Crude Oil Trade and Current Account Deficits

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Abstract

This paper provides an empirical exploration into the relationship between crude oil trade and a nation's current account for 91 countries over the 1984-2009 period. Reduced oil import dependence may initially reduce a country's general trade deficit under certain conditions. The analysis probes the nature of this relationship and whether it holds equally to oil-importing and oil-exporting countries, after controlling for other exogenous drivers. We find that net oil *exports* are a significant factor in explaining current account surpluses but that net oil *imports* often do not influence current account deficits. Among all oil importers the one exception applies to relatively rich countries, where higher oil imports appear to contribute to greater current account deficits. One explanation for these trends is that oil exporters and wealthier oil importers may view oil income gains and losses as temporary income sources that influence their savings patterns.

1 Introduction

Large oil and natural gas deposits are being discovered and in many cases developed in major oil-consuming and oil-importing countries such as the United States, Canada, and Brazil. Hydraulic fracturing and improved seisimic imaging processes have made tight oil and natural gas shale much more available at unexpectedly lower costs (US Energy Information Administration, 2012). As countries reduce their dependence on oil and gas imports, they may reduce their trade or current account balances[1] and make themselves less vulnerable to sudden oil and gas price shocks. Morse et al (2012) conclude that this new frontier in tight oil and natural gas shale supplies, combined with continued energy-efficiency improvements, could reduce the

U.S. current account by 60 percent within the next eight years (by 2020). See also Medlock, Jaffe, and Hartley (2011: p. 36) for optimistic assessments on the implications of the North American natural gas revolution for the U.S. trade outlook. If these trends also influence exchange rates, it may alter the growth in global oil demand (Brown and Phillips, 1984, Huntington, 1986, Austvik, 1987, and De Schryder and Peersman, 2015) or recalibrate the relationship between prices of globally traded crude oil and domestically sourced natural gas within North America (Hartley and Medlock, 2014).

Conceptual reasons exist for expecting these developments will lead initially to a declining trade exposure to oil and gas price movements as domestic energy production replaces energy imports. Whether these favorable trade conditions will persist depends upon a number of factors that are explained further below in section 3. Ultimately, however, the issue is empirical. This study adopts a long-term focus in order to evaluate whether favorable oil import or export trends provide beneficial trade balance effects. A longer term perspective is appropriate when policymakers want to understand trends in the current account balances and how sustainable these positions are. The study uses an annual panel data set for 91 countries over the 1984-2009 period to provide an empirical exploration into the relationship between crude oil imports and a nation's current trade account. The analysis probes the nature of this relationship and whether it holds equally to oil-importing and oil-exporting countries as well as to industrial and developing nations, after controlling for other exogenous drivers that could shape a nation's trading response.

The key mechanisms causing a rebalancing of the current account following an oil price movement are reviewed in the next section focusing on a review of the literature. The specification and available data are considered in Section 3. Key empirical findings are presented

for all countries and for the post-2003 and several country groups in Section 4. The final section concludes the evaluation and recommends promising future directions.

2 Oil and Aggregate Trade Imbalances

This section begins by evaluating whether oil imports and exports appear related to the current account deficits experienced in many countries. It then reviews past empirical studies of the intermediate and long-run current account balances and the reasons for including various explanatory variables. It concludes with a discussion about the potential role for oil trade balances as an additional explanatory variable.

2.1 Linking oil trade and current accounts

A number of price indices exist for measuring crude oil costs in various regions of the world oil market. For the most part, they are strongly related to each other because crude oil is a very fungible product despite important differences in key attributes such as gravity and density. By far, the Brent measure has become the leading global price benchmark for Atlantic basin crude oils, now covering about two thirds of the world's internationally traded crude oil supplies. Unlike the Western Texas Intermediate crude oil price that was used extensively within the United States in previous years, it is not distorted by regional imbalances such as shortages caused by an existing pipeline system that was unable to move crude oil supplies out of the area around Cushing, Oklahoma. Reflecting this problem, the US Energy Information Administration (EIA) has shifted its focus from the WTI and the US refiners acquisition costs to Brent prices when discussing global oil price trends in its Annual Energy Outlook.

The annual trend in the nominal Brent crude oil price in the post-1984 period is tracked in Figure 1. Oil prices collapsed in 1985 after Saudi Arabia decided to expand its production to

recapture some of the market share that it had lost during the previous five years (Jones, 1990). Oil prices began to rise sharply in the post-2004 period when Asian economic growth exploded much faster than expected and available supply remained relatively stable (Hamilton, 2009). Throughout this period, oil prices became much more volatile on a monthly basis (not shown in this figure). On a monthly basis since May 1987, they fluctuated about four times as much as U.S. imports on the basis of their standard deviation divided by the mean.[2]

These oil price movements significantly shifted wealth between oil-importing and oil-exporting nations. As a forerunner to the analysis below, one might ask whether there exists any relationship between the oil trade balance and the country's current trade account. Figure 2 provides an interesting display of this relationship for 91 countries over the 1984-2009 period. The countries have been separated into those that are net oil exporters with a positive oil-trade balance and those that are net oil importers with a negative oil-trade balance. When the oil trade bill is positive, the country is a net oil exporter. Plots above the horizontal axis reveal the experiences of these countries. There is a noticeable and strong tendency for the current account balance to become more positive as its oil export bill grows in these countries. For the oil-importing countries below the horizontal axis, however, there is no clear trend. Higher oil import bills are not necessarily associated with a deterioration in the current account balance. Solid and dashed trendlines have been inserted to show the separate trends for oil exporters and oil importers, respectively.

Although illuminating and suggestive, this chart does not establish that there is a relationship between these variables and that important differences exist for oil exporters and oil importers. Other factors not included in the figure could cause the trade balance experiences to differ between these two broad groups. Section 3 will develop an approach to test this conclusion

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by controlling for variations in other key driver variables that have been included in previous empirical studies and that are discussed in greater depth in section 2.2 below.

2.2 Past Current Account Studies

Policymaking continues to devote considerable attention to the factors and conditions that shape the longer-run trade balance trends and whether these trade positions are sustainable. There exists no comprehensive conceptual model incorporating all possible transmission mechanisms explaining the trends in current accounts balances. Experts differ on what factors lead to long-run periods of current account surpluses or deficits and how sustainable they can be (Mann 2002). Available panel-data studies by Glick and Rogoff (1995), Debelle and Faruqee (1996), Chinn and Prasad (2003), Chinn and Ito (2007), Gruber and Kamin (2007, 2009) and Bussiere, Fratzscher and Muller (2004) have confirmed that current account trade balances over the mid to long run are influenced by fundamental factors associated with a country's propensity to save and invest in both the public and private sectors. These studies include structural variables that explain saving and investment levels but exclude near-term flunctuations in the prices and quantities of tradable goods and services and altered external portfolio positions and asset prices. Studies by Chinn and Ito (2007) and Gruber and Kamin (2009) have used this basic framework as a foundation for evaluating other potential mechanisms, such as the quality of institutional investments as a contributor to the trade patterns. Similarly, this savings-investment approach serves a foundation for the analysis developed in this paper.

