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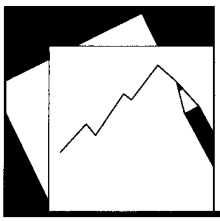

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Looking Beyond the Fiscal: Do Oil Funds Bring Macroeconomic Stability?

Ghiath Shabsigh and Nadeem Ilahi

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Prepared by Ghiath Shabsigh and Nadeem Ilahi[1]

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Abstract

Oil funds have become increasingly popular in oil exporting countries during the recent surge in oil prices. However, the literature on the contribution is small, tends to focus narrowly on their fiscal benefits, and concludes that they are redundant of such funds—in other words, that well designed fiscal management and policy are adequate substitutes for oil funds. This paper argues that a broader focus is needed in judging the effectiveness of such funds. We test whether oil funds help reduce macroeconomic volatility. The econometric estimation results from a 30-year panel data set of 15 countries with and without oil funds suggest that oil funds are associated with reduced volatility of broad money and prices and lower inflation. However, there is a statistically weak negative association between the presence of an oil fund and volatility of the real exchange rate.

JEL Classification Numbers: N1, Q38, Q43, Q48,

Keywords: Oil, oil funds, budget institutions, macroeconomic volatility, monetary policy, fiscal policy, real exchange rate, inflation, broad money

Author's E-Mail Address: gshabsigh@imf.org and nilahi@imf.org

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[1] Shabsigh is with the IMF Monetary and Capital Markets Department, and Ilahi is with Middle East and Central Asia Department. The authors are grateful to Klaus Enders, Aasim Hussain, Mohsin Khan, Lorenzo Perez and Eswar Prasad for helpful comments, and to Deborah Chungu for excellent research assistance.

Contents

I. INTRODUCTION

Oil funds are popular in oil exporting countries, and the recent upsurge in international oil prices has driven a number of oil and gas exporters to set up such funds. What benefits do oil funds bring to oil exporting countries? The existing evidence is limited; few studies empirically test the efficacy of oil funds. Most studies focus narrowly on the fiscal benefits—the role that oil funds play in reducing fiscal instability in the face of volatile international oil prices (see Davis, Ossowski, and Fedelino, 2003). The conclusion is ambivalent—oil funds have limited fiscal benefits and are largely redundant; instead, these benefits could be achieved by improving fiscal policy and administration. Furthermore, these studies find it difficult to ascertain the effect of oil funds from that of the overall policy environment or other country attributes.

This paper argues that to adequately judge the effectiveness of oil funds, there is a need to step back from a narrow fiscal focus and take a broader macroeconomic view. We posit that the benefits of the self-insurance provided by oil funds against volatile external inflows extend beyond the fiscal sector. By installing an oil fund, oil exporting countries may be able to lower the volatility of monetary aggregates and prices, and thus achieve greater overall macroeconomic stability.

We run tests on a panel dataset of 15 countries with and without oil funds spanning three decades. As an improvement on the existing literature, we are able to control for unobserved heterogeneity such as the time-invariant country policy environment or other fixed traits in our estimation of the relationship between macroeconomic volatility and the presence of oil funds. Notwithstanding data constraints—which include the absence of information on oil fund balances and on variables that capture growth or consumption volatility—we find that inflation and the volatility of broad money and prices are lower when an oil fund is in place than when it is not. However, we find statistically weak support for a similar effect on the volatility of the real exchange rate.

II. OIL PRICE VOLATILITY, THE MACRO ECONOMY AND THE RATIONALE FOR OIL FUNDS

Generally, there are two stated rationales for having an oil fund. Oil funds could be installed to guard against short term volatility in the international oil market or they could be a long-term saving instrument to transfer resources between generations, e.g., a future generations fund. Conceptually, by serving as an instrument of self-insurance an oil fund can provide macroeconomic stability (even a future generations fund can provide short-term stability). Two possible channels through which this can happen is that oil funds can smooth fiscal expenditures and provide a cushion to monetary policy in the face of volatile external inflows.

A. The Conventional View: Oil Funds as Fiscal Self-Insurance

Oil exporters face highly uncertain international prices and, as most oil proceeds belong to the government, price volatility can transmit to fiscal spending. Two factors may underscore the need to smooth government expenditures. First, external capital inflows tend to be pro-cyclical—in bad times, such flows either dry up or command heavy spreads (Engel and Meller, 1993), thus leaving oil exporting countries unable to substitute external borrowing for oil revenues during an oil price drop. Secondly, the benefits from increasing public outlay on lumpy investment projects in good times are often outweighed by the cost of shutting them down in bad times (Basch and Engel, 1993). Countries facing such constraints may place a high premium on liquidity (Davis, Ossowski, and Fedelino, 2003).

Despite the high volatility of global oil prices and the attendant risks borne by oil producers, insurance markets tend to be shallow and few oil producers have relied on them. Through the self-insurance it provides, an oil fund can help an oil exporter achieve a smoother path of fiscal expenditures than would otherwise be possible. Even those oil funds that are set up to provide long-term savings from one generation to another—rather than self-insurance against short-term volatility—offer an element of short-term security (Davis and others, 2001).

