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"INTERACTIONS BETWEEN PUBLIC DEBT MANAGEMENT AND DEBT DYNAMICS AND SUSTAINABILITY: THEORY AND APPLICATION TO COLOMBIA"

(Final Version for Comments)

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Abstract

In this paper we present an analysis of optimal public debt management and its interaction with debt sustainability, and apply it to Colombia. Optimal public debt management, a difficult and complex issue for emerging market economies, grows more challenging when a country has a large, increasing, and possibly unsustainable debt path that requires a major primary fiscal adjustment to restore debt sustainability. We survey the analytical literature on optimal public debt management and debt sustainability and financeability and emphasize the aspects that are more relevant for emerging markets with limited economic policy credibility. We then apply the analysis to the case of Colombia. This part first discusses the sustainability of the debt dynamics of the country and provides a primary gap analysis under various scenarios about the fiscal adjustment of the country. Then it provides an overview of the public debt structure and its management in the last decade, considers value at risk scenarios and stress tests for the current structure of the public debt (domestic and external). Finally, it analyzes the issue of optimal debt management by considering a VaR and Debt-at-Risk approach; describing and discussing the reference model used by the policy authorities; and analyzing the challenges faced in the management of the Colombian public debt in the next few years within a context of partial or severe domestic and international market access limitations. Over the next few years the authorities will face a very delicate task of managing the country debt under conditions of limited domestic market access, limited policy credibility, some economic and political/security uncertainty and unfavorable international financial and real market conditions. A sound management of the public debt by type, maturity and currency composition will be essential for the achievement of financial and debt stability.

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INTRODUCTION

In recent years, Colombian debt has increased considerably. The Gross Non Financial Public Sector Debt was under 30% of GDP in 1996 and reached 63,3% of GDP in 2001. The Central Government has been responsible for a great deal of the debt's growth, increasing from 17% of GDP in 1996 to 56% of GDP by 2001. As a consequence, total public interest payments grew from 3.5% of GDP to 5,2% in the same period. The tendency continued in 2002 and the net NFPS debt level reached 52% of GDP. The main factors behind such increase have been the deceleration of economic activity and the growing fiscal deficit (both primary and overall), nevertheless other elements such as high nominal and real interest rates in 1998 and the subsequent year as well as the nominal and real exchange rate depreciation in the 2000-2002 have also had important effects. This growth of debt led to an incipient financial crisis in the summer of 2002 when the country lost domestic and international capital market access and suffered a sharp increase in the yields on domestic debt and the spreads on foreign debt. Thus, a significant fiscal adjustment became compelling in order to stabilize the debt dynamics.

Debt composition has also changed significantly in the last years. While in 1990 the external debt represented close to 90% of total debt, by 2002 this percentage fell to 60% as a consequence of increasing domestic public debt. The distribution within each type of debt has also undergone substantial changes. The principal financing mechanism of external debt has become the issuance of bonds, while bilateral and commercial banking loans have reduced their share. Regarding domestic debt, an important diversification effort has taken place in order to lengthen the maturity of this debt with the issuance of new instruments. Despite the deep changes in the level, composition, and structure of public debt, their implications on public finances have been overlooked while existing studies have concentrated on sustainability issues. Nevertheless, the financial pressures recently experienced by the country have brought to light the need for an analysis of debt sustainability accompanied by an appropriate management of the debt in the more difficult external and domestic environment faced by the country.

Debt management decisions have begun to play a predominant role within governments' fiscal strategies. As debt grows and its role as a major instrument for financing government needs is enhanced, debt management decisions become very important as part of a fiscal strategy, particularly in the case of emerging economies which face long-term sustainability problems and need fiscal stabilization programs. In the case of Colombia, the matter of public debt has acquired an increasingly relevant role, because it has grown considerably in recent years and will continue to be a crucial financing instrument in the future. Considering that public debt management has fundamental effects on public finances, any attempt to determine the country's financing scheme in the medium term should involve adequate public debt management as well as a medium term debt strategy. A debt policy design that takes into account a broader time horizon is fundamental since this instrument must simultaneously accomplish different objectives: serving future financing needs, promoting fiscal stabilization, meeting the restriction of being sustainable and minimizing both the debt service costs and the vulnerabilities.

Debt policy contributes to ensuring and managing long-term debt sustainability. While the latter analysis defines the level of public debt that can be financed over a determined period of time without an unrealistically large future correction to the balance of income and expenditures, debt management determines the composition and structure the debt portfolio must have in order for its cost to be low and as less vulnerable as possible to market shocks. Indeed, the sovereign debt portfolio is highly vulnerable to financial, fiscal and macroeconomic conditions, and a sound management of its structure, level and composition intended to reduce vulnerabilities must be pursued. Colombia has recently made critical efforts in adopting debt strategies, especially intended to increase the maturity of the debt and reduce its costs, as a complementary measure of the fiscal adjustment and debt stabilizing program adopted at the in December 2002 and agreed with the IMF.

An optimal public debt policy depends on the specific conditions of each country, such as the starting point of the debt's level and objective level, the current tax structure, the foreign currency sources, and the specific characteristics of each economy (access to external markets, size of capital markets and evolution of macroeconomic variables). Colombia faces a series of

simultaneous constraints that must be taken into account in the design of any public debt strategy, both in the short-run as well as the medium and long run. First of all, medium to long-run analyses show that the current debt level and dynamics is not sustainable over time, given expected paths for income and expenses without imposing restrictions. For the debt to stabilize at a sustainable (financeable) level a primary surplus of close to 3% of GDP per year is required. The government has committed with a fiscal adjustment for the years coming in order to attain - at least partially - those requirements, and has committed to carry-out structural reforms which will guarantee the medium and long term fiscal stability. However, it is not obvious whether a 3% primary surplus will be achieved by 2005, since the fiscal targets for 2003 and 2004 agreed in a three-year program with the IMF were revised and weakened.

In second place, a debt strategy, more specifically the selection of the debt composition and instruments, must take into account market access conditions and restrictions, which are significantly different in the short term and medium and long term. In a long-term perspective, and assuming that the country moves towards a sustainable path, one might presume that the country would have access to external and internal capital markets; thus, the restrictions would relate to aspects such as the reduced size of the domestic capital market and the changes of Colombia's foreign credit status, i.e. the ability of the country to reach the investment grade that was lost few years ago. However, in the short-term access to markets restrictions may be much more severe. Since the middle of 2002 the internal market for domestic public debt suffered severe financing difficulties, and external private markets were virtually closed for a few quarters in 2002 due to the combined effect of the Latin American crisis (especially the Argentine crisis and the Brazilian electoral and policy uncertainty in late 2002) and the loss of confidence in Colombian economic performance related to the critical fiscal situation. Their re-opening at the end of 2002 and 2003 could be sustained - thus allowing tapping those markets on a regular basis - only if the fiscal stabilization program is fulfilled in the next few years.

Finally, with respect to the debt composition and structure, the strategy must also consider the macroeconomic conditions that make the different debt instruments vulnerable, and at the same, the macroeconomic impact of choosing a certain structure.

The main objective of this paper is to analyze the appropriate management of Colombia's public debt taking into account all the relevant financial, macroeconomic, short-term and long-term fiscal considerations, as well as debt paths that are sustainable over time. The first chapter reviews the literature on public debt management, and the second chapter studies the Colombian case. The first section presents the public debt evolution, considering its composition and structure; the second deals with the sustainability implications of the debt performance; the third analyzes the current debt portfolio and projects the debt costs in the medium and long-term under different scenarios through stress testing and sensitivity analyses; the fourth section considers a dynamic approach for the shorter run, and the last section proposes alternatives for hedging from eventual risks and gives guidelines for the debt management, both in the short and long-term perspectives.

I. Theoretical Framework on Optimal Debt Management

A. Optimal taxation and tax smoothing

The importance of accomplishing an analysis of the debt management begins by the close relation between debt and taxes. Analysts have worked for many years trying to find a solution to the great controversy related to establishing if debt is equivalent to taxes. Behind the answer stands the issue of who assumes the debt burden, if today or future taxpayers: i.e. if the debt burden is set on future generations. According to one perspective ("Ricardian Equivalence" view), debt is equivalent to taxes as any increase in debt that needs to be serviced will imply more expected tax liabilities for either current generations or future generations linked to current ones by an operational bequest motive (as in Barro, 1974)[1]. In contrast, Buchanan (1976) does not find equivalence between taxes and debt since agents undergo a "fiscal illusion": instead of raising their level of savings, taxpayers increase their present consumption since they do not fully incorporate future liabilities and consider that bonds represent an increase in wealth.

Beyond that debate, recent literature has concentrated in analyzing the public debt topic stating that it should imply the least possible distortions on the future tax burden. In this sense, the debt management objective of governments should be to minimize the present value of the expected excess burden (Bohn, 1990). Barro (1995) formally introduced the concept of "tax smoothing". In particular, if taxes are lump sum and other conditions of the Ricardian Equivalence hold, financing public spending with debt or taxes is irrelevant. However, in the context of distortionary taxes it is important to attempt to smooth them over time. Also, considering the presence of uncertainty in relation to other variables that affect the budget and fiscal performance (and the possible contingencies that can alter the tax burden), the concept of debt structure also becomes significantly relevant[2].

The stabilizing role of debt is a crucial aspect of its management. The present value of tax income should be sufficient to cover the initial value plus the present value of future government spending. However, any change (shock) in current or future expenditure, in the current or expected level of economic activity, or in the value of debt, would force the government to adjust its tax

income. In this case, if debt has been managed optimally, it should be able to absorb these contingencies, hedge the government from the sources of uncertainty, and thus minimize fluctuations in tax rates. As pointed out by Missale (1997), the reasons why debt management is important fall under four point of view in the literature: (1) when taxes are distortionary -pointing out that the design of debt policy must seek an optimal tax policy (tax smoothing) and assuring its intertemporal consistency-; (2) when markets are incomplete –in this case, debt policy must improve the process of risk sharing- (3) when markets are imperfect –debt policy must promote efficiency in financial markets-; and (4) when tax nearsightedness and short-term planning horizons exist –it is argued that debt instruments should be used for stabilization purposes-.

A realistic representation of the government's objective when contracting debt is that it must engage in a trade-off between minimizing the cost of debt service and minimizing the budget fluctuations that could alter the tax burden and its translation to the future (budgetary risk), where a relevant element should be the incorporation of the contingent debts in the liabilities portfolio[3]. If the main objective is to maintain a stable tax regime, minimizing the budgetary risk has great relevance and stimulates the government to use the debt to stabilize and smooth fiscal shocks Missale (1997)[4]. However, if the objective seek more to minimize the debt-servicing costs, other risk management becomes crucial. In fact, the government liabilities portfolio faces different kind of risks: market risks, budgetary risk, credibility and signaling, rollover risk, liquidity risk and reindexation risk[5]. Therefore, an optimum debt structure will depend on several macroeconomic conditions and characteristics as well as on the expectations of individuals regarding government policies.

B. Public debt management and debt strategies

Based on the theoretical framework of optimal taxation and tax smoothing, recent literature oriented itself towards seeking a broader strategy for public debt management in practice has been developed. In particular, the IMF and the World Bank recently designed guidelines regarding this matter, given the dynamic of the debt in emerging economies, and its relation with a poor debt management. Different recommendations and techniques have been proposed, with the

objective of adopting a comprehensive an forward looking debt strategy that allows governments to minimize the debt service and reduce the exposure to the main risks associated to a given level and structure of the government liabilities, while insuring that the debt service cost does not exceed the sustainable amount. In fact, in choosing a government portfolio, the borrowing must be consistent with the repayment capacity, taking into account the amount, terms and conditions of new loans.

To do so, risks should be considered in an ample manner (market, rollover, liquidity, macroeconomic, and government's balance sheet risks) and the financial characteristics of the fiscal revenues, other cash flows and external funds available to the government to service its domestic and external debt must be taken into account. Also, the vulnerability of income sources (exports, fiscal revenues) to unexpected shocks becomes a relevant issue. In addition, when choosing a debt structure and its level one might consider their direct influence on fiscal accounts and on the macroeconomic variables such as current account, investment and GDP growth, in the sense they can either augment or reduce the magnitude of the impact of shocks. In the case of emerging economies, special attention must be given to rollover risk, due to the fact that the governments are constrained by small domestic capital markets and a limited and volatile access to international market. In the same direction, liquidity risk becomes of special relevance in some short periods.

The final objective for governments is to design a set of possible strategies for debt management, incorporating the composition between domestic and external debt as well as the structure of each of these individually. External debt structure must take into account term, currency, and types of lenders and borrowers, while domestic debt structure considers term, denomination –foreign, local nominal and indexed- and conditions of the interest rate -fixed or variable-.

The criteria to be used in choosing the public debt have been broadly analyzed in the international literature[6]. The studies establish the conditions, advantages and disadvantages and the implications of using different debt maturities, instruments (indexed, nominal, denominated in foreign currency), and even include the role of expectations[7]. Nevertheless, as stated by Missale *et.*

al. (2000), although government officials are aware that the goal of debt management is to minimize the cost and risks of servicing public debt, exactly how this is pursued is not known[8]. In fact, the literature shows that an adequate (optimal) tax structure depends on each particular case, the specific conditions of each economy, the initial debt and future contingency levels, among the main aspects.

Thus, in the decision of how to structure its debt, the government must evaluate a series of macroeconomic conditions (among which are the additional financing needs) and the possible shocks to which it is exposed, because the debt instruments respond differently to each of these. Even, when the stochastic properties of the economy are known, the structure of the debt (maturity and currency denomination) may have an important macroeconomic insurance role as a hedging mechanism for governments. In fact, the debt composition and structure have a direct influence on fiscal accounts and on the macroeconomic variables and they can either augment or reduce the magnitude of the impact of shocks in the risk factors.

1. Currency composition and fixed rate versus variable rate debt

Issuing nominal fixed rate debt has some advantages as the higher the inflation the lower the real value of the cost of the debt. In that sense, nominal debt serves as a hedging instrument against certain types of shocks, such as production and public expenditure shocks. An exogenous shock that increases the interest rate implies larger payments of government debt that must be financed with higher taxes, which in turn could lead to an inflation rate that exceeds expectations. However, if the government has an important portion of nominal debt, the real value of debt is reduced with the higher inflation. In those conditions, the shock would be absorbed by the debt and there would be no need for increasing taxes. Similarly, when the fall in output is followed by a higher inflation, the tax adjustment necessary to keep the budget close to balance is lower: the revenues fall, but at the same time, debt costs fall in real terms (Bohn 1987).

Nonetheless, an argument against the nominal debt is related to its effect on government incentives and to agent's expectations (Barro, 1996, Missale, 1997). When issuing nominal longer-term debt, governments have incentives to inflate the economy in order to reduce the real

cost of this type of debt (Calvo, 1988). If rational agents perceive the incentives, the government can find it difficult to place large amounts of nominal debt or has to do it at elevated costs. This typical case of time inconsistency of government policies is tightly related with credibility and "signaling" problems[9]. When facing those risks, the issuance of other kind of debt such as indexed debt, foreign currency denominated debt or short-term nominal debt could be more appropriate.

