account for 57% of the fluctuations in oil importers' current account, for example, since the shocks that drive the global price of crude oil may also affect the current account directly. In particular, the aggregate demand shock is best thought of a shock to the global business cycle. It is instructive to decompose the contribution of the three shocks. Table 1 shows that the bulk of the variation in the oil trade balance is driven by oil-market specific shocks (49% and 55%, respectively, for oil exporters and oil importers), followed by aggregate demand shocks (39% and 30%, respectively). Oil supply shocks play a less important role (about 7% in both cases). The relative importance of aggregate demand and oil-specific demand shocks for the variation in both oil exporters' and oil importers' current account is more balanced. The two demand shocks each account for about a third of the variation in oil exporters' current accounts, and less than a quarter of the variation in major oil importers' current accounts. Their relative importance for capital gains ranges from 15% to 30%, approximately. Oil supply shocks account for about 22% of the capital gains and 33% of the changes in NFA in oil importing countries, about the same order of magnitude as the demand shocks. While these results are necessarily tentative, they provide a first glimpse at the determinants of these external accounts.

5.3. Historical Decompositions

Since several demand and supply shocks occur at any given point in time, and since the composition of innovations to the real price of oil evolves over time, impulse response estimates and variance decompositions do not tell us how much of the evolution of the external accounts must be attributed to a given shock during specific historical episodes. Historical decompositions of the fluctuations in external accounts shed light both on the cumulative effect of each oil demand and supply shock on a given external account and on their combined effect.¹⁶

5.3.1. The Combined Effect of Oil Demand and Oil Supply Shocks on External Accounts

Figure 5 shows the cumulative effect of all three demand and supply shocks combined on the external accounts of oil exporters. This decomposition is of particular interest, since by construction the mirror image of this decomposition is indicative of the evolution of the current account of all oil importers combined as well. Although the three shocks explain by no means all

¹⁶ These decompositions can be constructed by simulating the path of the dependent variable from the fitted regression model (2) under the counterfactual assumption that a given demand or supply shock in the oil market is zero throughout the sample. The difference between this counterfactual path of the dependent variable and its actual path is a measure of the cumulative effect of the shock in question.

movements in external accounts, they do explain a large part. With the exception of the non-oil trade deficit (and resulting current account deficit and loss of net foreign assets) in oil-exporting countries between 1985 and 1993, these shocks explain at least the trend of the trade and current account data and in many cases the rather abrupt shifts in NFA positions.¹⁷

5.3.2. The Evolution of the Relative Importance of Each Shock for the Current Account

Figure 6 decomposes the current account of oil exporters further to highlight the driving forces behind the large current account fluctuations. It shows that much of the oil exporters' current account surplus since 2003 was driven by a combination of aggregate demand shocks and (to a much lesser extent) oil supply shocks. In contrast, the current account deficit of 1998 was associated with the temporary drop in oil-specific as well as aggregate demand following the Asian crisis of 1997, when oil prices reached an all-time low in recent history. Oil supply shocks played no role. On the other hand, the current account deficit of 1991/92 reflected a combination of all three shocks, working in the same direction.

5.4. Issues to Be Addressed in Future Research

The variance decompositions and historical decompositions underscore the importance of global aggregate demand shocks in driving external balances. Although in this paper we have followed Kilian (2008d) in constructing the expected (or average) responses of external balances to aggregate demand shocks, there is no presumption that the relationship between global aggregate demand shocks and external balances is necessarily stable over time. For example, the non-oil trade balance of major oil importers might rise in response to a positive aggregate demand shock if that shock reflects an unexpectedly strong U.S. economy, but might fall when that same shock reflects unexpectedly high demand from emerging market economies. Likewise it could make a difference whether increased demand comes about as a result of productivity growth or as a result of a monetary expansion. An interesting challenge for future work will be to parse out the differences between alternative types of global aggregate demand shocks and their effects on the external balances in various regions of the world.