Existing studies on oil funds overwhelmingly focus on their fiscal aspects and find weak support of their effectiveness as self-insurance instruments. In the only quantitative study on oil funds to date, Davis and others (2001) assess the correlation between resource revenues and fiscal expenditures in oil fund and non-fund countries.[2] They find that some oil fund countries do exhibit a more limited expenditure reaction in response to resource revenue volatility than non-oil fund countries, but they also find that the establishment of an oil fund does not affect the relationship between government spending and resource export earnings. They ascribe their result to the presence of self-selection—countries that set up oil funds may be more prudent to start with, thus it would be inappropriate to attribute their good performance to oil funds. Nevertheless, they also acknowledge that in some cases oil funds may have helped maintain cautious policies.

Other studies also view oil funds narrowly as instruments of fiscal rather than macroeconomic stability (Fasano, 2000; Wakeman-Linn, Mathieu, and van Selm, 2003; and Engel and Meller, 1993). The Chilean Fund—a copper stabilization fund—is judged to have been successful especially because it helped reduce the correlation between natural resources revenues and government expenditures (Fasano, 2000). In Azerbaijan and Kazakhstan, the setting up of an oil fund enabled the authorities to disentangle tax-related decisions from the availability of easy oil money and allowed an increase in public expenditures to enhance productivity in the non-resource sectors (Wakeman-Linn, Mathieu, and van Selm, 2003). A recent review of economic performance in the middle east and central Asia region found that

[2] The sample used to test the hypothesis in Davis and others (2001) consists of four countries with oil funds. They run tests on the relationship between resource revenues and fiscal expenditures during periods with and without funds. Separate equations are estimated for each country, and no cross equation restrictions are imposed.

oil funds had improved oil revenue management and enhanced fiscal discipline (International Monetary Fund, 2005).

Conceptually, the usefulness of oil funds as self insurance has been widely questioned. It is commonly argued that because of persistence in global oil prices, oil funds run the risk of either accumulating resources endlessly or exhausting eventually, and are thus inherently inferior to contingent, market-based instruments (Davis and others, 2001. Devlin and Titman, 2004; and Daniel, 2003). The criticism may be valid, largely because of the inherently limited effectiveness of any form of self-insurance in the face of persistence of shocks. As to whether market insurance is superior to self-insurance, it is worth noting that while market- and self-insurance are substitutes, a combination of the two (i.e., an interior solution) may be the best strategy for an agent maximizing the expected utility of income (Ehrlich and Becker, 1972; and Gill and Ilahi, 2000). Thus oil exporting countries may be best served by relying on market insurance, provided such markets are complete and deep, as well as on their own savings. On the margin, the extent to which market insurance is superior to self-insurance is a positive function of the rarity of losses.

The debate on the effectiveness of oil funds is also part of a larger debate on the effectiveness of fiscal institutions in influencing government behavior and economic outcomes. Are such institutions merely veils—i.e., on their own, they add little to economic performance, and that the overall political economy, and policy environment are more likely to determine economic outcomes? Or do they have real effects? The veil argument overlooks the fairly large body of evidence that finds that institutions do matter.[3] Poterba (1996) argues that in the United States such institutions may have served as a form of self control imposed by fiscal actors on themselves. Alesina and others (1999) find procedures that include constraints on the deficit and are more hierarchical—in that they limit the role of the legislature in expanding the size of the budget and the deficit—are associated with smaller primary deficits.[4] To the extent that oil funds also limit the influence of fiscal actors on the budget and economic outcomes, it is plausible to view them as institutions that have real effects on economic performance.

While the view that oil funds are largely fiscal instruments that provide fiscal self-insurance is common, their role as instruments of macroeconomic stability has received only cursory attention. Some have alluded to their bluntness as instruments of macroeconomic policy and have argued that central bank reserves, the exchange rate policy regime and/or monetary policy may be better options (see, for example, Engel and Meller, 1993). As we argue below, this view is narrow and overlooks the potential role of oil funds as instruments of macro economic stability.

[3] See, for instance, a literature review in Fabrizio and Mody (2006).

[4] Also see von Hagen and Harden (1995) for similar results.

B. The Overlooked Aspect of Oil Funds: Instruments of Macroeconomic Stability

In an oil exporting country, the negative effects of international oil price volatility also extend to monetary policy, prices and the exchange rate. Sharp changes in international oil prices can affect monetary aggregates directly through volatility in external inflows, as well as indirectly through changes in fiscal responses to the shock. The monetary impact can in turn lead to price and exchange rate volatility as well as inflation. While disruptive effects of fluctuating prices, inflation and real exchange rate appreciation are commonly known, it is also worth noting that exchange rate volatility can be equally damaging to the non-resource sector, capital formation and overall economic growth (see, for example, Serven and Solimano, 1989). Again, countries facing such volatility may be willing to pay a risk premium to avoid, or insure against such risk.

