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Fiscal Sustainability in Emerging Market Countries with an Application to Ecuador

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Abstract[*]

This paper surveys the recent literature on fiscal sustainability, with particular emphasis on emerging market countries. It discusses the main elements that differentiate emerging market countries from industrial countries and then discusses how probabilistic models can help to evaluate fiscal sustainability in an uncertain environment. Based on this discussion, the paper uses Ecuador to illustrate an application of the probabilistic model, and of the framework to evaluate the impact of shocks to current account financing on sustainability.

Keywords: Fiscal Sustainability, Debt, Default, Sudden Stop, Emerging Markets, Ecuador

JEL Codes: E62; O23

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1. Introduction

In this paper, we review the recent literature on fiscal sustainability with particular reference to the problems that are specific to Emerging Market countries (EMs). In this setting, the paper focuses on the role of currency and maturity mismatches, Original Sin, Sudden Stops in capital flows, debt intolerance, and concessional debt.

After discussing standard models of fiscal sustainability, the paper highlights the importance of moving from deterministic models of fiscal sustainability to probabilistic models. To highlight differences across methodologies, the paper evaluates fiscal sustainability in Ecuador by using three different methodologies: (i) the standard approach; (ii) the probabilistic model developed by Mendoza and Oviedo (2003); and (iii) the Sudden Stop approach developed by Calvo, Izquierdo and Talvi (2002).

While the original literature on fiscal sustainability mostly focused on industrial countries (see, for instance, Buiter, 1985 and Blanchard, 1990) there are, by now, a few pieces that, like this one, focus on fiscal sustainability in EMs. Work that is closely related to ours includes Mendoza (2003). Other relevant papers include IMF (2002, 2003b), Chalk and Hemming (2000), and Cuddington (1996). Izquierdo and Panizza (2003) use an approach that is identical to that of this paper to evaluate sustainability in Egypt. Four papers that are closely related to our work on Ecuador are Artana, Tour and Navajas (2002), López-Cálix (2003), Tinsley (2003) and Barnhill and Kopits (2003). The latter two papers evaluate fiscal sustainability in Ecuador, but while Tinsley uses a standard sustainability approach, Barnhill and Kopits use a stochastic approach based on a value-at-risk model. One important theme that is not covered in this paper relates to how public private partnerships (PPP) should be included in fiscal accounts and sustainability analysis. Readers interested in this topic should refer to IMF (2004) and, for a theoretical analysis of PPP, to Hart (2002).

The paper is organized as follows. Section 2 introduces the concept of fiscal sustainability and discusses its main definitions and the main sustainability indicators that have been proposed in the literature. Section 3 focuses on the case of EMs, discusses what makes these countries different from industrial countries, and briefly touches on the recent debate on whether investment expenditure should be included in fiscal targets.

Section 4 briefly discusses the main stochastic models of fiscal sustainability, with particular emphasis on the model developed by Mendoza and Oviedo (2003). Section 5 discusses the case of Ecuador, describing the recent economic evolution of the country and conducting three different fiscal sustainability exercises. Section 6 concludes.

2. What Do We Mean by Fiscal Sustainability?

The term "fiscal sustainability" is often used without a clear definition. Drawing on an analogy with household behavior, a country's policies are defined as fiscally sustainable if they lead to a situation in which the country can satisfy its budget constraint. However, Mendoza (2003) suggests that this is an imprecise definition of sustainability. He points out that the "true" budget constraint is an accounting identity that, by definition, is always satisfied. A government, for instance, can decide to satisfy its budget constraint by not paying (via outright default) or by inflating away its debt. In this sense, any analysis of fiscal sustainability ultimately reflects a value judgment on the cost and benefits of alternative adjustment mechanisms. So, standard sustainability analysis implicitly assumes that adjustments through the level and composition of tax revenue or primary expenditure are preferable to adjustments via default or inflation (Mendoza, 2003).

2.1 Solvency versus Sustainability

IMF (2002) and Croce and Juan-Ramón (2003) discuss the difference between solvency and sustainability. According to their definition, a set of policies is unsustainable if it leads to insolvency (solvency is defined as a situation in which the future paths of spending and revenue satisfy the inter-temporal budget constraint). However, they suggest that solvency is only a necessary condition for sustainability because solvency could be achieved with very large and costly future adjustments. Sustainability, however, requires achieving solvency with unchanged policies. So, we can define a policy stance as sustainable if "a borrower is expected to be able to continue servicing its debt without an unrealistically large future correction to the balance of income and expenditure" (IMF, 2002, p. 4).

With these considerations in mind, we define as sustainable a situation that satisfies the following two conditions: (i) a country can satisfy its current period budget constraint without resorting to default or excessive debt monetization; and (ii) a country does not keep accumulating debt while knowing that a major future adjustment will be needed in order to be able to service its debt.

Up to this point, we have made use of two key terms in the fiscal sustainability debate without properly defining them. These terms are "current period budget constraint" and "inter-temporal budget constraint." The current period budget constraint is an expression that equates the flows of government revenues and expenditures with changes in the stock of public debt and in the monetary base. Formally:

$$(D_{t+1} - D_t) + (M_{t+1} - M_t) = iD_t + G_t - REV_t \qquad (1)$$

where D measures the stock of public debt (measured at the beginning of the period), M is the monetary base, i is the interest rate paid by government debt, G is government expenditure on goods and services, and REV represents taxation (net of transfers) and other revenues (such as royalties from natural resources). The equation above clearly shows that a given deficit can be financed either by issuing debt (bond financing) or by printing money (money financing). As excessive money financing may lead to high inflation, equation (1) is often written as $(D_{t+1} - D_t) = iD_t + G_t - REV_t$. It should be clear that equation (1) does not impose a strong constraint on governments that are able to issue debt. In fact, Wilcox (1989) points out that "virtually any pattern of deficit would be sustainable if it were possible to borrow money and pay the interest by borrowing more" (p. 291).

The inter-temporal constraint, instead, imposes a limit on the government's ability to borrow indefinitely, by requiring net initial debt plus the present value of expected future government expenditures to be equal to (or not greater than) the present value of expected future government revenues. Formally:

$$D_t + \sum_{k=0}^{\infty} \frac{E_t(G_{t+k} + iD_{t+k})}{(1+i)^k} \leq \sum_{k=0}^{\infty} \frac{E_t(REV_{t+k})}{(1+i)^k} \qquad (2)$$

where E_t denotes expectation taken at time *t*, and all other variables are defined as above. Note that evaluating equation (2) requires formulating expectations on the future path of government revenues and expenditures. Furthermore, we greatly simplified equation (2) by assuming that the interest rate paid on government debt is constant and equal to the discount rate. Relaxing these assumptions would further complicate the analysis.[1]

One implication of equation (2) is that in the limit (as *t* goes to infinity), the present value of debt in the terminal period should be zero. Formally, equation (2) requires that:

$$\lim_{\tau \to \infty} \frac{D_{t+\tau}}{(1+i)^{\tau}} = 0 \qquad (3)$$

Condition (3) is often referred to as the No-Ponzi-Game condition (NPG). As sustainability requires that the NPG should be satisfied without a radical change in policies, sustainability can be tested by looking at whether the current fiscal stance will eventually lead to a violation of (3). Starting with Hamilton and Flavin (1986), a long series of papers have used data from OECD countries to perform sustainability tests.[2] As these types of tests require long time series of fiscal data (and these time series should not have large structural breaks), research on developing countries has been much more limited.

2.2 Sustainability Indicators

As formal tests of sustainability tend to be problematic and rather demanding in terms of data requirements, some analysts have developed rule of thumb indicators aimed at checking whether current policies can stabilize or reduce a given debt ratio. While these

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[1] Equation 2 would become $D_t + E_t \sum_{k=0}^{\infty} \frac{(G_{t+k} + i_{t+k} D_{t+k})}{\prod_{j=1}^{k} (1+\delta_{t+j})} \leq E_t \sum_{k=0}^{\infty} \frac{(REV_{t+k})}{\prod_{j=1}^{k} (1+\delta_{t+j})}$ where δ is the time-varying discount rate.

[2] For a survey of these papers, see Cuddington (1996). Bohn (1995) was the first to explicitly include uncertainty in these tests.

indicators have the advantage of being simple, it should be recognized that they are not based on any well-specified definition of sustainability.[3]

The starting point for deriving these indicators is the current period budget constraint of equation (1) that, after dividing all variables by GDP, can be re-written as:

$$\Delta d = (r - g)d - ps \qquad (4)$$

where d is the debt to GDP ratio, r the steady state real interest rate, g the long-run growth rate of real GDP, and ps the primary surplus (defined as *(REV-G)/GDP*). A positive value of (4) indicates that debt to GDP is expanding and may be interpreted as an unsustainable policy. After setting Δd equal to zero, Equation 4 is often rewritten as $ps = (r - g)d$, and ps is interpreted as the primary surplus required to stabilize the debt-to-GDP ratio for a given real interest rate, growth rate of the economy, and initial stock of debt.[4] Given its simplicity, equation (4) is probably the most commonly used indicator of sustainability.[5]

Buiter (1985) suggests an alternative indicator of sustainability, defined as:

$$SUS = ps - (g - r)\frac{W}{GDP} \qquad (5)$$

where W is public sector net worth and all other variables are defined as above. The second term on the right hand side of equation (5) is equal to the primary surplus that keeps the public sector wealth-to-GDP ratio constant. So, according to this indicator, sustainability depends on the difference between actual primary surplus (ps) and the surplus that stabilizes net government wealth (scaled by GDP). Negative values of SUS are taken as an indication that the current fiscal stance is unsustainable. One advantage of

[3] For a description of the practical approach to sustainability followed by the IMF, see Chalk and Hemming (2000).

