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THIRD DRAFT

Good credit ratios, bad credit ratings:

the role of debt structure

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Abstract

Why do developing countries have low credit ratings and high risk premia while exhibiting credit ratios that are often much stronger than highly rated developed countries? This paper argues that the inability to borrow internationally in domestic currency and the inability to borrow even at home at long maturities and fixed rates in domestic currency – the so-called original sin – forces countries to opt for dollar debts or short-term domestic currency debts. This makes debt service vulnerable to shocks to the short-term real interest rate and the real exchange rate. The volatility and co-movement of these prices makes debt service volatile and anti-cyclical, increasing drastically at the worst times, thus increasing the probability that a country will not be able to make good on its debt service commitments. The paper presents a theoretical model of risk premia to illustrate the role played by debt structure and shows empirically that credit ratings are robustly related to measures of original sin while they are weakly linked to standard debt ratios. This implies that only lowering debt levels may not be the most effective way of lowering fiscal risk. Debt denomination may be an effective complement. The paper derives some implications for the debate on budget institutions and fiscal rules and proposes a system that targets a risk-adjusted level of debt.

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I. Introduction

Many emerging market countries suffer from bad credit ratings, poor access to finance and large and unstable risk premia. Policymakers usually attribute this result to weak fiscal policies: countries run large deficits and accumulate debts to the point where their solvency is compromised. This puts them on the brink of insolvency, a fact that is reflected in their low credit ratings and expensive access to capital. The policy recommendations that emerge from this view are clear: countries should tighten fiscal policies in order to reduce fiscal deficits, so as to allow debt ratios to fall. In order to credibly signal the consistent achievement of this outcome over time, budget institutions must be transformed in order to credibly impose the inter-temporal budget constraint. In due course, as debt ratios fall and as the markets see a consistently improving pattern, credit ratings will improve and access to capital markets will become cheaper and more secure.

This view has become conventional, but overlooks an important fact: what distinguishes highly rated countries from those with low credit ratings is not their public indebtedness. Emerging markets exhibit public debt ratios that are often lower than those of industrial countries. By contrast, their credit ratings are drastically lower. Figure 1 shows the public debt to GDP ratio and the credit rating[1] of 59 countries for 2000. Clearly, the debt to GDP ratio is a poor guide to perceptions of creditworthiness as measured by credit ratings. Countries like Belgium, Italy and Canada had public debt to GDP ratios similar

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[1] The credit ratings are those published by Standard and Poors and have been converted into a numerical scale where each notch represents a unit increase in ratings, with AAA getting a value of 19.

to those of India, Pakistan or Jordan. Argentina, Brazil, Mexico and Turkey exhibited debt to GDP ratios similar to those of Japan, USA, UK and Spain. However, the two sets of countries receive radically different ratings. What explains this difference?

One potential explanation is that GDP is not a good measure of a government's capacity to service its debt. Debt service is paid out of the portion of GDP that the government can appropriate. This depends on the tax base that the government has, or can potentially put in place. As can be seen in Table 1, developing countries have an average tax revenue of 26 percent of GDP, while the industrial countries average 43 percent. Since developing countries have a smaller tax base, they can support a smaller public debt. Hence, a better metric for the capacity to service debt is the debt to tax revenue ratio. If we take this latter ratio, developing countries do have a higher debt to revenue ratio than industrial countries (1.77 vs. 1.28, in Table 1). However, this difference cannot be the explanation for the large difference in ratings. Figure 2 shows a scatter plot of the average debt to tax revenue ratio of 51 countries averaged over the 1990s and their credit ratings. The relationship is remarkably loose. Paraguay has a debt to tax ratio similar to Denmark, Brazil to Spain and Mexico to the US, but their ratings could not be more different.

Table 2 regresses the credit rating on measures of fiscal fundamentals, controlling for the level of development, as measured by the log of their GDP per capita. It finds that neither the debt/GDP ratio nor the debt/ revenue ratio are significantly correlated with ratings. In fact, the coefficient on the debt/GDP ratio has the wrong sign while that of the debt/revenue ratio is very close to zero and insignificant.

These results are sobering. They suggest that something else must be causing countries to be perceived as risky, beyond the traditional credit ratios and the other institutional and economic factors that are reflected in the level of development. The point of this paper, is that debt structure plays an important role. In particular, it argues that a crucial difference is whether countries can borrow abroad in domestic currency. If they cannot, external debt service will be impacted by movements in the real exchange rate which are substantially more volatile than real output and co-move in such a way as to make debt service even harder in bad times. In addition, many countries are unable to borrow at long maturities and fixed rates in the domestic market. This makes domestic debt service sensitive to movements in the real short-term interest rate, which is also volatile and moves anti-cyclically, thus making debt service more difficult.

The central point is that debt structure affects the volatility of the debt service burden relative to the capacity to pay. The greater this volatility, the greater the value at risk and consequently, the higher the risk premia should be. This creates a positive feedback between the interest rate and the value at risk that can cause a multiplier effect.

One implication is that a country's debt carrying capacity depends on the structure of its debt and the variances and co-variances of its real exchange rate, its real interest rate and real income. This may explain why some countries get into trouble at levels of debt at which other countries are rated as AAA.

From a policy perspective, working on the structure of debt may reduce risk premia and allow rapid fiscal consolidation through reductions in debt service that are self-reinforcing. This also means that countries should be concerned not only with the level of debt, but also with its riskiness.

Our results are in line with other works in the recent literature. Reinhart (2002) finds that 84 percent of the debt crises were preceded by currency crises. Catão and Sutton (2002) find that measures of terms of trade and policy volatility help predict the likelihood of debt crises. Manasse, Roubini and Schimmelpfennig (2002) do an early warning approach to fiscal crisis prediction and find that beyond credit ratios, high inflation, low growth and large current account deficits, measures of illiquidity help predict fiscal crises. However, Detragiache and Spilimbergo (2001) find that the relationship between measures of liquidity such as short-term debt and international reserves and debt crises is plagued with problems of reverse causality as countries that get into trouble loose the capacity to borrow, especially at long maturities and use their reserves before the crisis.

The paper is organized as follows. Section 2 presents a simplified model of fiscal risk and derives the implications of volatility for country risk. Section 3 studies the effect of GDP and tax revenue volatility on credit ratings and finds that while the effects are significant they are far from the whole story. Section 4 introduces the implications of debt denomination as a determinant of what types of volatility are relevant. It discusses dollar-denominated debt, which makes the real exchange rate, its volatility and cyclical properties a relevant source of risk. Section 5 discusses the role of short-term debt in making debt service contingent on the volatility and cyclical properties of the short-term real interest rate. Section 6 simulates the joint impact of revenue, real exchange rate and real interest rate volatility on a model OECD and Latin American country to highlight the important role played by debt denomination in affecting the risks associated with debt service. Section 7 derives some policy implications of our approach.