Oil funds could help mitigate the transmission of oil price shocks to monetary policy and eventually to prices and the exchange rate. When some of the sterilization in response to an oil price hike (or stimulus when oil prices plummet) is conducted on the fiscal side through oil funds, there is a lesser burden on monetary policy. When the exchange rate is the nominal anchor and the policy burden lies with the fiscal authorities, building up or drawing down stocks of the oil fund can be particularly effective in achieving macroeconomic stability. In cases where money is the nominal anchor, but indirect instruments of monetary policy are underdeveloped oil funds can also play a useful monetary role (Wakemann-Linn, Mathieu, and van Selm, 2003). Arrau and Claessens (1992) observe that countries with oil funds appear to keep higher balances than could be justified for self-insurance reasons, partly because of "positive externalities"—when adjustment is costly, a high balance in the oil fund could provide the confidence of a stable exchange rate.

III. Empirical Specification and Data

A. Econometric Specification

We assess the impact of presence of an oil fund on macroeconomic volatility through econometric estimation. An issue that often plagues such estimation is that whether a country has an oil fund or not is not a random event, but rather could be based on time-invariant, but unobserved characteristics. Thus an estimation that does not control for such a problem is likely to give rise to the problem of unobserved heterogeneity and yield biased results of the effects of oil fund on macro volatility. We show below that an estimation strategy that compares the difference in outcomes between fund and non-fund countries in a cross section of countries, say through the use of dummy variables, suffers from this problem. Similarly, one that compares outcomes before and after an oil fund is installed in a sample of oil-fund-only countries (as in Davis and others, 2001) would suffer from a similar problem in that it would not allow for a comparison with a control group.

We utilize empirical strategies used in the labor economics literature to purge our estimation of the problems associated with time-invariant, unobserved heterogeneity (see Angrist and Krueger, 1998). Specifically, we use the case of the effect of unionization on wages, where unionization is not random, but rather, like the choice of an oil fund, a function of time-invariant, unobserved characteristics (Freeman, 1984).

Assume a country's macro volatility without an oil fund is given by:

$$V_i^{NF} = X_i'\beta + \varepsilon_i$$

where X_i consists of observed covariates and ε_i is a residual uncorrelated with X_i. The macro volatility with an oil fund could then be written as:

$$V_i^{F} = V_i^{NF} + \delta$$

where δ is the key coefficient of interest, capturing the effect of an oil fund on volatility, and is hypothesized to be negative. With the use of a dummy variable D^F which takes on a value of 1 if an oil fund is in place, and 0 otherwise, we can obtain:

$$V_i = X_i'\beta + D_i^F\delta + \varepsilon_i \qquad (1)$$

The problem with this specification is that oil fund status D^F is likely to be correlated with volatility without an oil fund (V_i^{NF}), even after controlling for covariates in X_i. For example, the deficiency of a country's policy environment in dealing with oil shocks may be associated with its propensity to use an oil fund. To the extent that the inability to adequately deal with oil shocks is something that is known to the country's policymaker but unobserved by the analyst (i.e., it is in ε_i), there would be an unobserved heterogeneity problem that would create a non-zero correlation between the regressors and the error term in (1). Thus an estimation of (1) through OLS would yield inconsistent estimates of the effects of oil funds on macro volatility.

One solution is to employ repeated country observations over time, i.e., panel data, and purge the unobserved heterogeneity. Rewriting the formulation in (1) in a panel format (i.e., $t = 1,...,T$ for each country) and including an unobserved, time-invariant heterogeneity variable α (as if it were observed), we get:

$$V_{it} = X_{it}'\beta_t + D_{it}^F\delta_t + \lambda\alpha_i + \xi_{it}$$

Where λ is the effect of the unobserved heterogeneity on volatility, and the error term ξ_{it} is uncorrelated with X_{it} and α_i by construction. Note that the causal effect of interest—the effect of an oil fund on volatility—is time varying in that up until the time period *T* countries can move in and out of oil funds. The identifying assumptions are that λ does not vary over time and $E(D_{it}^F\xi_{is}) = 0$ for $s = 1,...,T$.

Now since the heterogeneity variable α_i is indeed not observed and may not be of particular policy interest, the estimation strategy involves using multiple observations on a country to purge this variable. The most common formulation would be the fixed effects estimation that "demeans" the variables using country means:

$$V_{it} - \bar{v}_i = \beta'(X'_{it} - \bar{x}_i) + \delta(D^F_{it} - \bar{d}^F_i) + (\xi_{it} - \bar{\xi}_i) \quad (2)$$

An OLS estimation of the transformed formulation in (2) would yield unbiased and consistent estimates of the key coefficient of interest, δ. Note again that this estimated coefficient would no longer suffer from the doubt that countries that show a significant beneficial effect of the presence of an oil fund—as in the case of Davis and others, (2001)—may be doing so because of unobserved, time-invariant characteristics such as good policy environment and governance that do not change over time.

We run a set of three regressions, one for each dependent variable—a simple OLS with robust standard errors and two panel regressions, one with fixed effects and one with random effects, i.e., a one-way error correction model.

A set of variables that appropriately captures macroeconomic volatility should consist of volatility of growth, prices and monetary aggregates. The former could include volatility of GDP growth, or more specifically, that of non-oil growth. In addition, a good dependent variable candidate to test whether oil funds allow oil exporting countries to better smooth consumption is consumption volatility. We are unable to employ any of these variable because of severe data limitations—to construct an annual volatility variable we require monthly observations on the dependent variables (see below) and this information is typically not available for GDP, non-oil GDP or consumption volatility. We are thus restricted to using a narrow set of indicators of macroeconomic stability, namely, inflation and the volatility of prices, broad money and the real effective exchange.