[4] All the indicators discussed in this section assume that $(r - g) > 0$, which is a necessary condition for dynamic efficiency (for a discussion on this condition, see Blanchard, 1990).

[5] Equation (4) is the standard textbook formulation of the evolution of debt over GDP. A more precise definition of the evolution of debt in discrete time is $\Delta d = \frac{(r - g)}{1 + g} d - ps$. With this second formulation, the standard sustainability equation becomes: $ps = \frac{(r - g)d}{1 + g}$. For all practical purposes, the two definitions yield similar debt-stabilizing primary surpluses.

(5) is that it explicitly assumes that government expenditure could increase government wealth (this is one of the points recently raised by some developing countries, which we will discuss in detail later). One of the main problems with equation (5) is that government net worth is very difficult to measure.

Blanchard (1990) defines a set of sustainability indicators that require computing the constant tax rate that satisfies $t^* = \mathrm{E}(e+(r-g)d)$, where t^* measures taxes over GDP and e government expenditure over GDP.[6] This technique can be used to compute short-run (where expectations are replaced with current values of *e*, *r*, and *g*) or, depending on the length of the period for which expectations are taken, medium and long-run indicators. Blanchard (1990) points out that t^* has an easy interpretation because it is equal to the annuity value of expected future spending and transfers plus the difference between expected real interest rate and growth rate multiplied by the current debt-to-GDP ratio. Then, if t^* is larger than the current tax rate (t), an adjustment in spending or taxation will be required and hence the fiscal policy stance would not be sustainable. The sustainability indicator ($t^* - t$) measures the size of the required adjustment in the current period.

Blanchard (1990) suggests that different values of ($t^* - t$) will have different implications for sustainability depending on the starting level t. Countries with a low tax rate may have more room to adjust, while countries that already have high tax levels or limited ability to raise taxes (maybe because of the presence of a large informal sector, as often happens in developing countries) may have to resort to debt monetization or outright default.[7]

There are several caveats that apply to the indicators discussed above. First, they mostly focus on stabilizing a particular debt-to-GDP ratio but do not say anything about the optimality of this ratio. Hence, some countries may need to aim at a lower debt target, and sustainability should be defined as the policy stance needed to reach this new target.

Second, all the indicators discussed so far are sufficient (but not necessary) conditions for long-run sustainability. There are good reasons why a country may want to

[6] Under certainty, as $ps = t - g$, this is equivalent to $ps = (r-g)d$.

run a large deficit. Hence, it may be sub-optimal to prevent a country from smoothing expenditure (or conducting counter-cyclical policies) because this would lead to overshooting a fiscal ratio that corresponds to a long-run equilibrium (see, for instance, the discussion on the Growth and Stability Pact within the European Monetary Union).

Third, these indicators require assumptions on GDP growth, interest rates, government expenditures and revenues, and implicitly assume that these variables are exogenous. However, most of these variables tend to be endogenous and correlated with each other. It is clearly unrealistic to assume that changes in the primary deficit will have no effect on the interest rate and growth, or that changes in growth do not affect the primary surplus. Croce and Juan-Ramón (2003) propose a recursive fiscal sustainability indicator aimed at addressing these issues. They derive the primary surplus and discount rate that would prevail when a country reaches its target debt-to-GDP ratio and then build a fiscal sustainability indicator that lets these variables react to shocks that move the debt-to-GDP ratio out of its equilibrium value. This indicator identifies the reaction function of the government, and, hence, lets the analyst evaluate whether the fiscal stance is moving towards or away from sustainability.

Finally, most of these indicators do not take into account a host of factors that characterize the situation of most emerging market and developing countries and greatly increase uncertainty.

3. Why Are Emerging Markets Different?

Several features make emerging market countries different from OECD countries, for which most of the indicators discussed above have been derived. In particular, EMs often have limited capacity to raise taxes (because of a large informal sector) and a volatile revenues base; they are also subject to large external shocks (both real and financial) that increase the volatility of GDP growth and debt service and characterized by high levels of liability dollarization (see IMF 2003c). All these elements complicate the management of fiscal policy and greatly increase the difficulty of evaluating sustainability.

[7] However, countries with larger public sector and larger tax bases have more ability to adjust. See IDB

In order to clarify this statement, let us start by modifying equation (4) to include some of the elements that are common to EMs:

$$\Delta d = \left[\alpha r^{dl} + \beta r^{ds} + \gamma \frac{(1+\rho+r^f)(1+\varepsilon)-1}{1+\pi} + (1-\alpha-\beta-\gamma)\frac{(1+r^f)(1+\varepsilon)-1}{1+\pi} - g \right] d - ps \quad (6)$$

where α is the share of debt denominated in local currency at a fixed (long-term) interest rate, and r^{dl} is the corresponding real interest rate. β is the share of debt denominated in local currency at a floating (short-term) interest rate and r^{ds} is the corresponding real interest rate. γ is the share of debt denominated in foreign currency, ε is nominal depreciation, π is inflation, r^f is the international interest rate, and ρ is country risk. (1- α - β - γ) is official debt contracted with multilateral or bilateral institutions.[8] In contrast to OECD countries, in the typical EM β and γ tend to be high and α tends to be small. Therefore, EMs will tend to have a large share of their debt in either domestic currency at a floating rate or in foreign currency at a fixed rate. (While some EMs have a substantial share of concessional and official debt, but this tends to be the case for poorer developing countries.[9])

It is now easy to see how the characteristics of EMs complicate the sustainability exercises discussed in the previous section.

Real External Shocks (such as a terms of trade shock) tend to be larger in EMs. This affects the volatility of GDP growth and hence makes g difficult to estimate. There is also some evidence that the effect of external shocks is amplified by the presence of Sudden Stops in capital flows (Galindo and Izquierdo, 2003a).

A Weak Fiscal Position is another key characteristic of EMs and developing countries. Fiscal policies and budget institutions in EMs are often not credible, and this prevents them from managing counter-cyclical policies by making credible announcements to reduce public expenditure or cut taxes in good times (see IMF, 2003c).

(1995).

[8] We assume that this debt is contracted at the international interest rate. In some cases the actual rate will be higher (when the debt is not concessional) and in others, lower. However, this does not change our analysis as long as the interest rate applied to this type of debt has limited volatility.

[9] Edwards (2002) and IMF (2003a) focus on debt sustainability in low-income countries.

Liability Dollarization and Original Sin refer to the fact that in most EMs there are limited opportunities to borrow long-term in the country's own currency (hence, EMs have high values of β and γ).[10] Because of pervasive liability dollarization, EMs tend to suffer from "fear of floating" (Calvo and Reinhart, 2002; Hausmann, Panizza and Stein, 2001) and hence tend to overstabilize the exchange rate, even if the exchange rate regime is formally announced as a flexible one. However, stabilizing the exchange rate requires large adjustments in the domestic interest rate, and this amplifies uncertainty about the costs linked to servicing debt expressed in domestic currency at a floating rate. At the same time, episodes of financial contagion and the possibility of self-fulfilling fiscal crises affect country risk and increase the volatility of the cost of servicing foreign currency debt. Barnhill and Kopits (2003) point out that as the budget constraint of EMs is particularly difficult to observe, investor sentiments tend to be particularly volatile. These shocks may lead to multiple equilibria: a country that under a tranquil condition may have a perfectly sustainable policy stance may suddenly jump to an unsustainable situation just because fear of default leads international investors to ask for larger risk premia. Barnhill and Kopits (2003) study the case of Ecuador and show that the volatility of the sovereign spread is a major source of fiscal vulnerability, and is more important than terms of trade shocks. In this sense, there are instances in which the behavior of creditors is the ultimate determinant of sustainability.

Sudden Stops in capital flows could also be a key determinant of sustainability. For instance, Calvo, Izquierdo and Mejía (2003) argue that a loss of access to credit markets need not be the result of over-indebtedness *in the context of a good equilibrium*, but rather the result of an economy having fallen into a bad equilibrium *triggered by a Sudden Stop in capital flows*. This *Inverse Fiscal View* finds support in the fact that Sudden Stop episodes tend to occur around the same time, and for countries exhibiting a variety of fiscal situations. Sudden Stops in capital flows force abrupt adjustments of the current account deficit that may require a large adjustment (depreciation) of the real

[10] Eichengreen, Hausmann, and Panizza (2003a) point out that this is especially true in the case of external debt. They define Original Sin as the inability of a country to borrow abroad in its own currency. In earlier work, Eichengreen and Hausmann (1999) used the term Original Sin to refer to both the inability of some countries to borrow abroad in their own currencies and their inability to borrow at home at long maturities. For a discussion of the determinants of Original Sin, see Hausmann and Panizza (2003).

exchange rate (Calvo, Izquierdo, and Talvi, 2003). These adjustments may have large valuation effects and multiply the cost of servicing foreign currency debt because of excessive liability dollarization, thus pushing a country over the edge of unsustainability.[11] There is also evidence that, apart from amplifying the effect of Sudden Stops, liability dollarization may itself be a determinant of the probability of having a Sudden Stop (Calvo, Izquierdo and Mejía, 2003)