2. The simplest model of fiscal risk

To sort out the relationship between risk and interest rates it is useful to write down a simple model of fiscal risk. Suppose a country has a certain debt burden as a share of government revenues, which we label x:

$$x = \frac{iD}{tY} \tag{1}$$

where i and D are respectively the interest rate and the size of the government debt; Y is the gross domestic product and t is the tax rate which the government imposes on it.

Risks are related to the probability that the government does not pay its debt in full. Suppose – in order to keep things simple – that the government will pay its debt in full provided that the debt burden as a share of government revenues x is not larger than some maximum value $\bar{x}$. If it were to be larger, then the government would simply default on the total amount forever[2]. This assumption is consistent with standard sovereign risk models. In these models, the government values the net present value of government spending, dislikes taxes and the consequences of default in terms of "punishment"

[2] In the real world, the government would not default on all the debt, nor would it stop paying forever. However, a more realistic default rule would complicate the algebra without adding any new insights.

through the loss of access to credit or other costs[3]. If the benefits of default in terms of reduced debt service rise faster with debt than the costs, there will be a point at which it will be optimal to default. We capture this by assuming that this happens when $x = \bar{x}$.

Investors are risk neutral and hence require that the expected income of holding government debt equal the risk-free rate ρ. However, government debt pays according to the following schedule:

i D	if $x < \bar{x}$
0	if $x > \bar{x}$

In order for investors to earn the risk-free rate ρ, the contractual interest rate must equal:

$$i = \frac{\rho}{\Pr ob(x < \bar{x})} \tag{2}$$

What are the determinants of the probability that $x > \bar{x}$? Figure 3 shows a simple representation of the probability distribution of the value of x. It shows two distributions that differ in their volatility, but have the same expected value of x. The risk premium must cover the value at risk, i.e. the situations when $x > \bar{x}$. The narrow distribution has low volatility and a negligible value at risk. The second distribution has a significant part

[3] See Eaton and Fernandez (1995) for a systematic survey of the literature on sovereign debt.

of the distribution in which $x > \bar{x}$. The contractual interest rate would have to be higher in order to reflect this fact, even though the expected value of debt service is the same. Note however that as the contractual interest rate increases, x rises.

Equations 1 and 2 fully describe the model and are represented in Figure 4. The model is solved in the x vs. i space. The vertical line represents the locus of points in which the interest rate i is equal to the riskless rate ρ. The horizontal line expresses the points in which $x = \bar{x}$. The ray from the origin is equation 1. It expresses x as a function of i, with a slope equal to the debt to tax revenue ratio D/tY. We draw three such rays at different D/tY ratios.

The hyperbola is equation 2. For low values of x, the probability that $x > \bar{x}$ is essentially zero and hence i is very close to the riskless rate ρ. For high values of x – given a probability distribution – the probability of $x > \bar{x}$ goes up and hence the interest rate must be higher. Obviously, at no point can $x > \bar{x}$ since in that case the government pays nothing.

Equilibrium is determined where the ray crosses the hyperbola. As shown, at low D/tY ratio, the equilibrium is very close to the riskless rate. At higher ratios the ray crosses the hyperbola twice. This does not mean that there are multiple equilibria as the second intersection is unstable: small increases in i cause a rise in x that is larger than what would be consistent with equation 2, causing thus an even larger increase in i until the country becomes insolvent. By contrast, in the first intersection, small increases in i cause rises in x that are lower than would be consistent with equation 2, causing the interest rate to fall back. Finally, we show an even higher D/tY ratio in which there ray does not cross the hyperbola: there is no interest rate at which the expected return is ρ: the country is bankrupt[4].

Figure 5 analyzes the impact of volatility. A higher volatility – a fatter distribution of x – implies a southeastern shift in the hyperbola. Figure 5 shows two such curves. Note that for a given D/tY ratio, higher volatility may make a country bankrupt, while at lower volatilities it would have had market access at a reasonable interest rate. So volatility may be a major difference explaining why countries with the same debt-to-tax ratio would have very different risk profiles.

3. Volatility of revenues and fiscal risk

But where would the volatility come from? One source is the fact that the revenue base is volatile, as it depends on an unstable economy. Table 3 calculates the magnitude of revenue volatility for 76 countries over the 1990-1999 period. It shows that the volatility in the real rate of growth of government revenue averaged 3.6 percent in industrial countries, 11.8 percent in Latin American countries and 13.0 percent in other developing countries[5]. This larger volatility can be explained by much larger volatilities in the rate of growth of GDP and in the terms of trade.

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[4] If the distribution of the x's wher uniform, the hyperbola would be substituted by a straight line that would complete a triangle with the i=ρ line and the $x=\bar{x}$ line.

[5] These numbers are in line but somewhat lower than the 5.0 percent that Gavin et al (1996) calculated for the 1970-94 period for industrial countries, and 15.2 for Latin America in that period.

Can larger volatility in revenues explain the ratings differential? To study this issue we ran a set of regressions of ratings on either revenue volatility or its more fundamental determinants, such as terms of trade and output volatility. The results are presented in Table 4. In both equations we control for GDP per capita, as a variable that encompasses all other institutional and economic conditions for development. The equations show that there is a statistically significant relationship between measures of volatility and ratings. However, the estimated effects are substantial but not very large. For example, while the difference in ratings between developed and developing countries in our sample is about 9 notches, the elasticity measured in equation 1 on Table 4 implies that difference in revenue volatility can account for a bit less than 1 notch, while in equation 2, the difference in GDP growth and terms of trade volatility together can account for about 1.8 notches.

To illustrate why the effects might be limited, we simulate a one standard deviation income and GDP shock to two imaginary countries whose fiscal ratios look like the average of the OECD and Latin America (Table 5). The OECD-like country has a debt to GDP ratio of 50 percent, a tax to GDP ratio of 40 percent and a real interest rate of 4 percent. By contrast, the Latin American country has a debt to GDP ratio of 35 percent, a tax to GDP ratio of 25 percent and a real interest rate of 8 percent. They both have the same debt to tax ratio. We assume that the OECD country gets a one standard deviation shock to tax revenue and GDP of 3.6 percent, while the Latin American country gets one of 11.8 percent. The table calculates the impact on the debt service to tax ratio, our variable x. We notice that the greater shock to output and tax revenue, the higher interest rate and the smaller tax base interact to generate an impact on x which is 8 times larger in the Latin American type country than in the OECD country. Hence, revenue volatility may be part of the problem. However, we also notice that this effect would only increase the debt service burden by 3.2 percent of the budget in Latin America, not an altogether impressive amount. We conclude that while this may be part of the explanation, it is a very small part. Other factors may make *x* more volatile. We turn to these.