A central issue has been the role of government budget imbalances. Bernheim (1988) provides a thoughtful discussion of the "twin deficits" hypothesis linking the trade deficits with government budget deficits. If not offset by adjustments in private savings, soaring government budget deficits cause private and public domestic saving to be inadequate to meet profitable

domestic investment and government expenditures. Interest rates become higher and the local currency becomes stronger, which attracts foreign capital investment and discourages exports of goods and services. Both effects shift the current account more towards a deficit position, resulting in both government budget and trade imbalances. Indeed, national income accounting identities ensure that the two imbalances should be related. Although there is considerable debate about the precise mechanisms in the government budget's role, the empirical studies identified above tend to confirm that smaller government budget deficits reduce the trade deficit in the mid- to long-term.

These issues currently remain very much in the public limelight. The US current account deficit exploded at a time when US savings faltered, particularly within the government sector beginning in 2002. These conditions led to the "twin deficits" explanation where this nation was building deficits in both its trade account and government budget. Simultaneously, net savings expanded into a "savings glut" in Asian markets, where domestic aggregate consumption remained relatively modest and investors in these countries may have been searching for safer options after the Asian financial collapse in 1997. Higher oil prices since 2003 may have provided additional savings from countries with large petroleum resources.

Demographic variables should also be considered as they influence the savings rate and hence the current account imbalances. Gross saving rates are higher in populations with more workers than with children or retired people. Accordingly, current account surpluses are more likely in countries with a greater share of workers in their population (Higgins 1998).

It is more difficult to discern how GDP per capita will shape the current account balance. Higher domestic income relative to foreign incomes generally shifts the trade balance towards greater net imports of goods and services, although exchange rate adjustments can moderate this

effect. Moreover, Debelle and Faruqee (1996) emphasize the 'stages of development' hypothesis for the balance of payments. The transition between low and intermediate stage of development often requires more capital imports and higher current account deficits. As an economy matures at more advanced stages of development, it may begin to develop current account surpluses in the form of payments for past external liabilities and greater capital exports to developing economies. This possibility suggests a nonlinear specification that includes both the level and square of per capita GDP. The coefficient for income level should be negative while the coefficient for income squared should be positive to capture the U-shaped response between GDP per capita and the current account balance.

Some countries may adopt a tariff structure and other macroeconomic policies that achieve more imports and exports of all goods and services leading to greater trade openness. Dividing the sum of total imports and exports in an economy by its per-capita income is a frequently used measure of country policies favoring trade openness (e.g., Chinn and Prasad, 2003). This variable may contribute to positive current account balances, although researchers have not tried to connect these policies directly to a higher savings rate.

2.3   The Role for Oil Trade

The extent and timing of the near-term response of the trade balance within an oil-importing nation to energy price changes depend upon the sources of the shock and the various transmission mechanisms (Kilian, Rebucci and Spatafora, 2009; Le and Chang, 2013). Geopolitical and military events as well as sudden, rapid demand growth have been the primary reasons for past oil price shocks that have significantly shifted wealth between oil-importing and oil-exporting nations. More recently, new technologies for extracting shale resources in North

America and perhaps eventually elsewhere have been important catalysts for oil price movements.

Demand for petroleum is relatively price inelastic in the short run due to limited capital stock turnover, resulting in higher oil prices and initially higher net oil import bills in oil-importing countries. Over time, the net current account balance in oil-importing countries will adjust as shifting factor costs, exchange rates and redirected income flows alter the consumption and production of all goods and services. How oil-producing countries recycle their petro-dollars will affect their own current accounts by making investment funds more available globally.

These additional effects flow through both the trade and financial channels. Oil price movements change the prices and quantities of tradable goods and services and alter external portfolio positions and asset prices (Kilian, Rebucci and Spatafora, 2009; Le and Chang, 2013). Higher oil costs are transmitted to the price of imported goods and services in all countries and lead to higher interest rates if monetary authorities try to moderate the building inflation rate. These adjustments affect economic growth with corresponding effects on imports and exports of different countries.

Later adjustments in the economy may augment or counter any initial deterioration in the trade balance caused by higher oil imports. The country will find it more expensive to produce output with more expensive intermediate input imported from abroad. Additional rigidity in the turnover of the capital stock and wage-setting practices may escalate the impact attributable to these direct cost effects. Empirically, higher oil prices temporarily reduce economic growth within several quarters, although there exists some uncertainty about the magnitude of the impact (e.g., see the various studies by Hamilton, 2003, Kilian, 2008, Blinder and Rudd, 2008, and

Blanchard and Galí, 2010). With lower productive capacity, the economy will allocate fewer inputs for exports, even more so if these exports are energy intensive.

Meanwhile both oil and non-oil imports will decline as the economy contracts. Exports may not decline as much unless the country trades significantly with other oil-importing nations. Exports may begin growing if they become cheaper through devaluation. The country may also attract foreign financial loans if interest rates rise relatively more than in other countries.

In the longer run, the borrowing and lending patterns of a country can be very important in determining how net exports respond to reduced oil import dependence. The trade balance may show a net decline after these adjustments if the country borrows from abroad to offset an imbalance between domestic public & private saving and total investment in the economy. Many consider this twin deficit hypothesis between net total public and private savings and the current trade account as the primary source for current account deficits. In this view, the increasing US federal deficit and declining US saving have contributed directly to the worsening US current account since 2002.

A deteriorating oil import bill may contribute to longer-run trends in current account balances if the private and public sectors in an oil-importing country viewed this income transfer as a temporary contraction in its income. Following Friedman (1957) and Hall (1978), the permanent-income hypothesis suggests that consumption will move with changes in permanent rather than total income. The response to all income may incorporate a combination of agents responding to both permanent and transitional income sources (Campbell and Mankiw, 1989). As total income declines, oil-importing nations may maintain their current aggregate consumption levels by reducing their domestic gross savings. As they become net borrowers to replace declining domestic savings, they maintain their consumption levels and continue to

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import more goods and services, causing a deterioration in their trade current account balances. Similar forces operate on oil-exporting countries if they view these income gains as temporary rather than permanent sources. They will decide to invest their new sources overseas rather than to spend more on domestic goods and services. As long as nations spend less of their temporary income than their permanent income, oil price movements could be a source of changes in net savings and hence current account imbalances. As a result, the relationship becomes an empirical rather than a conceptual issue.

3   Data and Method

This analysis pools data from 91 countries (listed in Table 1) over the 1984-2009 period to explain annual current account balances. The selected independent variables follow closely those used in previous panel data studies by Chinn and Prasad (2003), Chinn and Ito (2007), and Gruber and Kamin (2007, 2009). Our focus is on the intermediate run rather than the short run, thus explaining our preference for annual rather than quarterly data. For similar reasons, we depart from the approach used by the above studies in which the time interval for each observation is the long run as measured by the average over a five-year period. In these previous studies, averages were computed over a shorter period of less than five years when there was missing data. In the current study, any annual observations with missing data were dropped from the analysis, resulting in an unbalanced data sample. For most countries, however, the data covered the entire post-1983 period.