The debt denominated in foreign currency is an instrument that allows the government to hedge from real economic shocks without the time consistency problem created by nominal debt. If domestic and foreign inflation are positively correlated, nominal debt in local currency and debt in foreign currency are substitutes in the liability portfolio of the government (Bohn 1989). However, for foreign currency debt to be preferred over nominal debt in local currency, certain conditions must be given: domestic inflation must be relatively uncertain (low credibility for maintaining inflation relatively low while issuing nominal debt); the country's GDP must be closely related to the global economy (exposed to economic world cycles), and the internal monetary market should be more volatile than the foreign one (Bohn, 1990)[10]. Additionally, an excessive concentration of foreign currency debt affects the exchange rate leading to devaluation and thus resulting in a larger debt cost.

A government can also issue debt indexed to the inflation or to short-term interest rates, which eliminates the inflationary incentives related to the reduction of the debt burden and sends a clear signal of the compromise of the government's anti-inflationary policy. Debt indexation helps to reduce debt cost particularly in countries where the different macroeconomic variables are highly volatile, because this volatility can induce investors to charge a risk premium for non-indexed debt. It also creates the appropriate hedge from shocks, especially demand shocks (with a positive correlation between output and inflation). Since output and inflation decrease, revenues and the cost of the indexed debt will fall; thus, the government is hedged if the fall in income is proportional to that of the cost of the debt[11] (Mylonas *et.al*, 2000). However, indexed bonds are less flexible instruments, and therefore make the adjustment difficult in case of exogenous shocks, increase budgetary risk, and augment the probability of default. Additionally, the sensitivity of the demand for money towards the interest rate makes it impossible to achieve a "first-best" optimum

using only indexed debt; thus the solution will always be a *second best*, and therefore it is convenient for a government to diversify its debt structure (Calvo, 1988).

2. Debt maturity

The government can also use the maturity term of debt as an instrument of strategic debt management; but there is a trade-off between reducing costs and reducing rollover risks. Reducing cost implies issuing short-term debt while reducing rollover risk implies issuing long-term debt. The appropriate choice has often been a mix of long-term and short-term debt.

Short-term debt reduces costs and facilitates the management of risks (liquidity, credibility and signaling): it allows the government to maintain temporary imbalances between revenues and expenditure without having to change the tax structure in order to acquire the resources it needs, and it is also convenient to reduce the credibility risk and to signal a clear anti-inflationary compromise (Blanchard and Missale, 1990)[12]. Through that way, short-term nominal debt can reduce the financial cost of debt, since investors will not require high liquidity premiums necessary to hedge from future monetary policy uncertainty Campbell (1995).

Nevertheless, long-term debt has enormous advantages in the sense that reduces the exposure to the refinancing risk faced by the government (rollover risk) or even the default risk (Barro, 1995). When the debt has a high concentration of maturities in the short run and market liquidity is insufficient, the government would have to incur in very high costs to either rolling over the debt or assume the consequences of a default (reputation)[13]. In addition, long-term debt must be preferred, when short-term interest rates are high relative to long-term interest rates.

C. Debt management trade-offs in emerging markets

The discussion above about alternative public debt instruments for the optimal debt management has various relevant implications for emerging market economies. The first one is that most currency and financial crises in emerging market in the last decade (from Mexico to Asia to Russia, Brazil, Turkey and Argentina) had one vulnerability in common: a large amount of short term domestic and/or external debt relative to the liquid foreign reserves of the country leading to the risk of rollover. Thus, maturity mismatch and its related rollover/liquidity risk were

always predominant. So, the first lesson is that to avoid rollover risk, emerging market economies should lengthen the maturity of their public debt.

This observation leads to the second one. Because of a history of poor policy credibility and poor macroeconomic management, many emerging market economies cannot borrow easily long term in their own currency. The "original sin" may lead to "liability dollarization", that is to a situation where the only long-term borrowing may be in foreign currency; but sound and credible macro policies may also lead, over time, to the creation and development of a local currency public debt market where longer maturities of government debt can be issued (as in Colombia in the last few years). Still, in the short run, emerging market economies that are trying to issue longer term government debt may not be able to do so in local currency at fixed nominal interest rates, because issuing such debt may be very costly in real terms if there is a lot of inflation uncertainty and poor credibility. Under those conditions, governments have essentially three potential options to lengthen maturities and reduce rollover risk, while minimizing the cost of debt service: a) inflation indexed debt, b) financially indexed debt (i.e. debt indexed to the short-term interest rate), c) currency linked debt (payable in either foreign currency or in domestic currency at the prevailing exchange rate at maturity).

Compared to long-term debt in local currency, these three instruments have higher budgetary risk in nominal terms (as coupons and/or principal are State contingent). However, if policy makers suffer of limited policy credibility (and may be tempted to wipe away the real value of long term nominal debt), and agents are risk averse and unwilling to take the inflation or currency risk, the real cost of some of these instruments may be lower than long term nominal interest rate debt. Thus, required equilibrium ex-ante real rates of return may be lower for these various indexed instruments compared to nominal debt. Also, while nominal budgetary risk is higher under these instruments, real budgetary risk may be lower: for example, inflation indexed-debt has a higher nominal budgetary volatility than nominal debt with fixed coupons but its real volatility is lower as the real cost of it is fixed and known in advance. On the other hand, the real cost of nominal debt may be ex-post higher or lower than expected ex-ante depending on whether inflation turns out to be lower or higher than what it was expected at the time this debt was issued.

enough history of policy credibility, it may lengthen maturity through some issuance of long term nominal fixed interest rate debt at ex-ante real cost that are moderate. But if "original sin" prevents this or makes it very expensive, it may be less risky and cheaper to issue indexed debt. Inflation-indexed debt may have the lower ex-ante real cost (controlling for the fact that it does not hedge against default risk) but a real cost that is constant over time and state non-contingent, and may be even the safest way to lengthen maturities. Financially indexed debt may be cheaper in real terms than inflation indexed debt if nominal and thus real short-term interest rates are low and remain low; however, its ex-post cost can spike if shocks lead to a sharp increase in short term interest rates. Finally, issuing currency-linked debt makes sense if one does not expect sharp real depreciations of a currency; otherwise its ex-post cost can be very high. In practice, a combination of indexed instrument may be the appropriate response, unless one of them dominates both in terms of real cost and its volatility.

II. The Colombian Case

In Colombia, a few studies of public debt issues have been carried out, most of them being mainly descriptive and few assessing debt management issues. Herrera (2000) evaluated the determinants of public indebtedness in Colombia. Based on Barro (1979) he analyzed whether public debt has served the purpose of smoothing transitory fluctuations in the GDP and public expenses, and found that public indebtedness served as a tool for smoothing transitory shocks in income and public expenditure. Also, the inclusion of bonds indexed to the CPI reduced the inflationary uncertainty, allowing the government to maintain greater credibility in its inflation targets. This author evaluated the sensitivity of the public indebtedness' currency composition (defined as internal and external debt) to the differential between debt costs, and found that the access to the different markets is flexible, although the elasticity is not too high, which implies that there is no perfect substitution between these markets.

On the other hand, Correa (2000) found that public indebtedness has been an obstacle for macroeconomic stability since the beginning of the nineties, arguing that the underdevelopment of

the capital market increased the cost of the 1998-1999 crisis, reduced the effectiveness of monetary policy and contributed to the high volatility of interest rates. A relevant problem faced by the internal capital market was the lack of a suitable regulatory and institutional framework that could guarantee a transparent debt management strategy: the regulatory restrictions contributed to a segmented market and reduced liquidity; the public debt instruments were too varied, not fungible, and issued in very small and illiquid series. But in recent years the debt market expansion has been accompanied by an effort to modernize and sophisticate it; market markers have been developed, new instruments have been issued, market placements have regained predominance relative to forced and agreed, and operational aspects in issuing, placing and managing public debt have significantly improved (Arbeláez *et al.* 2002). Furthermore, the government strategy has been emphasizing in improving the yield curves slopes and lengthens the maturity with a relative success. However, the rapid growth of public debt during the second half of the nineties and the significant increase in the investment in public securities (an average annual rate of 75%) substituted credit to the private sector and substantially changed the structure of the financial sector's balance sheet (Caballero, 2002).

Regarding the debt dynamics and its cost, Hernández *et al.* (2000) find that the explosive increase in debt interest payments is a consequence of excessive public expenditure in relation to government income rather than a consequence of a rigid monetary policy. The authors argue that from both an economic and social point of view the government should fulfill entirely its acquired financial obligations and conclude that the government should not resort to inflation or monetary emission in order to reduce the cost of its debt. In a different direction, Cabrera and Gonzalez (2000) establish that beyond the question of whether the government should pay or pilfer its debt, the concern should be to insure that the government is not paying a price for its debt that is higher than the market price for liabilities. They suggest establishing as a policy objective to structure interest rates in such a way that they reflect the fact that public securities have the least market risk.

Finally, a complete set of studies addresses the sustainability of Colombian fiscal policy. Most of the recent papers conclude that the current fiscal posture is not sustainable over time

unless deep fiscal adjustments are adopted, while studies done in the late 1980s and early 1990s are more optimistic. These have found that around 3% of GDP increase in government saving is needed to stabilize the debt-to-GDP ratio at roughly 50 percent[14].

A. The debt sustainability problem

One basic question about public debt is whether, regardless of its optimal management, the debt level and its dynamics are sustainable over time. If a country is on an unsustainable debt path, even the best debt management may not be able to prevent a debt crisis, either a rollover crisis or an outright default. So, sound debt management of is important but it is even more important to assure that the government is not following fiscal policy that will eventually lead to insolvency and default regardless. Thus, it is useful to add a discussion of debt sustainability. As we will see below there are two elements to sustainability, with the latter being relevant for debt management. First, sustainability can be thought as whether the overall debt path will or will not lead to eventual insolvency. Second, there is an issue of sustainability in the sense of financeability of an otherwise solvent debt path. Even an otherwise solvent government may follow debt management policies that lead to non-financeability of the debt path; for example, if the public debt is excessively short-term, then even a solvent government may face a debt rollover crisis; so, a sustainable debt path (under the assumption of rollover) becomes unsustainable, or better unfinanceable, if the maturity of the debt is too short term as this leads to the risk of a rollover crisis or liquidity run.

The analytical literature on debt sustainability provides a useful starting point, but is not particularly stringent because the intertemporal budget constraint of a country imposes only very mild restrictions on the evolution of the public debt (domestic and foreign). Specifically, as long as the discounted value of the government debt is non-zero in the infinite limit, the public sector is solvent; this means only that the government cannot increase its debt faster than the real interest rate on this debt. Subject to this constraint, any path of the fiscal (cum interest) surpluses/deficits such that the infinite sum of all fiscal balances is equal to the initial debt of the government is consistent with public sector solvency. The stock of public debt could increase without limit as

long as it does not increase faster than the real interest rate. The intertemporal solvency constraint does impose some limits on the behavior of the non-interest fiscal balance (i.e. the primary fiscal balance) in the sense that it requires that the discounted value of primary balances should be at least equal to the initial public debt; if a government is initially running primary deficits and has a stock of initial debt, it needs to run primary surpluses over time to remain solvent, a commitment that could be not realistic.

Given the looseness of the theoretical criteria for solvency and sustainability and the inefficiency or feasibility to run primary deficits or trade deficits for a long time in expectation of adjustment in an uncertain vague future, it may be valuable to consider more practical criteria for sustainability. In fact, a dynamics of the primary balance that leads to an increase without bounds of the public debt to GDP ratio can be seen as being effectively unsustainable: the financial markets will eventually get concerned about the country's ability and willingness to repay its debt and will limit its borrowing leading to a debt crisis. Therefore, *a non-increasing public debt to GDP ratio* is seen as a practical sufficient condition for sustainability: a country is likely to remain solvent as long as the ratio is not growing.

In this section we use the debt dynamics equations and the concept of primary gaps to estimate the primary adjustment required to permanently stabilize the debt to GDP ratio to its current 2002 level and the real and financial consequences of failing to do so or of postponing the required adjustment. Debt dynamics analysis implies that the yearly change in the debt to GDP ratio (d(D/GDP)) is equal to the negative of primary balance (as a share of GDP, defined as PB/GDP) plus the product of the real interest rate minus GDP growth differential (r-g) times the debt to GDP ratio (D/GDP) or $d(D/GDP) = -PB/GDP + (r-g)(D/GDP)$. Thus, the primary balance required to stabilize the debt to GDP ratio at its current value (or $(PB/GDP)^*$) is equal to the r-g differential times the debt to GDP ratio: $(PB/GDP)^* = (r-g)(D/GDP)$. Such required primary surplus will be larger the bigger are the public debt to GDP ratio and the differential between the real interest rate and the growth rate of the economy. Then, the primary gap is equal to the difference between the required primary balance and the primary balance (at given current and expected policies) or: Primary Gap = $(PB/GDP)^* - (PB/GDP)$[15].

In considering the primary fiscal gap, one should look not at current levels of real interest rates and GDP growth rates and current (cyclically unadjusted) values of primary balances but rather at the medium/long-run levels of real interest rates and growth and structural values of primary balances, i.e. stabilization of the debt to GDP ratio should be considered in a medium term perspective, not a short term one. In other terms, one should look at the "permanent" rather than "current" primary gaps[16].

Figure 1 illustrates the required primary balances and primary gaps given alternative assumptions for levels of debt and differences in interest rate and growth (A.1. Table 1 provides more detailed information). Take as the benchmark case where debt is stabilized from 2002 on to the 50% level, the growth rate is permanently equal to 3.0% of GDP and the average permanent real interest rate is 7.5% (r-g=4,5%), then the required primary balance to stabilize the debt ratio is 2,3% of GDP. If the differential (r-g) were lower, 2,5%, the required primary balance would be equal to 1,3% of GDP, and if (r-g) were higher, say 6.5%, the required primary balance would be higher, 3,3% of GDP. In 2003 Colombia experienced real interest rates higher than what is implied by our benchmark, and since the debt ratio has been growing further in 2003 and is expected to be closer to 54% of GDP by the year end, the actual required primary balance would be rather 3.5% of GDP.

Starting from the benchmark case, computing the permanent primary gap is complex because it depends on the level of the primary balance that is considered to be permanent. The primary balance in 2002 for the Non Financial Public Sector was 0,5% of GDP and –1,4% of GDP for the Central Government, but the fiscal adjustment program implemented by the government in 2003 may lead to a primary surplus close to 2% of GDP in 2003. However, the primary balances can worsen over time if, as expected, many spending programs (military, security, social spending) are implemented in the future and structural reforms (social security, transfers to regions) are not implemented.

As an illustrative example, considering the historical averages of the NFPS primary surplus as well as some long term official projections and correcting for cyclical factors, the

permanent primary balance could be a deficit of 0,5% of GDP. In that case, the primary gap (our benchmark case) would be 2,8% of GDP. Instead, if the permanent primary balance is better given the reforms made in 2003 (0.5% of GDP), the primary gap decreases to 2.3%% of GDP. Of course, this primary gap becomes bigger (smaller) the larger (smaller) is the (r-g) differential. In the benchmark case, if (r-g) is larger and equal to 6,5% (rather than 4,5%), the primary gap increases to 3,8% of GDP[17].

As an illustrative exercise we consider a passive scenario where the primary adjustment to fill a 2,8% primary gap does not occur right away and instead the country follows policies that lead to a further increase in the debt to GDP ratio[18]. Such unsustainable primary balance path would lead to an explosive growth in the debt to GDP ratio, up to 100% or even 200% of GDP[19]. The likelihood that the country would be able to persistently run such large primary gaps and increase its debt ratio to such high levels is very small, and most likely markets would sooner or later realize that this path is unsustainable and thus refuse to finance these large new imbalances. Thus, a debt crisis would emerge at some point before the debt ratios reach the very high and unsustainable levels.