4. Original sin, liability dollarization and the volatility in the real exchange rate

When emerging markets borrow abroad, they do so in foreign currency. This phenomenon – the so-called "original sin" – has important implications for macroeconomic stability and financial fragility[6]. If a country suffering from this syndrome has a net foreign debt then real exchange rate movements will have aggregate wealth effects on the economy. This will tend to make depreciations contractionary and monetary policy less effective. Under these conditions, monetary policy tends to exhibit "fear of floating" and will try to avoid exchange rate volatility by making domestic interest rates more volatile.

There are several theories of what may cause the phenomenon. Jeanne (2002) emphasizes the role of monetary policy credibility. Tirole (2002) discusses commitment problems in protecting the property tights of foreigners. Corsetti and Mancowizk (2002)

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[6] Eichengreen and Hausmann (1999) define the problem and discuss its implications for financial fragility. Hausmann, Panizza and Stein (2001) analyze its impact on monetary policy and the patterns of floating. Hausmann and Panizza (2003) study its causes. Eichengreen, Hausmann and Panizza (2003) present an analysis of causes, consequences and cures.

study the role of weak fiscal solvency. Chamon (2002), Aghion, Bachetta and Banerjee (2002) emphasize the fact that a positive correlation between depreciation and default risk creates incentives for borrowers to increase their foreign currency debt after they have secured a given amount of domestic debt. In anticipation of this, the domestic debt market may disappear. Chamon and Hausmann (2002) analyze the strategic interaction between debt denomination and monetary policy: risk-averse borrowers have an incentive to denominate their debt in a variable that the central bank is trying to stabilize.

However, Hausmann and Panizza (2003) find little empirical support for any of these theories. In fact, they show that 98.5 percent of cross-border lending takes place in 7 currencies. Original sin seems to be robustly related to the relative size of a country in the world economy and to accidents that may have converted it into an international financial center (e.g. Switzerland, the United Kingdom). This is consistent with theories that would emphasize the role of liquidity in generating economies of scale in currency denomination. While countries with bad institutions and policy credibility suffer from original sin, so do other well-behaved small countries.

The implication for our purposes is that we can take original sin not as one more consequence of poor fiscal performance but as a relatively exogenous determinant.

To understand the implications of original sin for the volatility of x it is useful to expand equation (1) in order to split the debt into three components: long-term, fixed – rate, domestic-currency debt (l-debt), short-term domestic-currency debt (s-debt) and long-term fixed-rate foreign currency debt (f-debt)[7].

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[7] We are abstracting from foreign currency short term debt and from long term domestic currency floating rate debt because they do not add any new interesting complications to our story.

$$x_t = \frac{i^l_{t-1} D^l_{t-1} + i^s_t D^s_{t-1} + i^*_{t-1} e D^*_{t-1}}{tY_t}$$

$$x_t = \frac{i^l_{t-1} D^l_{t-1} + i^s_t D^l_{t-1} + i^f_{t-1} e_t D^f_{t-1}}{tY_t} \tag{3}$$

Notice that at time t-1, the cost of servicing long-term, fixed-rate, domestic currency debt (which we call l-debt) is fully known. However, the interest rate on the short-term domestic-currency debt (s-debt) is uncertain and the exchange rate on long-term foreign currency debt (f-debt) is not known. Uncertainty over these two variables will affect the volatility of x.

Consider first the impact of dollar-denominated debts. If debt is denominated in US dollars then what matters is not the volatility of GDP or tax revenue growth measured in constant domestic prices but instead the volatility of these variables measured in US dollars. Table 6 presents comparative measures of the volatility of the rate of growth of tax revenues and GDP measured in US$ and the volatility of GDP measured in constant local currency units. What is clear from the table is that the volatilities measured in US dollars are much larger than local currency measures. While Latin America's volatility is a hefty 4.6 percent when measured in local currency units, in US$ at market prices it is 13.8 percent. The volatility in tax revenue growth in US$ is 17.9. For countries that can borrow in local currency, the relevant volatility may be related to the local currency unit, but if the bulk of the debt were in foreign currency then the latter would be the relevant measure.

As Table 7 shows the volatility of the real exchange rate in Latin America during the 1990's – calculated with annual data – averaged 21.4 percent, more than double the estimate for the United States. But in the US, the debt is denominated in domestic currency so changes in the real exchange rate do not affect debt service. In Latin America, the foreign public debt is in foreign currency and averaged 30 percent of GDP in 2000[8]. This means that a one standard deviation depreciation of the real exchange rate would increase the public external debt to GDP ratio by 6 percentage points, and would raise the interest burden of that debt by 21 percent.

Moreover, if the currency tends to depreciate in bad times, then the capacity to service dollar-denominated debts will decline at just the worst possible moment. Table 8 lists all the years in which the US$ value of GDP fell by more than 25 percent in a Latin American country since 1972. The list includes the major crises in the region. The average decline in US$ GDP is 39.6 percent, but the decline in GDP in local currency units is only 2.3 percent. Clearly, the decline in the capacity to service dollar denominated debts gets severely aggravated by the volatility in real exchange rates and their co-movement.

Another way to illustrate this point is presented in Table 9, which shows the results of a fixed-effects panel regression separately for an unbalanced sample of 20 Latin American countries and 20 industrial countries. They indicate that on average the real exchange rate appreciates by 0.37 when output increases by 1 percent. The pattern is not observed in industrial countries.

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[8] There is also a significant amount of domestic debt denominated in foreign currency. We do not have comparative data on this variable. Its presence increases the importance of the effects presented in this section.

So liability dollarization makes the real exchange rate a relevant variable in the determination of the burden of debt service. Its high volatility and its co-movement with the business cycle make the burden of debt service more uncertain and harder to bear in bad times.