The approach follows the general formulation adopted previously for understanding mid-term adjustments in the current accounts balances across multiple countries and years. These previously mentioned studies emphasize that current account balances are a relative concept that responds to conditions at home as well as abroad. Home country variables by themselves are

insufficient for determining current account balances. For consistency with previous panel studies on this topic, we have converted all variables from country levels to their deviations from global averages for each year, resulting in the following specification:

$$Y_{it} = \sum_i \beta_i + \alpha(X_{it} - X_t^*) + \varepsilon_{it} \tag{1}$$

where Y is the current account balance as a percent of GDP (both in nominal terms), X is a vector of independent variables defined below, X_t^* denotes the average for all countries in a particular year, ε is the disturbance term, and the subscripts i and t represent country and year, respectively. In addition to the relative economic conditions, the model includes the dummy variables (β_i) as fixed country effects to control for time-invariant factors associated with each individual country.[3]

A comparable approach producing similar results would be to extract and move the effects influencing the global averages for each year $[\beta_t = \alpha(X_t^*)]$ and include them as fixed time effects to control for country-invariant effects associated with each year. This alternative specification can be written with the same variables as above as

$$Y_{it} = \sum_i \beta_i + \sum_t \beta_t + \alpha(X_{it}) + \varepsilon_{it} \tag{2}$$

This model includes the level of each country variable along with dummy variables (β_i) as fixed country effects to control for time-invariant factors associated with each individual country and the dummy variables (β_t) as fixed time effects to control for country-invariant effects associated with each year. Results reported in this analysis are those based upon equation (1) above in order to main consistency with previous panel data studies on this topic.

The fixed-effect panel model appears statistically preferable to the random-effect approach in this application. The Breusch-Pagan Lagrangian multiplier test indicates that the

variance of the random effect can be distinguished from zero with a a χ^2 statistic of 1388.91 (significant at the 1% level). More importantly, the Hausman test comparing the generalized random with the fixed effects model results in a χ^2 statistic of 18.34 (significant at the 1% level), resulting in the decision to remain with the fixed-effect specification.

The independent variables include the following drivers:

AGE is the age-dependency ratio relative to the working-age population;

GOV is the government budget balance as a percent of GDP (nominal terms);

TRADE is the economy's openness as measured by the sum of exports and imports as a percent of GDP (nominal terms);

INCOME is the real GDP per capita (million 2000 $);

INCOME^2 is the *square* of real GDP per capita (million 2000 $); and

OIL is the net oil export balance as a percent of GDP (both in nominal terms).

A current account that becomes more positive or less negative is moving towards a trade surplus condition. As discussed in section 2, the current account is more likely to move in this direction when factors increase net domestic savings within a country. For this reason, it is expected that the government budget balance (GOV) and transitory oil income from petroleum exports (OIL) should influence trade surpluses positively. Note that the AGE variable represents the age-dependent population as a percent of the working-age population in the 15-64 age bracket. Populations with more children and elderly people tend to consume more and save less of their income than the working-age group. Therefore, age dependency should decrease the current account surplus.

TRADE will increase for economies with greater openness as measured by the sum of exports and imports as a percent of GDP. Previous studies have shown that exposure to international markets increases trade surpluses (e.g., Chinn and Prasad, 2003).

If the stage-of-development hypothesis is confirmed, per-capita income levels (INCOME) will reduce current account surpluses but its squared levels will increase these surpluses. If the data does not support the nonlinear specification, it is anticipated that higher per-capita income level should expand trade surpluses. Richer countries until recently have experienced a greater savings rate and exported more capital overseas.

A common practice in panel-data studies of the current account is to collect data from a variety of different sources. Table 2 reports a summary of the data, including separate entries for postive and negative oil trade bills that will be used to evaluate whether current account balances respond differently to oil trade balances in net oil exporters than in net oil importers. Positive oil trade bills represent net petroleum exports while negative oil trade bills are associated with net petroleum imports. The table also contains data sources, where government budget balances are those reported by the OECD statistics for the industrial member countries. In order to expand coverage to other countries outside the OECD, this study supplements this information with other sources, as done in the previous panel-data studies discussed above. The IMF World Economic Outlook database is used for the other countries.[4] Other non-energy variables are extracted from the World Bank World Development Indicators and energy variables are essentially those reported by the US Energy Information Administration (EIA). The latter's estimates of total crude oil imports and exports by country were multiplied by the nominal Brent price for oil. The value of net oil exports, computed as the difference between the value of exports and imports, was divided by nominal GDP. The Brent price represents a good indicator

of the real opportunity cost of using oil anywhere in the world. Unlike the West Texas Intermediate (WTI) price, the Brent price is relatively free from the effects of surplus pipeline capacity and other regional distortions. Prior to 1987, the Brent prices reported by the EIA were extended backwards to 1984-1986 by using the Brent prices reported by British Petroleum. There is substantial variation in the series for current account balances (ranging between -45% to +48%) as well as for the other variables.

Table 3 shows that Fisher-type augmented Dickey-Fuller tests (Choi 2001) reject the hypothesis that all panels have a unit root for all variables except trade openness. Rejecting this hypothesis for these variables means accepting the alternative hypothesis that some countries do not possess unit roots. It does not necessarily imply that the non-stationarity of the series can be rejected for every single country in the sample. The commonly used inverse normal Z-test rejects the presence of unit roots for all panels in the trade openness variable at the 15 percent but not at the 10 percent level. The Fisher-type tests are applicable in this setting because they allow the panel data set to be unbalanced. These variables are relative to global averages, because the estimation equations should include both domestic and foreign conditions, as discussed above. Stationary variables mean that standard estimation approaches will produce meaningful rather than spurious results.

In maintaining consistency with previous empirical studies on this topic, the unit root tests in Table 3 were applied on series that were demeaned by global averages to underscore the importance of relative concepts in determining current trade balances. Although this approach might also adjust for the problem of the interdependence between regions, it is now recognized that it fails to to be an adquate control when the covariances of the error terms between any two regions differs from those for other regional pairs (Pesaran, 2007). For this reason, additional

unit root tests were performed on the variable levels rather than their relative counterparts to provide additional information about the underlying data. Under these tests, it is important to allow the panels to have cross-section dependence. Pesaran (2007) CDF tests with a constant were applied to the unbalanced data set, and results for zeta [t-bar] are displayed in Table 4.[5] The tests reject at the one percent significance level the hypothesis that all panels contain a unit root for all variables except income and trade openess. Once again, rejecting this hypothesis for these variables means accepting the alternative hypothesis that some countries do not possess unit roots. It does not necessarily imply that the non-stationarity of the series can be rejected for every single country in the sample. For consistency with previous panel-data studies on long-run current account balances, the regression analysis below will include all five explanatory variables and discuss the effects of different specifications for trade openess and income on the estimates for oil trade balances.