Debt is riskier in EMs, leading to a situation in which relatively low (for industrial country standards) debt-to-GDP ratios lead to very poor credit ratings. Switzerland and Costa Rica have similar debt-to-GDP ratios, and so do the United States and Turkey—or Italy, Japan, and Belgium and Jordan, Pakistan and Jamaica. However, these EMs have very different credit ratings than those of developed countries. Switzerland, United States, Italy, Japan and Belgium have a rating of at least AA, while the EMs listed above are well below investment grade. This de-linkage between credit ratings and debt ratios has been recognized by several authors (Hausmann, 2003; Eichengreen, Hausmann and Panizza, 2003a and 2003b; and Reinhart, Rogoff, and Savastano, 2003) who, however, attribute it to different causes. Hausmann (2003) and Eichengreen, Hausmann and Panizza (2003b) emphasize the role of Original Sin and suggest that foreign currency debt makes the cost of servicing the debt dependent on the real exchange rate, which is uncertain and pro-cyclical. As these elements increase the probability of being in a state of the world in which payment becomes very difficult, they will lead to lower credit ratings.[12] Reinhart, Rogoff, and Savastano (2003), instead, introduce the concept of "debt intolerance" and define it as the inability of emerging markets to manage levels of external debt that are manageable for advanced industrial countries. In their view, lower credit ratings are due to poor credibility (proxied by high

[11] A liquidity crisis arises when an otherwise solvent debtor does not have enough liquid assets to meet or roll over its maturing liabilities. IMF (2002) correctly points out that liquidity may not be an issue for low income countries that, while having high debt ratio, do not need to borrow from the private capital market (because most of their external liabilities are with official creditors). However, it is a serious issue for even moderately indebted EMs.

[12] Hausmann (2003) discusses a formal model.

levels of past inflation) and a history of repeated default.[13] Finally, Mendoza (2003) emphasizes the role of limited and volatile tax bases.[14]

Whatever the cause is (and irrespective of whether there is a solution), there is a consensus that under the current rules of the game, EMs can safely manage only fairly low levels of external debt. While IMF (2002) sets the threshold for a safe level of debt at around 40 percent of GDP, Reinhart, Rogoff and Savastano (2003) are even more pessimistic and argue that some countries may not safely manage levels of external debt that are above 15 percent of GDP.

Non-Renewable Resources may affect the outcome of standard sustainability calculations. Chalk and Hemming (2000) show that in the presence of non-renewable resources sustainability would require equalizing a country's net worth (including the value of the nonrenewable resources) to the net present value of primary non-resource deficits. This method highlights the fact that increasing resource exploitation to pay debt would not affect sustainability. There are, however, at least two problems with this "Ricardian equivalence of natural resources." The first is the same as that highlighted above when we discussed Buiter's indicator of fiscal sustainability, i.e., computing a country's net worth is a very difficult exercise. Second, it assumes that "oil in the ground" has the same return as the various financial assets and liabilities of the government.

Concessional Debt also plays an important role in determining sustainability. In adopting any of the steady-state approaches described above it is important to recognize that, as developing countries grow and become richer, the share of their concessional debt is bound to decrease and this will increase the cost of financing total debt. This increase in the cost of debt should be taken into account in estimating the steady state real interest rate paid by government debt.[15]

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[13] For a discussion of the differences between currency mismatches, debt intolerance, and Original Sin see Eichengreen, Hausmann and Panizza (2003b).

[14] Tax-to-GDP ratios in industrial countries average above 40 percent, and 30 percent in developing countries. At the same time volatility of tax revenues (measured as the coefficient of variation) tends to be twice as large in developing countries.

[15] For a discussion of the relationship between concessional debt, debt relief and fiscal sustainability, see Edwards (2002).

3.1. Other Issues

In standard IMF-led stabilization programs, countries are often asked to commit to achieving a given target in terms of primary deficit with the implicit objective of stabilizing or reducing its debt ratios (for a survey, see Chalk and Hemming, 2000). This has come under criticism for failing to take into account two factors. The first relates to the fact that not all debt has the same level of risk. The second relates to the fact that deficits incurred to finance public investment should be treated differently from deficits incurred to finance current expenditure.

Equation (6) shows that the stock of public sector debt cannot be considered a monolithic entity; as discussed above, different types of debt have different implications for the volatility of the public sector deficit and, hence, for sustainability. Local currency fixed-term debt is clearly the safest form of debt because the cost of servicing this debt is by and large predetermined. Foreign currency official debt is also relatively safe. While it is subject to exchange rate risk, the interest rates charged by official creditors tend to be stable and the flow of financing is either a-cyclical or slightly counter-cyclical. Local currency floating rate debt is subject to interest rate volatility and the cost of servicing this kind of debt may increase substantially during periods of financial turmoil. Foreign currency non-official debt is the riskiest. The cost of servicing this debt is subject to the volatility of both the exchange rate and of sovereign risk (the latter applies only if the debt needs to be rolled over). Furthermore, Sudden Stops in capital flows may make emerging market governments unable to roll over debt, leading to both liquidity and solvency crisis.

On the basis of these considerations, it has been argued that debt sustainability exercises should be performed by making use of weighed debt-to-GDP ratios where, akin to the Basel Principles for evaluating banks' balance sheets, different types of debt should be weighted according to their risk.

The second issue relates to the way in which investment expenditures should be recorded in government accounts. The debate is motivated by the concern that, according to current practice, public sector adjustment strategies bundle together current expenditure and public investment. In response to this practice, the Rio Group (a permanent mechanism of political consultations and interaction among 19 Latin

American countries) has put forward a proposal aimed at excluding investment expenditure from fiscal deficit targets.[16] The main argument in favor of this proposal is that, as current expenditure tends to be difficult to adjust (because it is mostly composed of wages and entitlement programs), investment is the typical adjustment variable when the deficit exceeds the target. The proposal argues that the inclusion of investment expenditures in the target budget balance may be problematic because it basically considers every increase in debt as a reduction in government wealth, implicitly assigning no value to investment expenditure as an addition to net wealth. The Rio Group, instead, would favor the adoption of sustainability indicators similar to the one proposed by Buiter (equation 2).

As mentioned above, a potential problem with targets based on net worth is that net worth is very difficult to measure. Furthermore, this issue is linked to the role that the public sector in an EM should play in terms of its investment strategy. EMs typically face periods of financial constraints where capital markets close, and they are subject to credibility problems regarding their ability to remain sustainable in times of distress. Crises occur in a context in which expenditure remains inflexible, particularly given its high wage content, and there are a myriad of unsatisfied social demands facing EMs. Under this scenario, it may be beneficial for the government to remain involved only in co-financing investment activities that would otherwise not be carried out completely by the private sector and that are deemed to be socially profitable (instead of assuming responsibility for full financing of investment projects). This, of course, does not mean that governments should not invest, but that they should do so selectively, complementing private sector participation. If this principle is accepted, it follows that the share of a project that is financed by the government is, essentially, a subsidy—and, as such, should be computed "above the line." This does not imply that public investment will always result in a higher fiscal deficit, because account should be taken of the possibly higher fiscal revenue that such investment might entail (and which, again, should be computed "above the line"). Of course, to the extent that governments are not following this rule, there is still an issue regarding the need for accounting public

[16] This principle was restated in the "Carta de Lima" signed by several Latin American finance ministers at the 2004 meetings of the Inter-American Development Bank that were held in Lima Peru.

investment as an addition to net wealth, but then again, there are several factors that make valuation of this investment quite difficult, particularly because this capital is not easily marketable, being in essence a non-tradable good.[17]

4. Evaluating Sustainability under Uncertainty

Standard sustainability analysis starts by picking values for steady state growth and the real interest rate, and then uses these values to compute the level of primary surplus that is consistent with debt stabilization. The previous section examined how evaluating sustainability in emerging markets and developing countries is more difficult than evaluating sustainability in industrial countries because emerging market countries are characterized by higher volatility in both revenue and expenditure. Consequently, the various implications based on steady-state values for growth and the real interest rate (where volatility is not an issue) may not make much sense.

In this vein, a new policy paper published by the International Monetary Fund (IMF, 2003b) describes several methodologies to stress test standard sustainability analysis with shocks to the main macroeconomic variables (this could be done by observing the past volatility of the main variables or by using stochastic simulations) and explicitly including contingent liabilities. These simulations can then be used to build confidence intervals around the projected evolution of debt to GDP.

To address the issue of volatility, some authors are now developing probabilistic models of sustainability that specifically take into account volatility in macroeconomic variables. Barnhill and Kopits (2003) develop models based on the concept of value at risk and apply it to the case of Ecuador. Hausmann (2003) also uses the concept of value at risk and applies it in a cross-country context. Croce and Juan-Ramón (2003) develop a stochastic model aimed at deriving a fiscal policy rule that is observable by external analysts and indicates whether a country is adopting a sustainable policy stance. As surveying all these models would require a considerable amount of space and technicality, in our analysis, we will focus on the probabilistic model developed for the Inter-American Development Bank by Mendoza and Oviedo (2003). This is the model

[17] See forthcoming IDB notes on public investment for a detailed discussion.

that we will use as a benchmark for our analysis, focusing on revenue volatility and expenditure inflexibility. Section 4.1 describes the main characteristics of the model. We then illustrate its application for the case of Ecuador in Section 5.1.