B. Explanatory Variables and the Endogeneity Issue

To explain the volatility of broad money, CPI and REER, a number of right hand side variables are employed. Most importantly, an oil fund dummy is used; it takes on a value of 1 when an oil fund in present and zero when it is not. The significance and magnitude of the estimated coefficient of this dummy provides the critical test for judging the impact of the existence of oil funds on macroeconomic stability. Of course, a dummy variable is a blunt explanatory variable and a variable that captures the accumulated balance of an oil fund could be more useful in assessing the effect of an oil fund on macroeconomic volatility. However, given the lack of available information on oil fund transactions and balances in many oil fund countries, such a variable is impossible to construct.

The use of an oil fund dummy on the right hand side also raises the issue of potential endogeneity of this variable arising from time-varying factors, and thus calls into question whether such an econometric estimation allows us to establish causal relationships. First, the presence or absence of an oil fund could be a function of past fiscal and macroeconomic performance. For instance, the decision to set up an oil fund may not have been random, rather one taken after an episode of poor macroeconomic performance, thus exaggerating the effect of oil funds on macroeconomic performance. Second, both macroeconomic volatility

and the choice of an oil fund could be explained by an omitted third (time-varying) variable.[5] More generally, in assessing whether fiscal institutions help improve economic performance, the empirical comparative political economy literature has widely acknowledged the potential endogeneity of the former for these two reasons (see for instance, Acemoglu, 2005 for a detailed review).[6]

While many studies remain aware of the presence of the problem of endogenous fiscal institutions, none have as yet resolved it empirically because of the difficulty with identifying adequate instruments. It is practically impossible to find an exogenous component of fiscal institutions, and this is particularly true of oil funds. Nevertheless, in concluding his review of this problem, Acemoglu (2005) makes a persuasive case that while it may be impossible to correct for the endogeneity and thus establish causality between fiscal institutions and economic outcomes, robust non-causal relationships are nevertheless of value to policymaking. Given our inability to find adequate instruments of oil funds, we follow Acemoglu (2005) and argue that our results will point to robust non-causal relationships between oil funds and macroeconomic volatility.[7]

In addition to the oil fund dummy, we also employ a host of other control variables.

- A real GDP growth rate variable (annual) is employed to control for the effects of real output changes on the volatility of broad money, inflation and the real exchange rate.

- The importance of oil in total exports is used to control for the effect of oil dependence on macroeconomic variables.

- Oil prices changes are likely to have an important effect on macroeconomic volatility in oil exporting countries; the rates of growth of oil prices in contemporaneous and lagged form are used on the right hand side. In addition, periods of extreme intra-year variations in the international oil markets can affect macroeconomic volatility in oil exporting countries. We use time dummies for the years there was a sharp fluctuation in international oil prices.

- An important issue in judging the effect of an oil fund on the volatility of the real exchange rate is to control for the exchange rate policy regime. Countries with a fixed nominal exchange rate could exhibit a different effect of an oil fund on real exchange

[5] For instance, Perotti and Kontopolous (2002) observe that in assessing the effect of cabinet size on fiscal outcomes cabinet size would likely be endogenous because governments that are determined to run a loose fiscal policy might appoint a large cabinet because it facilitates the pursuit of this policy.

[6] Also see Stein, Talvi, and Grisanti, (1999), Fabrizio and Mody (2006), Alesina and Perotti (1995), and Perotti and Kontopolous (2002).

[7] To the extent possible, we try and avoid endogeneity problems from plaguing our results by using a lagged value of the oil fund dummy as it is unlikely that lagged values of oil fund dummy would be influenced by contemporaneous characteristics and variables (see Hviding, Nowak, and Ricci, 2004, for a similar treatment).

rate volatility than countries with more flexible arrangements.[8] We employ the ratio of broad money to GDP, an indicator of domestic financial depth, as a control for exchange rate policy (see Devereux and Lane, 2003, and Hviding, Nowak, and Ricci, 2004).[9,10]

C. The Data

Our sample consists of nine countries that have relied heavily on oil exports over some time in the past and had set up an oil fund—namely, Bahrain, Chile, Kuwait, Mexico, Norway, Oman, Sudan, Trinidad and Tobago and Venezuela.[11] Some other countries also qualified for inclusion in the sample but had to be excluded because of inadequate data.[12] In addition to the sample of countries with oil funds, a separate set of six oil exporting countries that have never used an oil fund was also used in the estimation, as a control group. These countries were: Egypt, Indonesia, Nigeria, Saudi Arabia, UAE and UK.

Figure 1 shows an even spread of the age profile of the oil funds in the sample countries—while five countries installed an oil fund in the last five years, three have had an oil fund for more than 15 years.[13] Also the sample is evenly spread across upper and middle income oil exporters and among new and old ones.

