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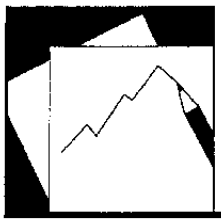

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Operational Aspects of Fiscal Policy in Oil-Producing Countries

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Operational Aspects of Fiscal Policy in Oil-Producing Countries

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Abstract

Oil-producing countries face challenges arising from the fact that oil revenue is exhaustible, volatile, and uncertain, and largely originates from abroad. Reflecting these challenges, the paper proposes some important general principles for the formulation and assessment of fiscal policy in these countries. The main findings can be summarized in some key guidelines: the non-oil balance should feature prominently in the formulation of fiscal policy; it should generally be adjusted gradually; the government should strive to accumulate substantial financial assets over the period of oil production; and, where necessary, strategies should aim at breaking procyclical fiscal responses to volatile oil prices.

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I. Summary and Conclusions

The unique fiscal challenges for an oil-producing country stem from the fact that oil revenue is exhaustible, volatile, and uncertain, and largely originates from abroad. The exhaustibility of oil raises complex issues of sustainability and intergenerational resource allocation. The uncertainty and volatility of oil revenue complicates macroeconomic management and fiscal planning—with the challenge being to avoid transmitting the oil price volatility, which is outside the control of policymakers, into the macroeconomy. Finally, since oil revenue often represents transfers from abroad, changes in oil revenue drive movements in the overall fiscal balance that do not directly affect domestic demand. The fiscal use of these resources, however, has significant consequences for the domestic economy.

Reflecting these challenges, the paper aims at deriving some general principles that are important for formulating and assessing fiscal policy in oil-producing countries. Oil-producing countries are, themselves, however, not homogeneous. There is wide variation in areas such as the relative importance of oil to the economy, the size of oil reserves, maturity of the oil industry, ownership and taxation structure in the oil sector, stage of development of the non-oil economy, and government financial position—all of which would affect fiscal policy decisions. Thus, what follows is necessarily general, and certain principles may apply more to some countries than others. The main findings can be broken down into three key guidelines.

First, the non-oil balance should feature prominently in the formulation of fiscal policy. Decomposing the overall balance into an oil and non-oil balance is critical for understanding fiscal policy developments, evaluating sustainability, and determining the macroeconomic impact of fiscal policy. Indeed, highlighting the non-oil balance in the budget would itself be an important step toward improving fiscal policy.

Second, the non-oil balance, especially expenditure, should generally be adjusted gradually. Large swings in fiscal policy—as measured by the non-oil balance—are destabilizing to aggregate demand, exacerbate uncertainty, and induce macroeconomic volatility. Moreover, from a purely fiscal perspective, large swings in expenditure are difficult to manage and reduce its quality and efficiency.

Third, the government should strive to accumulate substantial financial assets over the period of oil production. Oil extraction should be viewed as a portfolio transaction whereby oil wealth is transformed into financial wealth—implying oil revenue is conceptually more like financing than income. Asset accumulation over the years of production needs to be sufficiently large to sustain fiscal policy in the post-oil period.

The above guidelines are theoretically straightforward; nonetheless, they are often not followed in practice. For example, few oil-producing countries publish or include an analysis of the non-oil balance in the budget. At the same time, an excessive focus on the overall balance often leads to fiscal policy (as measured by the non-oil balance) moving in tandem with oil revenue, resulting in a volatile non-oil fiscal deficit with concomitant adverse

macroeconomic and fiscal consequences. And, despite years of oil production, many oil-producing countries have not accumulated financial wealth and have substantial net financial liabilities, raising questions about their fiscal sustainability.

Given the heterogeneity of oil-producing countries and the broad scope of this paper, it is not practical to draw quantitative conclusions as to the desirable non-oil deficit. Such determinations ultimately depend on country-specific factors, including the country's macroeconomic objectives. Nonetheless, the following considerations should help determine appropriate ranges for the non-oil deficit.

First, many oil-producing countries can, indeed, afford to run potentially sizable non-oil deficits. Analogous to a permanent income consumer, decisions on the non-oil deficit should be based on assessments of government wealth (including oil wealth), rather than on current oil income. There are strong precautionary motives, however, that would justify fiscal prudence, including enormous uncertainty regarding oil wealth.

Second, as in any economy, fiscal policy in oil-producing countries needs to support the broader macroeconomic objectives. These include macroeconomic stability, growth, and an efficient allocation of resources.

Third, as a result of procyclical fiscal policies and recurrent fiscal deficits, many oil-producing countries face interest rate premiums on sovereign debt and liquidity constraints related to sustainability and other policy concerns that restrict their ability to accommodate oil revenue fluctuations. These countries should pursue fiscal strategies aimed at breaking procyclical fiscal responses to volatile oil prices, targeting prudent non-oil fiscal balances, and reducing the non-oil fiscal deficits over time.

The remainder of this paper further explores and expands upon the above points. Section II focuses on long-run considerations pertinent for determining ranges for the size of the sustainable non-oil deficit. Section III discusses how, in formulating fiscal policy, this long-run perspective needs to be supplemented by a number of key short-run considerations.

II. Assessing the Fiscal Stance in the Long Run

An assessment of whether a fiscal policy is sustainable, let alone optimal, is especially challenging in an oil-dependent economy.[2] The dependence of revenue on oil proceeds, which are volatile, unpredictable, and exhaustible, significantly complicates fiscal management in the short and long runs. This section aims to characterize the fiscal policy consistent with long-run considerations, accepting that fiscal policy may need to deviate from this in the short run (as discussed in the next section).

[2] Chalk and Hemming (2000) provide a survey of fiscal sustainability in general, and include a section addressing countries dependent on non-renewable resource earnings.

Several studies have empirically examined the sustainability of fiscal policy in selected oil-producing countries. Tersman (1991); Liuksila, García, and Bassett (1994); and Chalk (1998) employed a framework focused on government wealth, inclusive of oil in the ground—similar to the analytical framework adopted below. The underlying question addressed below, however, goes beyond sustainability, and focuses on the more normative question of how the government should allocate resources over time.

A. Government Wealth and Permanent Income

The analysis follows what might be considered the standard theoretical approach to the problem.[3] The oil variable of primary interest is oil wealth, defined as the present discounted value of future oil revenue. Fiscal proceeds from oil are then viewed not as income, but rather as financing; specifically, a portfolio transaction that converts oil assets into financial assets. The long-run challenge for fiscal policy is to decide how to allocate government wealth (including the oil wealth) across generations. This challenge, reflecting a concern for intergenerational equity, should be met by targeting a fiscal policy that preserves government wealth—appropriately defined, inter alia, to include oil. Finally, and analogous to the standard permanent income arguments put forth by Friedman, the preservation of wealth would require that consumption in each period be limited to permanent income or, in this case, the implicit return on government wealth.

More formally, the optimal fiscal policy is defined as the path of non-oil revenue and primary government spending that maximizes the government's social welfare function. Appendix I develops and discusses the setup in greater detail. Nonetheless, a few observations are warranted. First, given the focus on intertemporal considerations, the analysis and exposition can be simplified by focusing on a measure of the deficit—which is ultimately what governs the transfer of resources between periods—rather than the specific mixture of taxes and spending. Second, the pertinent deficit measure to substitute into the social welfare function is the (primary) non-oil deficit, which makes explicit that revenue excludes oil income on the grounds that it is more like financing.

This highly stylized and simplified framework is capable of illustrating some of the main points of the analysis. A simulation of the evolution of fiscal policy in such a framework helps develop the intuition. Figure 1 (top panel) shows the time path of fiscal revenue—assuming constant non-oil revenue—in an oil-producing economy, which highlights the substantial drop in revenue that will occur when oil is exhausted or becomes obsolete (see Appendix I). However, since there is no uncertainty, the government knows what its wealth is, and can easily determine the optimal non-oil deficit—which is set equal to the return on its wealth. All the fiscal variables are now fully specified, and the evolution of the different balance measures and government debt can be simulated. The simplicity of the framework allows for a clearer understanding of the driving forces; nonetheless, the results and the

[3] In addition to the above papers, other examples include Alier and Kaufman (1999); Bjerkholt (2002); Engel and Valdés (2000), and Hausmann, Powell, and Rigobón (1993)—although some of these studies go on to develop alternative models.

underlying intuition should be quite robust to the addition of complicating features, some of which will be discussed later.

First, the primary non-oil balance provides the most useful indicator for measuring the direction and sustainability of fiscal policy. Fiscal policy, in this framework, is essentially constant as both non-oil tax revenue and (primary) government spending are held constant (as a share of non-oil GDP). However, as shown in Figure 2 (top panel), of the various fiscal balance measures only the primary non-oil balance is constant throughout. Even though fiscal policy is not changing, the other balance measures are moving due to other factors. The non-oil balance, for example, steadily increases over time as the existing debt stock is paid off and income-generating assets are accumulated.[4] The primary balance and the overall balance are affected by oil revenue, and thus move dramatically when oil revenue is exhausted. In a more general sense, this figure suggests that the government's objective boils down to choosing a primary non-oil deficit consistent with fiscal sustainability.