However, let's assume that at least for a while (until 2010) markets are willing to finance the country and allow it to run a primary gap of close to 2,8% of GDP per year as in the benchmark case, and then the debt ratio is stabilized to the higher level close to 75% of GDP. In such a situation, the resulting required primary balance and permanent primary gap would depend on four factors: first, the required primary balance changes with a debt of 75% for unchanged permanent real interest rates and growth; second, the higher debt ratio affects the equilibrium real interest rate; third, the higher debt ratio and higher equilibrium real interest rate affect the permanent growth rate of the country; and fourth, the lower growth rate affects the permanent primary balance. The interaction of these four factors significantly increases and exacerbates the primary gap at a debt ratio of 75%, leading to primary adjustment much greater than the real interest rate burden of the higher debt stock of 25% of GDP (relative to a stock of 50%).

Let us consider the various steps of the argument. First, there is an effect on the primary gap of the higher debt burden. Assuming that stabilizing the debt ratio at 75% has no effect on the

long run real interest rate or the growth rate or the permanent primary balance, the required primary balance would be 3,3% of GDP, rather than the 2,3% of GDP that was required to stabilize the debt at the 50% level, and would increase the primary gap to 3,8%. Approximately, any increase in the debt to GDP ratio of 10% leads to a higher (debt-stabilizing) required primary balance of 0,4% of GDP, so a 25% increase (from 50% to 75%) leads to an increase of 1% in the required primary balance.

Second, the delayed debt stabilization has an impact on the real interest rate. A higher debt ratio, 50% rather than 75%, will cause a higher permanent real interest rate as the default risk premium would be much higher when the debt ratio is higher, especially when the country can be buffeted by future growth, terms of trade and real interest rate shocks and when investors are risk averse. It is hard to assess the new interest rate equilibrium, but a low-ball park figure would be 1% and a higher figure would be 2%, increasing to 7.5% to 8.5% and to 9.5%. Then the increase in the real interest rate would increase the debt stabilizing required primary balance from 3,3% to 4,1% if r increases by 1% or to 4.8% if r increases by 2%. Thus, the primary gap would increase from 3,8% of GDP to either 4.6% or 5.3%, much higher than the benchmark value of 2,8%.

Third, there are effects on long run growth. If real interest rates are higher, investment will be lower and the permanent long run growth rate of the economy will also be lower. Suppose that the reduction in the growth rate is proportional to the increase in the real interest rate; i.e. the growth rate falls by 1% when the real interest rate increases by 1%, or alternatively, the growth rate falls by 1% if the real interest rate increases by 2%[20]. In such case, a an increase in the real interest rate (r=9,5% and g=2%) would lead to a primary gap increase the required primary balance of 5,6% of GDP rather than 4,8% that would emerge if the increase of 2% in r does not lead to a fall in growth and the primary gap goes up to 6.1% rather than the 5,3%. If the growth effects of a higher r are larger, the required primary balance goes up to 6,3% and the primary gap goes up to 6,8%, an even worse outcome.

Finally, if the growth rate of the economy will be lower in the long run, the permanent primary balance will be lower too. The lower growth means, first, lower revenues and possibly lower revenue to GDP ratios; and second, it may lead to a higher government spending to GDP

ratio and even to higher spending to support the incomes of those who are hurt by lower growth. The size of this effect of lower growth on the permanent primary balance is hard to assess. A ballpark figure may suggest that a 2% reduction in the GDP growth rate may reduce the permanent primary balance by 1% of GDP. Thus, in the scenario where the growth rate of the economy was falling from 3.0% to 1.0% when r was increasing from 7.5% to 9.5%, the primary gap increases from 6,8% of GDP to 7,8% of GDP. If the growth effects of the increase in r are smaller and if the primary balance effects of a fall in growth are smaller, these increases in primary gap are somewhat smaller.

In summary, the lesson is that considering all the effects of the failure to stabilize earlier the debt to GDP ratio to lower levels leads to potentially much higher fiscal burden costs, in terms of higher debt-stabilizing required primary balances and higher primary gaps. Compared to the benchmark where the debt ratio was stabilized at 50% and where the required primary balance was 2,3% while the primary gap was 2,8%, the required primary balance could be as high as 6,3% of GDP and the primary gap as high as 7,8% of GDP. So, the cost could be as high as a tripling of the required primary balance and almost as high as a tripling of the primary gap. And given the sizeable increase in the primary gap, this primary adjustment may not be politically or socially feasible, thus leading to a debt crisis.

Note also that, once a higher debt level is reached, say 75% rather than 50%, the costs of avoiding a very high primary gap at that level and an attempt to reduce the debt ratio to lower level (rather than stabilizing it at the higher 75% level) are very high. For example, while in the benchmark scenario with a 3,8% primary gaps and a required primary balance of 3,3% to stabilize the debt ratio at 75%, it would take 9 years of primary balances of 6% (rather than 3%) to bring back the debt ratio from 75% to 50%; and after that, the permanent primary balance would still have to remain at a permanent value of 2,3% to stabilize the debt ratio at 50%. Thus, any attempt to reduce the debt burden rather than stabilizing it at the higher level in a delay scenario would be extremely costly as they would entail an relatively long intermediate period of very high, and possibly unachievable primary surpluses.

There are several additional risks deriving from building up the debt level to a higher level such as 75% and then trying to stabilize it at that level. First, there is a higher risk of vulnerability of the debt to shocks to growth and real interest rates and real depreciation when debt levels are higher. Any such shock puts the debt ratio on an increasing path and requires further primary fiscal adjustment to prevent an unsustainable debt dynamics. Second, rollover risk is higher for any given maturity of the debt when the debt stock is higher as more debt implies that the amount of debt that needs to be rolled-over (both in absolute terms and as a share of GDP) will be higher. So, greater debt ratio makes the country more fragile and vulnerable both to insolvency risk (sustainability issues) and rollover risk (financeability issues). Thus, prudent debt management suggests that debt should be stabilized at the lowest possible ratio to GDP.

B. Evolution of the Colombian Public Debt

1. Overall Description

In Colombia, the measures of public debt vary from one source to another due to the methodological differences in its calculation. In this paper we use the total gross public debt being the sum of Non-Financial Public Sector (NFPS) external debt[21] and NFPS gross adjusted[22] internal debt. Total NFPS gross debt has significantly increased during the past decade, particularly since 1998: in 1996 it was just under 30% of GDP, by 1998 it has reached 39%, and it reached 63.3% of GDP in 2001. This trend is explained by a sustained increase in both domestic and external debt, which have grown at similar rates, maintaining their distribution constant along the decade (around 58% for domestic and 42% for external). Although it can be argued that in recent years the poor economic performance illustrated by a fall in aggregate output of 4.1% in 1999 and a slow recovery since then has contributed to the rise of debt as % of GDP, it is important to note that the issue being analyzed is the behavior of debt, and that as it grows with respect to GDP it becomes a greater burden for the economy, independently of whether this growth responds to an increase in debt itself or a decrease of output. Interest payments on the total gross public debt as a percentage of GDP[23] have also grown considerably: in 1998 these jumped from 3.4% of GDP to 4.3% of GDP; the following year the trend continued and it stabilized only after 1999.

Nevertheless, the implicit interest rate[24] has decreased, partly due to the government's effort to manage the debt more efficiently.

The Central Government has been responsible for a great deal of the debt's growth in recent years: in 1996 it was approximately 17% of GDP and accounted for 56% of total NFPS debt and by 2001 and it had grown to 49,3% of GDP and represented 78% of the total NFPS debt. However, a positive aspect of this is that the implicit interest rate of the Central Government's total debt is currently slightly lower: the average coupon interest rate for the central government's domestic debt has decreased significantly during the past few years resulting in a contributing factor to the reduction in the interest rates paid (Figure 2).

2. Internal Public Debt

NFPS internal debt is composed of three main parts: the internal debt held by the central government, the territorial entities, and other entities of the non-financial public sector (e.g.. state entities such as Ecopetrol, ISS, etc. and decentralized territorial entities). During the period 1996-2001 internal debt more than doubled: gross internal debt grew from 13% GDP to 27% and net adjusted internal debt grew from 8% of GDP to 17% of GDP[25]. In other words, the debt issued by the central government held by other public entities represents approximately 10% of GDP[26]. The Central Government is once again the greatest contributor to the notorious growth of the Internal Debt. In 1990, its debt amounted to 4% of GDP and in 1998 it achieved an explosive tendency reaching 23% of GDP by 2001. The internal debt is divided into three major parts: financial credit, bonds and central government promissory notes. Bonds have played a key role as an internal debt instrument, and have represented more than 60% of total internal public debt with an increasing participation within total internal debt reaching 81% by the end of 2001 (Government bonds have grown from 6% of GDP in 1995 to 21% of GDP in 2001) (Figure 3).

Although there are a variety of central government bonds, TES B have accounted for the majority of bonds that have been issued (In 2002 TES bonds have a share of 79% of the total portfolio), also showing a significant growth (5% of GDP in 1995 compared to 18% in 2001) (See

Table 1 in Appendix 1). TES B Bonds are issued by three different mechanisms; they can be auctioned in the primary market, sold through an agreement where the other party (a financial institution) acquires the bonds when it has an excess liquidity, or by means of a forced operation. During 2001, of all the TES B that were placed in the domestic market, 47.4% corresponded to auctioned bonds, 41.1% responded to a convened operation, and 11.5% were a forced investment. Observing the evolution, a clear tendency of an increase in auctioned TES is evident, as well as a reduction of the forced acquisition of these bonds. Agreed TES B reached a peak in 1999 participating with over 51% of total TES B placed in the market and since then their participation has been reduced.

The total sums have been distributed according to the term of each placement. A clear and significant reduction of 1 year TES B occurred, and as a general trend, longer-term debt (5-year term or more of maturity) has taken greater importance compared to shorter-term debt. In 1998, short term TES B accounted for 87% of total TES, while the remaining 13% was distributed mainly among 7-year and 10-year bonds. In 2001 the effort of extending the average maturity of debt was made even clearer, and short term TES represented less than 40% of total placements during the year. Additionally, 8-year bonds were auctioned for the first time and accounted for 5.6% of the total annual placements and 7 and 10-year bonds showed a significant contribution of 12.8% each (See Appendix A.1. Figure 1).

The change in strategy had a significant effect on the average maturity term of internal debt held in TES. The average term was calculated as a weighted average of the maturity according to the sums placed in the market both monthly and annually, and an increasing tendency is clearly observable. In 1998 the internal debt held in TES had an average maturity of 2.25 years, and by the end of 2001 it had already reached 5 years. The progress in the average maturity of the internal debt denominated in bonds has been accompanied by a generalized decrease in interest rates, once again a proof of the central government's effort to manage more adequately internal debt. The weighted average interest rates measured both in nominal an real terms have shown a significant reduction, particularly when compared to the crisis period of 1998

when interest rates peaked at 35% (nominal) and 15,6% (real). During 2002 interest rates continued to decrease but the August TES "crisis" caused a spike in both real and nominal rates (Figure 4).

Regarding the currency structure, the central government's debt held in bonds has been primarily denominated in pesos. In 1997, bonds in local currency represented 96% of total Central Government debt in bonds, with the remaining 4% corresponding entirely to debt in dollars. Bonds indexed to UVR were issued for the first time in 1999 and since then have gained relative importance. In 2002 TES in local currency (nominal) play a preponderant role since they represent 69% of total TES placed at the time, those denominated in UVR represent 27% and, the remaining 4% corresponds to those in US Dollars. It is important to emphasize that TES in UVR are mainly issued with a long maturity (mainly 7 years), while TES in USD have been issued on a short term (2 and 3 years at the time of the 1998-1999 crisis) and more recently at a very high maturity (8 years). The majority of internal debt has been issued at a fixed rate, approximately 79%, among which TES in COP, in Dollars and in UVR are found. Internal debt in COP issued at a fixed interest rate represent 48% of the internal debt portfolio, followed by debt in UVR that participates with 27% and debt in USD, which accounts for 4% of total internal debt. Debt issued in COP tied to the inflation rate (CPI) also has a significant weight within total internal debt, representing approximately 17% of the debt portfolio; only 2.4% depends on the passive interest rate, and 1.4% falls in other categories.

3. External Public Debt

The External Public debt of both the Consolidated Public Sector debt and NFPS debt[27] has also shown an increasing tendency in recent years, between 14% and 15% of GDP since 1996. By 2001, CPS External debt reached 29% of GDP and NFPS external debt reached 27% of GDP. Once again the Central Government is the main responsible for the increase external debt registered during the past years. The Central Government's external debt rose 15% within 1996 and 2001, reaching 22.4% of GDP in 2001, while Territorial external debt remained relatively

constant between 2,7% of GDP and 3,3% of GDP during this period and other NFPS external debt decreased significantly. (Figure 5)

This behavior affected the distribution of external debt among these entities considerably. In 1995 the Central Government held just over 50% of total external debt, leaving the other half to territorial and other public entities, and by 2001 the share rose to 82%. External public debt[28] has also changed its composition significantly during the past few years. In 1995, multilateral entities were the most important source of public external financing while providing 42% of these resources, followed by Commercial bank loans (29%) and bonds that were no more than 12% of total external public debt. During the decade two major changes were observed and in 2002 bonds augmented their contribution to external financing significantly reaching 60%, commercial banks reduced their participation within external debt considerably to 6%; multilateral organisms also reduced their participation to 31% in 2002 and the rest, 2%, is equally distributed among other government credits and export credits. This behavior is explained entirely by the central government's greater placements of bonds in foreign markets. While in 1995 bonds represented only 19% of its external debt, by the end of 2001 they had reached a participation of 62%. This instrument clearly substituted commercial loans and credit with bilateral entities, which reduced their participation 25.5% and 10.6% respectively during the same period. Territorial entities and the rest of the non-financial public sector have shown a completely different behavior: they have almost no bond issuance, therefore, their external debt is distributed manly among bilateral and multilateral credit as well as commercial loans. During 1995 the majority of the external debt corresponding to non central government entities came from multilateral institutions (52%) and commercial loans (25%), by 2001 these sources had leveled their participation to 38% and 32% respectively, maintaining their importance within total debt but revealing a clear re-composition between each other.

As a consequence of the change in structure, the composition of external debt according to types of interest rates has also changed significantly. It reveals the increasing importance of debt issued at fixed interest rates while variable or floating rates have maintained a relatively stable contribution and "semi-variable" rate has reduced its participation. In 2002, fixed rate debt

accounts for 63% of the external debt portfolio, 24% corresponding to a variable rate, and a remaining 13% of external debt held at a semi-variable rate. Regarding the composition of external debt according to currency, no notorious changes occurred between 1997 and 2001. It is primarily held in US Dollars, 82% of the total, and approximately 13% is in Euros, while the remaining 5% is distributed among other currencies (such as Japanese Yen, 4%).

C. Debt Portfolio Analysis, Long Run

1. Methodological Approach for optimal debt management

When managing the debt, governments must minimize the exposure to possible cost increases. Managing the risk starts by evaluating or measuring the different risks to which the debt portfolio is exposed, for which traditionally Value-at-Risk method is used. Based on the VaR concept, which calculates maximum expected or potential "losses" in a portfolio given a certain probability, the Cost-at-Risk measure can be used to study the maximum increase in the service cost of debt when market risk factors change within a certain probability range. For assets portfolios, the VaR technique provides the maximum expected "loss" at a chosen confidence level (a probability of p%) and excessive losses only occur with a low probability; it does not say anything about the magnitude of losses beyond the VaR level. In order to establish what can happen in the points of the distribution beyond the VaR it is necessary to perform a portfolio stress test that focuses only on the tail of the distribution and sheds light on the dimension of "heavy" losses.