Is original sin robustly correlated with measures of country risk? Table 10 repeats the equations in Table 2 including now a measure of original sin based on Hausmann, Panizza and Stein (2001) and recalculated and expanded in Hausmann and Panizza (2003). It is bounded between 0 and 1, with the higher limit indicating the absence of foreign debt in domestic currency. The equations show that while debt ratios have no power to explain the cross-country variation in ratings, original sin is strongly significantly correlated with ratings, even after controlling for the level of development. The coefficient implies that the presence of original sin can account for up to 3 notches in ratings, after controlling for the level of development and credit ratios.

5. The impact of short-term domestic currency debt

Many countries that who cannot borrow abroad in local currency also cannot borrow even at home at long maturities and fixed rates in domestic currency. This means that domestic debt is typically either short term or at floating rates. For example, Brazil's domestic currency debt is indexed to the overnight SELIC rate. In Venezuela, it is indexed to the average lending rate of the six largest banks. The fact that the domestic currency debt is mostly short term or floating rate implies that movements in short term real interest rates will affect debt service, as governments roll over their short term debt or as the floating rate debt is re-priced. Moreover, if the country is uable to borrow abroad in local currency, the central bank is likely to exhibit "fear of floating" and hence will make domestic interest rates more volatile.

Consequently, in countries with these characteristics, not only is debt service more sensitive to short-term interest rates, but the latter are also more volatile. As Table 11 shows, the volatility of changes in 12-month real interest rates in a sample of Latin American countries in the period 1994-1999 (excluding observations when inflation exceeded 40 percent), averaged 10.5 percent while it averaged 0.9 percent in the United States. So, real interest rate volatility has been an order of magnitude larger in Latin America.

This volatility is not only large, it also has the "wrong" correlation with the business cycle from the point of view of risk diversification: in good times, when the economy is buoyant, real interest rates are low, while in bad times they are high (Table 11). The average elasticity of Latin America implies that a one percent decline in real imports relative to trend is associated with an increase in the real interest rate by 1.26 percentage points. This estimated elasticity is about 40 times larger on average in Latin America, relative to the US experience. This elasticity is particularly large in Brazil, Peru, Argentina and Mexico.

The real interest rate also has the wrong correlation with the real exchange rate (Table 12). The estimated elasticity is orders of magnitude larger than in the US and is statistically very significant in all countries except Argentina and Colombia.

In fact, the three shock variables that we focused on - the real interest rate, the real exchange rate and the import gap (as a measure of income) have in Latin America, on average the "wrong correlation" in the sense that their co-movement amplifies the fiscal consequences of fluctuations. Bad times – defined as periods in which the import gap is negative – are also periods in which real interest rates are high and the real exchange rate is weak.

6. Bringing it all together

Why is Latin America perceived as so much riskier than OECD countries in spite of the fact that debt to GDP ratios are low and declining? We have mentioned the role of the lower tax revenue ratio, the higher interest rate, the currency denomination, and the volatilities and co-movements of the revenue base, the real exchange rate and the real interest rate.

To illustrate the role of all these factors we perform another stylized stress test using the same ratios we used in Table 5 designed to mimic the situation of an OECD country and a Latin American country (Table 13). We assume a debt to GDP ratio of 50 percent for the OECD and 35 percent for Latin America. However, the composition of this debt is different: it is all domestic currency in the OECD while in Latin America the foreign public debt is assumed to be 20 percent of GDP while the domestic debt is 15 percent of GDP. The domestic component is mainly (80 percent) long term in the OECD, but it is all short term (or floating rate) in Latin America. The real interest rate is assumed to be 4 percent in the OECD but is 8 percent in Latin America, a modest spread of only 400 basis points. We shall assume a tax revenue ratio of 40 percent in the OECD and of 25 percent in Latin America.

These numbers imply that the debt to tax revenue ratio is 125 percent in the OECD country, while it is 140 percent in Latin America. In the OECD country, debt service would amount to 2 percent of GDP and 5 percent of government revenues. In the Latin American country, it would represent 2.8 percent of GDP and 11.2 percent of the budget in Latin America.

Let us assume now that the economies receive a shock to tax revenues, to GDP, to the real interest rate and the real exchange rate equal to about one standard deviation, as estimated in previous tables. Moreover, we assume that all these shocks happen at the same time. We assume that the short-term rate goes up by 1 in the OECD (we had estimated 0.9 for the US) and by 10 percent for Latin America. The shock to the real exchange rate is 9 percent in the OECD, although it has no fiscal consequences as the debt is all in domestic currency. We assume a real depreciation of 21 percent in Latin America. We assume a revenue shock of 5 and a GDP shock of 2 percent in the OECD, respectively 5 percent and 8 percent for Latin America. All these numbers are in line with the volatilities estimated above.

In the OECD country, these shocks would cause an increase in the debt service burden of 0.1 percent of GDP and 0.6 percent of the budget. By contrast, in Latin America the shock would increase the debt service burden by 2 percent of GDP and by 9.8 percent of government revenues, almost doubling x. These are differences are more than 17 times larger.

We conclude that there is a very large difference indeed in the variance of x between a typical OECD country and a Latin American country that comes from the interaction between the denomination of the debt and the variances and co- variances of GDP, tax revenues, interest rates and real exchange rates with the latter two sources playing a quantitatively very significant role.

7. Conclusions and policy implications

Why is country risk so high in Latin America? Why do countries borrow in dollars? Why is fiscal policy pro-cyclical? Our framework has some light to shed on these issues.

Why are interest rates so high and volatile in Latin America? Risk premia are related to the probability that $x > \tilde{x}$. If this probability is high, interest rates are high. The probability that $x > \tilde{x}$ is related to the debt to tax revenue ratio but also to the volatility of x. There is no major difference in debt to tax ratios between Latin America and industrial countries. However, there is a significant difference in the volatility of x. This volatility is affected by the volatility of the real exchange rate and of the real interest rate given the debt denomination associated with original sin. This explains why interest rates are high and credit ratings low, in spite of good credit ratios.

Why has Latin American fiscal prudence not been rewarded with more secure market access? Why are interest rates so volatile and market access so uncertain? The model presented above has a multiplier effect. Increases in interest rates cause a rise in x which increases interest rates further. Hence shocks get amplified. In addition, the model presented has multiple equilibria: there is the possibility of moving from a low interest rate equilibria to a high one. Moreover, increased volatility can itself cause a country to become insolvent even if fiscal ratios do not change.

This implies that while the debt to GDP ratio or the debt to tax revenue ratio may have fallen in some countries, the probability that $x > \tilde{x}$ may have increased if the perceptions of real exchange rate and interest rate volatility have gone up. The spikes in interest rates after the Russian crisis and the large exchange rate movements in the 1998-2002 period suggest that this may well be the case.