Given the importance of the decade of the 1970s for the oil market, we have tried to ensure the sample contains continuous data since that period. However, because of data gaps for some countries, the time period covered by the data varies by the dependent variable in question.

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[8] For instance, oil funds could be more important in reducing exchange rate volatility in the Persian Gulf oil exporters than in other countries, because the former overwhelmingly rely on the exchange rate as the nominal anchor.

[9] As a first choice we tried to utilize the wealth of information on de facto exchange rate regimes available from the recent paper by Rogoff and Reinhart (2002). However, their classification does not cover many of the countries in our sample, and thus is not possible to use.

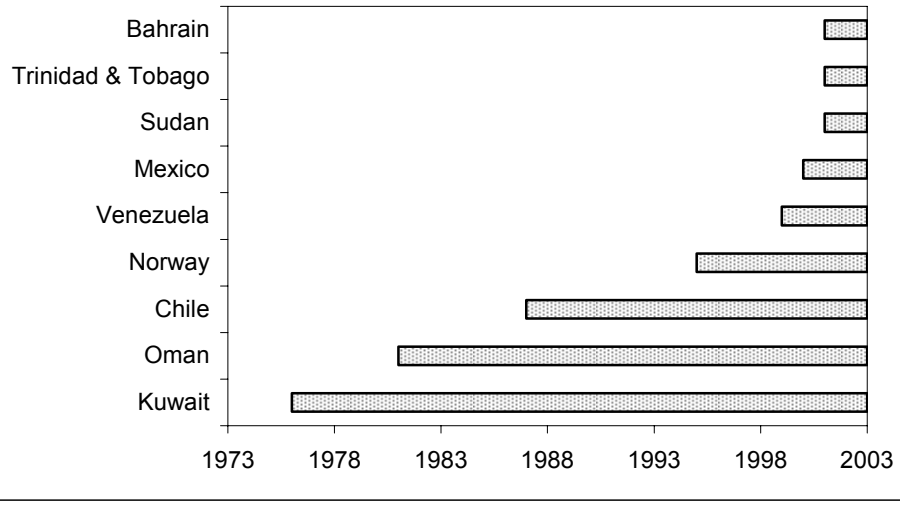
[10] For instance, the greater is domestic financial depth (the smaller are financial frictions), the less important is external financial dependence in determining the appropriate exchange rate policy (Devereux and Lane, 2003).

[11] In addition, Chile, which is a major copper exporter, is included in the sample because of its copper stabilization fund.

[12] Azerbaijan and Kazakhstan were excluded because of the lack of availability of adequate pre-independence data, i.e., prior to the early 1990s, while Algeria and Papua New Guinea were dropped because of missing observations on some of the dependent variables.

[13] To capture the time the fund began to have an economic impact, the date of start is the date the fund became effective or began accumulating resources.

Figure 1: Age Profile of Oil Funds



Annual information on broad money and CPI (including monthly observations for every year) is used for the period 1973-2003 (with the exception of the years 1977 and 1978 for which monthly information on broad money was missing for Chile).[14] The data for the real effective exchange rates (REER) are only available from 1980 onwards as most countries were not reporting exchange rate information to the IMF prior to then.

D. Summary Statistics

Summary statistics of the three dependent variables used in this paper—coefficient of variation of broad money, consumer price index and the REER and growth rate of CPI—as well as the independent variables are presented in Table 1. The information in table 1 is disaggregated by oil fund and non-oil-fund countries, the former further broken down by time periods with and without oil funds. A comparison of the means of variables in the nine oil fund country sample reveals a significant difference in macroeconomic volatility during the period an oil fund is under operation compared to the time when it is not—the mean coefficient of variation of broad money, CPI and REER are significantly lower when an oil fund is in place than when it is not.

[14] Source of the data used in this paper is the World Economic Outlook database, and IMF *International Finance Statistics*.

Table 1. Summary Statistics

	Oil fund Countries 1/						Non-oil fund		All Countries	
			Without Oil Fund		With Oil Fund					
	Mean	SD	Mean	SD	Mean	SD	Mean	SD	Mean	SD
Coefficient of variation										
Broad money	0.08		0.09		0.06		0.05		0.07	
CPI	0.05		0.07		0.02		0.03		0.05	
REER	0.04		0.06		0.03		0.05		0.05	
Oil fund (=1 if oil fund was in place that year; =0 otherwise)	0.36		0.00		1.00		...		0.23	
Oil fund country (=1 if country ever had oil fund; =0 otherwise)	1.00		1.00		1.00		...		0.64	
Financial Depth (broad money to GDP ratio)	0.12	0.09	0.11	0.08	0.14	0.10	0.11	0.08	0.12	0.09
Real GDP growth rate	0.04	0.08	0.03	0.06	0.04	0.10	0.05	0.10	0.04	0.09
Share of oil in total exports	0.48	0.30	0.40	0.30	0.62	0.24	0.56	0.31	0.51	0.30
Oil price growth rate	0.14	0.51	0.18	0.60	0.07	0.27	0.17	0.56	0.15	0.52

1/ Bahrain, Kuwait, Mexico, Norway, Oman, Sudan, Trinidad and Tobago and Venezuela plus Chile.