This is one of the reasons why stress testing is recommended as a complementary measure of portfolio risks serving to estimate potential extreme "losses". Moreover, another argument that supports the importance of carrying out stress tests is that, while in VaR analysis markets are assumed to remain constant over a period of time, stress analysis considers a break in the temporal constancy of the market and assesses the potential losses resulting from such breaks. This point is relevant when evaluating risks of the sovereign portfolio because stress tests allow considering risks in a more ample manner. The debt portfolio is exposed to different types of risks

that go beyond market risks, such as rollover risk, liquidity risk, risks associated to the government's balance sheet, and other macroeconomic risks, that can be measured through large movements of the risk factors that directly affect the portfolio. For those reasons, stress tests are becoming powerful tools for risk management purposes. More recently, combined with VaR risk analysis[29], it has been recommend that debt managers regularly conduct stress tests of the debt portfolio in the basis of the economic and financial shocks to which the government –and the country more generally- are potentially exposed.

When managing the debt it is also crucial to take into account liabilities together with assets, since changes in the net debt of the government are partially generated by gains or losses on assets and liabilities. Thus, the use of Asset Liability Management (ALM) is also seen as a basic technique for sovereign portfolio management. However, there are limits to the ability of using an ALM approach: many assets (the cash flow of the government) are not of a financial nature and therefore are not always sensitive to financial risks as liabilities are[30]; and some public assets (financial or otherwise) are hard to measure. So, while one would ideally want to study the overall "Net Worth" of a government and its evolution given various shocks, data limitation restrict the ability to do that. In general, none of the above methods (VAR, Stress Test, optimization, ALM) are enough to be used individually. In contrast, there must be used in an integrated manner complementing each other in order to m*eet al.*l the requirements for an adequate debt management and for creating a sovereign debt strategy both for the long and short run.

For debt management and long-term debt strategy, the Colombian authorities undertake risk analysis using the VaR approach and related concepts such as Debt-at-Risk, VaR optimization and ALM techniques. Through those techniques, they define long-term portfolio benchmarks, for internal and external debt and calculate different optimal (efficient) portfolios for the Central Government in terms of composition between internal and external, instruments, duration and liquidity. These are useful tools for debt risk valuation and give guidelines for managing the public debt in the long term. However, they could be complemented in several ways. First, debt analysis may consider situations of stress (using stronger assumptions) in the risk factors; second,

public debt can be analyzed considering other risks aside from market risks; third, a more dynamic approach incorporating new debt (not only current debt) is of great relevance; and fourth, short term risks –as well as long-term risks- must also be considered. This paper emphasizes these issues and uses a stress testing approach.

The stress test analysis is based on the following concepts: if r are the individual risk factors having an impact in the portfolio, $r = (r_1, r_2, \ldots r_n)$ is a vector that combines them and P is the function of the value of the portfolio, P(r) is the value of the portfolio that depends on the given values of the risk factors. For stress testing, each vector $\mathbf{r} = (r_0,\ldots,r_k)$ represents the different scenarios. The value of the portfolio under each scenario is represented by $P(\mathbf{r}_1),\ldots,P(\mathbf{r}_k)$; by comparing them with the current (market) value $P(\mathbf{r}_0)$ one can assess the losses that would be incurred if the market moves from $\mathbf{r}_0$ to $\mathbf{r}_k$.

Under certain assumptions of linearity, sensitivities (δ_i) of the value of the portfolio relative to a change in an individual risk factor (Δ_i) can be calculated.

$$\delta i = [P(r_1,\ldots r_i,\ldots r_n) - P(r_1,\ldots,r_i + \Delta_i, \ldots, r_n)] / \Delta_i \qquad (1)$$

The new value of the portfolio P* resulting from an individual factor change can be calculated as:

$$P^*(r_1, r_2,\ldots,r_n) = P(r_{0,1}, r_{0,2},\ldots,r_{0,n}) + \sum_{i=1}^{n} (r_i - r_{0,i})\,\delta i \qquad (2)$$

One can also consider simultaneous movements in risk factors, which corresponds to a new scenario (the sign of the change must be selected depending on whether the risk factor increases or decreases)

$$\mathbf{r} = (r_{0,1} \pm \Delta r_1,\ r_{0,2} \pm \Delta r_2,\ldots,\ r_{0,n} \pm \Delta r_n) \qquad (3)$$

Scenarios can be constructed in different ways serving different analytical purposes. Following the literature on risk analysis and stress testing, one alternative is to use historical data, assuming that past events can be repeated in the future, in order to identify and simulate periods of large movements in the risk factors. In order to construct a scenario that combines common movements using historical data, correlations between risk factors must be taken into account. This type of scenario has the advantage of portraying events that have actually occurred.

Additionally, portfolio-specific "worst-case scenarios" can be designed by identifying and taking into account the most adverse events that could occur and that affect the portfolio. Worst-case scenarios do not necessarily involve historical maximum movements; instead, they are more subjective and therefore more "flexible", since they involve assumptions on economic and even political events, which are presumed to cause large losses for the portfolio. Within such scenarios, a sequence of different events is translated in a plausible manner into changes in risk factors.

The analysis carried out attempts to evaluate the cost of the current debt portfolio and the burden of the debt, as well as their increment under different conditions when the risk factors to which the portfolio is exposed are heavily altered. Based on assumptions on the future evolution of the market risk factors, expected future servicing costs over a medium to long horizon are projected -as well as the resulting value of the debt stock-. Then, assuming changes in those market risk factors, the costs over time and the value of the portfolio are recalculated. The difference between those values determines the cost of the debt and the value of the current portfolio that is under risk, given different sets of assumptions.

Starting with the current debt structure, market variables that affect the portfolio are identified and assumptions on the path of those risk factors are made. The first set of assumptions corresponds to a "market neutral" situation, where market risk factors evolve without considering important shocks; the second set include important changes in those factors. The latter can change individually (which allows calculating the sensitivity of the portfolio relative to each factor) or within scenarios where different factors change simultaneously, assessing the impact of a change in the entire market situation.

Based on the framework described above, in the next sections the Central Government's debt portfolio is valuated. To do so, detailed information on the Government issuances is used. For each type of internal[31] and external[32] debt, the date of placement, maturity, yield and return characteristics are known. Thus, making assumptions on the different market variables that affect the debt value ("risk factors") it is possible to calculate (separately) the value of amortizations and interest payments for each year until the maturity term for every placement within the different

categories. The total value of the portfolio (the stock of the debt) is calculated as the sum of the present value of the amortizations, as well as the interest cost (the sum of interest payments) and the total cost of the debt. In order to make assumptions on the future value of the risk factors, historical information was taken into account. Thus, the complete scenarios were built based on the historical evolution of those variables and their correlations[33], as well as on qualitative information. This procedure gives us insight not only for setting the magnitude of the variations, but also for co-movements.

2. Value of the Portfolio under a base scenario

Given the current debt structure, the market risk factors associated to the debt portfolio are the CPI and the CPI middle income, the nominal exchange rate, the UVR that increases with inflation and the interest rate, and their changes over time determine the trend of the portfolio's value[34]. GDP also plays a crucial role since it determines the debt burden.

The base scenario supposes that the fiscal position improves in comparison to the situation of 2002, and the economy regains "normal" conditions of long-term real interest rates and growth. There is also room for monetary policy to continue controlling the inflation rate, even with higher demand pressures. The adjustment policy returns confidence to markets, so that nominal devaluation is moderate but positive, assuring no revaluation in real terms. Inflation is set as 5.5% for 2004 with an annual decreasing trend until 2006, where it stabilizes at 3.5%; devaluation is assumed to be the same, therefore real devaluation is 0%; UVR changes with inflation, and the real interest rate is assumed to be fixed at a nominal level of 7.7% for internal debt and 8,6% for external. An additional assumption is made regarding the real growth rate, being 3.0% from 2003 onwards. The exact values for assumptions on risk factors are presented in Appendix 1 (A.1. Table 3: **Base Scenario Assumptions**).

Under this scenario, the calculated present value of the debt[35] reaches 51.9% of 2002 GDP. If the total interests that have a present value of 21.5% of 2002 GDP are added, the total cost of the debt reaches a sum of 73.4% of GDP. The total cost of internal debt (principal + interests) has a present value of 35.1% of GDP in 2002, and external debt has a present value of

37.7% of GDP. The profile maturity for the internal and external debt, the interest payments and total cost are presented in Figure 6.

The graphs show that an important amount of the debt (both amortizations and interests) must be paid in the following years. Costs of internal debt are particularly elevated in the short run and remain high until 2007. Approximately, half of the internal debt comes to maturity in the first four years, and 45% of the total amortizations and 65% of the interest payments are concentrated in this period. The same trend, although less pronounced, is observed for the external debt, for which high costs go until 2012. Until 2006, 32% of the total amortizations debt will be paid and 42% of the total interests.

3. Sensitivity analysis

Following the approximation of formula (1)[36], we calculated how the value of total debt reacts towards individual changes in specific risk factors (inflation and devaluation). A similar change in inflation and devaluation was considered, that is an increase of 100 basis points (increasing inflation from 6% to 7% in 2003 or devaluation from 9% to 10% in the same year).

The results reveal that total debt[37] is much more sensitive to changes in the devaluation rate: the 1% increase in one year in this variable leads to a 0.31% increase in total debt, while the same rise in inflation only augmented the value of debt by 0.12%. Domestic debt is much more sensitive towards changes in inflation than in devaluation: the increase in inflation caused a rise of 0.12% in internal debt, while the change in devaluation only generated a 0.01% increase in value of this debt. In turn, a 1% increase in depreciation affects the external debt portfolio by 0.31% (Table 1).

4. Stress Test: Risk Scenario

In order to evaluate the changes in the cost of debt, both principal and interest payments, under a situation in which large and simultaneous movements of the risk factors are produced, a risk scenario is defined. For analytical purposes the scenario considers a situation in which, for

political or any other reasons, the Government is unable to undertake the complete fiscal adjustment. As a consequence, larger interest rates are expected, and greater devaluation and inflation (under the assumption of a pass-through effect) are observed[38]. The assumptions are presented in Table 3 Appendix 1 (A.1. Table 4). It is shown that inflation is considered to start at 8.5% in 2004, exhibiting a decreasing trend until 2006, where it stabilizes at a value of 6.5% (approximately 3% higher than in the base scenario). Devaluation is 13.5% in 2004 decreasing annually to 11.5% in 2006, which results in a real devaluation of 5%. According to the new inflation, IPC middle income is 2.5% higher in the risk scenario, and UVR increases at a higher rate.

Under those assumptions, the present value of the current debt increases from 51.9% of GDP corresponding to the base scenario to 71.9% of GDP, which suggests that an approximate value of 20% of 2002 GDP could be under risk. If the present value of interests is also taken into account, the total debt cost at risk increases to 25.8% of GDP and the total cost of the debt (principal + interests) would be 1% of GDP higher each year in comparison to the cost assumed under the base scenario (Figure 7)[39]. The greatest differences are observed from 2003 to 2012, with two isolated jumps in 2020 and 2027.

D. Debt Dynamics: short run analysis

When considering debt portfolio risks, one can take into account not only market factors (interest rates, exchange rate, inflation), but also rollover risks associated to a default or restructuring of the debt at higher rates (implying larger costs), liquidity risks that deal with the need for unforeseen liquid funds and the possibility of obtaining cash via loans in a short period of time, macroeconomic risks corresponding to changes in current account, financing needs and economic growth, and government balance sheet risks that includes changes in revenues, expenses and the magnitude of the primary balance.

A scenario that considers rollover risks, macroeconomic risks and budget risks, and which affects the debt evolution through significant movements in the risk factors, calls for the need to carry out a dynamic analysis that takes into account a new amount of debt each year.

Starting by the fact that Colombian economic performance in the next few years is mainly determined by the course of fiscal policy –the fiscal adjustment- one can establish different possible situations.

First of all, the sustainability analysis showed that a primary balance of about 3% of GDP is needed per year in order to stabilize the stock of debt at a level of 52% of GDP. The achievement of this fiscal objective is crucial for the debt dynamics and will determine the need of rolling-over the debt as well as it will affect economic performance. In the debt dynamics, the rollover risk associated to the budget risk (primary balance) becomes one of the major issues, and the impact of the two on the market variables (interest rate, spreads, exchange rate, inflation) and the economic activity, directly affects the cost of the debt. The stock is also altered when new debt is required to cover the higher costs, and when market variables change its value in domestic currency.

The total debt the government will accumulate by the end of each year will be given by the following equation:

$$TD_t = TD_{t-1} + Int_t + Amt_t + NI_t - PB_t$$

where TD_t is the total debt at the end of period t; Int_t and Amt_t are the interest payments and amortizations due in t; NI_t are the new interests that must be paid due to the extra cost of rolling over debt in period t; and PB_t is the primary balance achieved by the government in t.

The new interests generated by the roll over are given by the following:

$$NI_t = Int_{t-1} * (1+r_t) * (1+p_t) - Int_{t-1}$$

where r_t is the real interest rate and p_t the inflation rate in period t

The above stated equations were used to evaluate the effects on the debt burden, given specific changes in the risk factors. The debt dynamic's analysis was carried out based on detailed data regarding the stock of the issued debt and interest payments corresponding to National Central Government[40].

We consider a base scenario in which the Colombian government is committed to achieve a fiscal adjustment of approximately 1,7% of GDP for the Central Government in 2003, and keep this policy of adjustment for the next years until 2005. Based on these commitments

multilateral aid will be received, partially substituting funds from the private foreign markets, and the authorities expect to issue new debt in the domestic markets for completing the total financing needs for the year.

Given this fiscal adjustment package for the short run, and including structural reforms that guarantee a longer-term fiscal stability[41], confidence is recovered, both in the domestic and in international markets. As a consequence, the risk premium would decrease from the high spreads on external debt reached in the 2002 crisis period while domestic real interest rates would stabilize at low levels[42]. Due to the external inflows less pressure is also expected in the exchange rate market, and under the adjustment more flexibility is given to the Central Bank to control inflation, even if some pass-through from nominal devaluation to consumer prices can occur. Finally, since the fiscal adjustment assures lower longer-term interest rates and less crowding out pressures, there will be room for an increase in private activities (consumption and investment) and for a greater economic growth.

The fiscal adjustment supposes that a positive primary balance is reached and therefore there is no need to rollover the debt. As a result, the primary balance in 2003 (0.7% of GDP) is sufficient to cover the old debt service, including amortizations and interest payments, and new debt only arises from a higher devaluation and interest payments. For 2004 and 2005, the achieved adjustment covers the old debt service and the new interests (created by the new debt) and the primary surplus is kept at levels of 1,4% of GDP and 2% of GDP (Assumptions are presented in A.1. Table 5.) Under this scenario, the debt burden stabilizes at a level close to 52% of GDP (Table 2).

However, a stress situation can be visualized assuming the fiscal adjustment is not achieved in 2003 and the two following years (the government does not generate a primary surplus). Here, the rollover risk, the budget risk and the liquidity risk become predominant, and they lead to higher changes in the market risk factors, and the debt will adopt an unsustainable path.