¹⁷ Further disaggregation suggests that the model explains quite well the growing U.S. current account deficit since 1999 and most of the fluctuations in the U.S. NFA position. A similarly good fit is obtained for the Euro area and Japan. These results are not shown to conserve space.

6. Conclusions

This paper provided the most comprehensive analysis to date of the effects of oil demand and supply shocks on the external balances of oil exporters and oil importers. Our analysis explicitly recognized that oil price changes reflect at least in part the state of the global economy. We also distinguished between oil price changes caused by crude oil supply shocks, oil price changes driven by shocks to global aggregate demand for industrial commodities, and oil price changes associated with oil-market specific demand shocks such as shocks to the precautionary demand for oil.

Our study complements recent theoretical advances in modeling the effects of oil demand and oil supply shocks on external balances. This theoretical work has highlighted the importance of empirical studies of how external accounts respond to oil demand and oil supply shocks. For example, economic theory is informative about the direction and overall pattern of the response of the oil trade balance to an oil supply shock, but it is quiet about the magnitude of the response in question. Likewise, depending on the degree of financial market integration, the non-oil trade balance may not respond at all to an oil supply shock or the response could be potentially quite large. In addition, to date there has been no theoretical analysis of global aggregate demand shocks in industrial commodity markets. The effect of such shocks on external balances tends to be rather complicated, making it difficult to generate any theoretical predictions. These facts make the empirical analysis of the response of external balances all the more relevant.

Our key findings are: (1) Global business cycle demand shocks and oil-specific demand and supply shocks are important for the determination of external balances. For example, they jointly account for 86% of the variation in the current account of an aggregate of oil exporters and for 82% of the corresponding changes in NFA positions (all expressed as a share of GDP). Oil-market specific demand and supply shocks jointly account for about half of the variation in changes in NFA positions, whereas demand shocks associated with the global business cycle account for an additional one third. For an aggregate of major oil importers the corresponding shares are lower, but still large.

(2) The nature of the transmission of oil price shocks depends on the cause of the oil price increase. For example, positive oil demand shocks are associated with a statistically significant accumulation of NFA in oil exporting economies (and a corresponding decline in the rest of the world), whereas negative oil supply shocks are associated with a statistically

insignificant decline in NFA. A second example is that a positive innovation to global aggregate demand causes a current account surplus in oil-exporting economies that peaks in years 2 and 3 after the shock, whereas an oil-market specific demand shock causes a current account surplus in oil exporting economies that peaks immediately in years 0 and 1.

(3) The overall effect of oil demand and supply shocks on the trade balance of oil importers (and oil exporters) depends critically on the response of the *non-oil* trade balance. Empirical evidence on the response of the non-oil trade balance is especially useful because theory puts few restrictions on that response. Moreover, the extent to which the non-oil trade balance moves in response to external shocks sheds light on the degree of international financial integration. Our empirical results suggest that neither models of financial autarky nor complete markets model provide a good approximation to the data, and provide a benchmark for the construction of theoretical models of the transmission of oil demand and oil supply shocks under incomplete markets.

(4) In addition to the adjustment of the trade balance and current account, a second channel of adjustment is provided by valuation effects in the form of capital gains or capital losses on foreign assets and liabilities. We found evidence of systematic valuation effects in response to oil demand and oil supply shocks for both oil exporters and oil importers. International financial integration overall has tended to cushion the effect of oil demand and supply shocks on the change in NFA positions of oil importers and oil exporters. Our results highlight the importance of incorporating trade in assets in theoretical models of oil price shocks and suggest that theoretical models that ignore this channel of transmission will not be consistent with the data. We concluded that in predicting the effects of oil demand and supply shocks on external balances it is necessary to consider not only the degree of an economy's international financial market integration, but also its external portfolio configuration.