The importance of focusing on the primary non-oil balance is highlighted when oil price volatility is incorporated. Figure 2 (bottom panel) is a repeat of Figure 2 (top panel); however, instead of using a constant oil price, the actual series of oil prices over the last 20 years is used.[5] The overall and primary overall balance now swing wildly with the movements in oil prices, again even though fiscal policy is unchanged. Focusing on an overall balance measure would thus give a misleading impression as to developments in fiscal policy. For example, despite substantial increases in the primary surplus in some periods, it would not be appropriate to claim that there was fiscal consolidation—a term which implies a deliberate effort to adjust the fiscal position. All that has happened is oil prices have increased. Changes in the primary non-oil balance should be used as the basis for determining whether there has been a fiscal consolidation. The importance of other balance indicators will be discussed in Section III.

Second, in order to sustain the non-oil deficit when oil has been exhausted, the government should accumulate assets. Specifically, there should be enough accumulated assets for the *return* on those assets to finance the non-oil deficit once the oil revenue has dried up (see the bottom panel of Figure 1). In contrast, a strategy of targeting a non-oil deficit that would be financed by drawing down accumulated assets once oil production ceases would not be sustainable. Such a strategy would eventually deplete all of the assets, leading subsequently to steady government borrowing and explosive debt dynamics. The general conclusion is that fiscal policy should be targeted at accumulating substantial assets during the period of oil production to sustain the non-oil deficit in the post-oil period. Therefore, strategies aimed at stabilizing the (positive) net debt to GDP ratio or even just eliminating all debt would not

[4] The return on assets is treated as interest income and, therefore, is not included in the primary non-oil balance.

[5] In keeping with the spirit of the simplified framework, it is necessary to assume that all of the oil price movements were known with certainty. To generate a 40-year simulation, the last 20 years of prices were repeated. Also, the oil price series is normalized such that the present discounted value of wealth, and thus the primary non-oil deficit, is the same as in Figure 2.

generally be consistent with fiscal sustainability. Such strategies would result in either the need for substantial fiscal adjustment or explosive debt dynamics in the post-oil period.

Third, government wealth (including the present discounted value of oil revenues), rather than the flow of oil revenue, determines the sustainable non-oil deficit. In this framework, the government would choose a constant primary non-oil deficit (Figure 2)—since there is no uncertainty about either oil or non-oil revenue. Intuitively, and as pointed out by Hausmann, Powell, and Rigobón (1993), the government behaves as if it sold all of its oil immediately, thus effectively transforming the flow of oil revenue into a stock of financial assets. While the constant primary non-oil deficit follows from the simplifying assumptions, the underlying intuition that non-oil balance should be related to government wealth would generally apply.

The above policy guidelines are of significant practical importance as, by and large, many oil-producing countries would seem to fall short of achieving them. For example, few oil-producing countries highlight the (primary) non-oil balance in their budgets. Within the Fund, however, there has been an increasing trend toward presenting the non-oil deficit in country documents. As to the accumulation of financial assets, many oil-producing countries have sizeable sovereign net financial liabilities. In mature producers, such liabilities send a potentially troubling signal about the sustainability of fiscal policy, and are a source of fiscal vulnerability, especially when oil prices fall. At the same time, while not highlighted above, having oil wealth does afford the luxury of being able to sustain, if properly managed, a potentially sizeable primary non-oil deficit.

B. Sovereign Premiums, Precautionary Motives, and Capital Spending

Sovereign premiums

Many oil-producing countries pay a sovereign premium, suggesting that this is an important consideration for assessing fiscal policy. For present purposes, the reasons underlying the sovereign premium are not as important as its existence. Moreover, these premiums can be quite substantial (Table 1). The presence of a sovereign premium alters the problem because the government would now face two interest rates, a higher one for borrowing and a lower one for its gross savings. This functions much like a soft form of liquidity constraints—soft in the sense that the government can borrow, but only at a premium, and thus is not technically liquidity constrained.

Table 1. Selected Countries: Ratings and Spreads on Sovereign Debt

	Spread (basis points)[1]		Rating[2]	
	Nov. 15, 2000	Nov. 15, 2001	No v.15, 2000	Nov. 15, 2001
Ecuador	1,332	1,333	B-	CCC+
Mexico	354	348	BB+	BB+
Nigeria	2,001	1,657	...	...
Russia	1,070	809	SD	B
Venezuela	887	1,073	B	B
Memorandum items:				
EMBI+	775	1,025		
Oil Price (US$, monthly average.)	32.34	18.66		

Source: Bloomberg.
[1]Based on debt included in the J.P. Morgan EMBI+.
[2]Standard and Poor rating of sovereign long-term foreign currency debt.

A government that pays an interest rate premium on its sovereign debt should pursue a more conservative fiscal policy. Specifically, the government should strive to rapidly pay off its expensive debt. Once the sovereign premium is eliminated, then it would behave as the government in the above framework. The intuition is that the premium paid on debt increases the return to savings (while debt is positive) and thus would induce the government to save more in order to exploit the temporarily high interest rates. Compared to the above framework, the primary non-oil deficit would be smaller while the government has positive debt, with the primary non-oil deficit gradually increasing as the debt is reduced. From a policy perspective, the implication is that governments that pay a sovereign premium should pursue even more conservative policies than they otherwise would—they should spend less than the return on their wealth until the sovereign premium is eliminated.

Precautionary motives

The government of an oil country is confronted with significant uncertainty, including as regards oil wealth. The volatility of oil revenue due to swings in oil prices is problematic, especially for short-run macro-fiscal management, but it is the uncertainty regarding oil wealth itself that is most important for long-run considerations. Therefore, more than the volatility of prices, it is the uncertainty about the future path of prices—including the statistical properties of oil prices (see below)—that leads to enormous uncertainty about oil wealth. Additional complicating factors include uncertainty about oil reserves and the cost of extracting them. The following discussion looks at how the presence of these uncertainties would affect the optimal size of the non-oil deficit.[6]

In the standard consumption problem, an increase in uncertainty generally leads to more conservative consumption decisions. For example, adding income uncertainty to a perfect foresight consumption model would generally lead to an equilibrium with higher savings. This is referred to as precautionary savings—see Deaton, 1992, for a general discussion. Key for this result is that economic agents are risk averse. Given risk aversion, the intuition is that agents are concerned about the possibility of negative shocks, which would lead them to build up more assets than under conditions of certainty. The larger assets would effectively serve as an insurance policy should there be a bad realization of income.

Analogously, uncertainty about oil wealth would lead a government, for precautionary reasons, to incur a smaller primary non-oil deficit. Since projections of oil wealth are surrounded by considerable uncertainty, the precautionary motive could be quite strong. Uncertainty would depend, inter alia, on estimates of the size of oil reserves and the path of future production. A country with fewer years of production left would face less wealth uncertainty, with, at the limit (end of oil extraction), all oil-related uncertainty fully resolved.

[6] The potential role of precautionary motives has been cited by others, for example Tersman (1991) and Bjerkholt (2002), but, with the exception of Engel and Valdés (2001), has not featured prominently in the literature.

The fact that uncertainty about oil wealth is gradually reduced over time adds a unique dimension to the problem for oil-producing countries. As reserves decline, the precautionary motives would abate. Moreover, a large stock of financial assets should also have been accumulated as the end of production nears, so the uncertainty about the value of remaining oil reserves—especially in relation to the stock of assets—would be small. The reduction in uncertainty would cause a concomitant fall in the importance of the precautionary motive for determining the size of the non-oil deficit. This has consequences for the discussion below about the sensitivity of government spending to price changes.

Bird-in-hand consumption

Bjerkholt (2002) has argued the merits of a rule that targets a non-oil deficit equal to the anticipated return on existing financial assets. He describes this as the bird-in-hand rule, since spending decisions are predicated only on the assets already in hand. In contrast, the above permanent income type framework implies that the size of the primary non-oil balance should be determined by looking also at the expectations of government wealth.

The bird-in-hand rule implies a very conservative approach that could be viewed as an extreme form of precautionary saving, in that it is tantamount to assuming that there would be no future oil revenues. However, prior to the exhaustion of oil reserves or their obsolescence, oil wealth would be greater than accumulated financial wealth, and the rule would thus lead to very restrictive primary non-oil deficits.[7] In this regard, it serves as a lower bound to the solution of the framework that includes precautionary motives. This suggests that the optimal size for the primary non-oil deficit lies above that implied by the bird-in-hand rule but below that of the certainty equivalent framework above.

Obsolescence

The bird-in-hand rule highlights the potential for a shock to reduce the value of remaining oil reserves to zero. Technological advances, for example, could lead to alternative fuel sources that are more efficient and cost effective. Oil would not actually have to become obsolete, but rather its price would just have to fall to such a level that it is no longer cost effective (at least for most producers) to extract.

The possibility of obsolescence, even remote, creates an additional incentive for precautionary saving. Intuitively, the government would be very concerned about even the remote possibility that oil would become obsolete, an event which would entail the need to reduce significantly the non-oil deficit because of the sharp reduction in wealth associated with the loss of future oil earnings. This concern is manifested in higher savings, as the government attempts to insure itself against such an eventuality by accumulating financial assets.