Under this situation, a cut in the financing aid from multilateral institutions and an increase in the cost of both domestic and external debt are foreseen. Since domestic and external

markets are "virtually" closed and no primary balance is generated, the government is not able to completely service the debt and must roll it over issuing longer maturity debt. As a consequence, new debt is contracted at higher rates (yields and spreads) increasing the costs and creating new deficit. This new deficit deteriorates even more the primary balance, making it more difficult to meet the requirements[43]. Devaluation is expected to be higher and inflation increases. Consistently, a lower GDP growth is anticipated, which will also contribute to the greater debt burden (the set of assumptions under this stress scenario is presented in A.1. Table 5)

Under such a situation, even if that the government rolls-over the whole debt (to later than 2005) so it does not pay amortizations before that date, it pays interests on the old debt incremented by the additional cost as well as interests on the new debt, the latter resulting of the higher interest rates, the larger devaluation and the increase in inflation. The results show that the annual interest payments over GDP will be 4.4% in 2005, compared to 2.6% in the base scenario in the same year, and the present value of the total interest payments reaches 40% of GDP compared to 25.5% reached under a base scenario. The stock of the debt over GDP will increase from 51.4% in 2002 to 68% in 2005 (Table 2).

Going back to the sustainability analysis, a stabilization of the debt at a level of 68%, assuming a real interest rate of 8,5% and a growth rate of 2% and a permanent primary balance of 0%, would mean a primary gap of 4,4% of GDP, which turns the government into an insolvent situation if such a primary adjustment cannot be politically or socially achieved. Most likely, since Colombia already lost domestic and foreign market access in 2002 at a debt ratio of 50%, a scenario where the country is able to run up the debt to a level of 68% of GDP or higher is unlikely to occur in practice: markets and investors would force a debt crisis at a much lower debt level if the debt dynamics is perceived, as it was in mid 2002, to be unsustainable.

E. Long term risk analysis: VaR and reference portfolio

The Public Credit Office of the Ministry of Finance has been concerned with establishing an adequate reference portfolio considering that the optimal debt structure is tied to different macroeconomic variables that make it more or less sensitive to them depending on their volatility

and market changes over time. To do so, they studied domestic and external debt separately and used their results as an input for determining the optimal share of both types of debt within the total debt portfolio. The benchmark for domestic debt is derived by considering the composition of government tax revenues and their dependence on macroeconomic variables; they find that the internal debt reference portfolio should be 92%-94% in COP and 4%-8% indexed to the IPC. Based on the same approach, the benchmark for the external debt is determined using the currency composition of the International Reserves and the Trade Balance. According to this, external debt should have the following currency composition: 92.14% in USD, 6.65% in Euros, and 2.22% in JPY. In order to determine the optimal composition of total debt between domestic and external, the above results are used as input restrictions in a VaR model. Based on simulations of the market variables and the historical behavior of the domestic and external bonds' interest rates, a VaR model is constructed and an efficiency frontier is derived. This exercise yields several optimal portfolios; yet, the Credit Office found that the portfolio that minimized the risk and the cost at a 95% confidence level was the following: 64% internal debt and 36% external debt. Additionally, they found that the composition of the debt among its components should be: debt in local currency at a fixed rate is 46% of total, debt in USD 25%, debt in Euros 3%, debt in Yen 1%, debt in UVR 4% and Other sources 20%.

1. The optimality of the reference portfolio of the Credit Office

The portfolio described above has served as a reference only; in the last few years, actual practice has diverged from this optimal long-run reference portfolio. The actual portfolio has differed from the reference benchmark in at least two ways. First, the ratio of foreign to total debt has been higher. The reference portfolio suggests an optimal share of external debt [44] that is between 30% and 35% while in reality the ratio of foreign to total debt in Colombia has been closer to 50%. A low share of foreign currency external debt in the reference portfolio is the result of the relative high ex-post cost of such debt (given recent real depreciations) and its higher volatility. Second, in the optimal domestic debt portfolio the share of inflation-indexed debt (IPC or UVR) is small and close to 8% of the domestic debt share, while local currency debt of

different maturities is estimated to be optimally 92% of the domestic debt. In practice, the share of indexed debt to total domestic debt has remained close to 30%.

The gaps between the reference and the current portfolio are a result of the incongruity between the portfolio composition goals and the actual access to the required instruments. In the last few years, the growth of Colombian public debt stock has strained the ability of policymakers to finance this growth according to optimal debt management criteria. Thus, policymakers have used whatever markets were open and liquid, domestic or external, to finance an ever growing and unsustainable debt path. Since large pre-financing of amortization and new debt in the international market was perceived as helping the debt managers to later handle more easily the domestic debt rollover and new issuance problem, the authorities followed a policy of relying on Eurobonds issuance followed by domestic debt issuance.

Due to the concern of domestic and foreign investors regarding currency risk, foreign currency issuance of external debt became the first line of debt management, while the issuance of debt in local currency in the domestic market became the second line of defense. Nevertheless, the large reliance on external debt resulted costly once the currency depreciated considerably in 2002 (by over 20% in real terms). Ex-ante knowledge that sharp real depreciation would occur could have led to a lower reliance on foreign currency debt, as suggested in the reference portfolio. However, considering Colombia's limited capacity to issue domestic local currency debt, external debt became by default a leading source of financing for the sovereign.

Moreover, in 2002 the debt dynamics became so difficult to sustain (given the fiscal deficit patterns and trends) that the country lost external capital market access and had to start relying on official multilateral resources as a way to service its foreign currency external liabilities. The expected "bailout" of Colombia by IMF/World Bank/IADB may be as high, over a three-year period of 2003-2005, as 10% of Colombian GDP. Thus, the strong reliance on multilateral financial support for the next three years implies that the share of foreign currency debt in the Colombian portfolio is likely to remain in the 50% range (if not higher in case of further real depreciation) despite the 30% limit suggested by the reference portfolio.

Domestic debt composition between indexed and nominal debt also differs greatly from the reference portfolio as a result of what the mark*et al.*lows based on investors' interests and expectations. One of the objectives of the authorities has been to lengthen public debt maturities to reduce rollover risk. Preference was given to issuing longer term fixed rate debt as a way to reduce nominal budgetary risk. But this objective, partly achieved with the successful issuance of 5, 7 and 10 year maturity bonds eventually clashed with its cost and with the fact that, given the residual inflation risk, investors were not willing to absorb a lot more of longer term fixed rate debt at reasonable interest rates.[45] Given the residual risk that, once the nominal rate debt was issued, the government may be tempted to reduce its real value through surprise inflation, the demand for inflation-indexed longer-term debt remained high.

The authorities decided not to issue financially indexed debt nor much foreign currency linked domestic debt. Thus, the only way to maintain a longer maturity without spiking the yield on long term fixed rate bonds through excessive issuance of such debt was to issue longer maturity inflation-indexed debt. While the real required returns on such debt have not been much lower ex-ante than those on longer term fixed rate debt (as such real return was in the 7-8% range, a high number reflecting some default risk), a much more aggressive issuance of long term fixed rate debt may have led to a sharp increase in the yield on such debt. Indeed in 2002 when the country lost domestic market access during the TES crisis,[46] long term yields spiked by 500bps leading to a sharp increase in the potential cost of issuing new longer term debt (with returns rising over 11% in real terms). In practice, policy makers have been forced to rely on more inflation-linked debt than their optimal model recommends and such a situation is unlikely to change in the difficult debt management conditions of the next few years.

The official explanation given for the reference model's small share of inflation-indexed debt is somewhat peculiar. The argument is that domestic debt should be fixed rate if government revenues are correlated with GDP and indexed to inflation if government revenues are correlated with inflation. In Colombia's case, revenues are more correlated with GDP than with inflation, leading to an optimal 92% share of fixed rate debt in the reference portfolio. While the economic reasoning behind this approach seems valid, it is also notably limited. If one of the main objectives

of prudent debt management is to reduce rollover risk while minimizing budgetary costs of debt service, fixed rate debt of a certain maturity should be compared with inflation indexed debt of similar maturity to determine which one is likely to be cheaper ex-ante and ex-post in real terms. The answer may depend on investors' risk aversion: if investors are averse to inflation surprises and risk they may increase their demand for indexed debt, thus making it cheaper. Everything else equal, the share of inflation-indexed debt should be relatively high as such debt permits lengthening maturity while reducing real budgetary costs. While an approach stressing the correlation of government income stream with GDP or inflation has some long run validity, the optimal portfolio composition should also depend on investors' risk aversion and attitude towards inflation risk. In effect, Colombian investors have demanded and obtained large amounts of inflation-indexed debt.

Also, the Colombian policy makers may be placing too much emphasis on the importance of minimizing nominal budgetary risk. Although it is true that nominal budgetary risk is zero with fixed-rate debt as both coupons and principal repayment are known with certainty in advance, policymakers should also consider *real* budgetary risk. Contrary to fixed rate nominal debt inflation-indexed debt has no real budgetary risk. Therefore, while nominal budgetary risk should not be disregarded altogether (as sudden refinancing problems may be serious when nominal risk is higher), for medium and long term debt dynamics the true concern is real budgetary risk. Thus, forms of debt that reduce the government's real cost of borrowing while lengthening maturities may be favored by investors and may be optimal. Therefore, their share in an optimal portfolio may be higher than the modest 8% found in the Colombian reference portfolio.

Additionally, it is important to point out that the government's debt management strategy should be coordinated with the rest of macroeconomic policy. The high percentage of bonds in pesos within the reference portfolio has given a greater priority to the reduction of nominal budgetary risk. Implicitly, this suggests that the expectations of an increase in inflation predominate in the government's strategy (otherwise the government would privilege indexed debt), contrary to the official monetary policy target. Hence, if the goal of the monetary authorities is to reduce inflation and it is credible, indexed debt should be given greater participation.

Colombian authorities have improved considerably in identifying public debt portfolio risk factors and defining an appropriate long-term debt management strategy. Nevertheless, the reference portfolio doesn't consider restrictive access to markets or different levels of risk aversion of the agents, thus the current portfolio and the upcoming one[47] differ significantly from the line of reference. Additionally, the methodology and the obtained results reveal that the authorities have been more concerned with managing the rollover risk, possibly leading to higher debt costs.

2. Impact of changing debt structure: some illustrative examples

Three different exercises were carried out in order to evaluate the variations in the debt cost generated by changes in the structure of the portfolio[48]. These took into account different shares of domestic and external debt: a foreign currency debt reduction (avoiding currency risk), a longer average maturity in domestic debt (avoiding maturity risk) and a greater share of indexed bonds than nominal bonds (avoiding real budgetary risk).

The first exercise supposes that under similar conditions for internal and external markets, interest rates tend to be homogeneous and no significant difference between larger shares of external to domestic debt should significantly alter the total debt cost. When the composition of public debt in terms of foreign and domestic debt changes giving external debt a greater share (70% within total debt), the interest payments and the value of amortizations show very small variations[49]. (See Figure 8 "Alternative composition").

However, significant changes in debt burden and servicing costs are observed when the assumption of annual real devaluation (0% in the base scenario) is driven to an extreme assumption of 10%. When devaluation increases, the costs in terms of amortization and interest payments grow dramatically ("Alternative composition under risk"). These results ratify those obtained with the sensitivity analysis where a 1% increase in devaluation in one year can increase the value of external debt by 0,3% of GDP. When the alternative debt composition is placed under the risk scenario, the value of total debt is 10% larger than the value of total debt for the current composition under the same risk scenario. Therefore, under devaluationary conditions, as the share

of domestic debt increases within total debt, the channel through which devaluation has the stated impact is reduced and the government is less exposed to the increment in costs per 1% increase in devaluation. As can be observed in the last chart, the impact of devaluation in terms of total debt cost is clearly stronger if the portfolio has a higher participation of external debt[50].

The second exercise changes the term structure bearing in mind lengthening the average maturity term in order to reduce rollover risk; nevertheless, this implies a higher debt cost. The illustrative exercise evaluates the change in debt cost when debt is placed at a longer term and was carried out as follows: since TES B denominated in UVR and indexed to the IPC are the ones that traditionally have been placed at a longer term, the placements of these bonds in the shorter term (i.e. 5 and 7-year maturity) were all moved to a higher maturity (assuming 10 and 15-year maturity). Additionally, some of the short-term debt in pesos was placed assuming a higher maturity[51]. The effects of this reveal that, in effect, in the short term amortizations are reduced considerably, yet in the long run, the interest payments are larger. Overall, a 1.6% of GDP increase in total debt cost is observed (Figure 9). The third chart shows the annual net effect of a lengthening of maturities. It is observed how during the first four years as well as in 2007 a significant reduction in terms of amortization and interest payments as percent of GDP is obtained. This reduction is compensated in 2012. A longer maturity implies greater long run costs, but reduces considerably the pressures placed in the short run.

Finally, a simulation was carried out in order to observe the behavior of debt cost with changes in the composition of the internal debt portfolio. The instruments of domestic debt (TES COP, TES IPC, TES UVR and TES USD) were redistributed in two different manners, one to illustrate the government's suggested optimal portfolio and the other to illustrate a larger share of financially indexed bonds. Currently, domestic debt relies on a large portion of nominal bonds in local currency (33% of total domestic debt and approximately 46% of debt held in TES), TES in IPC and UVR basically account for the rest (35% of domestic debt and close to 48% of domestic TES[52]). This composition was changed giving greater importance to financially indexed bonds, that is making TES IPC and UVR participate with 79% of total debt in TES, while the share of

TES COP was reduced to 19%. This structure manages to reduce debt cost in the short term (reducing rollover risk), but it increases in the long term, mainly due to the fact that the majority of indexed bonds are placed with a longer maturity (7 year and 10 year bonds in general).

In Figure 10, two main characteristics are observed, on one hand the costs in the short term are reduced, on the other, although long-term costs are higher, the slope of the path of the debt cost is reduced, evening out what must be paid yearly due to interests over time. Placing financially indexed debt is useful when the agents are risk averse and inflation is uncertain and its advantage is that it reduces real budgetary risks.

Comparing the current structure with the one suggested by the exercises carried out by the Public Credit Office that considers reducing indexed debt to 8% of domestic debt with a term of 10 years, eliminating internal debt in dollars and increasing long term nominal debt in COP to almost 90% of domestic debt in TES, a marked difference is observed. Short term costs increase considerably, while in the long term these are reduced (Figure 10).

3. Debt management challenges in the near future given the risk analysis.

Public debt management is an important instrument within the fiscal strategy, especially when its stock is large and growing and leading to concerns about its sustainability. A strategy that reduces the risks and its cost must be combined with the achievement of a primary surplus in order to reestablish the sustainability of public debt. Given the composition of the Colombian debt portfolio, and despite the strong efforts carried out by the authorities in order to lengthen the average maturity of public debt, there is still a high concentration of its service (amortization and interests) in the short and medium term. In particular, almost half of the public debt placed until today must be amortized in the following five years. Additionally, the current debt portfolio is sensitive to the behavior of inflation, but in a greater degree to a real depreciation of the exchange rate. Under a scenario where the fiscal balance improves compared to the current situation and moderate inflation and depreciation can be projected, the present value of debt reaches 51% of GDP. If, on the contrary, there is no meaningful improvement of the fiscal balance, a stress

scenario where inflation and real depreciation are much worse needs to be considered. In this case, the country's debt burden is substantially larger (in present value), reaching 68% of GDP.