(5) Finally, our results are of interest for the recent policy debate about external imbalances. Our analysis suggests that shocks to the demand for industrial commodities driven by the global business cycle have played a significant role in recent years in the emergence of external imbalances. Valuation effects, however, have helped cushion the impact of these shocks on net foreign asset positions. For example, the widening imbalance in the U.S. current account can be explained to a large extent by the cumulative effect of the demand shocks reflecting the global business cycle as well oil-market specific demand and supply shocks, yet the impact of

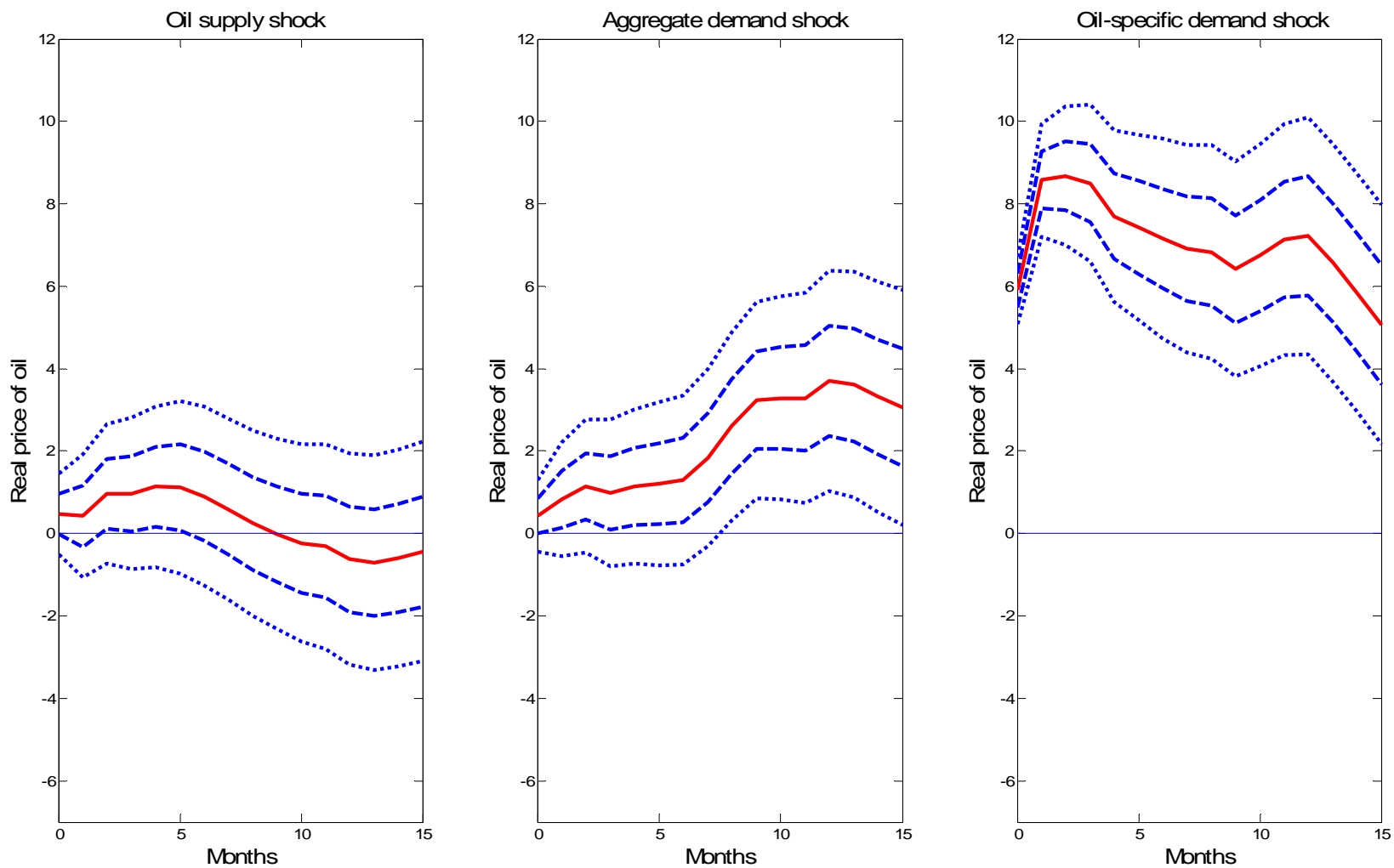
these shocks has been cushioned by valuation effects, suggesting that the recent global oil demand shocks were not as harmful to the U.S. economy as they would have been in the absence of international financial integration.