4   Empirical Findings

4.1   For all countries

Estimates including fixed country effects provide coefficients with the correct sign for all variables including oil import balances. Results are reported in the first column of Table 5. The direction and significance of these results are generally consistent with the previously discussed empirical panel-data studies of the long-run changes in the current account balances. Greater government surpluses, trade openness and oil trade all increase current account surpluses, while a more age-dependent population decreases these trade surpluses. The negative response for income levels and positive effect of income squared suggest a nonlinear income response that is consistent with the "stage of development" hypothesis discussed previously. All coefficients except for the income level are significant at the 1 percent level. The discussion below of various

alternatives will emphasize the oil trade balance effects because this analysis focuses upon this dimension of the trade issue.

Evaluation of the standard fixed-effect equation's residuals, however, strongly suggest that this equation suffers from heteroskedasticity. Application of the modified Wald test for groupwise heteroskedasticity in a fixed effect regression model results in χ^2 (91) = 16952.5, which rejects that the variances are the same across all countries at at the 1% significance level. Moreover, the Wooldridge test for autocorrelation in panel data rejects the conjecture that there exists no first-order autocorrelation at the 1% significance level with an F-statistic (1,90) = 50.6. For this reason, the remaining equations shown in Table 5 are based upon a generalized least squares (GLS) formulation for obtaining robust estimates. Later tables will consider the effects of relaxing the assumption that the responses to independent variables are homogeneous across country panels and do not vary by nation.

Several of the independent variables in the GLS robust estimation are no longer significant in the results shown in Table 5's column 2. These coefficients include those for income and its square, which suggests less support for the stage of development hypothesis for explaining current account balances than with the OLS estimates. This finding is consistent with the robust GLS estimates reported by Chinn and Ito (2007, Table 1). In this second equation, the effect of trade openness is also not significant. Age, government budget surpluses and oil import trade surpluses are the only determinants that remain significant.

Alternative estimates for this base robust, fixed-effect specification above are reported under the title "Robust Linear-Y" in the third column of Table 5. This equation replaces the nonlinear effect of income by a linear response where the income-squared term is dropped. Neither income nor income-squared terms were significant in the preceding equation and the

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income-level term had a t-value below unity. Under the "Robust Linear-Y" conditions, income level, government surpluses and oil trade balances are all significant with the correct sign. Age-dependency has a negative effect that is significant at the 10% level. The oil trade balance effect remains virtually unchanged with this alternative specification.

The first three specifications require that oil trade balances have a similar impact on current account balances, regardless of whether the oil trade balance is a surplus (positive) where the country is exporting oil or a deficit (negative) where a country is importing oil. This assumption is a particularly strong one, especially because oil exporters and oil importers may save differently when their oil wealth is changed. The fourth column of Table 5 relaxes this assumption by allowing the oil trade balance for oil exporters to have different effects than for oil importers. These results, shown under the column labeled "Robust Oil Exporters/Importers," indicate that positive oil export bills (for oil exporters) significantly increase the nation's current account, but negative oil export bills (for oil importers) have very little effect on current acounts. The oil-import effect appears absent. This result confirms the less rigorous findings based previously upon Figure 2. Oil exporters behave very much as if they are permanent income consumers with their new-found wealth. They are limited in their ability to spend their newly gained income and appear to view their additional wealth as temporary income that should be saved (abroad) rather than spent for domestic purposes. Such is not the case for oil importers when viewed as a single group. Countries with larger oil import bills do not tend to run larger current account deficits. The magnitudes of all other coefficients except the one for trade openness do not change much from the symmetric specification.

Results from the unit root tests in Table 3 suggested that the equations should be tested for robustness by considering different approaches for including trade openness. Similarly,

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results from the unit root tests in Table 4 suggested that the equations should be tested for the robustness by considering different approaches for including per capita income, and possibly trade openness. In conducting these additional specifications, it is important to emphasize that tests for rejecting unit roots often suffer from having relatively weak power in deciding the order of integration (e.g., see Campbell and Perron, 1991). Nevertheless, these additional specifications provide useful information about the base results shown in Table 5.

One approach would be to remove one or both variables because the unit root tests did not support the original hypothesis at the 5 percent level that the degree of trade openness or the stage of economic development (as measured by the level of per capita GDP) should even be included. It should be noted that trade openness is not directly related to the gross savings-investment balances in the same way that the age-dependency ratio and government budget deficits are. If removing these variables substantially changed the coefficient for oil trade balances, it could present a problem for an explanation that emphasized the influence of oil trade wealth on current trade accounts. When trade openness is eliminated from the "Robust Oil Exporters/Importers" specification in the last column of Table 5, the coefficient for oil trade balances within oil exporters ("Oil Trade Balances (+)") becomes 0.593 rather than 0.584 and its t-statistic increases slightly from 4.41 to 4.61. When both trade openness and per capita income are eliminated from the same specification, this coefficient declines slightly to 0.507 with a very similar t-statistic of 4.37. Clearly, the conclusions about oil trade balances are not sensitive to specifications that remove these two variables.

The second approach for evaluating this issue would be to replace the levels of these two variables by their first differences. Table 3 confirms that these first differences are of the same order of integration as the other stationary variables in this equation. When the change in trade

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openness replaces levels in the "Robust Oil Exporters/Importers" specification, the coefficient for oil trade balances within oil exporters ("Oil Trade Balances (+)") becomes 0.627 rather than 0.584 and its t-statistic increases slightly from 4.41 to 4.48. When changes in both trade openness and per capita income replace their levels in the same specification, this coefficient declines slightly to 0.545 with a very similar t-statistic of 4.33. Clearly, the conclusions about oil trade balances are not sensitive to specifications that replace the levels of these two variables with their first differences. It is important to note that the explanation for the roles of these two variables are now different when first differences are included. For example, the income variable now does not directly measure the stage of development (indicated by the GDP level) but rather the effect of a one-time increase in income.

A possible critique of the fixed-effect estimator is that this specification imposes the same response to the independent variables across all country panels when in fact they may differ across nations. Pesaran and Smith (1995) have developed the mean group estimator that allows different responses for each panel. The key issue for this analysis is that the conclusions derived from the robust, fixed-effect model may not be confirmed by switching to the mean group estimator. This possibility would seriously weaken the argument that oil trade balances matter when evaluating a country's trade balance.

The last three specifications in Table 5 were estimated again with the mean group estimator,[6] and these results are shown in Table 6. Reported coefficients are the unweighted average effects of the individual panel results. Most coefficients have different values with the mean group estimator, and all coefficients except for oil trade balances are not significant at even the 5 percent level. The reported Wald tests reject the hypothesis that there are no systematic differences between the mean-group and fixed-effect estimates. The mean-group estimates

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should be preferred when they can be estimated using the unbalanced data set, but that is not always the case. The most striking result for this study, however, is that the mean group estimator confirms the finding that oil trade balances have a significant effect on the current account balance and that this positive effect is due to how oil exporters rather than oil importers respond.