But according to short-term analysis, if the budgetary risks of not achieving the required adjustment are also considered directly (leading to a debt rollover), it would be necessary to contract large amounts of new debt in order to cover its service. In a span of only three years the level of debt could reach 68% of GDP. In order to stabilize the level of debt close to 50% of GDP, in addition to the fiscal adjustment, a debt management strategy that combines the needs and restrictions in the short term with those in the long term is required. Through different illustrative exercises we showed that the change in composition and structure of public debt has important effects on its cost. For example, the reduction in the share of external debt within the portfolio reduces debt costs significantly in the presence of real depreciation; the increase in the maturity term reduces the rollover risk and the cost in the very short term, yet it increases the cost as a whole; and finally, the increase in the share of indexed debt and debt in UVR within the portfolio reduces the costs in the short term and increases them in the medium and long term although in a small degree.[53] This contrasts with the long-term proposal of the Public Credit Office of the Ministry of Finance where even a small share of indexed debt increases the costs in the following years with respect to the current structure even more than proportionally to its reduction in the medium and long term.

4. Debt management in Colombia: some policy recommendations

Based on the results obtained from the Colombian debt portfolio exercises carried out above, the following section presents some recommendations for a better future management of the debt in Colombia.

Composition between domestic and external debt. The above considerations on the effects of alternative financing schemes and the financing challenges recently faced by the country have great relevance for the optimal management of Colombia's debt. The strategy followed in recent years of issuing a lot of external debt when international capital markets have been favorably disposed and open to the country, resulted very expensive ex-post and exacerbated the

debt dynamics (the real depreciation of 1998-99 and 2002 significantly contributed to the increase of the debt to GDP ratio)[54]. However, since the country could not rely more in those years on domestic debt issuance given its cost and the investors' appetite, issuing so much foreign currency external has been the only available option. This problem is not improving when the country replaces part of its foreign borrowing from private creditors with loans from official multilateral institutions (2002-2003). Such borrowing, however large and based on sub-market rates and spreads, is still all in foreign currency. Thus, further real depreciation of the exchange rates (possible depending on external and domestic shocks) would further increase the cost of such foreign currency debt.

Despite the existence of certain market restrictions, the high sensitivity of the cost of the debt to an exchange rate devaluation ratifies the need to reduce the share of external debt in the debt portfolio (long-term strategy established by the authorities) as allowed by the markets. Nevertheless, given the difficulty in changing the composition between domestic and external public debt in the short term, it is important that the macroeconomic management seeks the stabilization of the exchange rate in order to reduce the global risk faced by public debt.

Structure of domestic public debt. At the same time, if the budgetary outlook is uncertain (i.e. it is not sure that the government will succeed in making a primary adjustment that will stabilize the debt to GDP ratio), domestic and foreign investors may remain cautious and may prefer to shorten, rather than lengthen the maturity of their holdings of domestic debt. Thus, the task is to avoid maturity shortening that would increase rollover risk while minimizing the real cost of the debt burden. Issuing longer-term nominal rate debt may result expensive ex-ante in real terms and ex-post if the targeted reduction in inflation rate is achieved. Thus, a greater reliance on indexed debt may allow a longer maturity while minimizing real budgetary costs. Issuing domestic currency-linked debt may be too risky given that there is already a lot of foreign currency external debt and given that the risk of further real depreciation is significant. And since the authorities are wary of the idea of issuing financially indexed debt, the only residual solution is to rely on significant amounts of inflation-linked debt. In an environment where the nominal exchange rate has depreciated by around 25% in 2002, the policy objective of progressively reducing it to 4%

may take a back seat for a while; if inflation uncertainty and risk become important, inflation indexed debt in a period of fiscal adjustment uncertainty may provide the hedge that reduces the real cost of issuing such debt relative to a more uncertain fixed rate nominal debt.

One could also make a compelling case that there is some room for issuance of financially indexed debt (i.e. debt indexed to the short term interest rate), the argument being that the real ex-ante return on such debt looks much lower than the one on inflation indexed debt as short term nominal rates are low today in Colombia. But the authorities seem to show a significant resistance to such an option for a number of reasons: there is no market determined short rate; historical experience shows that nominal and real short rates can spike in periods of stress and thus increases sharply the cost of such debt (as in Colombia in 1998-99 or Brazil in 2002); monetary authorities do not want to be hampered in their willingness to increase short rates when necessary by concerns that such action would increase the real debt servicing cost of public debt; and issuing such debt would go against the strategy of creating over time markets for longer term domestic currency debt in fixed rates. In spite of such objection, a limited amount of financially linked government may be part of an optimal debt portfolio.

While an opportunistic drive to issue long term fixed rate debt in a reopened domestic debt market is sensible if the nominal and real rate on such debt is reasonable, in an environment where policy and inflation risks are still elevated the cost of such debt may be too high compared to inflation indexed debt. Relying on a successful issuance of longer term fixed rate debt may be costly ex-ante if required yields by investors remain high, but could be cheaper ex-post if inflation turns out to be larger than expected in the medium run. However, the real losses incurred by investors on their bond holdings via unexpected inflation would seriously hurt the policy objective of creating a viable long term fixed rate local currency debt market. So, if authorities were to maintain their commitment to reduce inflation rates over time, rather than surprise investors and increase inflation above expectations, the ex-post real cost of long term debt issued at high nominal rates would be even higher. Since minimizing debt service costs has to be an important component of a financial plan that restores debt sustainability (as excessively high real interest rates may undermine any success achieved through primary balance adjustment), it is of the

utmost importance in the next few years to follow a debt management strategy that minimizes the real cost of debt service while not unduly increasing rollover risk.

Over the next three years the authorities will face a very delicate task of managing the country debt under conditions of limited domestic market access, limited policy credibility, some economic and political/security uncertainty and unfavorable international financial and real market conditions. A sound management of the public debt by type, maturity and currency composition will be essential for the achievement of financial and debt dynamics stabilization.

The market restrictions for domestic public debt, together with the uncertainty concerning the evolution of inflation, imply the need to offer indexed debt (either UVR or IPC TES). It is also recommendable that the public debt portfolio have a significant share of this type of debt because it reduces the real budgetary risk and substantially reduces the debt cost in the short term, a mandatory condition given the current fiscal difficulties and the need to adjust public finances. As it was seen at an illustrative level, a change in the composition in favor of a greater percentage of this type of debt can lead to a reduction of 0.7% in the cost of debt in the next three years, and additionally lead to a flattening of the yield curve. Also, due to the fact that this type of debt has been mainly medium and long-term, this could contribute to a further increase in the average maturity term of domestic debt.

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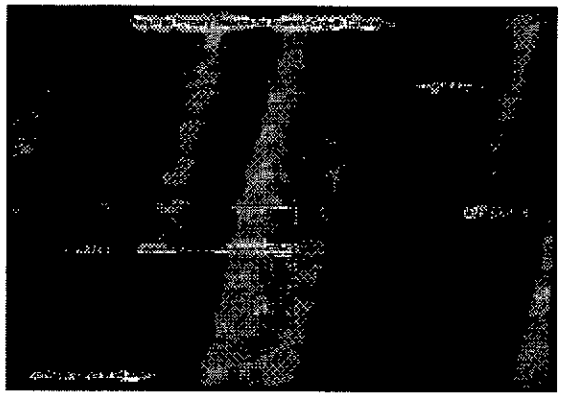
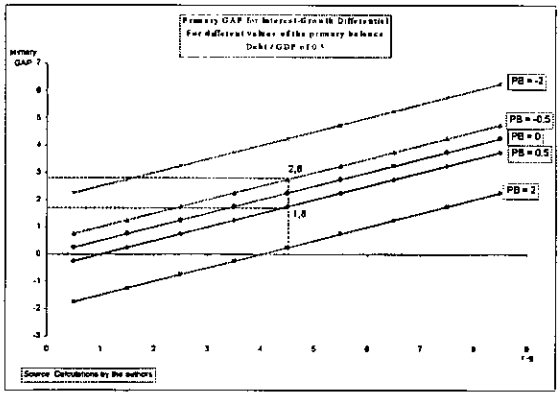
FIGURES

Figure 1
Required Primary Balance for Interest Growth Differential



Primary Gap for Interest Growth Differential for Different Values of the Primary Balance
Debt / GDP = 0.5



Debt / GDP = 0.75

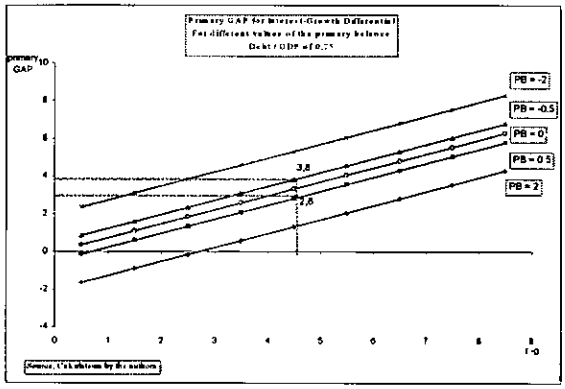


Figure 2
Total Gross Debt
Non Financial Public Sector and Central Government as % of GDP

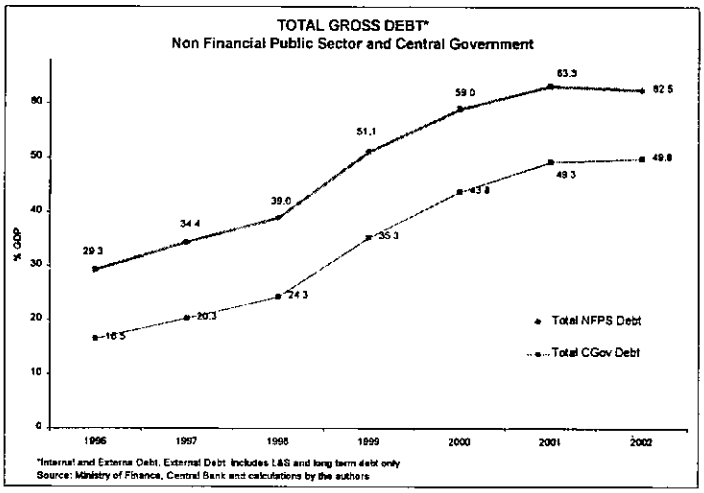


Figure 3
Evolution of the Gross Internal Debt

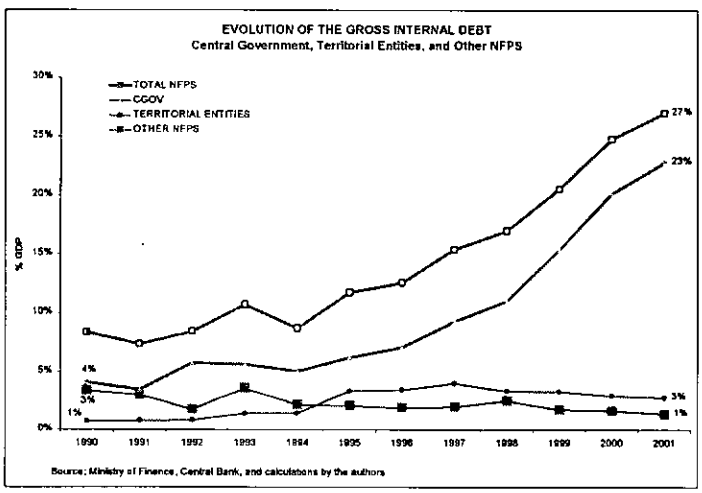


Figure 4
Average Maturity and Average Interest Rate
TES B Placements

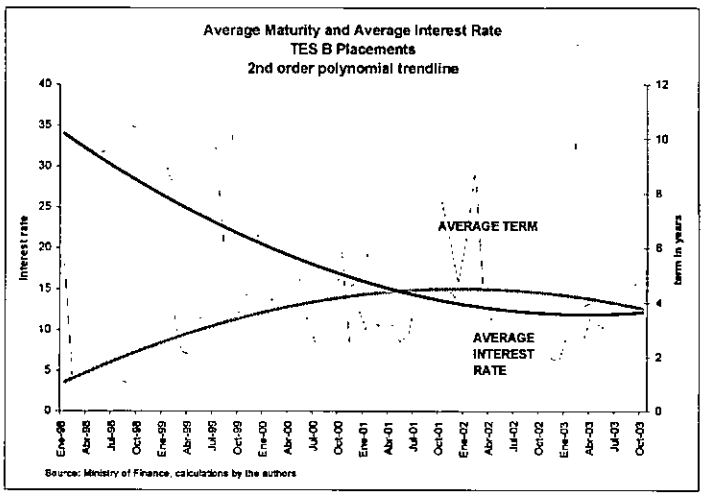


Figure 5
External Public Debt for the Consolidated and Non-Financial Public Sector as % of GDP

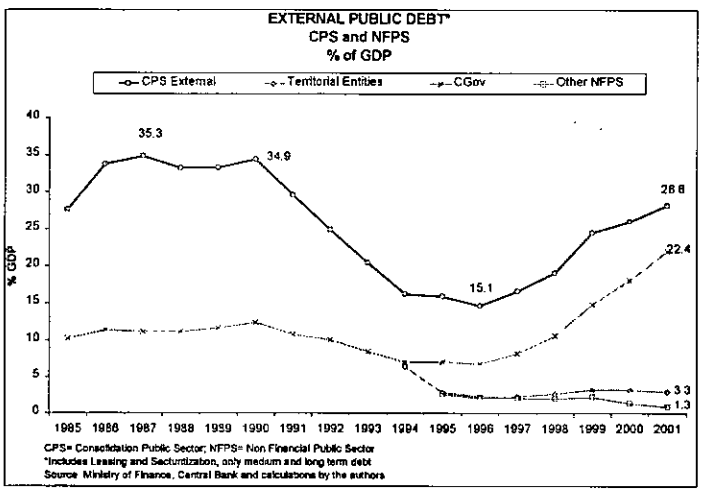
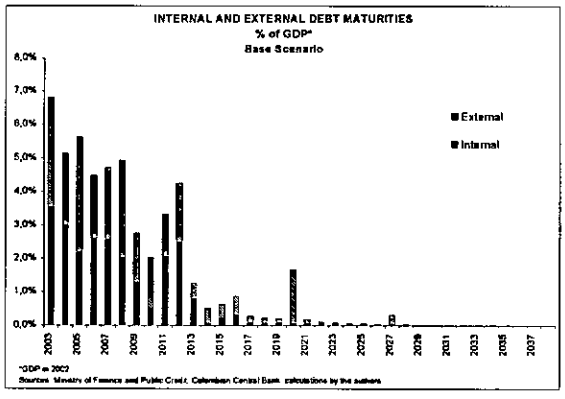


Figure 6
Internal and External Debt Maturities as % of GDP in the Base Scenario



Internal and External Debt Interest Payments as % of GDP in the Base Scenario

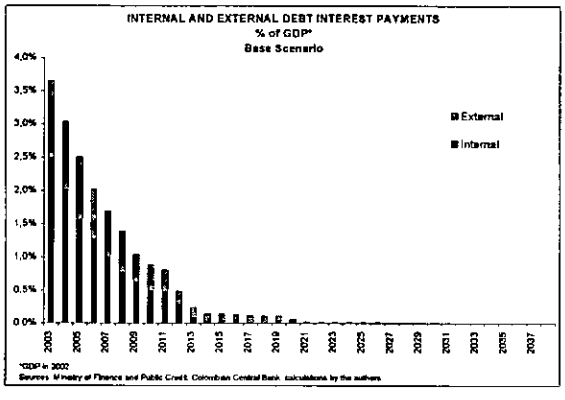
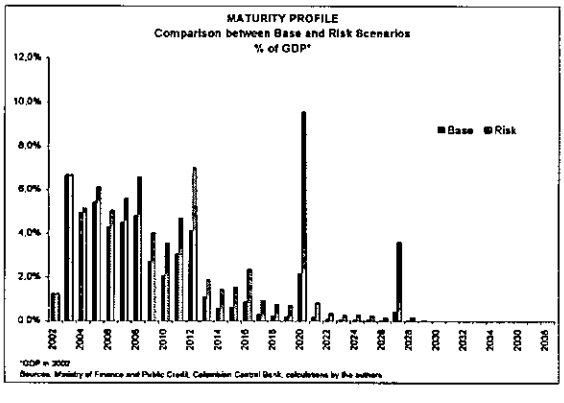