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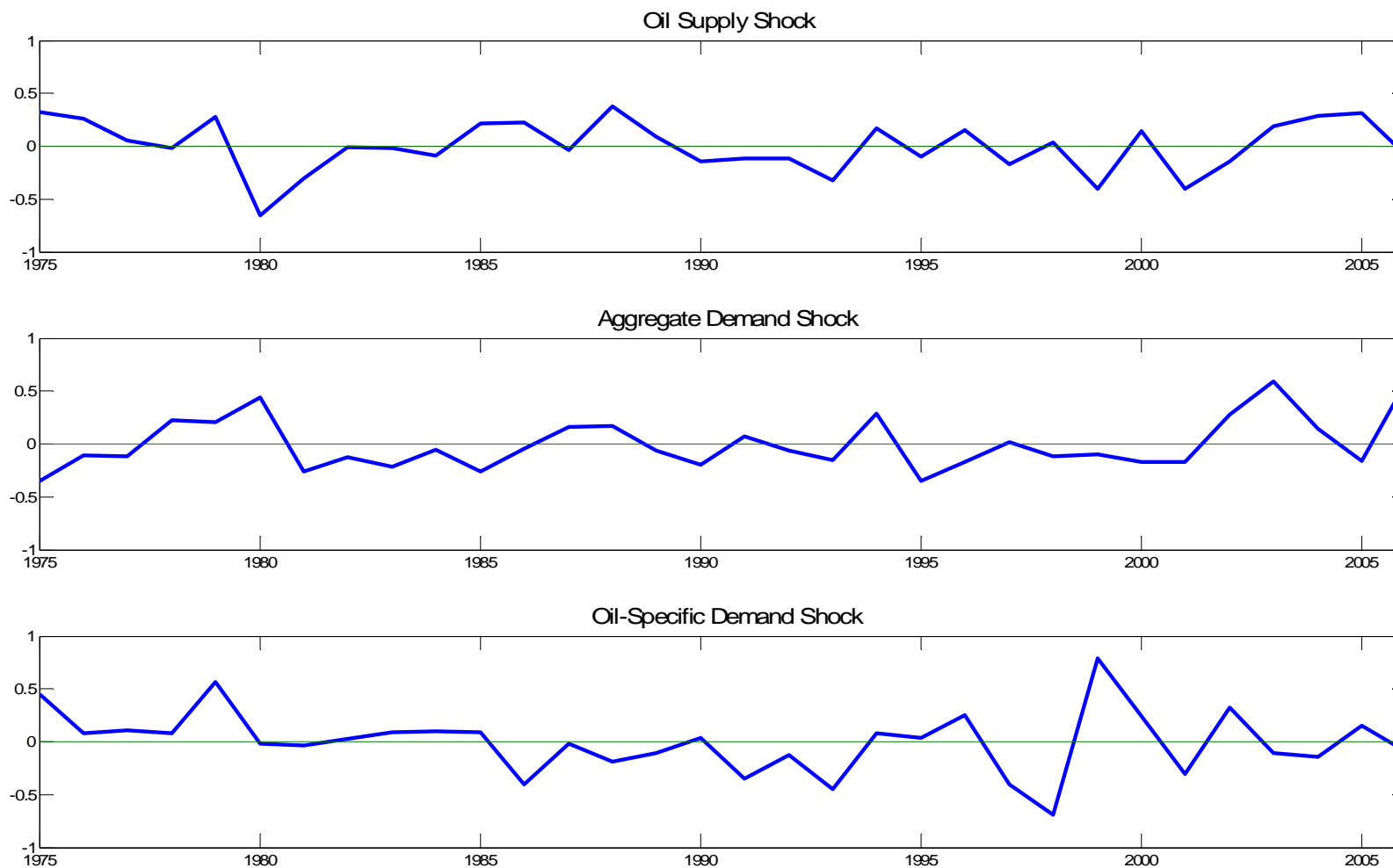
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Figure 1: Responses to One-Standard Deviation Structural Shocks with One- and Two-Standard Error Bands