4.1 The Mendoza-Oviedo Model

The guiding principle of the Mendoza-Oviedo (MO) model is that of "credible payment commitment" (CPC). According to their definition, a commitment to repay is credible only if the government is able (if not necessarily willing) to repay its debt in every state of nature.[18] This implies that the government cannot accumulate more debt than the level it could service if it were to enter a fiscal crisis, defined as the case in which the primary balance remains forever at its lowest possible value. Were the actual level of debt to remain higher than the threshold determined by the CPC, then the government would be facing a positive probability of default on its debt, something a risk-averse lender would not allow to happen.[19]

With these considerations in mind, Mendoza and Oviedo (2003) develop a full-blown dynamic stochastic general equilibrium model where the path of government revenues is endogenously determined by the behavior of utility-maximizing individuals and profit-maximizing firms, in a context where both tradable and non-tradable goods are produced. In their model, there is a mismatch in the government's balance sheet because the government debt is mostly denominated in tradables and tax revenues are mostly denominated in non-tradables. They also assume that volatility in government revenues can be traced back to volatility in fundamentals such as the terms of trade, foreign interest rates, or productivity. As discussing the full specification of this model would require considerable technical detail, we follow a simplified version of Mendoza and Oviedo (2003) that transmits the flavor of its more complex formulation. This simplified version is the one we use to conduct an application to Ecuadorian data in Section 5.2.

We make the following three assumptions: (i) the path of government revenues is stochastic and exogenously determined; (ii) there is no currency mismatch (government

[18] Including the case in which government revenues (expressed as a share of GDP) remain indefinitely at their minimum.
[19] For more on this, including a discussion on outcomes using optimal contracts, see Mendoza (2003).

revenues and debt are denominated in the same currency); and (iii) both the interest rate (r) and long-run GDP growth (g) are known with certainty.

These assumptions lead to a simple formulation of the credible repayment commitment, where the threshold value for the debt-to-GDP ratio satisfies the following condition:[20]

$$d \leq d^* \equiv (t^{\min} - e^{\min}) \frac{1+g}{r-g}. \qquad (7)$$

Here d^* represents the threshold value for the debt to GDP ratio, $t^{\min}$ is the lowest possible realization of government revenues over GDP, and $e^{\min}$ is the minimum level of government expenditure-to-GDP ratio that can be sustained if the country were to enter a fiscal crisis in which tax revenue reaches (and stays at) $t^{\min}$ and pushes d above d^*. In this model (abstracting from willingness to pay issues) the government would always be able to repay any debt level below d*. Thus, the interest rate investors will charge is the risk-free interest rate, r.

Heuristically, $e^{\min}$ measures a government's ability to reduce expenditure in the presence of a prolonged negative shock to revenue. Countries that can sustain larger adjustments will be able to sustain larger debt-to-GDP ratios relative to countries with rigid public expenditure.

In this version of the model, the government has a constant desired level of primary expenditure, $\bar{e}$. Each period, it observes the realization of revenue and finances any gap between revenue and total expenditure (including interest payments) with new debt, as long as the resulting debt does not hit the debt threshold d^*. Otherwise, it needs to adjust expenditure in order to meet the debt threshold restriction. Thus, as long as debt is lower than the threshold, the debt-to-GDP ratio evolves according to the following formula:

$$d_t = d_{t-1} \frac{(1+r)}{(1+g)} + \bar{e}_t - t_t \qquad (8)$$

Given an initial debt level, and a sequence of revenue realizations based on the stochastic characteristics of the revenue process (mean, standard deviation, and persistence), the model generates a set of relevant results despite its simplicity. Not only does it determine a threshold debt level, but it also produces a probability distribution of debt *n* periods ahead. This probability distribution can then be used to calculate the probability of reaching the debt threshold at any given point in time.

An important difference between the approach to sustainability of Mendoza and Oviedo and the traditional long-run approach is that the traditional approach defines a policy target (expressed as the primary-balance-to-GDP ratio) aimed at stabilizing the current debt-to-GDP ratio (which is assumed to be the steady state level of debt to GDP). In contrast, in the probabilistic model, only the maximum level of debt to GDP is defined, but this level is not the equilibrium that will necessarily be observed, and it is clearly not the optimal level of debt. The task of the government is to strengthen fundamentals so that the probability of reaching the upper bound of government debt remains low.

An implication of the probabilistic model is that, for any given average revenue-to-GDP ratio, governments that have a less volatile revenue base (for instance, governments that depend less on natural resources) will have higher values of $t^{\min}$ [21] and hence they will be able to sustain higher levels of debt. Furthermore, what really matters is not the actual value of expenditure adjustment that a country can announce, but the value of $e^{\min}$ that can be *credibly* announced. Countries that can commit to a large adjustment in expenditure can also sustain higher debt-to-GDP ratios and may never be asked to act on these commitments.[22]

Mendoza (2003) uses equation (7) to compute sustainable debt-to-GDP ratios under different assumptions for the volatility of revenues, the difference between GDP growth and the real interest rate, and the ability to adjust expenditure. He shows that the

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[20] Equation (7) could also be written as $d \leq d^* \equiv \frac{(t^{\min} - e^{\min})}{r - g}$. See footnote 5 for a discussion.

[21] Where, for example, $t^{\min}$ is assumed to be equal to the mean minus two standard deviations.

[22] Countries could also commit to adjusting their tax rate and, by increasing $t^{\min}$, obtain a similar result.

results are very sensitive to the choice of this last parameter. In particular, he finds that emerging market countries that cannot adjust expenditure by more than 1 percent of GDP will not be able to sustain positive debt. Emerging market countries with larger capacity to adjust (defined as countries that can adjust the expenditure-to-GDP ratio by at least 8 percent) may be able to sustain debt-to-GDP ratios that range between 40 and 150 percent. When he calibrates the results to the "average" emerging market country, he finds a sustainable debt-to-GDP ratio of 60 percent for low-risk emerging market countries ("low-risk" is defined as having a small difference between real interest rate and GDP growth) and 30 percent for high-risk emerging market countries. Comparable estimations calibrated to industrial countries yield a sustainable debt-to-GDP ratio that can reach up to 350 percent, with average values of 85 percent.

Notice that these large differences in sustainability were obtained by just assuming differences in the volatility of revenues and the capacity to adjust primary expenditure. Hausmann (2003) suggests that valuation effects brought about by liability dollarization and Original Sin are likely to greatly amplify these differences. In fact, liability dollarization, by making a given country riskier, will affect the difference between real interest rate and GDP growth, and hence play a role in determining which countries are in the high-risk group.

5. The Case of Ecuador

This section surveys the main issues related to fiscal sustainability in Ecuador, including two sustainability exercises, the first related to revenue volatility under the Mendoza-Oviedo framework, and the second dealing with the effects of Sudden Stops in capital flows and the effects of oil price shocks under the Calvo-Izquierdo-Talvi approach.

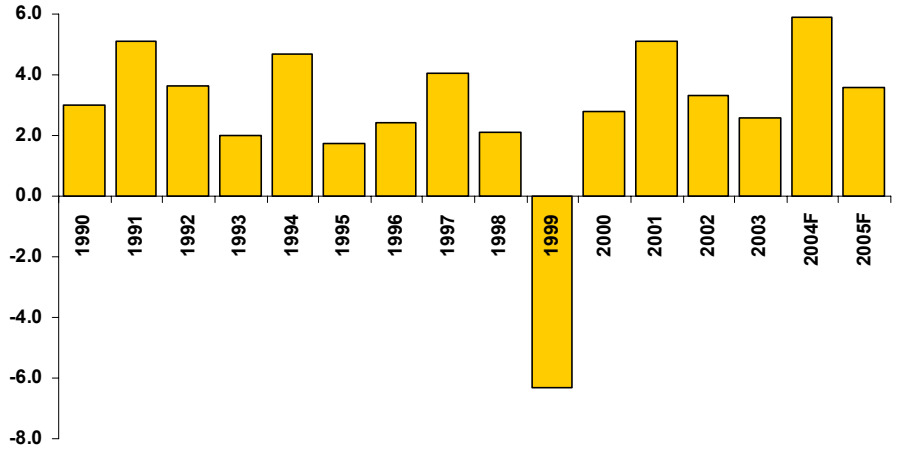
5.1 Some Stylized Facts

Despite high revenues from oil, the accumulation of persistent fiscal deficits throughout the mid-70s and most of the 1980s left Ecuador by 1990 with a high debt-to-GDP ratio of about 100 percent.[23] The combination of GDP growth averaging 3.6 percent per year (see

[23] World Bank-IDB Ecuador Public Expenditure Review, forthcoming, 2004.

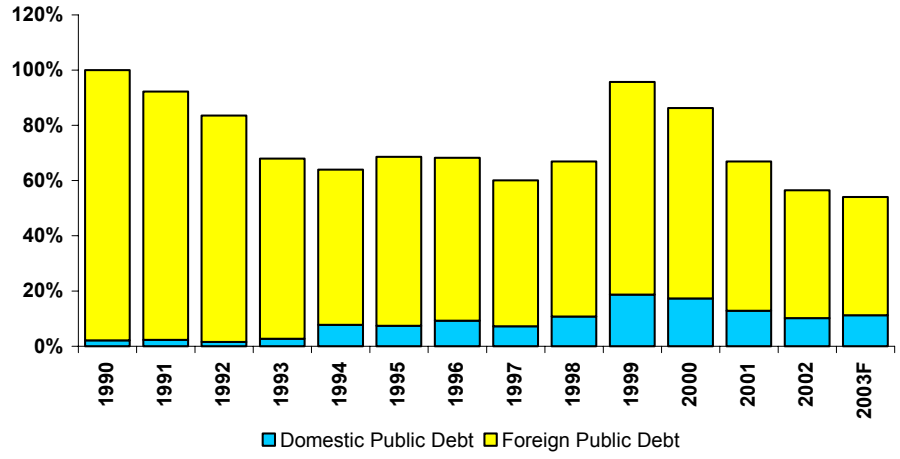
Figure 1), real exchange rate appreciation of 5.3 percent per year, and sound fiscal policies that kept public debt almost constant in dollar terms were the main factors behind a reduction in the debt-to-GDP ratio to 68 percent by 1993 (see Figure 2).