4.2   For Post-2003 Era and Country Groups

The trend shown in Figure 1 emphasizes that crude oil prices began to rise sharply after 2003. It may be that different factors were shaping oil prices in this latter period and that their effect may be masked by the longer horizon in our data sample. For this reason, it appeared important to test whether the post-2003 responses to the independent variables differed as a group from the responses experienced in the earlier period. To evaluate these differences, a more comprehensive model was evaluated that allowed the coefficient for each independent variable for the post-2003 period to differ from the preceding set of years. Separate intercept terms were included for all countries to make the results comparable to the previous estimates. Setting the additional post-2003 responses jointly equal to zero is rejected by an F-statistic $(6, 90) = 3.92$ that is significant at the 1 percent level. The responses during the post-2003 period differ significantly from the earlier period.

It is much easier and more direct to evaluate the post-2003 period by focusing on that particular subsample than to discuss the more comprehensive equation discussed above. Estimated coefficients for the post-2003 period are shown in the first column of Table 7. Government budget surpluses and positive oil trade balances remain significant as they were in the full 1984-2009 sample, More trade openness has a positive impact on the current account balances that just barely fails 5% significance (at 5.2%). The age-dependent population, per-

capita income and negative oil trade balances do not have significant effects for the post-2003 period. The latter result indicates that the current account balances of oil importers in the post-2003 period do not respond much when their oil import wealth changes.

Chinn and Ito (2007) emphasize that the current account balances respond differently in industrial than in developing nations. To understand these differences, it is important to exclude the very poor nations (often in Africa) from the other developing countries. Very poor countries often do not have the same data-collection administration and capabilities that other developing countries have. The problem is not due to their geography (being located on the African continent) but rather to their poverty.

In addition, it is not obvious which nations to place in the rich group, as the membership of industrial countries in the Organization for Economic Cooperation and Development (OECD) has grown over time since 1983. For this reason, we developed dummy variables for each group based upon whether they satisfied specific quantifiable criteria rather than define them as African and OECD. Rich countries is an indicator variable for countries with per-capita GDP exceeding $15 thousand (2000 US dollars) while poor countries have per-capita GDP falling below $500. Observations for the rich countries account for 29.6 percent and those for the poor countries account for 13.5 percent of the total sample.

Again, the analysis considered an expanded model that allows one to test whether the responses for rich nations differed as a group from those for the other countries. Each independent variable was interacted with indicator (dummy) variables for rich and poor countries. Variables that were not interacted with rich and poor groups represented the response of the non-poor developing countries. This equation also included intercept terms for each country. Eliminating the interaction terms for poor countries demonstrated that these

coefficients were significantly different from the other responses at the 10 percent but not at the 5 percent level, as the F-statistic $(6, 90) = 1.99$. In contrast, the interaction terms with rich countries emphasized that these coefficients were significantly different from the other responses, as the F-statistic $(6,90) = 4.99$ when these interaction terms were set jointly equal to zero.

The responses of these different groups can best be explored by considering separate regressions estimated on each subsample. This step shows clearly that the failure of the coefficients of the poor countries to be significantly different from the middle-income countries can be attributed to the former's very poor fit to the data most likely resulting from the lack of quality data-collection procedures. For this reason, the analysis focuses upon the estimated coefficients for the non-poor developing (labeled "middle" in the table) and rich countries displayed in the second and third columns of Table 7, respectively. Countries included among the rich nations are shown with bold, underlined text in Table 1. Government budget surpluses and positive oil trade balances remain significant in both country groups. There are different patterns for the other variables. The age-dependency variable is significant for developing countries but not for industrial countries. On the other hand, greater trade openness leads to higher current account surpluses but only in the rich countries.

Isolating the rich from the other countries provides an interesting perspective on the role of oil trade balances for the oil importers, as revealed by the coefficient for "Oil Trade (-)" in the specification presented in the third column. A petroleum importer that reduces its oil imports will increase its oil trade balance by making it less negative. This significant positive response (at the 1% level) shows that increasing its oil export balance (through reductions in oil imports) among the rich countries tends to increase their current account surpluses *ceteris paribus*. This effect is

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consistent with the savings-investment explanation of the current account if oil importers view volatile oil import expenditures as transitional income adjustments that cause them to save less. When their oil trade worsens, the transitional loss in oil wealth within these countries appears to be a source for more international borrowing and less domestic saving. These adjustments shift the economy more in the direction of a trade deficit.

4.3   For Savings Rates

It is interesting to explore the extent to which the same factors that explain the current account balances can also explain a country's savings pattern. National income accounting suggests an identity between net savings and current account balances. However, this identity is not an explanation but rather an equilibrium that occurs as the economy adjusts. Gross savings as a percent of GDP is explained by the other variables in the first column of Table 8. Positive oil export balances, government budget surpluses, trade openness, per capita income and the age-dependent population are all featured prominently in this equation, with impacts that are significant at the 1 or 5 percent level. These variables feature prominently in the equations for both current account balances and the gross savings rate. Negative oil trade balances for oil importers remain insignificant in the savings specification.

The role of savings is corroborated if the same explanatory variables are regressed on gross savings for the rich and middle income countries. Columns 4-5 show that oil trade balances for oil importers have different effects depending upon whether the country is rich or middle income. Rich oil importers that increase their oil import levels (making their oil trade balances more negative) will significantly decrease their gross savings, but middle-income oil importers that increase their oil import levels fail to change their savings rate. Thus, the current account surpluses resulting from an improving oil trade balance in rich countries appear to operate

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through increased savings. Middle-income countries experiencing an improving oil trade balance do not shift towards current account surpluses because they do not increase their savings.

Structural differences between rich and middle-income economies most likely explain why they behave differently. Many developing countries have underdeveloped financial systems that offer relatively low-quality assets relative to the more wealthy economies (Mendoza, Quadrini, and Rios-Rull, 2007; von Hagen and Zhang, 2014). These differences in financial development may cause different savings and investment patterns and explain why poorer countries export capital to their richer neighbors.

It may also be that the widespread use of price controls on refined petroleum products in many middle-income economies (e.g., see Parry *et al*, 2014) may make savings less responsive to world oil trends. When these countries experience a deteriorating oil import balance through a higher world oil price increase, subsidies may protect private consumers from a temporary loss of income. Incentives to reduce gross savings to maintain their permanent consumption levels may be muted under these conditions. The results in Tables 7 and 8 will hopefully stimulate additional research into the range of factors that might explain the different responses.

5   Conclusions

Oil-importing nations can benefit in many ways if they can reduce their vulnerability to wildly fluctuating commodity prices in the crude oil market. Higher crude oil prices can reduce economic growth in the next several quarters as well as shift a massive amount of wealth between countries. Consumers will not respond quickly to higher prices, causing oil import bills to increase rapidly in the near term. On an annual basis, however, it is very difficult to unearth a significant effect on a country's trade deficit for aggregate goods and services. Both casual and more structured analyses find little evidence that this relationship applies for all oil-importing

countries over the last 25 years or for the period since 2003. Only when countries are separated by their relative development does a clear pattern emerge. Relatively rich industrial nations appear to have high trade imbalances in both oil and their current account.