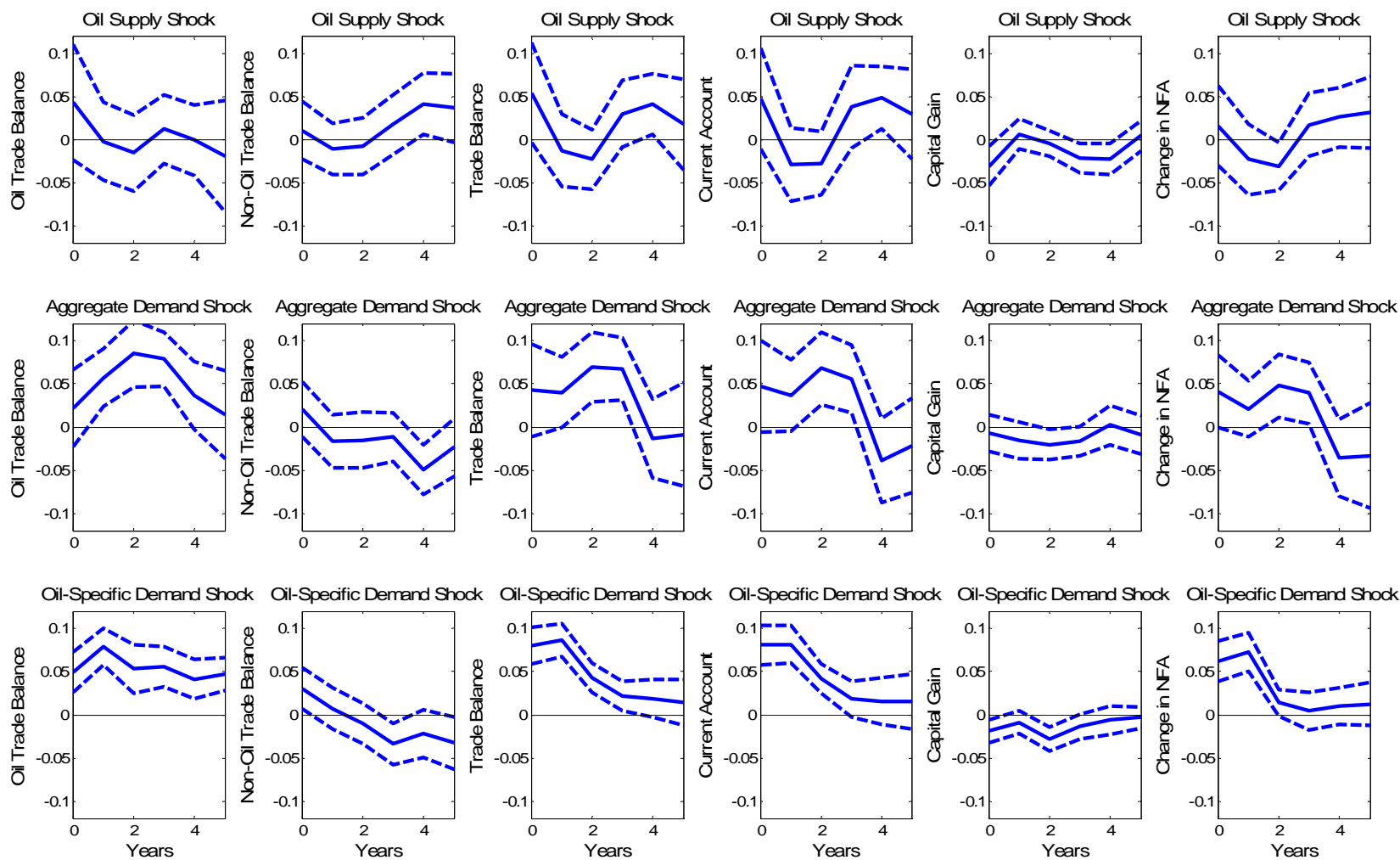
NOTES: Estimates based on model (1) described in the text. The confidence intervals were constructed using a recursive-design wild bootstrap (see Gonçalves and Kilian 2004).