2/ Egypt, Indonesia, Nigeria, Saudi Arabia, United Arab Emirates and the United Kingdom.

There are surprisingly sharp differences in the dependent variables between oil fund countries (when they do not have an oil fund in place) and non-oil fund countries—with the former group displaying higher macro volatility. However, the two types of countries display similar means of most of the control variables. For the independent variables two things are worth noting. First, the share of oil exports in total is significantly higher when an oil fund is in place (62 percent) than when it is not (40 percent). Second, international oil price growth is much lower when an oil fund is in place (18 percent) than when it is not (7 percent).

IV. Empirical Results

A. Specification

Two specification tests were run to determine the appropriate estimation technique. An F-test for the null hypothesis that all country-specific effects are jointly zero had to be rejected in favor of the alternative that such effects were present in all the regressions. This points to the appropriateness of using fixed effects estimation over simple OLS regression.

To establish whether the error components model is appropriate, we conducted a Hausman test that determines whether the unobserved country effects are correlated with the included regressors (i.e. if the random effects specification is appropriate). The results in the tables below indicate that the null hypothesis could not be rejected for any of the equations. It is tempting to assume that random effects estimates should be preferred over fixed effects ones. However, it should be kept in mind that with large T (time periods) and small n (countries)—as is the case with our sample—the precision of the random effects estimator approaches that of the fixed effects one and the random and fixed effects estimates tend to be close (Wooldridge, 2002). Indeed our results show parameter estimates under the two specifications are almost identical.

The results of the tests for whether the presence of a fund helps reduce the volatility of macroeconomic variables are provided in Tables 2-4. As mentioned earlier, the volatility of the dependent variables is measured by their coefficient of variation—i.e., as the ratio of intra-year standard deviation (based on monthly observations) and intra-year mean. Inflation is measured as the growth rate of the CPI. To control for the effects of large outliers, a log transformation of the dependent variables is employed.

B. Estimation Results

The results in Table 2 indicate clearly that in our sample of oil fund and non-oil fund countries the volatility of broad money is significantly lower when an oil fund is present (as indicated by the estimated coefficient of the oil fund dummy) than when it is not. The magnitude of the estimated coefficient is high—the existence of a fund lowers the coefficient of variation of broad money by about 20 percent—and the statistical significance of the estimated coefficient is high and robust to the inclusion of other right hand side variables and selected time dummies.

Table 2. Panel Regression Estimates: The Effect of Existence of Oil Funds on Volatility of Broad Money in Countries With and Without Oil Funds

	OLS 5/		Country Fixed Effects		Random Effects	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
	Dependent Variable: Coefficient of Intra-year Variation of Broad money (log)					
Oil fund dummy (lagged) 1/	-0.30	-3.67	-0.19	-2.06	-0.20	-2.23
Oil fund country dummy 2/	0.41	5.94	...	...	0.39	1.57
Real GDP growth rate	-0.04	-0.11	-0.10	-0.33	-0.09	-0.32
Share of oil exports in total exports	-0.06	-0.66	0.12	0.71	0.08	0.54
Oil price growth rate	-0.20	-1.22	-0.09	-0.71	-0.10	-0.76
Oil price growth rate (lagged)	0.17	3.34	0.20	4.03	0.19	4.03
1973 dummy	0.35	1.83	0.30	1.90	0.30	1.91
1974 dummy	0.95	2.31	0.70	2.05	0.71	2.10
1979 dummy	0.21	0.84	0.09	0.39	0.09	0.43
1986 dummy	-0.43	-2.24	-0.36	-2.33	-0.37	-2.38
1998 dummy	-0.16	-1.3	-0.10	-0.70	-0.11	-0.74
2000 dummy	-0.04	-0.21	-0.12	-0.78	-0.12	-0.75
Intercept	-3.08	-45.08	-2.94	-32.16	-3.17	-14.79
F (13,378) 3/			13.61**			
Chi-square (11) 4/					0.75	

1/ =1 if country had an oil fund that year; =0 otherwise

2/ =1 if country ever had an oil fund; =0 otherwise.

3/ F-test for the null hypothesis that all country effects are zero; * (**) indicate rejection of the null at the 10 percent (5 percent) level of significance.

4/ Hausman test for the null hypothesis that the unobserved country effects are uncorrolated with the included regressors. ** (*) indicate significance at the 10 (5) percent levels.

5/ With robust standard errors.

Table 3 presents the results for prices—i.e., inflation and volatility of the CPI. The presence of an oil fund significantly lowers inflation after controlling for other variables, as well as unobserved heterogeneity (i.e., the fixed effects); the estimated coefficient indicates inflation is lower by one-quarter in countries with oil fund than ones without it. The results for the volatility of the CPI are stronger than those for the volatility of broad money. After controlling for the influence of other independent variables on the volatility of CPI, the estimated coefficient of the oil fund dummy is highly significant (at more than 1 percent level of significance) and suggests a lower CV of CPI by more than 80 percent when an oil fund is present than when it is not.