Figure 1. GDP Real Growth (% points)



Source: IMF, World Economic Outlook (Apr-2004)

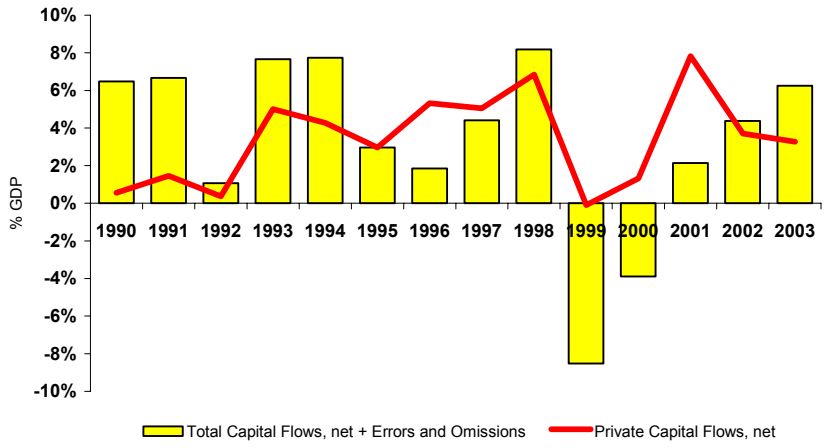
Figure 2. Total Public Debt in Ecuador (% GDP)



Source: IMF and Central Bank of Ecuador

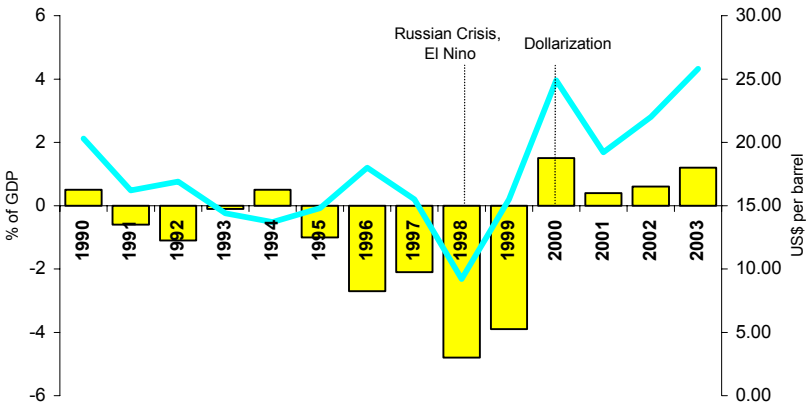
As in many other Latin American countries, 1993 marked the beginning of a wave of capital inflows that lasted until 1998, averaging 5.5 percent of GDP (see Figure 3). Despite this favorable external environment, resulting in GDP growth of almost 3 percent per year over the same period, fiscal performance waned, particularly in 1996 and 1997, even before the materialization of the macroeconomic crisis of 1998. On average, the overall deficit of the Non-Financial Public Sector (NFPS) remained at 1 percent of GDP for the period 1993-97, before hitting rock bottom in 1998, when it reached 4.8 percent of GDP (see Figure 4).

Figure 3. Net Capital Flows to Ecuador (% GDP)



Source: World Economic Outlook (Apr-2004)

Figure 4. Fiscal Performance and Oil cycles in Ecuador
(NFPS Global Result/GDP and Oil Prices)



Source: Banco Central del Ecuador and Ministry of Finance

It should also be noted that 1998 was an extremely difficult year for Ecuador because the country was subject to a set shocks affecting its main sources of vulnerability:

- A Sudden Stop in capital flows that took place in 1998 following the Russian crisis of the same year (see Izquierdo, 2002 for more details) that turned into a capital flow reversal of about US$3.5 billion by 1999, equivalent to 20 percent of GDP, or 56 percent of credit to the private sector prevailing in 1998. This reversal brought about a dramatic swing in the real exchange rate that seriously diminished fiscal sustainability, both directly through debt revaluation as a share of GDP,[24] and indirectly through the materialization of contingent liabilities derived from the ensuing financial crisis that led to bankruptcy for non-tradable sectors with foreign currency debt.[25]
- A collapse in oil prices (averaging US$9.2 per barrel, the lowest value in the 1990s), indeed another relevant shock given the high correlation between oil prices and fiscal outcomes (see Figure 4).
- The effects of El Niño floods in late 1997 and 1998.

The resulting collapse in revenue, coupled with the costs of the resolution of the banking crisis and the reconstruction efforts after El Niño, in a context of closed world capital markets, led to enormous pressure for the monetization of fiscal financing needs. By early 1999, Ecuador chose to abandon its crawling-band regime in favor of a floating exchange rate, but given the pressure coming from the fiscal side, monetary commitments were subdued and the monetary system collapsed as devaluation expectations remained high. Under these circumstances, the only option for recovering any credibility whatsoever was to abdicate monetary policy by dollarizing in 2000. Even then, this

[24] Given that most government debt was denominated in foreign currency, whereas GDP has a large non-tradable component.
[25] The fiscal cost of the banking crisis is estimated at around US$2.6 billion, nearly 20 percent of GDP in 1999. See IMF Staff Country Report No. 00/125, October 2000, for more details.

policy was not fully successful until debt-restructuring agreements were reached several months later.[26]

The adoption of dollarization, coupled with the closure of capital markets for government debt, forced authorities to make drastic adjustments in public finances. As a result, the primary balance, which averaged 2.3 percent of GDP for the 1993-1998 period, increased all the way to 8.1 percent of GDP in 2000.[27] Since then, and partly as a consequence of increasing oil prices, the government has been able to sustain positive overall balances (see Figure 4). Although a substantial effort was carried on in 2000, as evidenced by the large primary balance, it has since fallen to much lower levels, and Ecuador still remains vulnerable to shocks like the one experienced in 1998. Even after a second debt restructuring undertaken in 2000, the debt-to-GDP ratio remains high, at about 54 percent of GDP by end-2003,[28] not too far from the figure prevailing before the crisis of 1998.

Although the Sudden Stop of 1998 led to an economic downturn in the late 1990s that worsened Ecuador's fiscal accounts, the country's budgetary problems are not purely attributable to this event and are rooted in the volatility of its revenues (partly due to the high concentration of the export sector) and the rigidity of its expenditures (Artana, Tour and Navajas, 2002; López-Cálix, 2003; Jácome, 2004). All these factors contribute to making fiscal accounts particularly vulnerable to fiscal shocks, as indicated by the fact that Ecuador had to restructure its debt twice in a ten-year period, being the first country to default on Brady bonds.

By taking a look at the main components of Ecuador's fiscal figures (Table 1), it is easy to find structural problems that need to be addressed by a change in policy stance. In particular, the accounts of the NFPS show an increase in current expenditure that is mostly due to a higher wage bill. Public sector employment and nominal public sector

[26] This may be due to the fact that, given the disappearance of a domestic money base to tax via inflation (a consequence of dollarization), default risk on government debt increased (as was reflected in the increase in government debt spreads), and the economy did not stabilize until debt restructuring took place in the second half of 2000. For more on this see Galindo and Izquierdo (2003b).

[27] We use data from the Central Bank of Ecuador.

[28] In August 2000, the Ecuadorian government restructured its sovereign bonded external debt; moreover, in September 2000, Ecuador reached an agreement to reschedule US$880 million of the US$1.3 billion that the country owed to the Paris Club of creditor nations, agreeing to repay this amount in an 18-year period with a three-year grace period.

wages tend to be very difficult to cut and, in the past, Ecuador has been able to reduce the real public sector wage bill through inflation. However, with dollarization, inflation through monetary expansion is no longer an option and, hence, a higher public sector wage bill may increase the rigidity of the budget and worsen the fiscal situation in the coming years. It is worth noting that the increase in current expenditure was balanced by a reduction in capital expenditure and, therefore, total expenditure remained more or less constant as a share of GDP. The rigidity of Ecuador's budget is confirmed by a recent analysis of the composition of public expenditure, which found that 95 percent of revenues are preallocated and only 5 percent are freely available (López-Cálix, 2003).