Figure 7
Maturity Profile: Comparison Between Base and Risk Scenarios as % of GDP



Total Annual Interest Payments: Comparison Between Base and Risk Scenarios as % of GDP

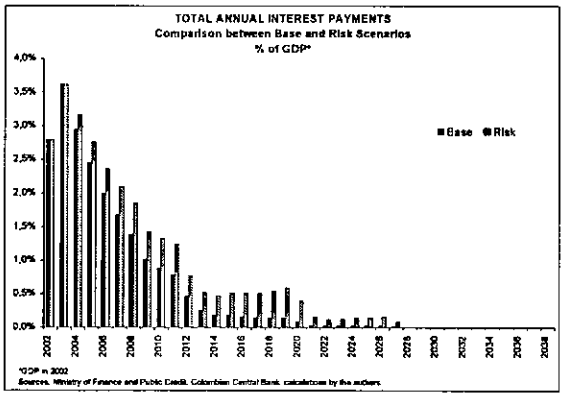
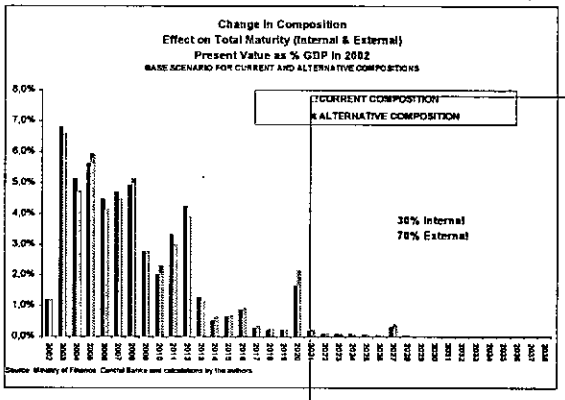
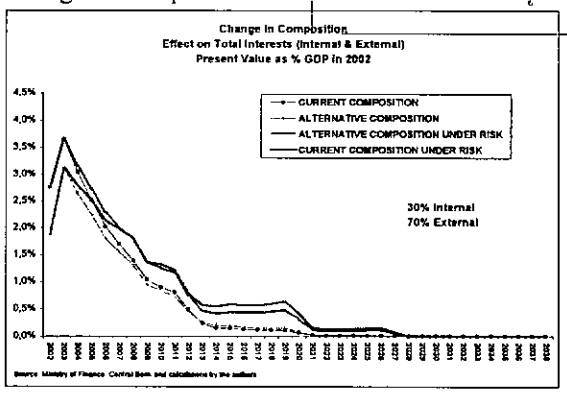


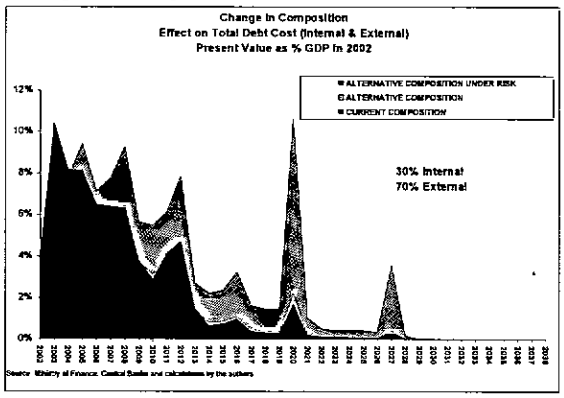
Figure 8
Change in Compositions: Effect on Total Maturity



Change in Compositions: Effect on Total Interest



Change in Compositions: Effect on Total Debt Cost



Comparison Between Debt Values of Different Compositions Under the Same Risk Scenario

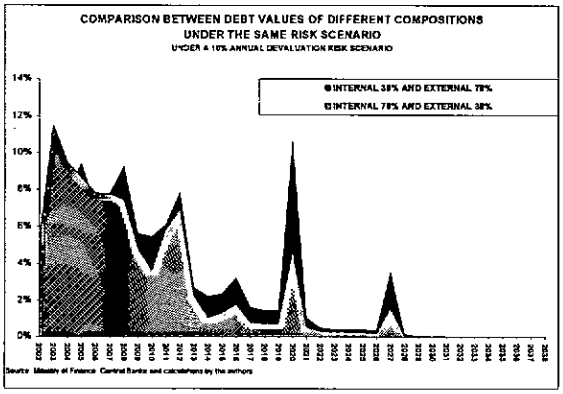
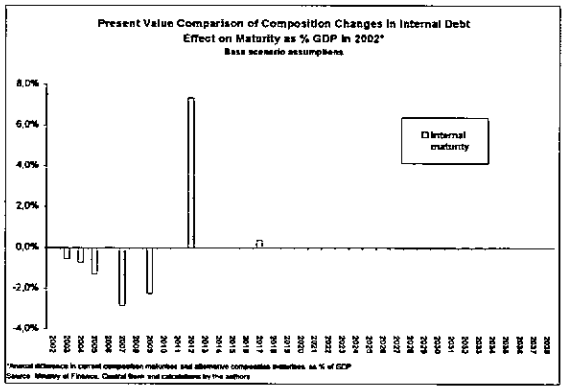
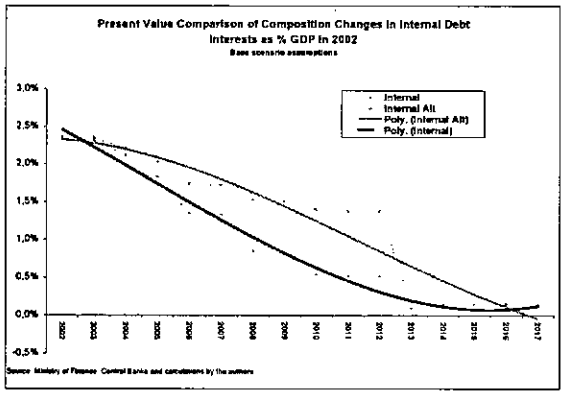


Figure 9

Present Value Comparisons of Composition Changes in Internal Debt: Effects on Maturity as % of GDP



Present Value Comparisons of Composition Changes in Internal Debt: Effects on Interests as % of GDP



Present Value Comparisons of Composition Changes in Internal Debt: Total Effect on Amortization and Interests as % of GDP

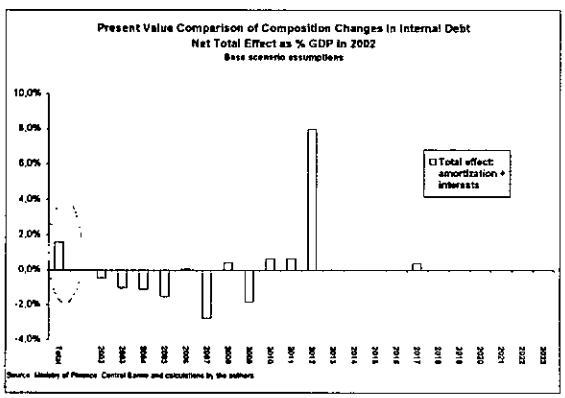


Figure 10
Present Value Comparison of Changes in Internal Debt: Interests as % of GDP

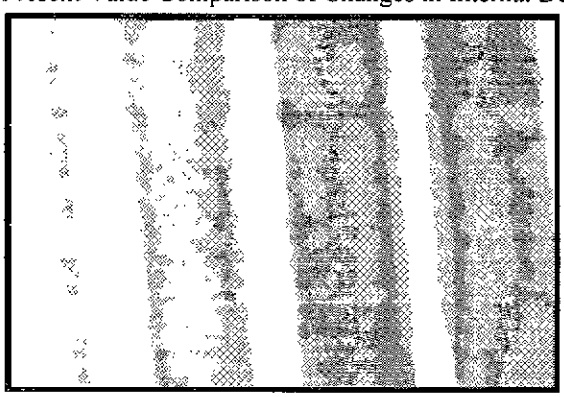
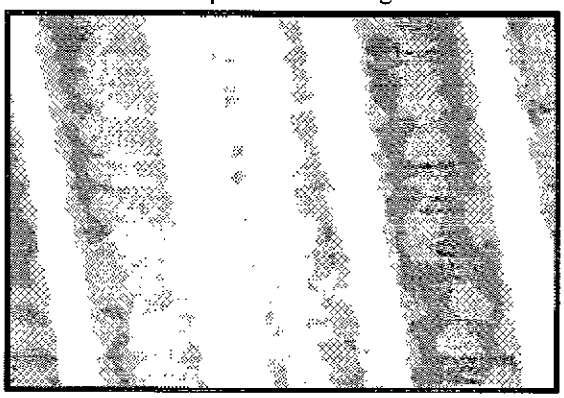


Figure 11
Present Value Comparison of Changes in Internal Debt: Interests as % of GDP



TABLES

Table 1

Debt Portfolio Sensitivity Increase in Total Debt Value		
	1% inflation increase in 1 year	1% devaluation increase in 1 year
Maturity		
Internal	0,06%	0,01%
External	0,00%	0,23%
Interests		
Internal	0,06%	0,00%
External	0,00%	0,06%
Total Debt Cost		
Internal	0,12%	0,01%
External	0,00%	0,30%
Total (internal + external)	**0,12%**	**0,31%**
Source: Ministry of Finance, calculations by the authors.		

Table 2

Year	BASE SCENARIO			RISK SCENARIO		
	Debt / GDP	Old debt interests / GDP	New debt Interests / GDP	Debt / GDP	Old debt interests / GDP	New debt Interests / GDP
2002	51,4%			51,4%		
2003	52,8%	4,6%	0,0%	56,1%	5,0%	0,0%
2004	53,2%	4,0%	0,6%	61,8%	4,7%	1,5%
2005	52,4%	3,5%	0,6%	67,4%	4,4%	1,9%

IV. APPENDIX 1

A.1. Table 1

Sustainability Scenarios Stabilizing D/GDP = 0.5

			Required Primary Balance / GDP	Primary Gap when Permanent Primary Balance / PIB (%) is:								
r-g	r	g	%	2	1,5	1	0,5	0	-0,5	-1	-1,5	-2
0,5	3,5	3	0,3	-1,8	-1,3	-0,8	-0,25	0,25	0,75	1,3	1,8	2,3
1,5	4,5	3,0	0,8	-1,3	-0,8	-0,3	0,25	0,75	1,25	1,8	2,3	2,8
2,5	5,5	3,0	1,3	-0,8	-0,3	0,3	0,75	1,25	1,75	2,3	2,8	3,3
3,5	6,5	3,0	1,8	-0,3	0,3	0,8	1,25	1,75	2,25	2,8	3,3	3,8
4,5	7,5	3,0	2,3	0,3	0,8	1,3	1,75	2,25	2,75	3,3	3,8	4,3
5,5	8,5	3,0	2,8	0,8	1,3	1,8	2,25	2,75	3,25	3,8	4,3	4,8
6,5	9,5	3,0	3,3	1,3	1,8	2,3	2,75	3,25	3,75	4,3	4,8	5,3
7,5	10,5	3,0	3,8	1,8	2,3	2,8	3,25	3,75	4,25	4,8	5,3	5,8
8,5	11,5	3,0	4,3	2,3	2,8	3,3	3,75	4,25	4,75	5,3	5,8	6,3

Sustainability Scenarios Stabilizing D/GDP = 0.75

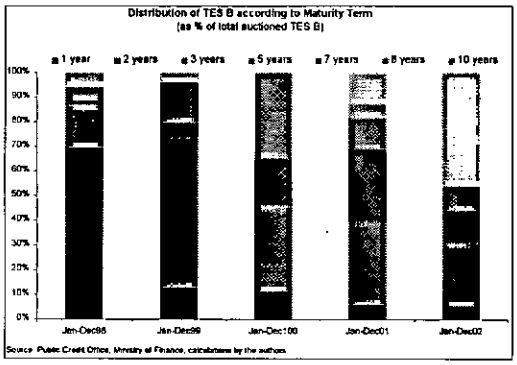
			Required Primary Balance / GDP	Primary Gap when Permanent Primary Balance / PIB (%) is:								
r-g	r	g	%	2	1,5	1	0,5	0	-0,5	-1	-1,5	-2
0,5	3,5	3	0,4	-1,8	-1,1	-0,6	-0,1	0,4	0,9	1,4	1,9	2,4
1,5	4,5	3,0	1,1	-0,9	-0,4	0,1	0,6	1,1	1,6	2,1	2,6	3,1
2,5	5,5	3,0	1,9	-0,2	0,4	0,9	1,4	1,9	2,4	2,9	3,4	3,9
3,5	6,5	3,0	2,6	0,6	1,1	1,6	2,1	2,6	3,1	3,6	4,1	4,6
4,5	7,5	3,0	3,3	1,3	1,8	2,3	2,8	3,3	3,8	4,3	4,8	5,3
5,5	8,5	3,0	4,1	2,1	2,6	3,1	3,6	4,1	4,6	5,1	5,6	6,1
6,5	9,5	3,0	4,8	2,8	3,3	3,8	4,3	4,8	5,3	5,8	6,3	6,8
7,5	10,5	3,0	5,6	3,6	4,1	4,6	5,1	5,6	6,1	6,6	7,1	7,6
8,5	11,5	3,0	6,3	4,3	4,8	5,3	5,8	6,3	6,8	7,3	7,8	8,3

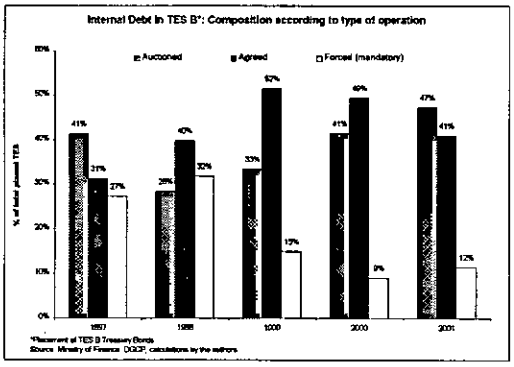
A.1. Table 2

INTERNAL PUBLIC DEBT IN BONDS IN 2001			
	COP millions [1]	as % of GNC debt	as % of each type of debt
1. CENTRAL GOVERNMENT (A+B+C)	**39.132.690**	**100%**	
A. BONDS DENOMINATED IN PESOS	**25.127.994**	**64%**	**100%**
AGRARIAN BONDS	56.144	0%	0%
TAN	348	0%	0%
INTERNAL PUBLIC DEBT BONDS (Law 21/1963)	13.675	0%	0%
CONSTANT VALUE EDUCATIONAL BONDS		0%	0%
TES A	183.973	0%	1%
I. TES B	**22.483.529**	**57%**	**89%**
SECURITY BONDS	412.594	1%	2%
PEACE BONDS	1.221.138	3%	5%
CONSTANT VALUE BONDS (Series A y B)	645.982	2%	3%
BONOS DE CESANTIA	110.612	0%	0%
B. BONDS DENOMINATED IN DOLLARS	**3.553.268**	**9%**	**100%**
BONDS LAW 55,1985	76.755	0%	2%
COLOMBIA BONDS	17.459	0%	0%
BONDS RESOLUTION 4308/1994	1.673	0%	0%
ii. TES B	**3.457.383**	**9%**	**97%**
C. BONDS DENOMINATED IN UVR	**10.451.427**	**27%**	**100%**
iii. TES B	**7.424.354**	**19%**	**71%**
LAW 546/99 (*Ley de Vivienda*)	2.178.028	6%	21%
TRD - TITULOS DE REDUCCION DE DEUDA	849.045	2%	8%
TOTAL TES B (i + ii + iii)	**33.365.266**	**85%**	

[1] The value of bonds in dollars and UVR are calculated according to the end of year exchange rates.