Why do governments borrow in dollars? Is it because of irresponsible moral hazard behavior? Borrowing in dollars exposes the fiscal accounts to real exchange rate volatility. However, if the alternative is to borrow at short maturities, interest rate volatility may expose the fiscal accounts to greater risks. The measures of volatility presented above suggest that the volatility of the real interest rate is larger than that of the real exchange rate. Since the two are not perfectly correlated, a prudent government would choose an optimal portfolio that includes both. However, given the large measured volatility in the interest rate, a large share of foreign currency debt may make prudent sense[9].

Moreover, governments should not only pay attention to the fiscal consequences of relative price volatility. The interest rate is mainly a monetary policy instrument. A government that wants to defend its monetary independence from fiscal considerations would value the fact that the cost of servicing dollar-denominated public debts does not go up when the central bank decides to respond to an acceleration of inflation by raising interest rates. In fact, to the extent that interest rate increases cause the exchange rate to appreciate, it would lower the debt service cost of the foreign debt. By contrast, a large stock of short term domestic currency public debt would cause debt service to go up when the Central Bank is fighting inflation, thus creating so-called unpleasant fiscal arithmetic problems. A government that wants to maintain a strong monetary stance or that wants to be able to mount an interest rate defense may be particularly fearful of short-term domestic debt. Hence, for both prudential reasons and to maintain the independence of monetary policy, governments may opt for dollar debts.

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[9] Jeanne (2002) argues similarly for corporates: borrowing in domestic currency is risky, especially if a government has low credibility so that it may suffer from a significant peso problem. Chamon and Hausmann (2002) argue that there is a strategic interaction between the public's choice of debt denomination and the central bank's choice of instrument to stabilize. They argue that if people borrow in dollars (pesos), the central bank will favor exchange rate (interest rate) stability, thus justifying the initial choice.

However, liability dollarization is likely to make the central bank have a larger preference for stabilizing the exchange rate by allowing a more volatile interest rate. This will prevent the development of a long-term domestic currency market and will induce the private sector to also borrow in dollars to avoid the interest rate risk.[10].

Why is fiscal policy pro-cyclical in Latin America? Why don't governments let automatic stabilizers take effect by adopting Barro-style fiscal rules? Why do they so often raise taxes and cut spending in bad times? The preceding analysis provides an answer. In bad times, debt service increases significantly because of the interaction between debt denomination and the pattern of movements in output, real exchange rates and real interest rates. This has the effect of causing an increase in debt service in bad times, which increases borrowing needs. A country without original sin would only need to finance the worsening of the primary balance during the recession. A country with original sin would need in addition to finance the increased debt service. Moreover, as x increases, interest rates go up, making further borrowing even more difficult. This limits the degrees of freedom to let the primary surplus adjust anti-cyclically.

Policy implications. The preceding analysis suggests that Latin America's fiscal problems are related not so much to the accumulation of large debts or deficits but

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[10] Hausmann, Panizza and Stein (2001) show that countries with original sin that float allow much more interest rate volatility than exchange rate volatility when compared to countries that do not suffer from original sin. Chamon and Hausmann (2002) have both the currency denomination of debt and monetary policy determined endogenously and show multiple equilibria in debt denomination and monetary policy.

instead to the risks inherent in the accumulated stock of debt, given its denomination. These risks make reductions in debt ratios less effective in terms of reestablishing solvency and securing access to markets. Therefore, policies geared simply at limiting the flow of deficits may not be adequate. An alternatively and potentially more successful policy involves acting on debt denomination. This means that policies should internalize the costs associated with debt service risks.

Public debt takes on risky denominations because of "original sin. The solution would be to get rid of the problem. However, the causes of original sin are not well understood, and it is not easy to learn from the few countries that have achieved "redemption". It is too global a phenomenon to be explained by Latin American-style fiscal or macroeconomic peccadilloes[11]. It affects virtuous Chile and prudent East Asia as much as it does the lesser credits. Eichengreen, Hausmann and Panizza (2002) propose an international initiative to create liquidity in baskets of emerging market currencies. However, a discussion of international policies lies beyond the scope of this paper.

With respect to fiscal rules, the analysis presented in this paper has important implications. First, targeting the *overall deficit* is not a good focus of policy. In a Barro-style first-best world the overall deficit should be volatile in the short run. In the Latin American context, given the volatility of revenues and of debt service, a stable overall

[11] Hausmann and Panizza (2002) show that the inflation history of a country, the independence of its monetary authority, the strength of its fiscal stance and the quality of its institutions have little effect on the presence of original sin.

deficit would imply a very unstable level of primary spending, which is not a good policy.

Targeting a cyclically adjusted overall deficit is better, since it would make sure that the budget is balanced over the medium term while providing for short term stability. However, doing so in an emerging market context is much more complex. In the standard IMF approach[12], cyclical adjustments incorporate only the effect of the output gap on the budget. The volatilities and elasticities shown in this paper suggest that while the volatility of the output gap in Latin America is larger than in industrial countries, much bigger adjustments would be required to account for the fiscal impact of the difference between current and equilibrium values of the real exchange rate, the real interest rate and the terms of trade. Making these corrections requires interpretation and estimation, i.e. discretion. If these adjustments are done by an interested party such as the Ministry of Finance, they will hardly be credible. Hence, an independent scorekeeper would be needed to constrain discretion.

An alternative is to target a variable that is a bit more clearly in the control of the authorities: primary spending and to a lesser extent the primary surplus are good candidates. Movements in the exchange rate or the real interest rate do not directly affect these variables, although the primary deficit is affected by the output gap and the terms of trade. For example, between 1999 and 2002 Brazil was able to meet its primary deficit

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[12] Hagemann, Robert P (1999) The Structural Budget Balance - The IMF's Methodology, IMF WP/99/95.

targets consistently and build some credibility for being able to do so, at a time when the overall deficit was ballooning due to movements in the real interest rate and the real exchange rate. Nevertheless, this credibility was not large enough to avoid very high risk premia and rising debt ratios. Hence, the fact that a country may choose to control what it can does not mean that it controls what matters.

It is important to note that as long as debt service swells in bad times, the space for anti-cyclical policy is going to be very limited: in bad times, governments must make sure that they can find additional financing at reasonable costs to cover the rising debt service burden before they can contemplate a deterioration of the primary balance.