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[7] The rule is more applicable to countries with positive net financial assets. In countries with negative net financial assets, the rule would entail running primary non-oil surpluses.

Capital expenditure

Fiscal sustainability analyses often do not distinguish between capital and current expenditure. If, however, government investment is assumed to be productive in the sense that it boosts output, then investment decisions would be based on the return that the government can get, and the problem would boil down to a portfolio decision between financial and physical assets. Alternatively, government investment could be viewed as if it were a consumer durable, in the sense that the stock of government capital generates social welfare rather than a financial return. As discussed below, these two approaches have significantly different implications.

Productive spending

Government investment in public infrastructure should arguably have a positive impact on growth. In a review of the literature, however, Gramlich (1994) highlights that estimates of the productivity of public infrastructure vary widely, ranging from zero to higher than the return to private capital. For present purposes, the actual productivity of such public infrastructure is less important than the possibility that public infrastructure could be productive. The government is then faced with a portfolio choice regarding the composition of financial versus physical assets. The following conclusions should be taken into account.

First, the return to government investment would have to be quite high for the government to undertake it without a change in fiscal sustainability. Unlike the private sector, the government's financial return is largely limited to what it can recover through higher tax revenue. For a project to be worthwhile—in the sense that it will pay for itself via future returns—output would have to increase substantially (Fischer and Easterly, 1990). For example, with a tax rate of 20 percent, the marginal product of capital would have to be five times the interest rate.

Second, the analysis is not directly affected by the presence of oil wealth. An oil-dependent economy would, in this respect, behave no differently than any other economy: it should borrow to undertake any capital spending that would pay for itself via higher future tax revenues. The productivity of government capital (a supply consideration) and the cost of capital determine the desired stock of government capital. Wealth, oil or otherwise, should not directly impact this decision. There may, however, be an indirect effect to the extent that the presence of (or changes in) oil wealth may lower the cost of capital—although, as noted earlier, many oil producers pay a sovereign premium. Conceptually, there is no reason to believe that the surprise discovery of oil, for example, would change domestic supply conditions so as to increase the productivity of (non-oil) government capital.[8]

The rationale for higher government investment often applied to new oil producers is that there are substantial development needs and an insufficient stock of government capital.

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[8] Rodríguez and Sachs (1999) show that over-investment could explain the sluggish growth performance of resource-dependent economies.

However, the discovery of oil would not make such investments (in the non-oil sector) more worthwhile, although, as noted above, the discovery of oil could lower the cost of financing for the government. Ultimately, the decisions confronting such countries are the same as those faced by any other country, and boil down to determining whether the financial return from the investment justifies its expense—a calculation that is independent of oil wealth.

Durable consumption

In contrast, modeling government capital spending as being more akin to durable consumption yields different results. In this interpretation, the government undertakes capital spending not because the capital is productive, but rather because it yields a flow of social benefits. That is, once built, government capital provides benefits for many years. The government thus has two types of consumption, durable goods (capital spending) and non-durable goods (current spending).

Viewing capital spending this way would provide a rationale for larger non-oil deficits following an increase in expected government wealth. This has intuitive appeal for many oil-producing countries, especially the new producers. With the discovery of oil, such countries are wealthier and thus justified in wanting to boost consumption (increase the non-oil deficit). The stock of government capital goods—here seen as durable public goods—could in this case be too low, even assuming it had been at the right level just before the discovery of oil. In other words, the desired stock of public capital goods would be higher for a wealthier country, provided government capital is a normal good.

The durable consumption view of government capital would provide a rationale for a tilted pattern of deficits. Specifically, larger primary non-oil deficits would be incurred until the government capital stock reached its new and higher equilibrium level. Even in this case, however, precautionary motives and liquidity constraints as discussed above would maintain their relevance. Indeed, under the assumption that government capital is less liquid than financial assets, the precautionary motives would likely be heightened.

Oil price sensitivity

An issue that was touched upon, but not explicitly addressed above, relates to how sensitive the primary non-oil balance should be to movements in oil prices. As discussed in the next section, in many oil-producing countries government spending has been positively related to oil prices. At the same time, the above analysis emphasized that the primary non-oil balance should respond to changes in oil wealth. The extent that oil price changes translate into changes in oil wealth is thus of fundamental importance for determining how sensitive government spending should be to oil price changes. This question, in turn, depends on the statistical properties of oil prices.

There is evidence that, although oil prices are periodically subject to permanent shocks, most oil price changes have a significant transitory component.[9] This would imply that

[9] See for example Engel and Valdés (2000), and Barnett and Vivanco (2002).

expectations about long-run wealth would not change that much with a given oil price change. Therefore, based on sustainability considerations, government spending should not be that sensitive to changes in oil prices.[10] However, this needs to be interpreted carefully, because wealth itself is not known with certainty. Indeed, there are numerous factors that lead to great uncertainty about wealth, including parameter uncertainty, uncertainty about future shocks (which have a minimal effect), the possibility of a structural break in oil prices (including obsolescence), and uncertainty about the amount, quality, and ease of extraction of oil reserves. The substantial uncertainty about wealth would imply that precautionary motives would be particularly strong.

Alternatively, assuming oil prices have a unit root leads to somewhat different conclusions. Technically, more than just having a unit root, oil price shocks would have to have a large permanent component. But if this holds, then changes in oil wealth would be strongly correlated with changes in oil prices—since the change in price is effectively permanent. This would provide a stronger rationale for the observed correlation—on fiscal sustainability grounds—between government spending and oil earnings (but see the next section). Perhaps less obvious, but equally important, is that the presence of a unit root would also imply that there is markedly more uncertainty about oil wealth. The variance of expected future oil prices, especially for the distant future, would be substantially higher than the case of oil price changes having a significant transitory component. The higher variance of prices translates into even higher uncertainty about wealth, and thus even stronger precautionary motives.

III. The Short-Run Fiscal Stance and Operational Issues

The long-run factors discussed in the previous section help determine broad fiscal parameters. Within these parameters, however, fiscal policy is ultimately pinned down by short-run considerations.

As in any economy, fiscal policy in oil-producing countries should be consistent with achieving macroeconomic objectives such as macroeconomic stability and an efficient allocation of resources. Given its crucial role in injecting part of the oil rent into the economy, fiscal policy is a key tool of short-run macroeconomic management in these countries. Thus, in addition to delivering government saving consistent with optimal consumption out of permanent income, fiscal policy has a key role to play in managing short-term fluctuations in the external and macroeconomic environment.

The rest of this section is organized as follows. Section A discusses the costs of macroeconomic and fiscal volatility and considers some aspects of the short-run macroeconomic impact of fiscal policy. Section B examines how the feasibility of various fiscal policy responses to oil revenue volatility depends on the government's financial position. Finally, Section C reviews the use of various fiscal balance concepts in oil-producing countries, and highlights some measurement issues.

[10] An exception would be cases where for one reason or other, an oil price shock is expected to be permanent.

A. Macroeconomic and Fiscal Volatility and the Short-Run Impact of Fiscal Policy

Reliance on oil revenue, particularly when it makes up a large share of total revenue, renders short-run fiscal management, budgetary planning, and the efficient use of public resources difficult. The challenges largely stem from the volatility and unpredictability of oil prices.

There is ample evidence that oil prices exhibit volatility in the short run and large fluctuations over the medium term. According to a recent study, one-third of the time the oil market will be faced with the prospect of a monthly price change greater than 8 percent. At current oil prices, in any month there is a one-in-six chance that the spot oil price may drop by some US$2 a barrel (Cashin, Liang, and McDermott, 1999). And the experience of the last few years has shown that large annual price movements can take place in either direction. Annual average oil prices surged by nearly 30 percent in 1995–96, declined by 36 percent in 1997-98, and then more than doubled in 1999–2000. Moreover, these fluctuations are often difficult, or even impossible, to predict.

The volatility of oil prices leads to corresponding volatility in the fiscal cash flow.[11] The dependence of fiscal revenue on the oil sector renders public finances vulnerable to a volatile external variable that is, for the most part, largely beyond the control of policymakers. For example, in Venezuela, mainly reflecting the oil price developments mentioned above, oil revenues accruing to the public sector fell from 27 percent of GDP in 1996 to 12½ percent of GDP in 1998, before rising again to 22½ percent of GDP in 2000. And, a change in the oil price of US$1 a barrel on an annual basis is associated with a variation of close to 1 percentage point of GDP in Venezuela's public sector revenue.

Thus, dependence on oil as a major source of export earnings and government revenue confronts policymakers in oil-producing countries with the short-run issues of how to address sharp and unpredictable variations in oil prices and revenues, and how to use oil revenues. The analysis of the short-run fiscal stance in oil-producing countries should take into account the macroeconomic and fiscal costs of a volatile fiscal pattern, and the impact of fiscal policy on short-run macroeconomic dynamics.

Macroeconomic costs of fiscal volatility

There is a strong macroeconomic case for smoothing fiscal expenditures. As elaborated below, abrupt changes in government spending—or more generally the non-oil deficit—contribute to macroeconomic volatility, which, in turn, leads to worse economic outcomes. Thus, in the short-run, efforts should be made to minimize the correlation between government spending and volatile oil prices.