Figure 2: Annual Averages of the Shocks that Determine the Real Price of Oil: 1975-2006



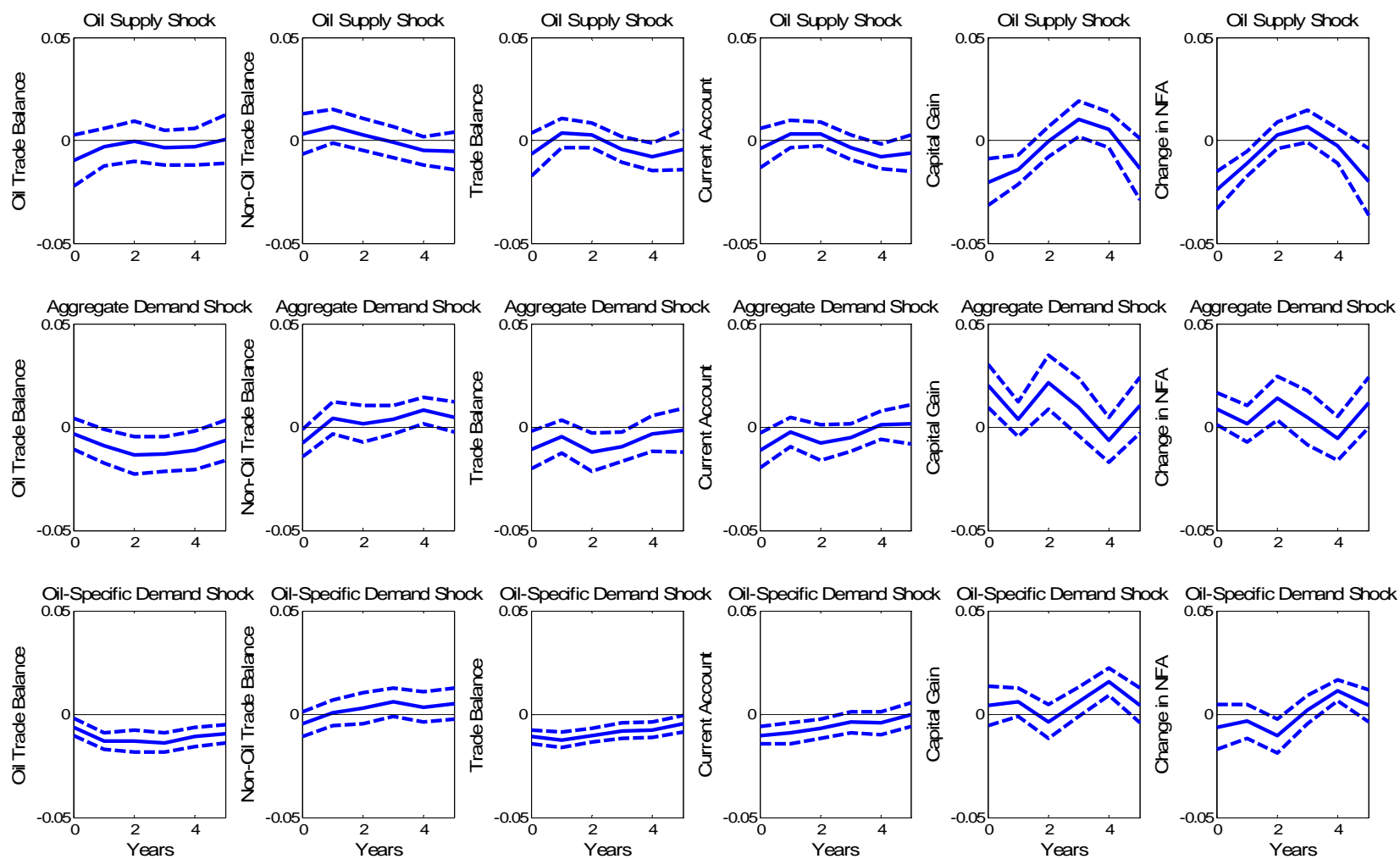
NOTES: Annual averages of the structural shocks underlying the responses in Figure 1.