Table 3. Panel Regression Estimates: The Effect of Existence of Oil Funds on Inflation and Volatility of Prices in Countries With and Without Oil Funds

	OLS 5/		Country Fixed Effects		Random Effects	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
			Dependent Variable: Growth rate of CPI (log)			
Oil fund dummy (lagged) 1/	-0.17	-4.6	-0.26	-3.8	-0.23	-3.7
Oil fund country dummy 2/	0.13	3.5	...	...	0.16	2.0
Financial depth	-0.62	-3.2	-0.66	-1.7	-0.69	-2.4
Real GDP growth rate	-0.81	-2.2	-0.84	-3.3	-0.82	-3.2
Share of oil exports in total exports	-0.03	-0.6	0.17	1.5	0.07	0.7
Oil price growth rate	-0.87	-2.2	-0.79	-8.7	-0.81	-9.0
Oil price growth rate (lagged)	-0.06	-2.2	-0.06	-1.6	-0.06	-1.6
1973 dummy	...	...	...	...	...	...
1974 dummy	2.40	2.1	2.16	9.4	2.24	9.7
1979 dummy	0.95	1.9	0.83	5.6	0.87	5.9
1986 dummy	-0.46	-2.2	-0.42	-3.9	-0.43	-4.0
1998 dummy	-0.39	-2.5	-0.33	-3.2	-0.36	-3.4
2000 dummy	0.38	1.7	0.34	3.1	0.35	3.2
Intercept	0.29	6.0	0.30	3.9	0.24	2.7
F (11,328) 3/			5.6**			
Chi-square (11) 4/					1.90	
			Dependent Variable: Coefficient of Intra-year Variation of CPI (log)			
Oil fund dummy (lagged) 1/	-0.78	-5.9	-0.83	-6.1	-0.82	-6.0
Oil fund country dummy 2/	0.40	3.3	...	...	0.43	1.1
Financial depth	-3.95	-7.5	-2.69	-3.4	-2.92	-3.9
Real GDP growth rate	-1.03	-1.7	-0.80	-1.5	-0.82	-1.5
Share of oil exports in total exports	-0.31	-1.7	-0.32	-1.3	-0.34	-1.5
Oil price growth rate	-0.56	-2.4	-0.44	-2.4	-0.45	-2.4
Oil price growth rate (lagged)	0.04	0.6	0.07	0.9	0.06	0.9
1973 dummy	...	...	...	...	...	...
1974 dummy	1.63	2.9	1.21	2.6	1.24	2.6
1979 dummy	1.02	3.0	0.82	2.7	0.83	2.7
1986 dummy	-0.05	-0.2	-0.01	0.0	-0.01	0.0
1998 dummy	-0.35	-1.3	-0.27	-1.3	-0.28	-1.3
2000 dummy	-0.21	-0.7	-0.24	-1.1	-0.24	-1.1
Intercept	-3.15	-23.8	-3.03	-18.7	-3.31	-9.5
F (11,326) 3/			33.9**			
Chi-square (11) 4/					0.81	

1/ =1 if country had an oil fund that year; =0 otherwise

2/ =1 if country ever had an oil fund; =0 otherwise.

3/ F-test for the null hypothesis that all country effects are zero; * (**) indicate rejection of the null at the 10 percent (5 percent) level of significance.

4/ Hausman test for the null hypothesis that the unobserved country effects are uncorrolated with the included regressors. ** (*) indicate significance at the 10 (5) percent levels.

5/ With robust standard errors.

The results for the volatility of the real exchange rate, discussed in Table 4, are weaker than for the other two dependent variables. While the estimated coefficient of the oil fund dummy does indicate a 20 percent reduction in the CV of the REER when an oil fund is present than when it is not, the t-ratios indicate a borderline level of statistical significance and the result does not display robustness to the inclusion or exclusion of other regressors.

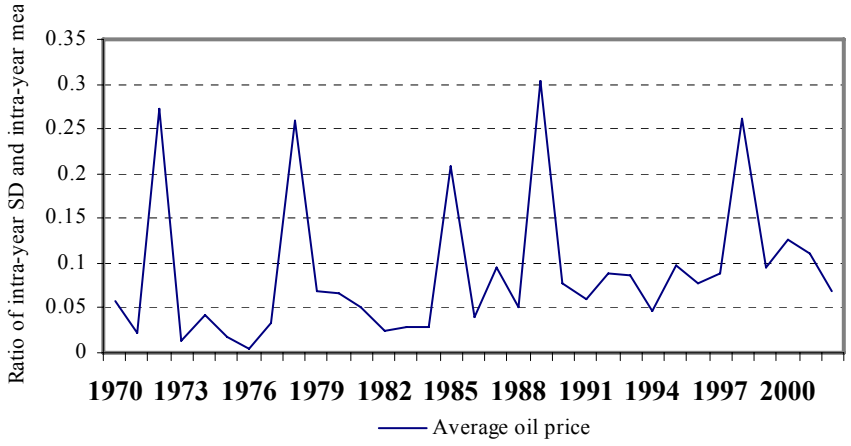
Table 4. Panel Regression Estimates: The Effect of Existence of Oil Funds on the Volatility of the Real Exchange Rate in Countries With and Without Oil Funds