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[11] A distinction should be made between risks posed by oil price uncertainty and volatility to government net worth (as discussed in Section II) and to the fiscal cash flow.

A number of studies have highlighted the costs of a volatile macroeconomic environment for investment and growth.[12] The disappointing growth and weak economic performance of oil producers has also been the focus of research. Even controlling for other factors, oil-exporting countries have tended to grow slower than resource-poor countries. While several channels have been suggested to account for this stylized fact,[13] a key policy factor contributing to the disappointing economic performance of many oil-producing countries have been the procyclicality of government expenditures, evidenced in expansionary and contractionary fiscal impulses associated with fluctuations in oil revenues (Gelb, 1988; Auty and Gelb, 2001; Bjerkholt, 2002). Indeed, Gelb has argued that the most important recommendation to emerge from his study of oil windfalls is that spending levels should have been adjusted to sharp rises in oil income far more cautiously than they actually were.

Large and unpredictable changes in expenditure, and the non-oil fiscal deficit, can entail macroeconomic costs. They include the reallocation of resources to accommodate changes in demand and relative prices, real exchange rate volatility, and increased risks faced by investors in the non-oil sector. Sharp fluctuations in government spending make it difficult for the private sector to make long-term investment plans and decisions, with attendant adverse effects on private investment and the growth of the non-oil economy (Hausmann, Powell, and Rigobón, 1993).

International experience suggests that fiscal volatility can be destabilizing for the real effective exchange rate and real output. In the case of oil-producing countries, oil shocks can affect the level and volatility of the real effective exchange rate through several channels. While disposable income and wealth effects are prominent factors, a key transmission channel of external volatility to the real exchange rate is procyclical government spending on nontradables. In this case, the variability of oil receipts can carry over to the real effective exchange rate. The volatility of the latter, in turn, has been shown to be damaging to the non-oil sector and capital formation. World Bank studies suggest that the degree of variability of the real exchange rate is as important as its level for the development of a diversified nontraditional tradable sector (World Bank, 1993; and Servén and Solimano, 1993).

Thus, on macroeconomic grounds there would be merit in smoothing fiscal expenditures. By reducing the volatility of public spending, the government would contribute to a more stable evolution of aggregate demand and of the macroeconomic environment.

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[12] For example, Gavin (1997) reports a negative relationship between volatility and economic growth, while Aizenman and Marion (1993) show that investment and growth are adversely affected by volatility in measures of monetary and fiscal policy. Gavin and Hausmann (1996) find that large external shocks—including terms of trade shocks—are one explanation of Latin America's high degree of macroeconomic instability. However, they also argue that the volatility of the domestic policy environment, as reflected in the magnitude of short-run uncertainty about fiscal deficits and monetary growth, has been quantitatively more important.

[13] They include: the postponement—facilitated by the availability of oil resources—of politically painful but ultimately growth-enhancing reform (Auty, 2001); Dutch disease (Gelb, 1988; Sachs and Warner, 1995); the delcterious effects of competition for natural resource rents accruing to the public sector between fiscal pressure groups (Tornell and Lane, 1998; Leite and Weidmann, 1999); and institutional quality issues in countries that are rich in natural resources (Dalmazzo and de Blasio, 2001).

The fiscal costs of volatile expenditure

There are also strong fiscal arguments for smoothing expenditures. In particular, short-term fluctuations in government expenditure can entail potentially substantial fiscal costs, including a reduction in the quality and efficiency of spending. This provides a further rationale for insulating government expenditure from short-run oil volatility.

The level of spending should be determined taking into account its likely quality and the capacity of the administration to execute it efficiently. In this connection, the sudden creation or enlargement of expenditure programs associated with oil windfalls carries risks. A hasty undertaking of large-scale public spending programs may exceed the government's planning, implementation, and management capacity, with the result that it may be difficult to prevent wasteful spending.[14] For instance, the criteria for the selection of capital projects may become lax, leading to suboptimal decisions. The costs of new projects may also increase due to bottlenecks in the supply of some inputs (Engel and Valdés, 2000). Large-scale capital expenditure programs can also be a fertile ground for governance problems. Expenditures should not rise faster than transparent and careful procurement practices will allow.

Moreover, typically government expenditure proves difficult to contain or streamline following expansions, as spending programs become entrenched and take a life of their own. Booms tend to lock in powerful hysteresis effects that prolong high spending levels and can set the stage for serious macroeconomic imbalances marked by inflation, abrupt demand cuts and sharp falls in output and growth (Auty and Gelb, 2001). On the other hand, drastic expenditure reductions in the face of negative external shocks (which may involve cuts in social spending and the government payroll, besides capital spending) may lead to social instability, discouraging investment and reducing future growth. Such reductions could involve, in particular, the abandonment of viable capital projects, where the return on some additional expenditure might be high.

Special care needs to be exercised when public expenditure has increased rapidly in recent years. In these cases, the marginal value of additional expenditure is likely to be in question—particularly if, due to institutional constraints, the quality of expenditure is suspect. In any event, the point will be reached where an oil-producing country would benefit more from keeping resources in the form of financial assets or lower gross public debt levels.

Fiscal policy and short-run macroeconomic dynamics

The discussion above suggests that a generally volatile expenditure pattern may entail macroeconomic and fiscal costs, and therefore provides arguments for smoothing the path of spending in the face of oil price fluctuations. In addition, in coming to a view as to the appropriateness of the short-run fiscal stance, macroeconomic issues such as the direct

[14] For examples, see Amuzegar (1999).

effects of fiscal policy on aggregate demand, inflation, and the balance of payments, and the availability of other policy stabilization instruments must be considered.

The short-run effect of an increase in the non-oil deficit of an oil-producing country financed through higher oil revenues from abroad would be similar to a foreign-financed increase in the fiscal deficit in other countries.[15] A rising non-oil deficit will signal either a relaxation of domestic revenue collection or an increase in expenditure, both of which would tend to put pressure on domestic demand with consequences for activity, inflation, and the external non-oil current account. The relative significance of these effects will depend in part on the initial macroeconomic position, the composition of the increase in spending in terms of imported and domestic goods and services, and the capacity of the economy to absorb increases in government expenditure.

The effects of a fiscal expansion financed with higher oil revenues are likely to include pressure toward the real appreciation of the currency—an adverse shift in relative prices against the production of tradables. For example, large increases in capital spending are likely to have a significant nontradable component. Unless there is substantial initial slack in the economy and supply is responsive, such increases will inevitably put pressure on domestic resources and inflation. Thus, the evaluation of the non-oil fiscal policy stance must include consideration of trends in competitiveness and the potential for Dutch disease effects.

Instead of being spent, an increase in oil revenues could be saved by repaying net public debt. An automatic sterilization of additional oil revenues would be achieved by parallel reductions in net external public debt. Higher revenues could also be used to build up deposits with the domestic banking system or repay domestic debt. In these cases, however, if there is less-than-perfect capital mobility, there may be effects on domestic liquidity and interest rates. This form of asset management response to higher oil revenues could be expansionary, including through the associated reduction in interest rates, and might imply the need for offsetting monetary policy measures.

A variation in oil prices may have effects on activity and the real exchange rate even if the government decides to finance externally (sterilize) the resulting change in oil revenues. First, oil sector activities tend to be correlated (perhaps with some lags) to oil prices. For example, oil booms may lead to an expansion of private oil sector investment, with knock-on effects on demand and activity in the non-oil sector. Second, they may affect private consumption and savings indirectly through wealth effects. Thus, surges in private sector demand associated with higher oil export receipts (which, moreover, may be accompanied by capital inflows or reduced capital outflows) may put upward pressure on the currency and raise inflation concerns.

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[15] For the central or general government, the non-oil balance would normally be defined to exclude all oil-related revenues and expenditures, with the exception of excises and other taxes on refined products sold domestically. For the public sector, it would normally be defined as the overall balance, excluding oil revenues from abroad and oil-related expenditures.

Policy instruments available to deal with these effects include sterilization, nominal exchange rate appreciation, and fiscal policy. Under a managed or fixed exchange rate system, however, it may not be possible for the central bank to sterilize the foreign exchange inflows,[16] and the use of exchange rate appreciation may be constrained by competitive considerations.[17] In these circumstances, fiscal policy may need to be tightened to contain inflation and prevent an excessive appreciation of the currency, particularly if the foreign exchange inflow is large relative to the absorption capacity of the economy.

In certain macroeconomic settings, therefore, the stabilization function of fiscal policy, the need to address short-term macroeconomic disequilibria, and constraints limiting the use of other policy instruments, would provide justification for a counter cyclical non-oil fiscal stance that, depending on the circumstances, might need to be more restrained than required by fiscal sustainability. Similar considerations would apply in the case of a rapidly expanding oil sector, where there could be an overshooting of the real effective exchange rate because of large investment projects and broader wealth effects.

B. Fiscal Policy, Stabilization, and the Government's Financial Position

The ability to absorb unanticipated cash flow shocks depends on the robustness of the government's financial position. A government that is liquidity constrained or not able to access credit at reasonable interest rates would likely be forced to undertake potentially costly adjustments even in the case of moderate or temporary downturns in oil revenue. Moreover, the perceived sustainability of the fiscal stance and the credibility of the policy framework would themselves influence a government's creditworthiness and the cost of financing.