The more substantive conclusion of this paper is that deficits and debt ratios are just one of the ingredients in determining fiscal risk. The probability that $x > \tilde{x}$ is affected strongly by debt denomination and its interaction with the structure of variances and covariances of the real exchange rate, the real interest rate, the output gap and the terms of trade. These factors can trap relatively prudent policies in a high interest rate path in which debt ratios become unsustainable. Hence incorporating the debt structure and taking account of the monetary and exchange rate regime (which affects the structure of variances and covariances) is key. The fact that major improvements in the overall deficit and in debt ratios over the last decade in Latin America have not paid-off as expected in terms of reduced risk premia and secured markets access suggests that working on the other determinants may deliver a higher pay-off.

In an ideal world, fiscal rules should internalize the fiscal risks associated with debt structure. Countries should be able to judge whether a strategy that substitutes relatively cheap short-term domestic currency debt for more expensive long term domestic-currency fixed-rate debt is convenient. A target on the deficit discourages this change.

One way of incorporating this logic into a rule is to create a system of risk weights for public debt. The idea is to have a synthetic way to value the implied risks of each obligation by borrowing a page from current banking regulations that target a risk-adjusted level of capital. However, in our context, the risk weights should reflect the variance and co-variance structure of the obligations. Long-term fixed income domestic-currency debt would get a relatively low weight as it would protect the budget from shocks to the short-term real interest rate or the real exchange rate. Commodity linked-debt would also receive a lower weight as it would protect from shocks to the term of trade. Debt indexed to the short-term interest rate or debt denominated in dollars would receive a higher weight that would reflect the estimated structure of variances and covariances. Liquid assets, hedging operations or contingent credit lines should be given a negative weight as they reduce the overall fiscal risk.

Under this system, the goal of fiscal policy would be to target the risk adjusted level of debt. To incorporate cyclical considerations, it could target the risk adjusted debt to *trend* tax revenues. Governments could then internalize the trade-offs between working on deficits *vis a vis* operating through debt structure. For countries that float their exchange rate, the aggressive creation of a long-term fixed-income debt markets could radically reduce the implied fiscal risks and get countries into a virtuous circle of declining risk premia and improving overall fiscal performance. Mexico has moved in this direction. However, if countries find this too difficult or expensive, indexing the debt to the price level may facilitate the extension of maturities. Chile is a good example of this. For countries that dollarize in a sustainable manner, in the sense that the *equilibrium* real exchange rate is relatively stable[13], the debt can be converted more easily into long-term dollar debt and thus limit the fiscal risks, given the rather subdued fluctuations in real exchange rates that would characterize these countries.

Debt denomination has powerful effects on creditworthiness. Fiscal rules that only focus on limiting the flow of deficits and the accumulation of debts are not efficient. They leave aside important avenues for the reduction of fiscal risks. Fiscal rules should facilitate the internalization of the costs associated with these risks. A system that targets a risk-weighted level of debt is one way to do it.

[13] This requires the country to form part of an optimal currency area with the US, a condition that was obviously not met in the case of Argentina.

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Figure 1. Credit ratings vs. debt to GDP ratio, 2000
Source: WEO dataset

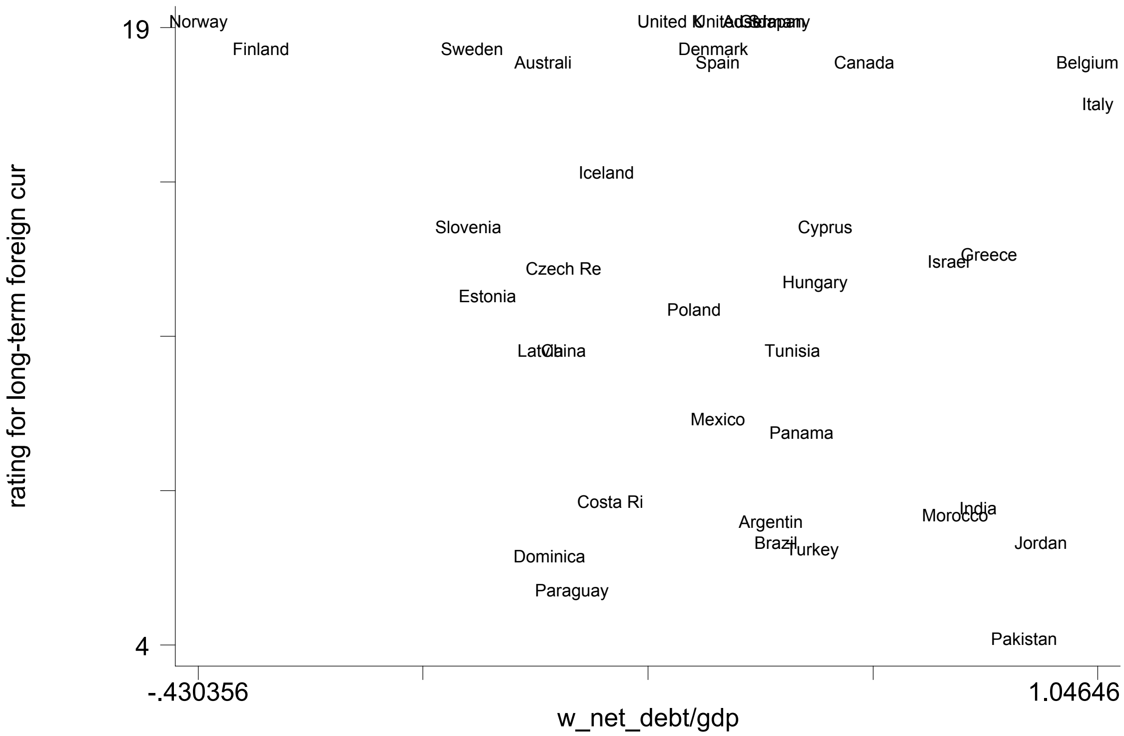

Figure 2. Credit rating and the debt to tax revenue ratio, 2000
Source: WEO dataset