Table 1. Public Sector Operations (percent of GDP)

	1997	1998	1999	2000	2001	2002	2003
Non Financial Public Sector Results							
Total Revenue	**23.4**	**17.3**	**21.1**	**25.9**	**23.5**	**25.7**	**25.7**
Oil Revenue	5.4	3.9	6.3	9.2	6.4	5.7	6.2
Non Oil Revenue	13.3	13.3	14.0	15.8	16.5	19.2	19.0
VAT	3.9	3.6	3.5	5.6	6.9	6.8	6.5
Income Tax	2.0	1.5	0.9	2.0	2.6	2.4	2.7
Soc. Security Contribut.	2.3	1.9	1.4	1.4	2.2	3.1	3.4
Total Expenditure	**25.9**	**22.1**	**25.0**	**24.4**	**23.1**	**25.1**	**24.5**
Current Expenditure	16.8	17.2	19.0	19.4	16.4	18.6	19.1
Wages	7.7	7.3	5.9	4.8	5.5	7.2	8.5
Interest on Domestic Debt	1.0	1.0	2.1	1.2	1.0	0.8	0.7
Interest on Foreign Debt	3.7	3.2	5.0	5.4	3.7	2.7	2.4
Capital Expenditure	6.2	5.0	6.0	5.0	6.6	6.5	5.4
Surplus (-Deficit)	**-2.1**	**-4.8**	**-3.9**	**1.5**	**0.4**	**0.6**	**1.2**
Primary Surplus (-Deficit)*	**2.1**	**-0.6**	**3.2**	**8.1**	**5.1**	**4.2**	**4.3**

Table 1., continued

	1997	1998	1999	2000	2001	2002	2003
Central Government Results							
Total Revenue	**14.6**	**13.9**	**16.1**	**20.4**	**18.3**	**18.8**	**17.8**
Oil Revenue	5.1	3.8	6.0	8.8	6.1	5.6	5.8
Non Oil Revenue	9.5	10.1	10.2	11.6	12.2	13.2	12.0
VAT	3.3	3.6	3.3	5.2	6.4	6.3	5.9
Income Tax	1.7	1.5	0.7	1.8	2.3	2.2	2.2
Total Expenditure	**15.8**	**18.0**	**19.0**	**20.3**	**19.0**	**19.6**	**18.7**
Interest on Domestic Debt	1.0	1.0	2.0	1.2	1.0	0.8	0.8
Interest on Foreign Debt	3.0	3.0	4.7	5.1	3.5	2.6	2.3
Global Result (Surplus/-Deficit)	**-1.2**	**-4.1**	**-2.9**	**0.1**	**-0.7**	**-0.8**	**-0.9**
Primary Surplus (-Deficit)	**2.8**	**-0.1**	**3.9**	**6.5**	**3.7**	**2.6**	**2.2**

Source: Banco Central del Ecuador and IDB estimates.

While total expenditure has remained more or less constant, the procyclicality of tax revenues and shocks to oil prices has led to a situation characterized by extremely volatile total revenues (López-Cálix, 2003). Such volatility may lead to structural problems because during good times the fiscal situation improves, and this might reduce the government's commitment to fiscal reforms (in fact, there were concerns that the country could have lost some steam on its reforms after achieving a 8.1 percent NFPS primary surplus in 2000).[29] Concerns about Ecuador's fiscal performance led Standard and Poor's to downgrade the country's foreign currency sovereign debt from B- to CCC+ in 2001, effectively constraining Ecuador from tapping world capital markets.[30]

The previous analysis suggests that revenue volatility and external shocks such as a Sudden Stop in capital flows or a sudden drop in oil revenues might still have a large negative impact on Ecuador's fiscal sustainability. We analyze these sources of vulnerability in the next section.

[29] A recent World Bank report states "[Ecuador] must either take the path of austerity and competitiveness…or once again squander the country's petroleum riches" (López-Cálix, 2003, p. 3).
[30] This rating has since been revised several times without major changes; the last revision in September 2003 left the rating as CCC+ for long-term debt, with a stable outlook, and a short-term rating of C.

5.2 Sustainability Analysis

In this section we assess fiscal sustainability in Ecuador using three exercises: (i) a standard sustainability analysis; (ii) the Mendoza-Oviedo (2003) probabilistic approach; and (iii) the Calvo-Izquierdo-Talvi (2002) Sudden Stop approach.

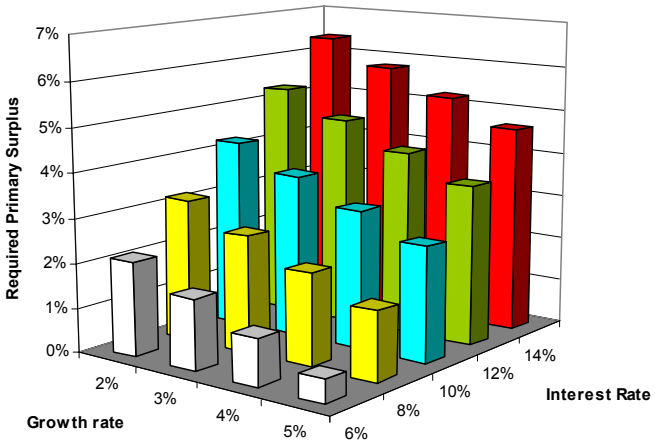
These three approaches are useful in assessing different sustainability issues. The traditional approach, which equates the current debt to GDP ratio to the steady state debt level, is useful for calculating the primary surplus that is consistent with that debt at various interest rates and growth rates. The second approach incorporates revenue volatility and expenditure flexibility to the previous case. Finally, the third approach is concerned with the effects of an external shock that leads to adjustment in the current account balance and real exchange rate depreciation.

Standard Approach to Sustainability

The standard approach requires assumptions on initial debt, steady-state GDP growth and steady-state real interest rate. For our baseline calculation, we assume that the starting level of debt is 54 percent of GDP, i.e., the value of total public debt prevailing by end-2003, and we let the steady- state growth rate range between 2 and 5 percent and the real interest rate range between 6 and 14 percent. Figure 5 shows that in the most favorable conditions (6 percent real interest rate and 5 percent growth rate of the economy), the Ecuadorian government could stabilize debt with a primary surplus equivalent to 0.5 percent of GDP. If we move away from this rosy scenario, however, we find that required primary surpluses go well above 3 percent of GDP. In particular, if we assume that steady-state long run growth is equal to the geometric average of the GDP growth observed for the period 1985-2003 (2.5 percent) and the real interest rate is equal to the average interest rate that will eventually prevail for Global bonds (which yield a value of 11 percent[31]), we obtain a required primary surplus of 4.5 percent of GDP. This is slightly higher than the observed balance for 2002 and 2003. A first look at these figures would seem to indicate that the fiscal position is relatively appropriate, but it must be acknowledged that the observed primary surplus was obtained under a very favorable context for oil prices and the capital account (see Figures 3 and 4). The next two sections

will show that once the main sources of volatility related to oil prices and the capital account are considered, the situation could worsen substantially.

Figure 5. Primary Surplus required to stabilize debt at 54% of GDP



Probabilistic Approach to Sustainability

The Mendoza-Oviedo (MO) probabilistic approach is useful in illustrating how revenue volatility can be incorporated into a sustainability analysis. The MO probabilistic model requires information on: (i) volatility of government revenues; (ii) average levels of revenue and expenditure; (iii) the size of potential adjustment in expenditure were the government to fall into a crisis state; (iv) the world real interest rate; and (v) the economy's steady-state growth rate.

As a first step, we calculate volatility based on a measure of the cyclical component of government revenue (obtained by taking a Hodrick-Prescott filter to the log revenue) in real terms for the period 1985-2003.[32] Next, we approximate cyclical component behavior to a first-order autoregressive (AR1) process, and take the standard deviation of this process as our measure of volatility. We then transform this volatility in terms of government revenue into volatility in terms of government revenue as a share of

[31] This is analyzed in more detail in the next section.

GDP, which yields a value of 2.55 percent. Average revenue and average non-interest expenditure as a percentage of GDP for the period 1985-2003 were 22.6 percent of GDP and 19.4 percent of GDP, respectively.

To estimate the average growth rate of the economy, we use the same period used to estimate volatility and obtain a value of 2.52 percent.[33] For the world real interest rate, we make the same assumptions as in Mendoza (2003) and Mendoza and Oviedo (2003) and use a value of 6.5 percent. As for the initial amount of debt, we use the prevailing level of net public debt at end-2003, equivalent to 54 percent of GDP.

Finally, in order to compute the potential adjustment in case of fiscal crisis, we need to make further assumptions about minimum revenue, as well as the flexibility of public expenditure. We make the two following assumptions: (i) the minimum revenue level lies two standard deviations below the mean. Given our measures for volatility and mean revenue, this yields a value of t_{min} equal to 17.5 percent of GDP; and (ii) the government can reduce non-interest expenditure in the neighborhood of 30 percent (departing from current expenditure levels) in the event of a fiscal crisis.[34] All the assumptions necessary to perform the sustainability exercise are summarized in Table 2.