A strong fiscal and financial position provides the government of an oil-producing country with room to maneuver during oil price downturns. In particular, the government can accommodate cash flow fluctuations through a mix of adjustment and financing. By doing so, the government can afford to pursue short-run fiscal strategies that avoid fiscal instability and help insulate the domestic economy from oil revenue volatility. Moreover, when the government can smooth expenditures and the non-oil balance in the face of cash flow volatility, the use of oil revenue can be successfully decoupled from current earnings, enhancing the stabilization role of fiscal policy (Bjerkholt, 2002).

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[16] The ability of the central bank to sterilize the effects of the foreign exchange inflow on the monetary base could be restricted by the lack of suitable instruments and the state of development of the financial markets. Such operations could also be constrained by potentially significant quasi-fiscal costs of sterilization arising from the differences between the interest earned on the central bank's foreign exchange reserves and the borrowing costs incurred to finance its sterilization operations. Moreover, the resulting higher interest rates, by attracting capital inflows, could make such strategies self-defeating.

[17] In the case of a flexible exchange rate system, there would be pressure for the appreciation of the nominal exchange rate.

In some oil-producing countries, a history of prudent fiscal policies and the existence of large official financial assets and/or low levels of public debt has facilitated an orderly mix of adjustment and financing during temporary oil price downturns. For example, in Norway the solid financial position of the government reflects to a large extent the more fundamental long-run policy objectives of spreading the benefits of oil over time—notably through high government savings rates and the build-up of foreign assets, resisting potential damage to the non-oil tradable sector from Dutch disease, and being able to withstand negative oil market developments. These strategic choices seem to have helped Norway maintain macro stability and reasonable growth rates even in the context of unfavorable oil market environments.

Thus, there are important advantages in pursuing a cautious expenditure policy during oil booms to reduce the country's exposure to adverse oil and other financing shocks (both external and domestic). Such a policy, based on *precautionary motives* in the face of uncertainty, would leave margins to allow for short-run oil revenue risks and provide some insurance against oil revenue fluctuations.

In contrast, in a number of oil-producing countries procyclical fiscal policies and persistent fiscal deficits have led to less favorable financial positions and recurrent fiscal sustainability concerns related to the volatile and excessive use of oil revenues. A regular feature of fiscal policy in many oil-producing countries has been the inability to rein in public expenditure at times of rising oil prices.[18] Expenditures have subsequently proven difficult to reduce during oil price downturns. There may also have been the belief that the oil price decline would be short-lived, prompting the temptation to ride out the downturn.

The resulting fiscal deficits have been financed with external and/or domestic borrowing. However, the former has rendered many borrowers vulnerable to increases in the interest rate on foreign loans, as well as to the drying up of new loans as sustainability concerns set in, while the latter has often been inflationary or has crowded out private sector access to credit. Eventually, mounting external and fiscal imbalances, lack of external financing, and in some cases monetary disequilibria and inflation associated with the domestic financing of deficits, force the adoption of belated, costly, and disorderly expenditure cuts (often involving the suspension or abandonment of investment projects), sometimes accompanied by currency depreciations.

Thus, when governments are unable to generate fiscal surpluses during periods of rising oil prices that would permit the budget to withstand adverse oil shocks without falling into deficits that lead to sustainability concerns, fiscal policy tends to transmit oil volatility to the rest of the economy. Lack of financing during oil price downturns, in turn, eventually forces governments to undertake sharp and disruptive fiscal contractions, at a time when the economy can least afford them.[19] Countries where external financing is limited, and available

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[18] For a discussion of procyclical fiscal policies in Nigeria and Venezuela, for example, see Hausmann, Powell, and Rigobón (1993); World Bank (1994); and García and others (1997).

[19] Gavin (1997) provides a similar discussion of fiscal policy and macroeconomic instability in Latin America.

domestic financing fluctuates with shifts in sentiment toward the domestic currency, are particularly vulnerable.

Therefore, in countries which are unable to accommodate oil revenue fluctuations due to financing constraints related to sustainability and other policy concerns, a key policy objective should be to pursue fiscal strategies aimed at breaking the procyclical response of expenditure to volatile oil prices. This would imply eliminating expansionary fiscal policy biases during oil booms, and, critically, targeting prudent non-oil fiscal balances and reducing the non-oil fiscal deficit over time. Such a strategy would create fiscal room that could become available if needed when a transitory oil boom ends, and restore or enhance creditworthiness to improve access to credit markets. This would place the government in a better position to deal with oil market volatility, and increase the likelihood that it can weather temporary oil shocks without drastic short-run fiscal adjustments.

A strong financial position is also essential to allow for an orderly adjustment to catastrophic oil shocks that turn out to be long-lasting, such as the oil market collapse in 1986. As argued in Section II, there is evidence that oil prices are subject to periodic long-lasting changes or regime shifts. A collapse in oil prices that appears to be permanent may prompt major solvency reassessments, and would require adjustment to restore sustainability. A country with a strong financial position can afford to adjust the non-oil deficit in a gradual and orderly fashion. In contrast, a country that is liquidity constrained would be forced to undertake a sudden and large adjustment with all of the concomitant macroeconomic and fiscal costs.

Medium-term budgeting, fiscal rules, and hedging

To aid the implementation of fiscal policy, some countries have resorted to institutional mechanisms such as medium-term expenditure frameworks and fiscal rules, or have recourse to contingent financial instruments.[20]

Medium-term expenditure frameworks

The formulation of an overall fiscal policy may be aided by a medium-term expenditure framework, which can help limit the extent of short-run spending responses to rapidly changing oil revenues. Multi-year expenditure planning can also allow a better appreciation of the future spending implications of present policy decisions, including the recurrent costs of capital spending.[21]

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[20] Some countries have created oil stabilization funds to help in the implementation of fiscal policy. For a discussion of oil funds, see Davis, Ossowski, Daniel, and Barnett (2001).

[21] See Potter and Diamond (1999).

Fiscal rules

Many oil-producing countries have faced political difficulties in maintaining stable expenditures. Governments come under recurrent political pressures to spend the higher revenues arising from rising oil prices. In countries that face financing constraints, moreover, expenditure increases are typically followed by costly fiscal adjustments during oil downturns. Some oil-producing countries are therefore giving consideration to the establishment of more formal constraints on fiscal policy in the form of fiscal rules, to help insulate fiscal policy from political pressures.[22]

The discussion above makes it clear that, in oil-producing countries, fiscal rules applied in other countries that target a certain overall or primary fiscal balance, or particular public debt levels relative to GDP, would not be consistent with the objective of avoiding procyclical fiscal policies. Such rules would in fact transmit oil price fluctuations to expenditure and the non-oil deficit.[23]

Appropriate fiscal rules should instead seek to decouple expenditure policy and the non-oil deficit from the short-run vagaries of oil prices. This suggests that, from a stabilization perspective, the focus of fiscal rules would be better placed on the ratio of the non-oil primary deficit to non-oil GDP, which could be adjusted for the non-oil economic cycle. This general approach would be consistent with the fiscal sustainability analysis discussed in Section II.

The size of the permissible non-oil primary deficit under the fiscal rule would need to take into account the possibility of financing constraints. In addition, because of the volatility of oil prices, some built-in cushion should be incorporated in the rules, to deal with potential oil revenue declines. Significant and protracted oil revenue falls that lead to overall solvency reassessments, however, would entail the need to review the fiscal rules.

Contingent financial instruments

Medium-term expenditure frameworks and fiscal rules take the uncertainty and volatility of oil revenue facing the government as given. The latter, however, could be reduced through the use of contingent financial instruments such as futures, options, and swaps, which transfer risks to international financial markets (Daniel, 2001). Recourse to contingent

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[22] Fiscal rules may constrain expenditure or the deficit, or they may restrict the ability to borrow. As discussed in Kopits and Symansky (1998), fiscal rules can have both advantages and disadvantages. For an application to oil-producing countries, see Bjerkholt (2002).

[23] Under an overall balance rule, when oil revenues are buoyant expenditure can be increased, which may result in a high non-oil fiscal deficit at a time when the private sector may be buoyant. Regarding a debt rule, other things being equal the ratio of public debt to GDP would fall automatically when oil prices increase (which would raise nominal GDP)—but this may be temporary. A subsequent decline in oil prices could entail the need for fiscal adjustment to comply with the debt rule.

markets might permit price ranges for oil deliveries in future periods to be "locked in." As a result, budgeting could become more realistic and certain. Hedging could also provide some protection against substantial oil price declines. In practice, however, there are limitations to the extent to which future oil revenue might be hedged, particularly in the case of large oil producers and countries with limited access to credit.

C. Indicators of Fiscal Stance in Oil-Producing Countries

The special characteristics of oil revenue and their implications for short-run fiscal policy in oil-producing countries require that attention be given to several fiscal balances to interpret the impact of fiscal policy appropriately. In addition, measurement issues associated with oil prices and exchange rates need to be taken into account.