Figure 3: Responses of External Accounts as a Share of GDP (with One-Standard Error Bands)
Oil Exporters



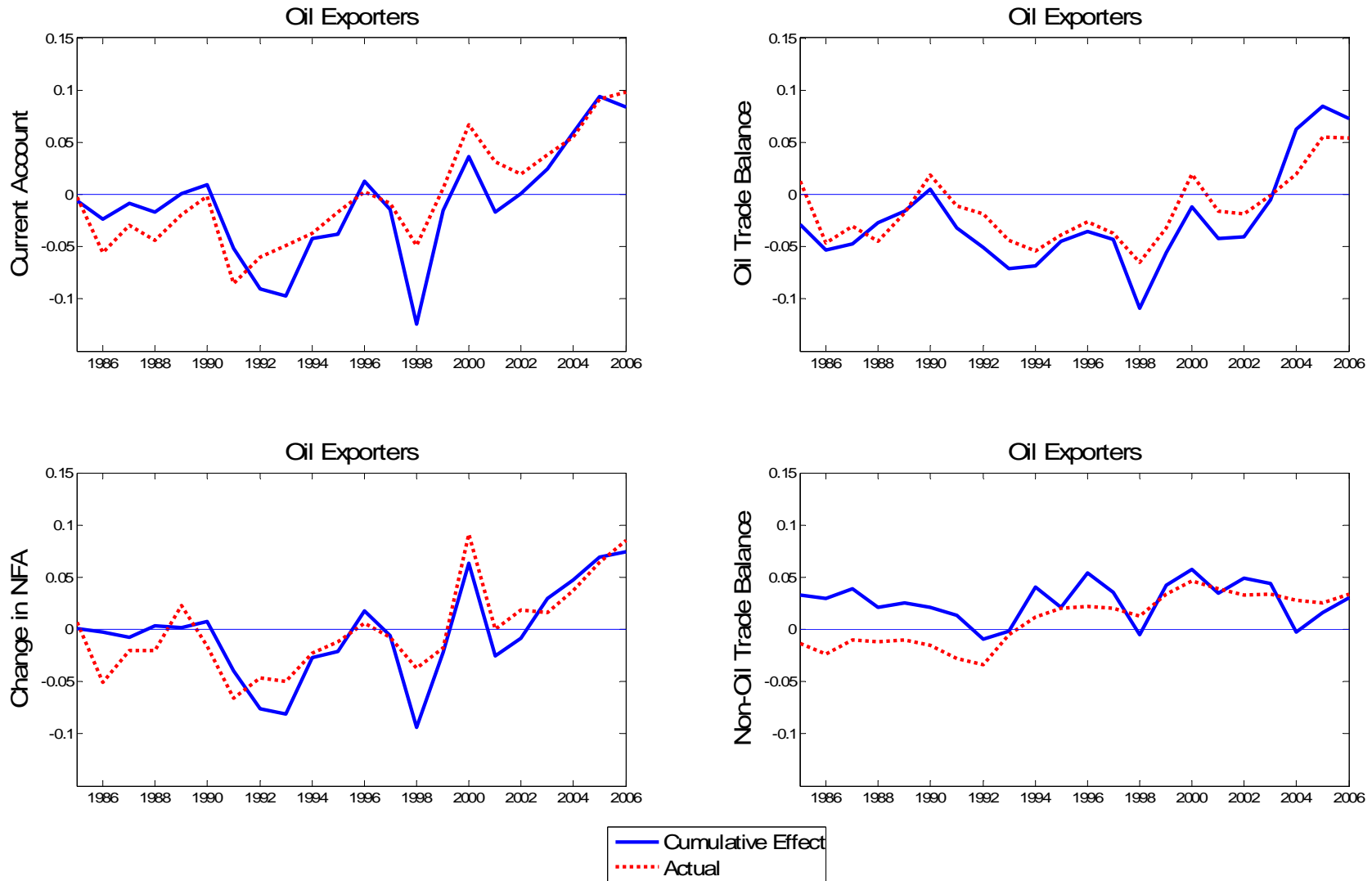
NOTES: Estimates based on model (2) described in text.