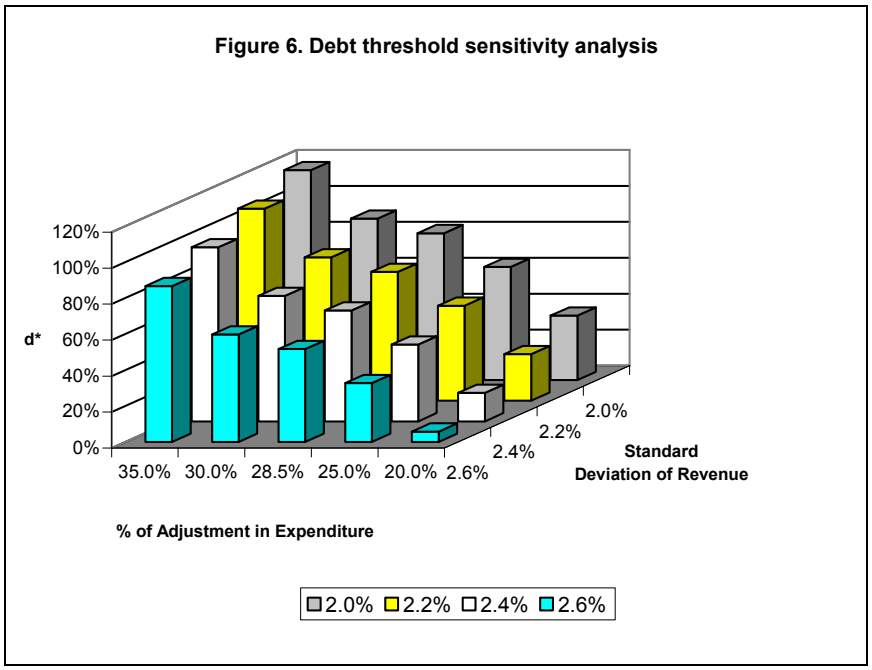
Table 2. Baseline Assumptions for the MO Model Applied to Ecuador

Variable	Value
Volatility of government revenues (percentage of GDP)	2.55%
Average levels of revenue (percentage of GDP)	22.61%
Average levels of non-interest expenditure (percentage of GDP)	19.37%
Minimum level of revenues (percentage of GDP)	17.5%
Maximum expenditure adjustment	28.5%
World real interest rate	6.5%
Initial level of debt (percentage of GDP)	54%
Steady state GDP growth	2.52%

[32] We compute trend revenue using data on general government (NFPS) for the period 1985-2003. We excluded the period 1980-1984 from our estimations to avoid excessive volatility derived from the massive adjustment that the debt crisis of the 1980s brought to Ecuador.
[33] Computed as a geometric average from IMF/IFS GDP data.
[34] The exact figure is 28.5 percent, and it is chosen to maximize the size of the primary balance in times of crisis so that the debt threshold remains slightly above current debt levels.

The assumption on the ability to adjust non-interest expenditure is particularly important and merits further discussion. In particular, we assumed an ability to adjust expenditure that is quite large. We use this rate of reduction in our estimations to maximize the size of the primary balance in times of crisis in order to keep debt limits above current debt levels. This does not imply that the government can realistically be expected to reach this level of expenditure reduction. This value of expenditure reduction is chosen mainly to illustrate the usefulness of this approach in analyzing debt sustainability. Lower levels of potential reduction in government spending would lower the size of the debt threshold, thus making crisis much more likely. However, it must be noted that, during the 1999 crisis, Ecuador's government expenditures represented approximately 70 percent of their 2003 value in real terms, providing some indication that Ecuador has been able to live with much lower levels of public expenditure, although amidst an appalling fiscal and financial crisis.

Figure 6 is helpful in depicting debt threshold sensitivity to different assumptions on revenue volatility and expenditure adjustment. Taking interest and growth rates as given, the figure illustrates the values of the debt thresholds (d^*) that would be obtained under different assumptions for revenue volatility and expenditure adjustment. Using as a benchmark our estimates mentioned above for revenue volatility and expenditure adjustment, the debt threshold hovers around 54 percent of GDP. Lower values of volatility would allow for higher debt levels. For instance, by reducing volatility to 2 percent (and maintaining the same level of expenditure adjustment), we obtain a debt threshold of 81.7 percent of GDP.



On the other hand, if we were to relax our assumption that the government can adjust expenditure by almost 30 percent and replace it with the assumption that it can adjust expenditure by only 20 percent, we would obtain a debt threshold close to 8 percent of GDP. This would imply that current debt is already above the threshold that guarantees debt repayment under all states of nature and that *Ecuador would already be in a state of fiscal crisis* (i.e., current debt is already above the threshold that guarantees debt repayment under all states of nature).

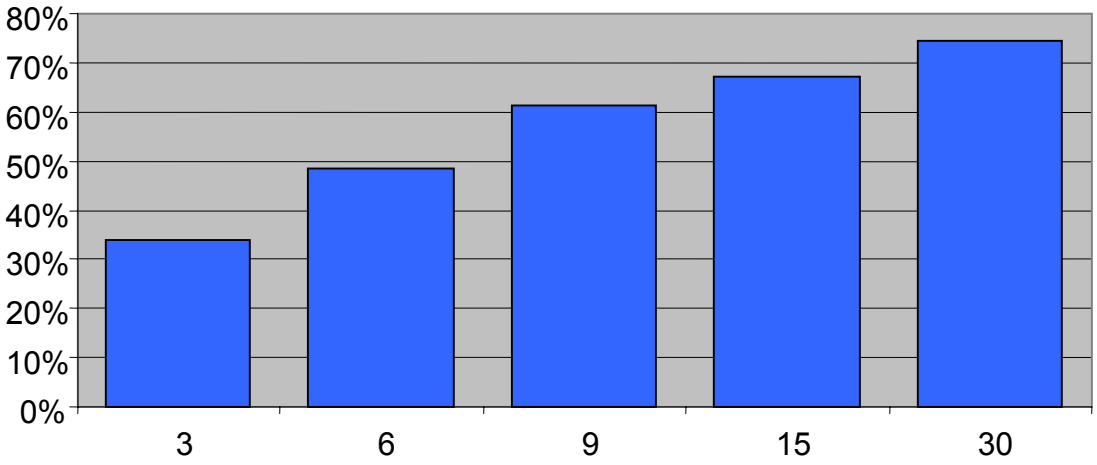
It should be recognized that the definition of sustainability used here is a very conservative one because it insures the public sector against default even under the worst scenario (in which revenue remains at its minimum forever). Furthermore, by considering sustainable only those levels of debt that are less than or equal to the level of debt that can always be repaid, the model implicitly assumes that creditors obtain complete insurance. Creditors of emerging market countries clearly do not expect such insurance, and this is reflected in sovereign spreads.[35]

[35] However, note that this analysis is carried out using world average interest rates, which are much lower than the rates typically used for sustainability analysis, precisely because of the assumption of the government's full ability to repay.

This simple exercise points out that Ecuador's fiscal position is far from being a slack one. The current level of debt appears to be sustainable (in the probabilistic definition) only if we are ready to assume high flexibility in government expenditure. As mentioned before, Ecuador has been able to swiftly reduce government non-interest expenditure in the recent past, amidst a dramatic macroeconomic crisis that involved huge swings in the exchange rate. However, it should be pointed out that such adjustment may much more difficult to reproduce under dollarization, given that it would probably take a long time for the real exchange rate to adjust through a recession.

We now turn to model simulation. Based on the assumptions presented in Table 2, we perform 500 simulations of the model, which implies obtaining 500 possible tax revenue paths, based on mean revenue of 23.7 percent of GDP and the volatility and persistence previously obtained. Assuming that the government keeps expenditure constant at its mean level, we can estimate the probability of hitting the debt threshold in the future. Taking as initial debt the level prevailing at end-2003 (54 percent of GDP), we compute the relative frequency distribution of government debt *n* periods ahead and then estimate the probability of entering a crisis. Figure 7 indicates that the probability of entering an adjustment phase within three periods is rather large (34 percent), and it increases after 6 periods to almost 50 percent

Figure 7. Probability of Hitting the Debt Threshold *n* Periods Ahead



Note: Initial Debt Level is 54% of GDP.

One of the main advantages of the probabilistic model is that, by providing a distribution for the probability of hitting a crisis, it highlights the current vulnerability of the fiscal stance. By warning of possible negative outcomes with sufficient anticipation, it offers a chance for the authorities to correct fiscal policy before hitting debt thresholds.

Sudden Stop Approach to Sustainability

We now focus on the fiscal distress that is typically generated by shocks to financing of the current account, or Sudden Stops in capital flows. As stated in Calvo, Izquierdo, and Talvi (2003), this type of shock has been quite relevant for emerging markets, particularly so following the Russian crisis of 1998. These events can be interpreted as shocks to credit. A fall in the financing of the current account deficit implies a forced adjustment in the absorption of tradable goods. To the extent that consumption of non-tradable goods is a complement in consumption of tradable goods, a fall in the latter will imply a fall in the former, leading to a decrease in non-tradable prices. Since for a small open economy tradable prices are taken as a given, this implies that the real exchange rate will have to adjust. Adjustment in the real exchange rate will generate valuation effects on the debt-to-GDP ratio, which, in turn, affects fiscal sustainability.

The potential of fiscal distress following a Sudden Stop for a country like Ecuador was much larger in 2002, when its current account deficit reached 5.4 percent of GDP, than in 2003, when it was substantially reduced to 1.6 percent of GDP.[36] Still, Ecuador is also exposed to shocks to the current account that could work just like a Sudden Stop. For instance, a fall in the price of oil or sudden drop in the flows of remittances would reduce resources available to finance other items of the current account deficit, generating effects similar to those of a Sudden Stop in capital flows.[37]

For the sake of illustration, we evaluate a large shock to the international price of oil that would reduce it to US$ 12 per barrel (close to the real average price of oil of 1998), implying an equivalent fall in real terms of about 50 percent of the average price

[36] Data from Banco Central de Ecuador and authors' calculations. According to IMF figures, the current account deficit was 4.9 in 2002 and 1.7 in 2003 (source: IMF).