Fiscal balances

The discussion of long-run fiscal issues in Section II and the short-run analysis of fiscal policy in this section have highlighted the importance of the *non-oil fiscal balance* as a fiscal indicator in oil-producing countries. From a short-run perspective, the non-oil balance is a key indicator of government demand on the economy. Indeed, in countries such as Norway, budget documents and fiscal policy discussions focus prominently on the non-oil balance and its impact on the domestic economy.

If the government decides to spend an oil export revenue windfall, expenditures can rise without either a deterioration in the overall balance or the imposition of additional tax burdens. However, higher government spending would add to demand pressures, including on imports. This effect would be seen in a higher non-oil fiscal deficit, but would not be picked up by the overall balance, which could improve with rising international oil prices despite the loosening of fiscal policy implied by spending some of the additional oil revenues, and mask an expansionary or unsustainable fiscal policy stance.[24] Conversely, a deterioration in the overall balance because of lower oil revenues may mask significant fiscal adjustment efforts.

The non-oil fiscal balance also provides a clearer picture of the underlying policy stance and is a more reliable measure of discretionary fiscal policy than the overall balance, since it is a fiscal variable largely under the control of the authorities. It also provides a measure of fiscal vulnerability. If expenditures have been increased during a period of rising oil prices, the resulting non-oil deficit may be difficult to finance, or become unsustainable in the absence of compensating fiscal adjustment at lower oil prices.

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[24] To identify more accurately the direct expansionary impact of government on the domestic economy, the domestic balance could be used. This balance includes only those components of the overall balance that arise from transactions with the domestic economy, and omits those transactions directly affecting the balance of payments. For operational purposes, however, the non-oil deficit will often be a reasonable proxy for the domestic balance.

There are advantages in highlighting the non-oil deficit in budget documents that form the basis for legislative and public discussion. This would help make the use of oil revenue more transparent, and delineate policy choices more clearly.

The *overall fiscal balance*, on the other hand, is the relevant indicator for assessing the government's financing requirement and fiscal vulnerability. The evaluation of a particular overall balance will require assessment of the fiscal and macroeconomic impact of alternative methods of financing it. For example, the domestic financing of an overall deficit may be inflationary or may crowd out private sector investment, while external financing may be too costly or unavailable.

Unlike the non-oil balance, however, the overall fiscal balance in an oil-producing country may not be a good pointer for the impact of fiscal policy on domestic demand and the government's adjustment effort. Changes in the overall balance arising from fluctuations in oil revenue that are externally financed should be expected to have limited direct effects on domestic demand.

The fact that international lending to developing primary commodity producers with large volatile resource revenues tends to be procyclical has particularly important implications for countries facing financing constraints. When assessing the financeability of a given fiscal position under alternative oil price scenarios, it should be borne in mind that these countries may find it difficult to ensure financing when oil prices fall sharply, at a time foreign resources may be most needed.

It will often be important to gauge the sensitivity of overall fiscal outcomes (and their implications for financing) to variations in key macroeconomic variables (including, prominently, oil prices) and other sources of economic risk.[25] For example, increases in expenditure or reductions in taxes at a time of rising oil prices may not raise immediate financing concerns, but could increase the budget's exposure to turnarounds in oil prices. Projections of the overall balance under current policies should therefore be made several years into the future under alternative oil scenarios, to examine the trajectory of net government financial assets and possible medium-term financing vulnerabilities.

In the case of oil producers where the financial position of the government is particularly weak, the volatile and uncertain nature of oil revenues would also require undertaking sensitivity analyses of alternative oil price scenarios for the *gross borrowing requirement*. This would be particularly important where market concerns about fiscal sustainability and short-run liquidity raise questions about the availability of credit to finance the overall balance and amortization needs.

[25] Hemming and Petrie (2000) provide a general framework for assessing fiscal vulnerability.

Measurement issues

Fiscal analysis and projections in oil-producing countries should take into account the fact that oil prices and the exchange rate are key fiscal variables that can have significant direct effects on the public finances. Moreover, they can also have major effects on the ratios of fiscal variables to GDP because the oil and non-oil GDP deflators can deviate markedly.

Movements in total GDP related to oil sector developments, usually prices, can cause the GDP ratios of non-oil fiscal variables to vary substantially. This could lead to an erroneous conclusion that there has been a modification in the underlying fiscal policy, even though all that has happened is oil prices have changed. For example, assuming unchanged non-oil revenue and expenditure, an increase in oil prices would lead to higher nominal GDP, and thus directly cause the ratios of non-oil deficit to total GDP to fall (see Appendix II). Declining ratios of the non-oil deficit to total GDP could mask an expansionary fiscal policy undertaken in the context of rising oil prices.

Changes in the exchange rate may cause similar measurement problems by raising or lowering the share of oil GDP in total GDP. As in the case of changes in oil prices, this has a bearing on the ratios of fiscal variables to GDP. For example, a depreciation of the currency may result in a lower non-oil deficit as a share of GDP as the latter is boosted by the increase in oil GDP. Great care should therefore be exercised when evaluating the ratio of the non-oil deficit or expenditure to GDP in years with large exchange rate fluctuations.[26]

When the terms of trade or the exchange rate display significant fluctuations, it is vital to consider other fiscal indicators besides ratios to total GDP. In particular, important information may be conveyed by percentage changes in the relevant variables—in nominal terms as well as deflated by a broad domestic price index such as the consumer price index or the non-oil GDP deflator—and by ratios to non-oil GDP.[27]

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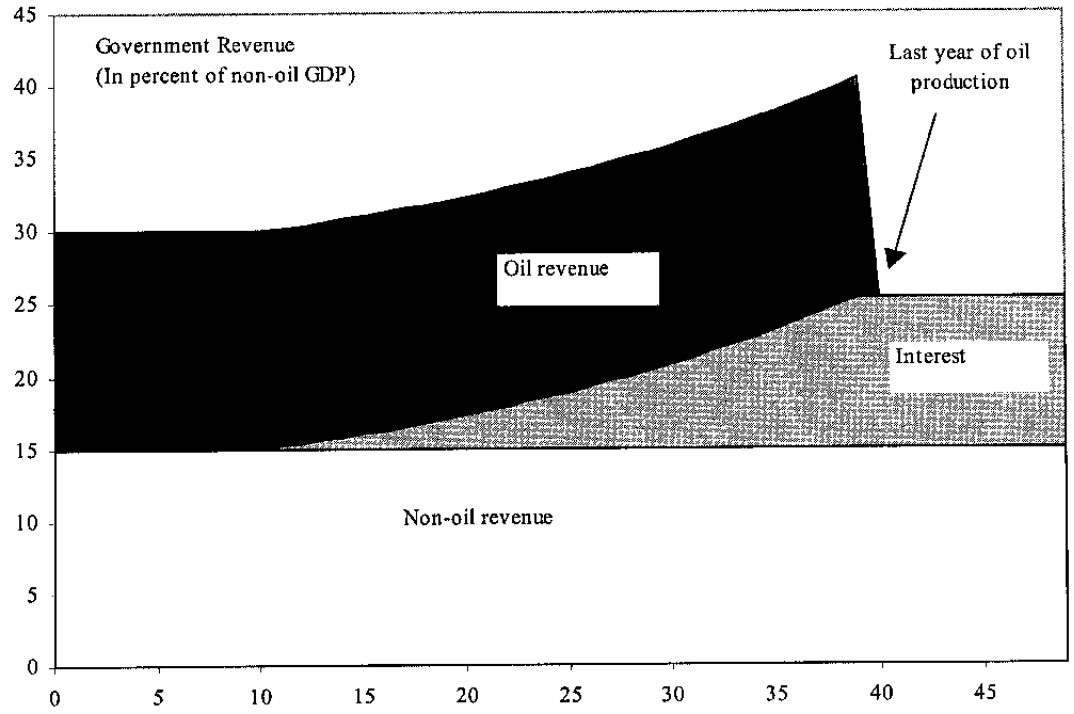
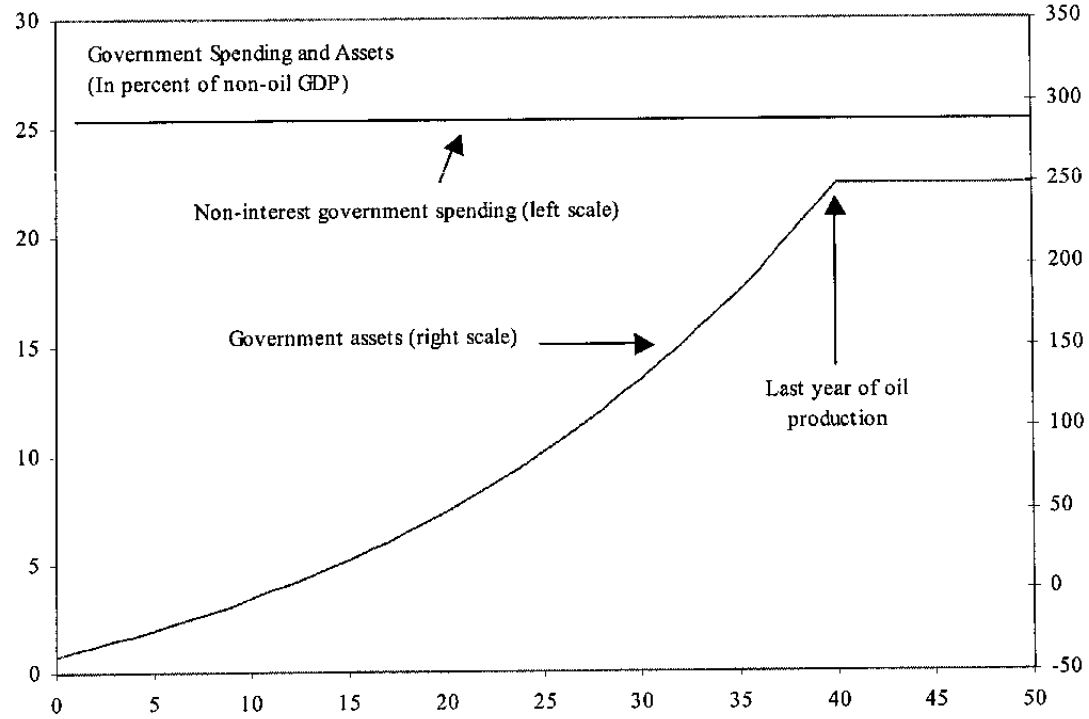
[26] A real appreciation of the currency, by reducing the domestic purchasing power of foreign exchange and therefore of oil fiscal revenue, will typically weaken the overall fiscal balance of countries heavily dependent on oil for their fiscal revenues.