It has been argued here that these twin imbalances coexist for these countries because oil wealth transfers have been viewed as transitonal rather than permanent income redistribution, at least through 2009 (the last year in the sample). Expected future aggregate consumption does not change as rapidly or as completely as real national income in many wealthier industrial economies. Net borrowing allows them to maintain their previous consumption patterns. Why this pattern appears so pronounced between richer economies and all other oil-importing nations (including many in the middle-income developing group) remains an important puzzle for further evaluation.

This pattern among the richer oil-importing economies is similar to its counterpart for oil-exporting nations. Temporary expansions and contractions in the oil wealth in both groups do appear to influence their saving and borrowing decisions. As a result, current accounts do appear to rise among oil exporters and decline among rich oil importers when oil prices are moved higher. This conclusion suggests that different energy options, technologies and policy prescriptions may have some limited effect on a nation's trade balance, even though the main channel will be through aggregate consumption and saving responses rather than through oil prices and imports directly.

An important caveat on this and related research is that economists' understanding of the drivers of international financial experiences remains a work in progress. Although this analysis has adopted variables that have appeared important in other studies, it leaves out some of the complicated relationships between the current account and its important linkages to economic

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growth, fiscal balances, and a favorable investment environment. Furthermore, expectations and short-run adjustments may be more important in the intermediate-run results than could be adequately incorporated in this analysis. This issue will continue to attract additional researchers as new tools and concepts are developed.

Table 1. Countries Included in the Study

Rich countries are shown in bold, underlined text.

Algeria
Angola
Argentina
Australia
Austria
Bahrain
Bangladesh
Barbados
Belgium
Benin
Bolivia
Brazil
Brunei Darussalam
Bulgaria
Cameroon
Canada
Chile
China
Colombia
Congo, Rep.
Costa Rica
Cote d'Ivoire
Cyprus
Denmark
Dominican Republic
Ecuador
Egypt, Arab Rep.
El Salvador
Finland
France
Gabon

Germany
Ghana
Greece
Guatemala
Hungary
India
Indonesia
Iran, Islamic Rep.
Ireland
Israel
Italy
Italy
Jamaica
Japan
Jordan
Kenya
Korea, Rep.
Kuwait
Libya
Madagascar
Malaysia
Mexico
Morocco
Netherlands
New Zealand
Nicaragua
Nigeria
Norway
Oman
Pakistan
Panama

Paraguay
Philippines
Poland
Portugal
Romania
Saudi Arabia
Senegal
Sierra Leone
Singapore
South Africa
Spain
Sri Lanka
Sudan
Suriname
Sweden
Switzerland
Syrian Arab Republic
Tanzania
Thailand
Trinidad and Tobago
Tunisia
Turkey
United Kingdom
United States
Uruguay
Venezuela, RB
Vietnam
Yemen, Rep.
Zambia

Table 2. Summary Statistics for Key Variables, 1984-2009

Variable	Mean	Std. Dev.	Min	Max	Definition
Current Account	-0.20	8.61	-44.84	48.21	current account as % GDP (nominal)
Income per capita	9.85	10.67	0.15	41.90	real per capita GDP (2000 $)
Government Surplus	-1.56	6.04	-24.32	43.30	government budget balance as % GDP (nominal)
Age Dependency	61.22	16.60	29.50	115.85	% of working-age population
Trade Openness	75.73	48.79	11.09	460.47	exports+imports as %GDP (nominal)
Oil Trade	2.55	12.68	-42.81	86.05	net oil export balance as %GDP (nominal)
Oil Trade (+)	4.39	11.43	0.00	86.05	net oil export balance > 0
Oil Trade (-)	-1.84	3.76	-42.81	0.00	net oil export balance < 0
Savings Rate	21.80	9.90	-17.16	69.78	gross savings as % GDP (nominal)

Observations = 1580   Maximum observations = 26

Countries = 91   Minimum observations = 7

Government Surplus for OECD Nations (budget balance)

Source: OECD, Link: http://www.oecd.org/statistics/, accessed 9/20/2012.

Government Surplus for Non-OECD Nations (budget balance)

Source: International Monetary Fund World Economic Outlook Database, Link: http://www.imf.org/external/pubs/ft/weo/2012/01/weodata/weoselco.aspx?g=2001&sg=All+countries, accessed 9/14/2012.

All Other Non-Energy Variables

Source: World Bank, World Development Indicators, 2012, Link: http://data.worldbank.org/data-catalog/world-development-indicators, accessed 30-Aug-12.

Oil Imports and Exports

Source: US Energy Information Administration, Link: http://www.eia.gov/petroleum/data.cfm#imports, accessed 30-Aug-12.

Brent Oil Prices (1984-86)

Source: British Petroleum, Link: http://www.bp.com/sectionbodycopy.do?categoryId=7500&contentId=7068481, accessed 30-Aug-12.

Brent Oil Prices (1987-2009)

Source: US Energy Information Administration, Link: http://www.eia.gov/dnav/pet/pet_pri_spt_s1_d.htm, accessed 30-Aug-12.

**Table 3. Fisher-type Augmented Dickey-Fuller Tests
for All Panels Containing Unit Roots**

	Inverse chi-squared	Inverse normal	Inverse logit t	Modified inv. chi-squared
	P	Z	L*	Pm
Current Account	338.90	-5.94	-6.60	8.22
	(0.000)	(0.000)	(0.000)	(0.000)
Government Deficit	329.86	-5.62	-6.18	7.75
	(0.000)	(0.000)	(0.000)	(0.000)
Trade Openness	186.55	-1.10	-0.95	0.24
	(0.393)	(0.135)	(0.170)	(0.406)
Oil Balance	244.23	-3.85	-3.93	3.26
	(0.001)	(0.000)	(0.000)	(0.001)
Age Dependency	412.48	-3.16	-5.05	12.08
	(0.000)	(0.001)	(0.000)	(0.000)
Savings	291.89	-3.07	-3.75	5.90
	(0.000)	(0.001)	(0.000)	(0.000)
Per Capita GDP	329.17	-5.06	-6.09	7.71
	(0.000)	(0.000)	(0.000)	(0.000)
Change, Trade Openness	1142.01	-24.00	-32.04	50.32
	(0.000)	(0.000)	(0.000)	(0.000)

Notes:

Probabilities are listed in parentheses below its test value.

Null hypothesis is that all panels contain a unit root.

Each variable is demeaned by its global average for that year to
indicate country's position relative to other countries.

Table 4. Results from Pesaran CDF Tests for
Unit Roots with Cross-Section Dependence

	Z[t-bar]	P-value
Current Account	-7.78	0.000
Government Deficits	-4.53	0.000
Trade Openness	-1.36	0.087
Oil Balance	-3.03	0.001
Age Dependency	-24.09	0.000
Savings	-2.82	0.002
Per Capita GDP (log)	-0.55	0.292
Change in:		
Trade Openness	-13.73	0.000
Per Capita GDP	-6.24	0.000

Notes:

Null hypothesis is that all panels contain a unit root.