[37] While a country with full access to international capital markets could borrow to smooth these kinds of shocks, this is clearly not the case for Ecuador.

prevailing at end-2003. Assuming that production of oil stays constant, this percentage price fall would be equivalent to a reduction in the value of net oil exports. Thus, financing could fall by slightly over US$ 1 billion, equivalent to a reduction of about 13 percent in total imports. Assuming that the latter represents the needed percentage fall in the absorption of tradable goods, that a similar percentage fall in the demand for non-tradable goods would take place (this would be the case with homothetic utility functions), and that the relative price elasticity of non-tradable goods has a value similar to that of other developing countries (approximately 0.4), this would yield a real depreciation of approximately 33 percent.[38]

To evaluate the effect of real depreciation on fiscal sustainability we need to make a number of assumptions regarding the currency composition of public debt, output composition, growth rates, and interest rates. Currency composition is the easiest; as Ecuador's legal tender is the US dollar, we assume that 100 percent of the debt is in foreign currency.[39] It can be shown that real exchange rate fluctuations will have no valuation effects on the debt-to-GDP ratio as long as the ratio of debt in domestic currency (or in non-tradables, B) relative to debt in foreign currency (or in tradables, B*) is the same as the ratio of non-tradable output (Y) to tradable output (Y*), or equivalently:[40]

$$\frac{B/B^*}{Y/Y^*} = 1 \qquad (9)$$

As Ecuador produces non-tradable goods as well as tradable goods (and, hence $0 < \frac{Y}{Y^*} < \infty$) and, as we have already pointed out, all of Ecuador's debt is contracted in terms of tradable goods, $\frac{B/B^*}{Y/Y^*}$ is equal to zero indicating that a real depreciation will bring about valuation effects on the debt-to-GDP ratio.

[38] A real depreciation is defined as an increase in the price of tradable goods vis-à-vis that of non-tradable goods. For a detailed description of this calculation, see Calvo, Izquierdo, and Talvi (2003).

[39] Although Ecuador still has some outstanding debt in Sucres, the dollarization of the economy implies a fixed exchange rate for that debt, which will probably be paid in foreign currency at its maturity. Thus, for the present exercise we have assumed that all of Ecuador's domestic debt is denominated in foreign currency.

[40] See Calvo, Izquierdo, and Talvi (2003).

We now put Ecuador's data to the test by analyzing the effect on the required primary surplus (using standard sustainability analysis) of a RER depreciation triggered by a fall in the price of oil; the results are shown in Table 3. We conduct the exercise under four different assumptions for the real interest rate (and use the same steady state growth rate employed in the Mendoza-Oviedo framework). Artana, Tour and Navajas (2002) estimate that the average interest rate of the public debt of Ecuador in 2002 was 7.22 percent. However, this interest rate is low given the large share of concessional debt in Ecuador's total debt. Looking into the future, a more realistic rate for this analysis would be the interest rate prevailing in post debt-restructuring Global bonds, under the assumption that concessional debt will eventually be replaced by market-placed debt. Thus, we construct an average of the interest rate of fixed rate Global 2012 bonds and the one that will prevail in the long run for Global 2030 bonds, which yields a value of 11 percent (for comparison purposes, we also include two alternative interest rate scenarios discussed by Artana, Tour and Navajas (2002) of 12 percent and 14 percent, respectively).

We focus our analysis on the second scenario, with a real interest rate of 11 percent, which we consider more realistic. In this scenario, the government's observed primary surplus for 2003 is slightly below the surplus that would stabilize debt in a no-shock scenario, equivalent to 4.5 percent of GDP (exercise *a* in Table 3). Once the valuation effect of real exchange rate depreciation following the fall in oil prices kicks in, the required primary surplus would increase to 5.24 percent (one point of GDP above the observed primary surplus). Exercises *c* and *d* recognize that negative external shocks such as a fall in oil prices are often accompanied by higher interest rates and lower growth, and they examine the consequences of such negative shocks. For example, an increase of 200 basis points in interest rates, coupled with a fall in growth of 1 percent would increase the required primary surplus by an additional 2 percentage points to about 7.2 percent of GDP.

Finally, we take into account the fact that in many recent crises, governments have bailed out banks in trouble, particularly because of the emergence of non-performing foreign currency loans handed to non-tradable sectors that go bankrupt after a substantial rise in the RER. Therefore, we analyze the potential impact that contingent

liabilities in the financial sector could have on fiscal sustainability (López-Cálix, 2003, discusses the main vulnerabilities of Ecuador's financial sector). We assume that the entire loan portfolio of the banking system is denominated in terms of tradable goods. In order to calculate the share of loans allocated to the non-tradable sector, we exclude loans to the agriculture, mining and manufacturing sectors weighed by the fraction of output of these sectors that is actually exported[41] from the total loan portfolio of the Ecuadorian banking system.[42] We estimate that bank loans allocated to the non-tradable sector were about 12.6 percent of GDP by 2003. For illustrative purposes, we assume that 20 percent of these loans go into default following a rise in the RER, and that the government incorporates this amount into their liabilities following a bailout. Thus, public sector debt would increase by 2.5 points of GDP. Exercise *e* shows that including such contingent liabilities in the analysis would increase the required surplus to 7.5 percent of GDP. In the event that all these factors materialized jointly (as outlined in exercises *b* through *e*), not an uncommon event in times of crisis, the current primary surplus, which, by historical standards is very high, would not be sufficient to stabilize debt. It should be noted that this exercise highlights the valuation effects of the change in relative prices following the fall in the price of oil, but it does not take into account the direct effect on the government's budget that lower royalties on oil would entail, unless this effect were to be buffered by the use of Ecuador's oil fund.

[41] Hence, we assume that credit allocated to tradable activities within each sector is proportional to the share of exports in that sector's output

[42] Information on loan allocation refers to September 2003 and is from the Ecuadorian Banking and Insurance Superintendency. For the construction of these weights we used sectoral GDP and exports as of 2001 from Ecuadorian Central Bank statistics.

Table 3. Sudden Stop Exercise (Fall in Oil prices to US$ 12 pb)

	1	2	3	4
Basic Assumptions				
Debt over GDP ((B+B*)/(Y+Y*))	54.0%			
Interest rate (r)	7.22%	11%	12%	14%
Steady state GDP Growth (θ)	2.50%			
Fall in Oil Net Exports/Imports of G&S	13.15%			
Real Depreciation	32.88%			
Actual Primary Surplus	4.3%			
Sustainability analysis				
Required Primary surplus:				
a. Base Exercise (no shock)	2.49%	4.48%	5.01%	6.06%
b. Change in Relative Prices (valuation effect)	2.91%	5.24%	5.86%	7.09%
c. b + Increase in Interest Rate of 200 BPS	4.14%	6.47%	7.09%	8.32%
d. c + Decrease in GDP Growth of 1 percent	4.81%	7.16%	7.78%	9.03%
e. d + Contingent Liabilities 2.54 percent of GDP	5.03%	7.49%	8.14%	9.45%

Note: All data refer to 2003.

A similar exercise was conducted to analyze the impact of a Sudden Stop in capital flows. As Ecuador has closed much of its current account gap between 2002 and 2003 (the 2003 current account deficit was about 1.6 percent of GDP), a Sudden Stop in capital flows would imply a limited real depreciation (estimated at 15.4 percent) and would not lead to large valuation effects. In fact, Table 4 estimates that the plain valuation effect on the primary surplus would range between 0.23 percent of GDP (column 1) and 0.57 percent of GDP (column 4). Compared to the adjustment that followed the Sudden Stop in 1998-1999 (when the current account deficit was 11 percent of GDP and the change in the current account balance from 1998 to 1999 was almost 50 percent of imports), we find that, in under current conditions, a Sudden Stop of capital flows is not an important source of vulnerability for the Ecuadorian economy. However, exercises *c*, *d*, and *e* in Table 4 show that, even with this limited current account deficit, shocks that typically accompany a Sudden Stop in capital flows could have serious consequences.

Table 4. Sudden Stop Exercise
(Depreciation needed to close the current account deficit)

	1	2	3	4
Basic Assumptions				
Debt over GDP ((B+B*)/(Y+Y*))	54.0%			
Interest rate (r)	7.22%	11%	12%	14%
Steady state GDP Growth (θ)	2.50%			
Real Depreciation	15.38%			

6. Conclusion

In this paper, we survey the recent literature on fiscal sustainability with special focus on emerging market countries. We highlight that, because of greater uncertainty and high revenue volatility, standard sustainability analysis is not easily applicable to emerging market countries. With these considerations in mind, we describe in detail a model that aims at evaluating sustainability by using probabilistic methods. We conclude our discussion with an application to the case of Ecuador.

We find that although Ecuador's fiscal stance has improved substantially in recent years, the introduction of uncertainty in tax revenue shows that there is a positive probability that the country could enter fiscal crisis in the near future. This is particularly so because there seems to be high inflexibility in government non-interest expenditure, and high volatility in government revenue that leave the country vulnerable to external shocks, as evidenced by two defaults on external debt throughout the 1990s.

Furthermore, even though Ecuador greatly improved its external position and, by reducing its current account deficit, lowered the potential impact of a Sudden Stop in capital flows, the country is still susceptible to external shocks to the current account. In particular, we showed that an oil shock can work like a Sudden Stop in capital flows and have a substantial fiscal cost.

These results show that, although current primary surpluses are roughly consistent with a no-shock scenario, Ecuador needs to make further efforts toward fiscal consolidation that accounts for its sources of volatility. This is particularly important because dollarization, while doing away with credibility problems related to poor monetary policy, has left fiscal policy as the only instrument available for buffering

shocks. Therefore, much more flexibility in fiscal policy is required. This can be achieved through a reduction in expenditure entitlements and the consolidation of a reliable oil stabilization fund, as well as by reducing public debt levels.

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