[27] For example, the ratio of non-oil revenue to total GDP may provide little information and be hard to interpret. The link between non-oil revenue and oil GDP is likely to be tenuous, and terms of trade and real exchange rate effects of oil GDP on total GDP will affect the share of non-oil revenue to GDP. Therefore it is important to analyze non-oil revenue developments in terms of ratios to non-oil GDP.

Figure 1. Simulation of Revenue, Expenditure, and Assets
(In percent of non-oil GDP)

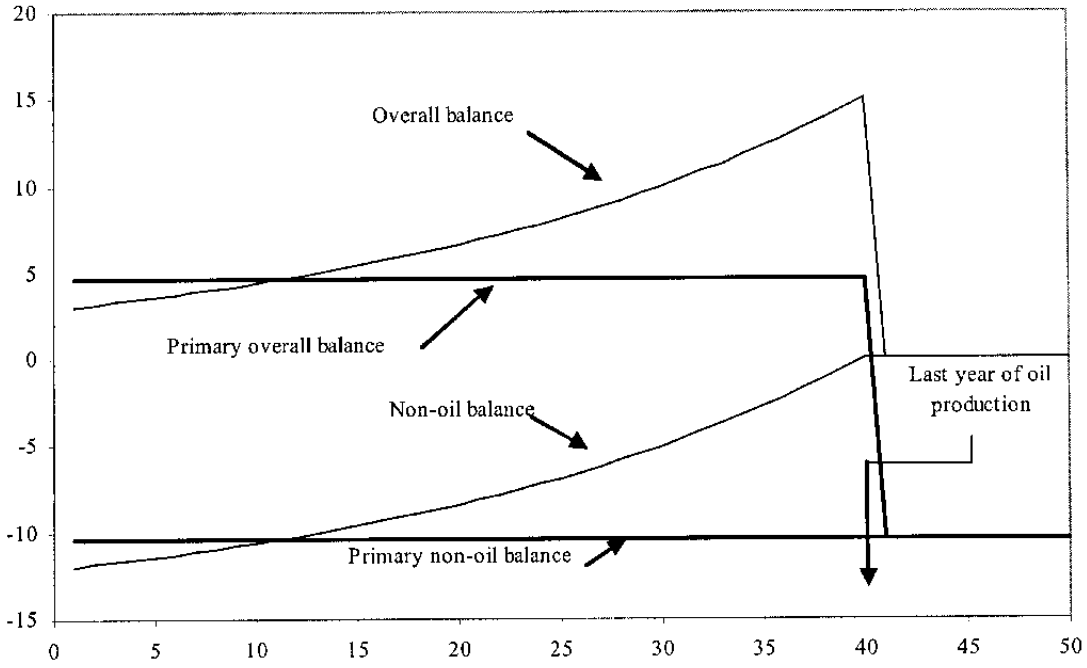




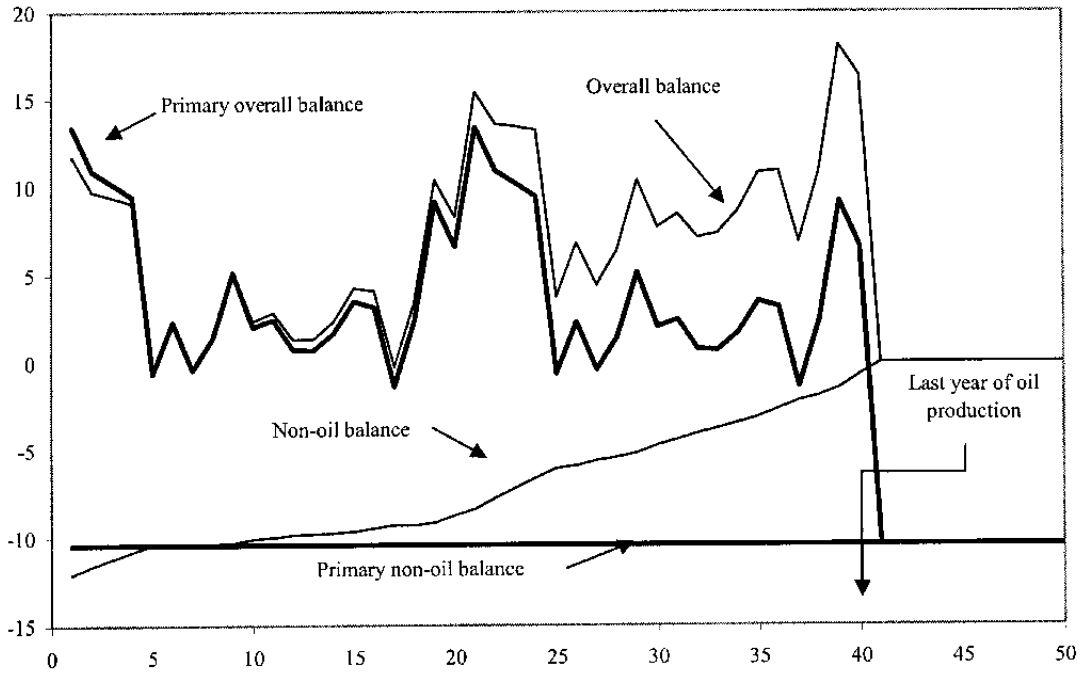
Source: IMF Staff calculations.

Figure 2. Simulation of Fiscal Balances
(In percent of non-oil GDP)

Various Fiscal Balance Measures
(In percent of non-oil GDP)



Variable Oil Prices: Various Fiscal Balance Measures
(In percent of non-oil GDP)



Sources: World Economic Outlook; and IMF Staff estimates.

INTERTEMPORAL ALLOCATION OF FISCAL RESOURCES (A FORMAL MODEL)

This annex sketches the formal model underlying the analysis in Section II of the paper. A more detailed presentation is in Barnett (2002). At the core of the analysis is that the government chooses a tax and spending policy to maximize a social welfare function subject to an intertemporal budget constraint and a transversality or no-ponzi game condition. These latter two equations are, respectively,

$$B_t = RB_{t-1} + G_t - T_t - Z_t \tag{1}$$

$$\operatorname{Lim}_{s\to\infty} B_{t+s} = 0 \tag{2}$$

where B_t is government debt at the end of the period, R is the interest rate (assumed to be constant), G_t is primary government expenditure, T_t is non-oil revenue, and Z_t is oil revenue. It is assumed that there is no uncertainty, that oil revenue Z_t is constant and lasts for exactly N periods, and that non-oil GDP (denoted by Y_t) is also constant.

The setup of the problem allows for the social welfare function to be expressed in several equivalent ways. The above assumptions imply that fiscal policy variables (revenue and expenditure) do not affect the other macroeconomic variables, which are assumed to be constant and exogenous. In this respect, examining equation 0 suggests that it is only the difference between revenue and (primary) expenditure ($T_t - G_t$), or equivalently the primary balance, that matters for the evolution of government debt—the levels of revenue and expenditure themselves are not important. It is equivalent, therefore, to express the social welfare function in terms of just the primary balance (as implicitly done in the text), or in terms of revenue for a given level of expenditure (a tax-smoothing approach), or government spending for a given level of revenue. The latter approach, with the assumption that revenue is constant, is adopted in what follows because it simplifies the exposition by accentuating the parallels with the permanent income consumption problem. Formally, the problem then is to maximize the social welfare function,

$$\operatorname{Max}_{\{G_t\}_{t=1}^{\infty}} \sum_{t=1}^{\infty} \beta^{t-1} \mathrm{U}(G_t) \tag{3}$$

where β is the discount factor (and $\beta R = 1$ is assumed to hold), $\mathrm{U}(G_t)$ is the felicity or utility function, and the maximization is subject to equations 0 and 0.