A.1. Figure 1





A.1. Table 3: **Base Scenario Assumptions**

Year	IPC	UVR	Average annual devaluation	Exchange rate COP per USD	IPC Middle Inc.	GDP Growth	External credit interest rate	Libor 3 Months	TES average annual interest rate	DTF weighted average
2001	7,6%	121,41	5,6%	2.300	6,5%	1,39%	9,5%	0,0%	15,4%	12,47%
2002	6,0%	128,67	9,1%	2.508	5,1%	1,65%	7,8%	1,8%	12,0%	8,92%
2003	6,5%	137,03	15,0%	2.884	5,5%	3,00%	8,6%	1,8%	12,4%	7,70%
2004	5,5%	144,57	5,5%	3.043	4,6%	3,00%	8,6%	1,8%	11,0%	7,70%
2005	4,5%	151,08	4,5%	3.180	3,8%	3,00%	8,6%	1,8%	11,0%	7,70%
2006	3,5%	156,37	3,5%	3.291	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2007	3,5%	161,84	3,5%	3.406	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2008	3,5%	167,50	3,5%	3.525	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2009	3,5%	173,36	3,5%	3.649	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2010	3,5%	179,43	3,5%	3.776	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2011	3,5%	185,71	3,5%	3.909	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2012	3,5%	192,21	3,5%	4.045	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2013	3,5%	198,94	3,5%	4.187	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2014	3,5%	205,90	3,5%	4.334	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%
2015	3,5%	213,11	3,5%	4.485	3,0%	3,00%	8,6%	1,8%	11,0%	7,70%

A.1. Table 4: **Risk Scenario Assumptions**

Year	IPC	UVR	Average annual devaluation	COP/USD	IPC Middle Inc.	GDP Growth	External credits IR	Libor 3 Month	TES average annual interest rate	DTF weighted average
2001	7,6%	121,41	5,6%	2.300	6,5%	1,39%	9,5%	0,0%	15,4%	12,47%
2002	6,0%	128,67	9,1%	2.508	5,1%	1,65%	7,8%	1,8%	12,0%	8,92%
2003	7,5%	138,32	17,0%	2.934	6,3%	3,00%	10,6%	1,8%	14,4%	9,70%
2004	8,5%	150,08	13,5%	3.330	7,2%	1,50%	10,6%	1,8%	13,0%	9,70%
2005	7,5%	161,33	12,5%	3.747	6,3%	1,50%	10,6%	1,8%	13,0%	9,70%
2006	6,5%	171,82	11,5%	4.178	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2007	6,5%	182,99	11,5%	4.658	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2008	6,5%	194,88	11,5%	5.194	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2009	6,5%	207,55	11,5%	5.791	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2010	6,5%	221,04	11,5%	6.457	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2011	6,5%	235,41	11,5%	7.200	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2012	6,5%	250,71	11,5%	8.027	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2013	6,5%	267,01	11,5%	8.951	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2014	6,5%	284,36	11,5%	9.980	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%
2015	6,5%	302,85	11,5%	11.128	5,5%	1,50%	10,6%	1,8%	13,0%	9,70%

A.1. Table 5: Debt Dynamics Assumptions: Base and Risk Scenarios

Base Scenario (Sufficient Fiscal Adjustment) No Roll-Over								
Year	Primary Balance (% of GDP)	GDP real annual growth	Nominal Devaluation	Inflation rate	Spread (basis points)	Short term real interest rate	Long term real interest rate	External interest rate
2003	0,7	2,0	6,0	6,0	400	4,0	7,0	8,8
2004	1,4	2,5	6,0	6,0	400	4,0	7,0	8,8
2005	2,0	2,5	6,0	6,0	400	4,0	7,0	8,8
Risk Scenario (Insufficient Fiscal Adjustment) Necessary Roll-Over								
Year	Primary Balance (% of GDP)	GDP real annual growth	Nominal Devaluation	Inflation rate	Spread (basis points)	Short term real interest rate	Long term real interest rate	External interest rate
2003	0,0	1,5	19,0	9,0	900	8,0	12,0	11,9
2004	0,0	1,5	19,0	9,0	900	8,0	12,0	11,9
2005	0,0	1,5	19,0	9,0	900	8,0	12,0	11,9

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[1] Based on an intergenerational model, Barro (1974) argues that debt issued by one generation will be compensated by an increase in savings that arises from the perception of the current generations that future ones must assume higher taxes.

[2] Missale (1997) shows that the effects of a tax regime change on social welfare are greater when distorting taxes exist rather than if they are of a fixed amount. He establishes that minimizing the loss of social welfare due to distortionary taxes (on income) requires that debt returns paid by the government cannot grow if product falls and decrease if public spending increases. This

design of public debt policy prevents income taxes from increasing when the product decreases of when public spending increases.

[3] Debt contingencies can be of different kinds: pension debt, bailouts of the financial sector and/or to regions in the presence of implicit or explicit government guarantees. The value of net public debt should include these contingencies (Carneiro, 2000).

[4] Debt structure must allow the government to distribute costs in such a way that these are low when GDP is lower than expected and public expenditure exceeds expectations.

[5] Market risks involve specific factors such as changes in the exchange rate, interest rates, commodity prices, as well as their volatility; budgetary risks refer to the eventual economic contingencies that alter the budget and the primary balance; credibility risk refers to loosing reputation and signaling to the signals that the government sends; rollover risk is associated to the need to refinance an obligation once the term has expired; and reindexation risk is related to the need to index a paper, for example to neutralize the inflation tax.

[6] Barro (1995), Blanchard & Missale (1991), Missale (1997), Goldfjan (1996, 1998), Calvo (1998), Calvo & Guidotti (1990), Bohn (1988, 1990), Alesina (1990), Giavazzi & Pagano (1990), Miller (1997), Price (1995), and Harberger (1995), among others.

[7] See Calvo (1988) and Missale & Blanchard, (1991).

[8] The author states that the minimization of cost can be attained mainly by creating liquid markets for the bonds and following a predictable issuing strategy, by issuing bonds that satisfy the demand of investors, or by following an active trading strategy bearing in mind future interest rates.

[9] This is more relevant in countries with higher indebtedness where authorities are highly concerned in maintaining credibility in its anti-inflationary policy.

[10] Debt in foreign currency exposes the local government to possible changes in the foreign country's monetary policy.

[11] In this case, the co-movements between inflation and growth are crucial: if positive, the appropriate issuance is a short term indexed linked debt, and if negative, the appropriate is a long-term nominal fixed rate.

[12] According to Blanchard & Missale (1997) a government that wishes to maintain its reputation regarding its control on inflation should reduce the average maturity of its debt as debt increases.

[13] An inadequate maturity structure can expose the government to choosing between rolling over or declaring a default of its debt. A debt default is very costly credibility and the option is rarely considered. A debt roll-over can be seen as a less costly solution, yet refinancing the debt has implicit costs that can be larger or smaller depending on the macroeconomic conditions and the people's expectations. As the level of debt is larger, investors demand greater risk premiums, resulting in a higher servicing cost. Additionally, recurrent debt roll-

overs result in higher risk premiums and can eventually lead the investors to suspect the government is unable to pay its debt and therefore they will not agree to re-contract debt at a longer maturity. This would result in a severe financing crisis for the country.

[14] For a complete discussion and Colombian references on sustainability see Arbeláez *et al.* (2002).

[15] An appropriate measure of debt would be net debt (i.e. debt net of any assets that the government or the country holds). In addition, gross liabilities should include possible implicit liabilities of the sovereign (deriving for example from guarantees of deposits of insolvent banks and implicit liabilities deriving from the operation of social security systems).

[16] The permanent primary gap can differ from the current primary gaps for at least three reasons: first, the current primary balance may be different from its permanent value because of a current recessions/boom or expected changes in spending and taxes in the future embedded in the expected path of current policies; second, the current growth rate can be different from its permanent value; third, the current real interest rate can be different from its permanent value.

[17] This case is closer to the real interest rates observed in Colombia in recent years

[18] The expected primary balance for the Non Financial Public Sector for 2003 and 2004 is close to 2% of GDP.

[19] Sustainability analyses and results are described in Arbeláez, *et al.*, 2002.

[20] There is no clear empirical evidence on which of these two cases is more likely; but it is clear is that higher real interest rates will lead to lower growth.

[21] Only includes medium and long-term external debt. It also includes leasing and securitization which begun in 1995, and represents 2.9% of GDP. This amount was not considered in the official debt data until 2001, resulting in a lower debt level. Also, figures are higher if Financial Public Sector external debt is included.

[22] Gross Adjusted Internal Debt includes the debt held by territorial and other public entities with the national central government. The adjustment carried out by the Ministry of Finance is as follows: [CG internal debt – *Bonos de valor constante* (constant value bonds) + *Bonos Fogafin* + Arrears)] + [Territorial Gross Internal Debt + Debt of territorial administrations with the CG + Debt of territorial administrations with INFIS] + [Other non financial public sector entities Internal Debt + their debt with the CG]

[23] Total interest payments are calculated as the sum of the interest payments of the NFPS that correspond to internal and long term external debt.

[24] Calculated as the interest payment / stock of total debt.

[25] Internal debt can be measured in gross terms, that is, The Ministry of Finance adjusts gross debt to include bonds issued by specific centralized entities such as *Fogafin* and *Banco Agrario*, and the *Rezago Presupuestal*. Net internal

debt subtracts that which is held among public entities and the Central Government (such as TES issued by the Central Government). Currently, the "adjustment" accounts for 25% of the gross adjusted internal debt, and the debt among public sector entities accounts for 35% of internal gross debt. The Ministry of Finance also calculates an internal debt net of financial assets, which is an approximation to the concept of net financial equity.

[26] In order to simplify the analysis, only gross internal debt will be taken into account from here onwards.

[27] There are several methodologies for calculating external debt. A standard measure of external public debt only takes into account medium and long-term debt (short-term external debt represents only 0.1% of total external debt), and since 1996 it began to include leasing and securitization. In the calculations for total public debt, only the values corresponding to the Non-Financial Public Sector were considered. Nevertheless, for descriptive purposes the use of total external public debt (including public financial entities) can complement the analysis because the information goes further back.

[28] For this analysis we will use medium and long-term external debt without leasing and securitization.

[29] See International Monetary Fund and the World Bank (2002)

[30] See Montpellier (2000).

[31] Central Government debt corresponds to TES, Security Bonds, Agrarian Bonds, Peace Bonds, Bonds Law 546, Constant Value Bonds, TRD Bonds,

Fogafin Bonds, and Pension Bonds. TES are disaggregated into TES A, short term TES B (90-day), TES in COP (nominal), CPI indexed TES, TES in UVR and USD TES.

[32] Central Government debt includes Bonds, IDB, BIRF and CAF loans, commercial loans and others.

[33] Taking a long period of time (30 years) we found a positive correlation between nominal devaluation and interest rates, and positive but low between devaluation and inflation. The correlation between GDP and devaluation (either nominal or real) is negative; positive and relatively high after the eighties between GDP and inflation; and negative between GDP and interest rates. On the other hand, inflation and nominal passive interest rates are positively correlated.

[34] The ending year for the internal payments is 2015, and 2030 for external debt payments.

[35] Which is the sum of internal and external amortizations.

[36] And assuming linearity of the portfolio to the risk factors.

[37] The sum of domestic and external debt.

[38] Interest rates also increase but they do not affect the cost of the current debt since the coupon for the COP debt is fixed.

[39] The values are presented as a percentage of the GDP of 2002 in order to maintain a constant comparative parameter and therefore observe the impact caused exclusively by the risk factors without the effect that is produced by the difference in GDP form one scenario to another.

[40] We used the specific information on each bond that has been placed in the internal market with its corresponding maturity term and interest rate, allowing for a precise analysis of what could happen to Colombian Public debt, under two different scenarios that yield a dramatically different behavior of the debt burden. The way the information is registered makes it possible to control the type of debt that can be rolled over (the bonds that can be rolled over basically cover only TES B in the internal market and certain bonds in the external market) and the new rates at which new debt is contracted.

[41] Such as the Pension Reform and the Budget Responsibility Law (Ley de Responsabilidad Fiscal).

[42] In August 2002 interests peaked an average level of 15.7% for the 10-year bonds.

[43] Although a slight adjustment is considered for each year, it is assumed that the government is unable to create a primary surplus.

[44] Foreign debt denominated in foreign currency.

[45] Note that longer-term debt issued at coupons of 15% and inflation close to 6% implied ex-ante real interest rates of about 9% and possibly much higher ex-post real interest rates if the government objective of lowering inflation to 4% in the medium run was achieved.

[46] The TES crisis led to no auctions of internal bonds during September and October of 2002.

[47] A government debt portfolio cannot be totally modified from one moment to another via issuance of new debt. The process takes time and therefore the structure of the portfolio that develops in the following years will depend to some degree on the current one.

[48] In order to do so, the detailed information of the government debt portfolio was aggregated according to the type of bonds (TES in COP, TES IPC, TES UVR, TES USD and other) and to the maturity term of the issued bonds. The obtained structure reveals the "average" structure that the debt has in 2002 gathering information since 1994. The data can be manipulated to reflect the maturity and interest wise impact of changes in the aggregate structure and the analysis reveals what would happen today to the cost of the debt if this same debt were contracted differently.

[49] Increasing the participation of external debt within total debt from 52% to 70% (an 18% increase) leads to a reduction in total interest payments (internal and external debt) along the 36 year period of 2.5% of 2002 GDP.

[50] The last of the four charts in figure 17 compares the total debt values of different compositions (70% internal and 30% external versus 30% internal and 70% external) when under a risk scenario of 10% annual real devaluation.

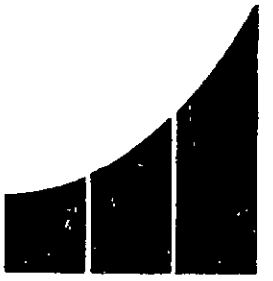
[51] TES in pesos placed at1, 2, 3, and 5-year maturity were reduced by half and this was assumed to have a 10 year maturity. The overall pattern of placements was not changed, in other words, if there are no placements of TES in

pesos with an 8-year maturity, a placement of an 8-year term TES in pesos was never assumed.

[52] It is important to bear in mind that approximately 27.6% of internal debt corresponds to other TES and debt that cannot be manipulated in terms of structure (constant value bonds, pension bonds, Fogafin bonds, etc.)

[53] Because this type of debt is placed mainly at 7 and 10 years.

[54] In mid 2002 Colombia faced difficult market conditions (the country lost domestic and foreign capital market access given the unsustainable debt dynamics) and experienced a sharp increase in sovereign spread in dollars (above 1000bps towards late 2002), a spike in long-term domestic currency rate of over 500bps and a real depreciation of over 20%. Market access improved in 2003, but the fiscal adjustment has been lower than expected and debt has continued to increase.



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