All variables are country levels prior to adjusting for global averages.

Table 5. Coefficients for All Countries with Fixed Country Effects, 1984-2009

	Fixed b/se	Robust b/se	Robust Linear-Y b/se	Robust Oil Exporters/ Importers b/se
Age Dependency	-0.132**	-0.132*	-0.083	-0.089*
	(0.033)	(0.053)	(0.044)	(0.043)
Income per capita	-0.222	-0.222	0.195*	0.229**
	(0.137)	(0.288)	(0.086)	(0.086)
Income per capita^2	0.011**	0.011		
	(0.003)	(0.007)		
Government Surplus	0.360**	0.360**	0.359**	0.340**
	(0.033)	(0.068)	(0.068)	(0.069)
Trade Openness	0.029**	0.029	0.031	0.010
	(0.011)	(0.022)	(0.023)	(0.028)
Oil Trade	0.442**	0.442**	0.457**	
	(0.045)	(0.116)	(0.119)	
Oil Trade (+)				0.584**
				(0.133)
Oil Trade (-)				-0.007
				(0.243)
Adjusted R-sqr	0.693	0.693	0.691	0.695
Observations	1580	1580	1580	1580
F-statistic	60.8**	14.9**	16.0**	14.5**
AIC	9282.1	9280.1	9289.1	9269.9
BIC	9319.6	9312.3	9316.0	9302.1

Notes:

* p<0.05, ** p<0.01

Dependent variable is current account/GDP ratio.

Standard errors appear in parentheses.

Table 6. Coefficients for All Countries with Mean Group Estimator, 1984-2009

	Nonlinear-Y	Linear-Y	Oil Exporters /Importers
	b/se	b/se	b/se
Age Dependency	-0.092	-0.117	-0.132
	(0.166)	(0.110)	(0.119)
Income per capita	-0.609	0.130	0.392
	(0.833)	(0.346)	(0.380)
Income per capita^2	0.039		
	-0.027		
Government Surplus	0.040	0.099	0.027
	(0.055)	(0.053)	(0.054)
Trade Openness	-0.012	-0.005	-0.028
	(0.024)	(0.027)	(0.028)
Oil Trade	0.732**	0.666**	
	(0.111)	(0.114)	
Oil Trade (+)			0.911**
			(0.135)
Oil Trade (-)			-0.402
			(0.300)
Wald	47.500**	38.779**	50.956**
Observations	1573	1580	1573

Notes:

    * $p<0.05$, ** $p<0.01$

    Dependent variable is current account/GDP ratio.

    Standard errors appear in parentheses.

Table 7. Estimated Coefficients for Subsamples, 1984-2009

	Post-2003 b/se	Middle b/se	Rich b/se
Age Dependency	0.103	-0.242**	-0.024
	(0.145)	(0.064)	(0.055)
Income per capita	0.525	-0.218	0.445**
	(0.485)	(0.222)	(0.075)
Government Surplus	0.305**	0.482**	0.092*
	(0.089)	(0.105)	(0.036)
Trade Openness	-0.066	0.005	0.054**
	(0.035)	(0.040)	(0.016)
Oil Trade (+)	0.848**	0.585**	1.020**
	(0.110)	(0.134)	(0.151)
Oil Trade (-)	-0.132	0.043	0.353*
	(0.267)	(0.367)	(0.159)
Adjusted R-sqr	0.905	0.574	0.906
Observations	522	900	467
F-statistic	38.2**	26.7**	14.6**
AIC	2684.8	5485.9	2227.6
BIC	2710.4	5514.7	2252.5

Notes:

* $p<0.05$, ** $p<0.01$

Dependent variable is current account/GDP ratio.

Standard errors appear in parentheses.

Table 8. Coefficients Explaining Savings Rate, 1984-2009

	All b/se	Middle b/se	Rich b/se
Age Dependency	-0.274**	-0.381**	-0.133*
	(0.074)	(0.115)	(0.050)
Income per capita	0.207**	-0.186	0.268**
	(0.066)	(0.250)	(0.086)
Government Surplus	0.395**	0.471**	0.384**
	(0.063)	(0.106)	(0.081)
Trade Openness	0.059*	0.049	0.042
	(0.025)	(0.034)	(0.028)
Oil Trade (+)	0.565**	0.592**	0.599*
	(0.105)	(0.147)	(0.272)
Oil Trade (-)	0.017	-0.052	0.532*
	(0.298)	(0.404)	(0.198)
Adjusted R-sqr	0.800	0.750	0.934
Observations	1563	892	467
F-statistic	29.2**	20.2**	24.0**
AIC	8957.6	5282.5	2069.5
BIC	8989.8	5311.2	2094.4

Notes:

* $p<0.05$, ** $p<0.01$

Dependent variable is gross savings/GDP ratio.
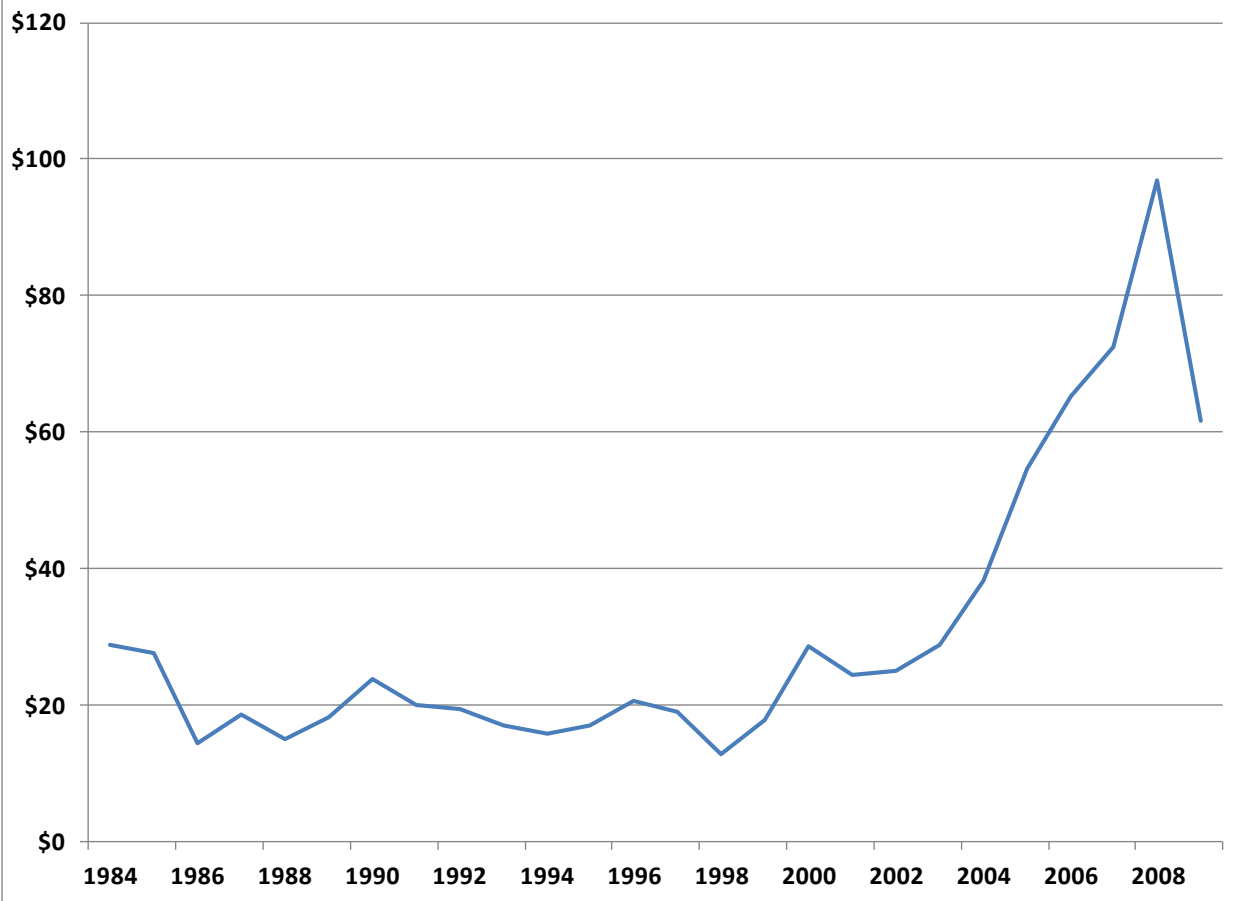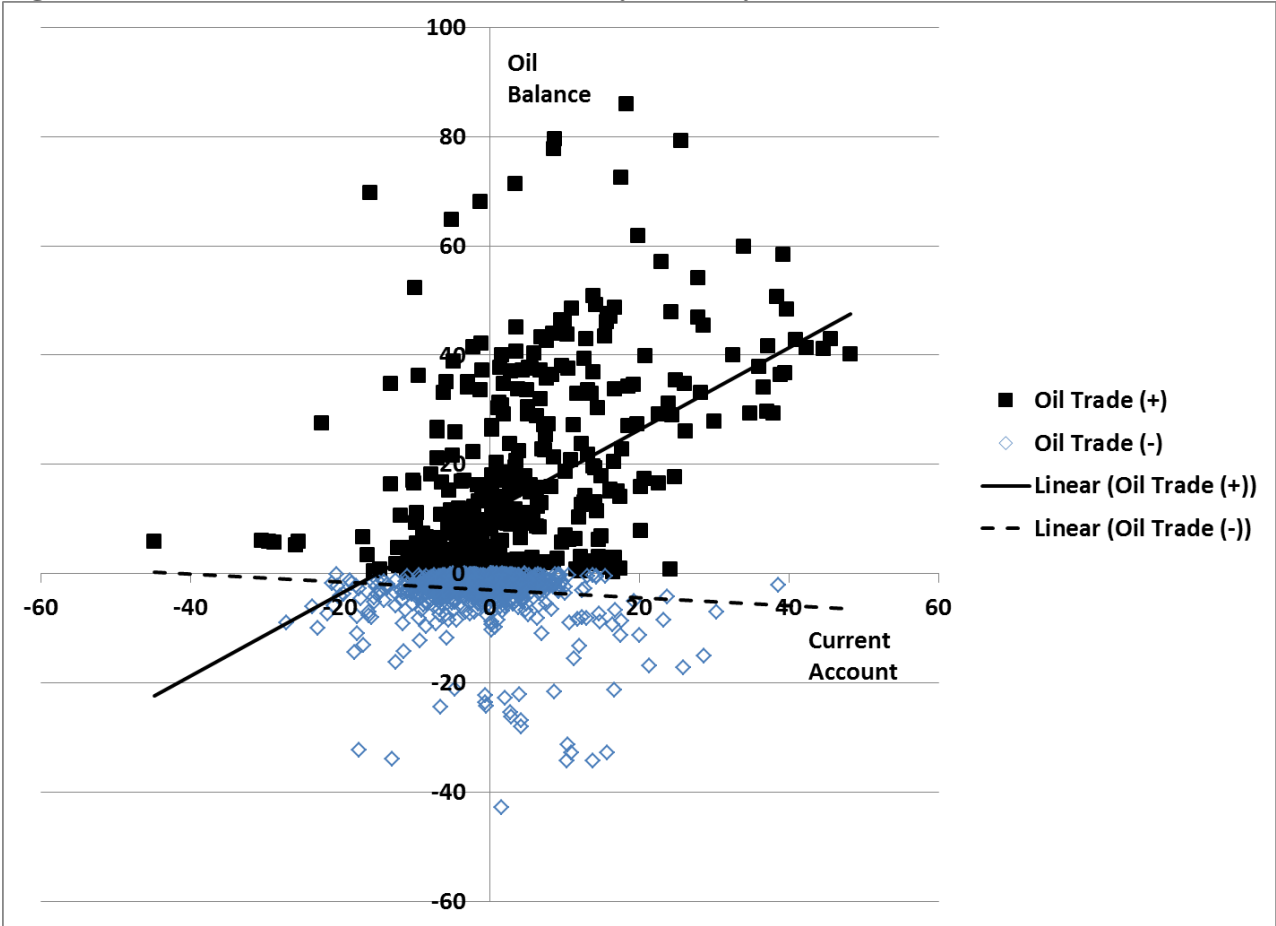
Standard errors appear in parentheses.

Figure 1. European Brent Crude Oil Price (nominal $ per barrel)

Source: See Table 2.

Figure 2. Oil Balance and Current Account by Country, 1984-2009

Data Source: See Table 2.

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Endnotes

[1] The analysis focuses upon current accounts which is a more comprehensive measure than the trade balance. It includes income from domestically owned resources in foreign countries and is therefore consistent with the Gross National Product accounts.

[2] Based upon data reported on the US Energy Information Administration's website, the normalized standard deviation for the monthly Brent crude oil price is 79.3 percent and that for monthly U.S. import levels is 20.7 percent since May 1987.

[3] Conceptually, the current account deficits by nation should balance out globally to equal zero, which it effectively is in Table 2 below.

[4] OECD data is the preferred data set by other researchers for government balances in OECD countries. These estimates are similar to those in the IMF data set but the latter provides incomplete coverage to several important OECD countries. The OECD data excludes data for countries outside the OECD. The IMF data is a useful source for exploring issues in the rapidly more dominant non-OECD countries. Later in the paper, separate regressions are reported for the wealthier and other countries.

[5] These unit root tests used the STATA routine, pescadf, authored by Piotr Lewandowski.

[6] The mean group estimator results are based upon the STATA routine, xtmg, authored by Markus Eberhardt.