This problem yields a closed form analytical solution that is independent of $\mathrm{U}(G_t)$. The first order condition, or Euler equation, is given by,

$$\mathrm{U}'(G_t) = \beta R\, \mathrm{U}'(G_{t+1}) \tag{4}$$

where $U'(G_t)$ denotes the derivative. Since $\beta R = 1$, regardless of $U'(G_t)$ the result emerges that $G_{t+1} = G_t \equiv \overline{G}$ or, simply put, government spending is constant. Moreover, spending is just equal to permanent income or the return on the present discounted value of wealth. Formally,

$$\overline{G} = T + \frac{r}{R}\sum_{i=0}^{N} R^{-i} Z - rB_{t-1} \tag{5}$$

where the middle term is the return on the present discounted value of oil revenue—that is, oil wealth. To simulate the model, quantitative values of the parameters are set as follows: non-oil GDP is 100 ($Y = 100$); revenue is 15 percent of non-oil GDP, or $\tau = .15$ such that $T = \tau Y = 15$; oil revenue is 15 percent of non-oil GDP ($Z = 15$); oil reserves are sufficient to last 40 years ($N = 40$); the discount factor is 0.96 ($\beta = .96$), implying that the interest rate is around 4 percent; and the initial debt is 40 ($B_0 = 40$).

The introduction of non-oil GDP and population growth complicates the algebra but does not affect the qualitative results. Following Tersman (1991) the government utility function could be expressed in terms of non-oil GDP, where $g_t = \frac{G_t}{Y_t}$ and $U(g_t)$ is used in the social welfare function (equation 0) in place of $U(G_t)$.[28] To keep the problem well behaved and simple, the following additional assumptions are also made (where small case letters are shares of non-oil GDP): the growth rate of non-oil GDP is constant and equal to η, such that $Y_{t+1} = (1+\eta)Y_t$; the discount factor is adjusted such that $\beta\frac{1+r}{1+\eta} = 1$; and z_t is constant, which implies that oil revenue is growing at the same rate as non-oil GDP. With these assumptions, the solution is analogous to equation 0, except the government expenditure to GDP ratio is constant, and the interest rate terms are adjusted by η. To keep government wealth as a share of GDP from falling in the post-oil period entails a smaller primary non-oil deficit than in the model without growth (for any given level of assets), as some of the asset returns—an amount equivalent to the growth in non-oil GDP—have to be reinvested. In other words, the non-oil deficit would have to be less than the return on government wealth, and instead be the difference between the return and the non-oil GDP growth rate. The following examples, however, are based on the simpler case with zero growth in non-oil GDP.

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[28] Scaling in terms of non-oil GDP has advantages over obvious alternatives such as using real spending, real per capita spending, or some rule such as just sharing oil wealth equally. As to the first two options, they would imply that government spending as a share of non-oil GDP is tending toward zero over time (provided non-oil GDP growth is greater than population growth). This does not seem plausible, as in the long run it would seem more realistic to assume that the government expenditure to (non-oil) GDP ratio converges to some steady state value. As Tersman (1991) points out, however, this specification "...means that one has to accept the idea that future generations are better off simply because they come later." As to defining the welfare function in terms of sharing the oil wealth equally, Solow (1986) notes "The current generation does not especially owe to its successors a share of this or that particular resource. If it owes anything, it owes...access to a certain standard of living or level of consumption."

Obsolescence can be modeled as a specific form of uncertainty, in which the future price of oil falls to zero, and stays there forever. Let π denote the probability (assumed to be constant) of oil becoming obsolete in a given period, then equation 0 would become,

$$\mathrm{U}'(G_t) = \beta R\left[(1-\pi)\mathrm{U}'(G^P_{t+1}) + \pi\,\mathrm{U}'(G^0_{t+1})\right] \tag{6}$$

where G^P_{t+1} is the government spending if oil prices remain positive in $t+1$, and G^0_{t+1} the spending that would occur if prices go to zero. For the case of oil becoming obsolete, there would be no uncertainty left and government spending (G^0_{t+1}) would simply be set to permanent income. Permanent income, however, in which oil wealth is zero. In contrast, G^P_{t+1} is based on permanent income in the event that oil prices are still positive, thus it is clear that $G^P_{t+1} > G^0_{t+1}$, and G^0_{t+1} is likely substantially smaller provided that the present discounted value of oil reserves is relatively large. From equation 0, the obsolescence effect would be larger the higher the probability of obsolescence (the larger is π), the larger the value of remaining oil reserves (expanding the gap between G^P_{t+1} and G^0_{t+1}), and the more risk averse the government is (governed by $\mathrm{U}'(G_t)$).

The impact of sovereign risk premiums are easiest to see by looking at some of the first order conditions. In particular, if there is positive debt (technically at the end of the period) then the following first order condition applies,

$$\mathrm{U}'(G_t) = \beta\tilde{R}\,\mathrm{U}'(G_{t+1}) \tag{7}$$

where $\tilde{R} = 1 + r + \rho$, and ρ is the sovereign premium (such that $\rho > 0$). Since $\tilde{R} > R$, then it must be the case that $\beta\tilde{R} > 1$ and therefore $G_{t+1} > G_t$. This indicates that government spending, at least while debt is positive, is steadily increasing. Once there are positive assets, then the solution is identical to that of equation 0 and government spending is constant. Given that there is initially debt, the path of government spending implies a gradually increasing non-oil deficit (until the debt is retired) and, for this to be sustainable, the initial non-oil deficit must be smaller than it would have been in the absence of the premium.

The models that incorporate capital spending can be motivated intuitively. In the case of capital spending boosting non-oil GDP, non-oil GDP becomes a function of government capital (K_t), where $\mathrm{Y}(K_t)$ has the usual properties $\mathrm{Y}'(K_t) > 0$ and $\mathrm{Y}''(K_t) < 0$ (which rules out increasing or even constant to returns to scale). The intuition is the most straightforward if convex adjustment costs and depreciation are abstracted from, in which case government investment is undertaken to the point where,

$$r = \tau\,\mathrm{Y}'(K_{t+1}) \tag{8}$$

that is, the point where the marginal return to the government, $\tau Y'(K_{t+1})$, is equal to the interest rate (or the marginal cost of investment). What may not be immediately obvious, however, is that $Y(K_t)$ is independent of oil wealth—so, for example, an increase in oil wealth does not affect the productivity of government investment in non-oil GDP. Finally, in the case of modeling capital expenditure as a durable consumption good, the mathematics are somewhat less intuitive. However, the intuition is that provided that there are convex adjustment costs—giving an incentive to adjust the capital stock slowly—an increase in oil wealth would lead to an increase in desired government durables. The convex adjustment costs would make the adjustment process gradual, implying a period of larger than normal conventionally measured fiscal deficits.

FISCAL BALANCES AND MEASUREMENT ISSUES

Some of the measurement issues discussed in the last subsection of the paper are illustrated in Table 2, which shows fiscal variables and GDP for a hypothetical oil-producing country. The example suggests that care should be exercised in interpreting the fiscal aggregates when the oil price moves from year to year.

In the illustrative example, while nominal non-oil GDP is unchanged throughout, oil prices rise sharply in year 2 before falling back in year 3, leading to parallel movements in oil GDP, total GDP, and fiscal oil revenue. In year 2 expenditures are increased, leading to a higher non-oil deficit (in nominal terms and as a share of non-oil GDP), but the non-oil deficit as a share of GDP declines. The deterioration in the non-oil deficit is masked by the improvement in the overall balance, and would become clear if the oil price returned to its initial level. In year 3, although there is an adjustment effort as evidenced in the reduction in expenditures, the non-oil deficit as a percent of GDP deteriorates. Non-oil revenue as a share of non-oil GDP is constant throughout, but its ratio to GDP is volatile and hard to interpret.

Table 2. Fiscal Variables and GDP in a Hypothetical Oil-Producing Country

	Year 1	Year 2	Year 3
	(In national currency)		
Nominal GDP	1,200	1,350	1,150
Oil GDP	300	450	250
Non-oil GDP	900	900	900
Government finances			
Revenue	230	305	205
Oil revenue	150	225	125
Non-oil revenue	80	80	80
Expenditure	250	265	250
Non-oil balance	-170	-185	-170
Overall balance	-20	40	-45
	(In percent of GDP)		
Government finances			
Revenue	19.2	22.6	17.8
Oil revenue	12.5	16.7	10.9
Non-oil revenue	6.7	5.9	7.0
Expenditure	20.8	19.6	21.7
Non-oil balance	-14.2	-13.7	-14.8
Overall balance	-1.7	3.0	-3.9
	(In percent of non-oil GDP)		
Government finances			
Revenue	25.6	33.9	22.8
Oil revenue	16.7	25.0	13.9
Non-oil revenue	8.9	8.9	8.9
Expenditure	27.8	29.4	27.8
Non-oil balance	-18.9	-20.6	-18.9
Overall balance	-2.2	4.4	-5.0
Memorandum item			
Oil price (US$bbl)	15.0	22.5	12.5

Source: IMF staff calculations.

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