	OLS 5/		Country Fixed Effects		Random Effects	
	Coefficient	t-ratio	Coefficient	t-ratio	Coefficient	t-ratio
	Dependent Variable: Coefficient of Intra-year Variation of REER (log)					
Oil fund dummy (lagged) 1/	-0.25	-2.7	-0.21	-1.7	-0.21	-1.6
Oil fund country dummy 2/	-0.05	-0.5	...	...	-0.08	-0.2
Financial depth	-1.27	-2.5	1.05	1.3	0.69	0.9
Real GDP growth rate	-1.77	-3.0	-1.65	-3.3	-1.67	-3.4
Share of oil exports in total exports	-0.09	-0.6	-0.14	-0.5	-0.17	-0.7
Oil price growth rate	-0.59	-2.5	-0.54	-2.6	-0.54	-2.7
Oil price growth rate (lagged)	-0.25	-2.8	-0.21	-2.1	-0.21	-2.1
1973 dummy	...	...	...	...	...	...
1974 dummy	...	...	...	...	...	...
1979 dummy	...	...	...	...	...	...
1986 dummy	0.09	0.3	0.09	0.5	0.10	0.5
1998 dummy	-0.30	-1.5	-0.27	-1.5	-0.28	-1.5
2000 dummy	0.27	1.6	0.25	1.2	0.25	1.2
Intercept	-3.06	-25.5	-3.37	-19.0	-3.26	-9.8
F (13,313) 3/			13.5**			
Chi-square (9) 4/					1.68	

1/ =1 if country had an oil fund that year; =0 otherwise
2/ =1 if country ever had an oil fund; =0 otherwise.
3/ F-test for the null hypothesis that all country effects are zero; * (**) indicate rejection of the null at the 10 percent (5 percent) level of significance.
4/ Hausman test for the null hypothesis that the unobserved country effects are uncorrolated with the included regressors. ** (*) indicate significance at the 10 (5) percent levels.
5/ With robust standard errors.

A greater financial depth is also associated with lower price growth and volatility, and the estimated coefficients have high statistical significance. This association highlights that a developed financial sector can help oil exporting countries self-protect against inflation and volatility, ceteris paribus. Again, the effect of financial depth on the real exchange rate is not statistically different from zero.

Figure 2:
Coefficient of Intra-year Variation of International Oil Prices



Our results show a nuanced effect of oil prices on macro volatility. The intra-year volatility of the CPI tends to rise during periods of falling oil prices, though this result captures the effect of annual (inter-year) changes in oil prices on intra-year volatility of the dependent variable—i.e., CPI becomes more volatile during periods that oil prices are declining. The independent variables used in the volatility regressions are based on inter-year variation, largely because country-specific data on intra-year prices are not available. If the intra-year volatility in oil prices were declining over time then that would explain the decline in

volatility of the macroeconomic variables. However, this can be ruled out—a look at international oil prices reveals that their intra-year CV has been increasing since the 1970s (see Figure 2).

One possible channel through which oil funds can lower macro volatility is if they indirectly dampen the effects of volatile international prices. We tested if the presence of an oil fund mitigates the effect of international oil prices on macroeconomic volatility. We tried interaction terms between the oil fund dummy and oil prices (lagged, contemporaneous or both) as additional explanatory variables. The results did not indicate a significant relationship.

Two useful results for REER volatility merit a mention. First, a drop in annual real GDP growth significantly increases REER volatility; the estimated coefficient is of high statistical significance and is robust to the inclusion of other regressors. Second, as in the case of volatility of CPI, falling oil prices (i.e., a year to year fall) induces greater intra-year real exchange rate volatility.

V. Conclusions and Policy Implications

The results in this paper provide support for a hitherto overlooked benefit of oil funds: that they provide self-insurance against macroeconomic volatility. The results indicate a robust negative relationship between the presence of an oil fund and inflation and the volatility of broad money and prices in oil exporting countries. The results for the volatility of the real exchange rate are weaker, and it is probable that this weakness is because of the role of other variables that comprise the real effective exchange rate—mainly, the foreign nominal exchange rates and inflation.

The results also appear to contradict the commonly held view that oil funds may simply be "veils"—i.e., their apparent success may be ascribed to the inherent prudence of the countries that adopt them, and that in and of themselves, they do not affect economic performance. Compared to other work on oil funds, we are able to control for time-invariant unobserved factors that may be correlated with the decision to have an oil fund. Through the use of panel data and fixed effects estimation we show that, regardless of the time invariant policy environment, country capacity or other unobserved factors, the presence of an oil fund is negatively associated with the volatility of macroeconomic variables.

Nevertheless, while we are able to control for the time-invariant policy environment in the relationship between macroeconomic volatility and oil funds, we are unable to control for the role of time-varying factors and endogeneity of oil funds because of a lack of adequate identifying instruments. Thus, our results should be interpreted with caution in that they do not point to the existence of causality, but rather to a robust non-causal association.

Two more caveats are worth mentioning. First, partly because of the lack of information on balances in oil funds, we are unable to investigate the optimal level of oil fund savings that bring such benefits. Second, we do not tackle the proverbial issue of whether oil funds help oil exporting countries avoid Dutch disease effects; this is perhaps a topic best left for another paper.

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