Figure 4: Responses of External Accounts as a Share of GDP (with One-Standard Error Bands)
Major Oil Importers



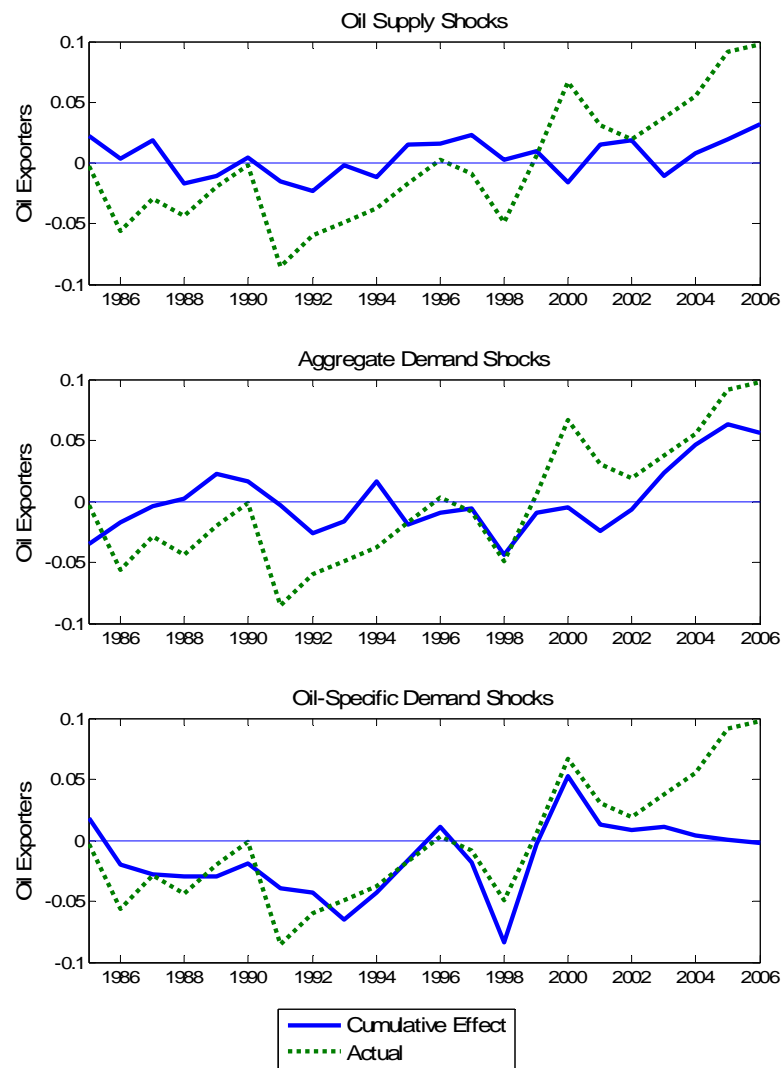
NOTES: See Figure 3.

Figure 5: Historical Decompositions of Oil Exporters' External Accounts as a Share of GDP



NOTES: Fitted values of model described in text plotted against demeaned actual data.

Figure 6: Historical Decompositions of Oil Exporters' Current Account as a Share of GDP by Shock



NOTES: See Figure 5.