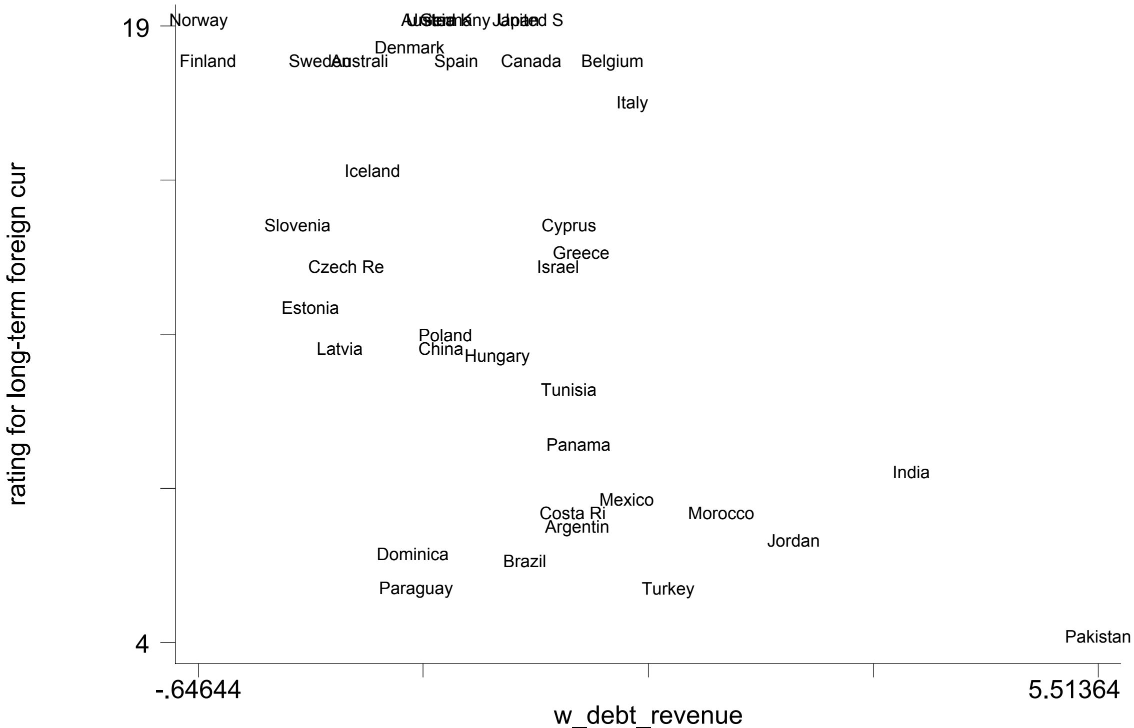

Table 1. Fiscal fundamentals: unweighed average for 1993-2000

	Debt/GDP	Revenue/GDP	Debt/Revenue
OECD	0.53	0.43	1.28
Developing and transition countries	0.45	0.26	1.77
-Latin America	0.35	0.25	1.43
-East Asia and Pacific	N/A	0.22	N/A
-Eastern Europe	0.95	0.34	3.01
-Middle East and North Africa	0.66	0.32	2.0
-Sub-Saharan Africa	N/A	0.23	N/A
-South Asia	0.78	0.22	3.88

Source: Own calculations based on IMF. Sample of countries is not constant across each concept.

Table 2. Ratings and fiscal fundamentals

	(1)	(2)
	Rating	Rating
Debt/GDP	-0.987	
	(1.06)	
Debt/Revenue		0.042
		(0.13)
log GDP_PC	3.380	3.352
	(13.79)***	(12.07)***
Constant	-17.083	-17.097
	(7.60)***	(6.32)***
Observations	59	51
R-squared	0.79	0.80

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 3. Average standard deviations of the growth rate of tax revenue, GDP and terms of trade

	# countries	Growth in tax revenue	Growth in GDP	TOT
Industrial Countries	20	3.6%	2.0%	4.4%
Developing countries	56	12.6%	4.8%	11.6%
-Latin America	20	11.8%	4.6%	10.7%
-Other countries	36	13.0%	4.9%	12.0%

Source: Own calculations based on fiscal data from the WEO database and macroeconomic data from IFS database, International Monetary Fund.

Table 4. Revenue volatility and credit ratings

	(1)	*(2)*
	Ratings	Ratings
Log GDP per capita	3.329	2.981
	(12.41)***	(10.46)***
S.D. Revenue growth	-14.241	
	(2.51)**	
S.D. Terms of trade		-17.445
		(3.04)***
S.D. GDP growth		-38.290
		(2.11)**
Constant	-16.286	-11.527
	(6.21)***	(3.78)***
Observations	57	55
R-squared	0.82	0.85

Absolute value of t statistics in parentheses

* significant at 10%; ** significant at 5%; *** significant at 1%

Table 5. Impact of a 1-standard deviation shock to revenues and GDP in for the typical OECD and Latin American country

	OECD	LAC
Real Interest rate ($)	**4.0%**	**8.0%**
Fiscal revenue to GDP	**40.0%**	**25.0%**
GDP	**100.0%**	**100.0%**
Debt to GDP	**50.0%**	**35.0%**
Debt to revenue	**125.0%**	**140.0%**
Debt service to GDP	**2.0%**	**2.8%**
Debt service to revenue	**5.0%**	**11.2%**
Revenue and GDP shock	**-3.6%**	**-11.8%**
New debt to revenue ratio	**41.5%**	**28.3%**
New debt service to GDP	**51.9%**	**39.7%**
New debt service to revenue	**5.4%**	**14.4%**
Increase in debt service to revenue	**0.4%**	**3.2%**

Table 6. Various volatility measures: tax revenue and GDP growth measured in US$ and GDP growth measured in local currency units and the real exchange rate. 1980-1999.

	US$ Revenue	US$ GDP	LCU GDP
Industrial Countries	12.6	12.1	1.9
Developing Countries	18.4	14.0	4.7
-Latin America	17.9	13.8	4.6
-Others	18.7	14.1	4.8

Source: Government Financial Statistics for revenue, International Financial Statistics for nominal GDP and average exchange rate.

Table 7. Real exchange rates in Latin America and the United States: volatility and cyclical properties

Elasticity of real exchange rate to imports in the 1990s

	elasticity	t-stat	volatility	External public debt to GDP in 2000
United States	-0.03	-0.9	9.1%	…
Latin America	0.18	8.9	21.4%	30.6%
Argentina	0.02	1.2	21.1%	29.7%
Brazil	0.42	10.4	18.8%	15.5%
Chile	0.32	4.5	16.0%	7.9%
Colombia	0.26	6.2	19.3%	24.9%
Ecuador	0.27	3.7	25.7%	80.7%
Mexico	0.61	10.7	18.3%	14.7%
Peru	0.15	3.1	28.4%	43.3%
Venezuela	-1.04	-7.7	23.6%	28.0%

Note: excludes periods in which inflation exceeded 40 percent

Table 8. Latin America: Declines in US$ GDP growth of more than 25 percent

country	year	USD Revenue	USD GDP	LCU GDP
Bolivia	1986	23.1	-28.2	-2.6
Chile	1975		-58.2	-11.4
Chile	1982	-26.4	-28.8	-10.3
Costa Rica	1981	-42.0	-50.8	-2.3
Dominican Republic	1985	-36.8	-52.4	1.0
Ecuador	1986	-44.3	-31.2	3.1
Ecuador	1999	-20.7	-31.8	-7.3
El Salvador	1986	-30.6	-30.8	0.2
Guatemala	1986	-4.4	-26.6	0.1
Guyana	1987	-48.1	-35.5	0.9
Honduras	1990	-35.4	-43.0	0.1
Jamaica	1984	-26.0	-37.1	-0.9
Mexico	1976	-39.6	-40.6	4.4
Mexico	1982	-45.4	-49.3	-0.6
Mexico	1986	-32.6	-30.7	-3.8
Mexico	1995	-31.9	-33.3	-6.2
Paraguay	1989	-1.7	-30.3	5.8
Suriname	1994		-95.3	-2.3
Trinidad and Tobago	1986	-45.5	-36.7	-3.3
Uruguay	1983		-56.0	-10.3
Uruguay	1984		-25.8	-1.1
Venezuela	1984		-29.3	1.4
Venezuela	1989	-9.6	-30.2	-8.6
Average		-27.7	-39.6	-2.3

Table 9. Evidence of cyclical co-movement of real exchange rates and output in Latin America

	(1)	*(2)*
	Log (rer)	Log(rer)
	Latin America	Industrial Countries
Lgdpreal	0.374	0.058
	(3.77)***	(0.91)
Year	-0.024	-0.002
	(6.94)***	(1.19)
Constant	50.812	8.571
	(7.74)***	(2.62)***
Observations	440	402
Number of cc	20	20
R-squared	0.14	0.00

Absolute value of t statistics in parentheses

*significant at 10%; ** significant at 5%; *** significant at 1%

Table 10. Original sin and credit ratings

	(1)	*(2)*
	fc_lto	fc_lto
Log GDP pc	3.231	3.193
	(10.07)***	(8.40)***
Debt / GDP	-0.113	
	(0.10)	
Original sin	-2.923	-2.918
	(2.70)**	(2.71)**
Debt / Revenue		-0.077
		(0.21)
Constant	-14.015	-13.613
	(4.09)***	(3.34)***
Observations	35	35
R-squared	0.83	0.83

Absolute value of t statistics in parentheses
* significant at 10%; ** significant at 5%; *** significant at 1%

Table 11. Real interest rates: volatility and cyclical properties

Elasticity of real interest rate to imports
(monthly data, 1990-1999)

	elasticity	t-stat	Volatility
United States	-3.25	-4.1	0.9
Latin America	-126.26	-10.9	10.5
Argentina	-221.87	-10.3	4.0
Brazil	-451.64	-3.4	17.2
Chile	-8.76	-1.0	5.4
Colombia	-16.63	-2.3	7.8
Costa Rica	-19.72	-5.0	5.0
Ecuador	-2.35	-0.5	12.2
Mexico	-73.31	-13.2	23.0
Panama	-0.43	-0.6	0.6
Peru	-151.40	-1.7	11.2
Uruguay	2.59	0.4	11.8
Venezuela	0.08	0.0	17.6

Note: excludes periods in which inflation exceeded 40 percent

Table 12. Correlations between the real exchange rate, the real interest rate and the import gap (monthly data, 1990-1999)

	Reer vs. M gap	RER vs. RIIR	RIRATE vs, M gap
United States	-0.09	-0.17	-0.37
Latin America	0.21	-0.43	-0.33
Argentina	0.12	-0.09	-0.72
Brazil	0.71	-0.67	-0.43
Chile	0.41	-0.59	-0.10
Colombia	-0.47	-0.06	-0.35
Ecuador	0.34	-0.46	-0.05
Mexico	0.72	-0.85	-0.79
Peru	0.48	-0.34	-0.19
Venezuela	-0.61	-0.39	0.00

Note: excludes periods in which inflation exceeded 40 percent

Table 13. Stress test on the debt service capacity: an illustration.

	OECD			Latin America		
	Normal	Shock	Stress	Normal	Shock	Stress
Real Interest rate ($)	4.0%	0.0%	4.0%	8.0%	0.0%	8.0%
Real Interest rate (local)	4.0%	1.0%	5.0%	8.0%	10.0%	18.0%
Real exchange rate	100.0%	-9.0%	91.7%	100.0%	-0.2%	99.8%
Fiscal revenue to GDP	40.0%	-3.6%	38.6%	25.0%	-11.8%	22.1%
GDP	100.0%	-2.0%	98.0%	100.0%	-4.5%	95.5%
Debt to GDP	50.0%		51.0%	35.0%		36.7%
-foreign currency	0.0%		0.0%	20.0%		21.0%
- domestic long term	40.0%		40.8%	0.0%		0.0%
-domestic short term	10.0%		10.2%	15.0%		15.7%
Debt to revenue	125.0%		132.3%	140.0%		166.4%
Debt service to GDP	2.0%		2.1%	2.8%		4.5%
Debt service to revenue	5.0%		5.5%	11.2%		20.4%
Increase in debt service to GDP			0.1%			1.7%
Increase in x			0.5%			9.2%

Figure 3. A graphical representation

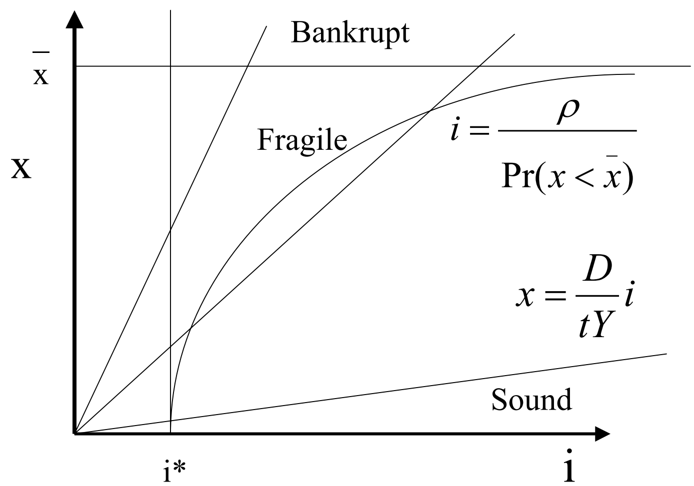

Figure 4. The role of volatility