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WP/94/4

INTERNATIONAL MONETARY FUND

Research Department

The U.S. Public Debt: Implications for Growth

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January 1994

Abstract

The increase in the U.S. public debt over the past twelve years raises questions about its implications for investment and economic growth. This paper places these developments within an international and historical context and quantitatively examines the implications of various measures of the current U.S. public debt-to-GDP ratio on economic growth. The analysis is undertaken through extensions of recently developed endogenous growth models. The results suggest that while higher levels of the public debt may affect long-run economic growth negatively, the order of magnitude is not large enough to be a cause for serious concern.

JEL Classification Numbers:

D58, E13, H20

1/ The author is grateful to Sterie T. Beza, José De Gregorio, Jorge Márquez-Ruarte, Donald J. Mathieson, Gian Maria Milesi-Ferretti, Jorge Roldós, Luis Rivera-Batiz, Fernando Saldanha and Carlos Végh for useful comments and discussion. Any opinions are those of the author alone and do not necessarily reflect those of the International Monetary Fund or its staff.

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I. Introduction

The increase in the U.S. public debt over the past twelve years raises questions about its implications for investment and economic growth (Table 1). This paper quantitatively examines the implications of the current U.S. public debt-to-GDP ratio on economic growth. The analysis is carried out using an extension of a general endogenous growth model. The results are presented in the context of international and historical evidence.

Section II reviews the growth of the U.S. public debt and the decline in aggregate savings in the context of historical and international benchmarks. This is of interest because the growth in the U.S. public debt has economic growth considerations if the government dissaving, implied by increases in the public debt, has passed through to aggregate savings.

The two main conclusions of Section II are that: increases in the U.S. public debt are more troublesome when viewed on a historical basis than on an international level; and, increases in aggregate savings will likely require increases in government savings. On a historical basis, recent increases in the public debt represent the second instance in which a debt to GDP ratio increase occurs during peace-time. On an international level, the U.S. ranks close to the median among industrial countries in terms of its debt to GDP ratio; moreover, this ratio increased during the 1980s for all industrial countries other than Japan, Norway and the United Kingdom.

Section III reviews the empirical association between savings and investment over time and across countries. This is important because the close association in the savings/investment relationship entails implications for the effects of a large public debt on economic growth. The positive association between savings and investment found at different time frequencies suggests public debt policy is relevant not just in the long- but also in the short-term.

Section IV focuses on the domestic/foreign composition of the U.S. public debt. This section concludes that the deteriorating U.S. current account balance during the 1980s can be linked to a trend decrease in gross national savings, not to an increase in investment expenditures. Moreover, while the evidence indicates a positive association between current account deficits and fiscal deficits, there have been several significant deviations. These suggest that private sector response or shocks other than fiscal deficits make that association a not very strong one.

Section V views the outstanding stock of public debt in the context of the government's solvency, or intertemporal budget, constraint. In particular, a positive outstanding stock of public debt today implies that on average the government will be required to run primary surpluses in the future. 1/

Whether a large public debt will translate into future taxes or expenditure cuts is of central importance to the design of fiscal targets. This is so because in order to have a sensible notion of the government's net worth, knowledge of future taxes and expenditure cuts is needed. In particular, assumptions about the exogeneity of government behavior are crucial in ascertaining the average fiscal surpluses the government will have to run in the future. 2/ For example, this may include assumptions about future government expenditure commitments, such as in the areas of social security and defense.

The effects of future taxes, needed to pay back the outstanding public debt, on economic growth will differ according to the mix of factors of production on which taxes are levied. As discussed in Section VI, calculations of such effects are sensitive to, among others: the factors on which taxes are levied (e.g., physical versus human capital); the magnitude of depreciation rates for both types of capital; the tax treatment of inputs in sectors producing human capital; and, share parameters in input-producing sectors.

Section VI extends a fairly general aggregate endogenous growth model 3/ to account for the government's solvency constraint. Such extension allows us to quantify the effects of government policy on economic growth under multiple fiscal correction scenarios. Specifically, we compute long-run equilibria associated with several fiscal correction scenarios and derive upper (or least unfavorable) bounds on the effects of alternative fiscal corrections on economic growth. These bounds are derived for various measures of the debt to GDP ratio, gross and net of approximate adjusted present values of social security liabilities. 4/ These calculations are of interest not only because they provide benchmarks against which one can rule out some plans but also because of the sensitivity of growth effect calculations in non-debt settings.

Our results suggest that while higher levels of the U.S. public debt may affect long-run economic growth negatively, the order of magnitude is not large enough to be a cause for serious concern (Tables 5 and 7). Moreover,

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1/ That is, surpluses excluding interest payments on the debt.

2/ For a discussion on the importance of assumptions about the exogeneity of government behavior in ascertaining a correct measure of government net worth see Bohn (1992b).

3/ Endogenous growth models are those in which the economy's long-run rate of growth is driven by (endogenous) variables such as government policies, and not just exogenous technological change.

4/ The growth effects computed in Section VI are upper bound measures since in the model we use, human and physical capital are inelastically supplied.

in our calculations, negative growth effects amount to at most a ten percent reduction in the rate of economic growth. Furthermore, this occurs at high levels of the debt to GDP ratio (in the 200 to 250 percent range).

The issue of whether or not social security creates a government liability is a complex one. Different arguments have been put forth on both points of view. A sensible view is that of Bohn (1992) who, while recognizing social security to be a liability, argues that it differs substantially from other liabilities (say, Treasury bonds). This is so, he argues, because other liabilities are enforced by market-based mechanisms while social security obligations are enforced only by political mechanisms (for a related view see Tabellini (1990, 1991)). As a result of the different points of view on this issue, our analysis includes debt to GDP figures both gross and net of adjusted present value estimates of social-security liabilities (which, for 1990, ranged between 50 and 90 percent of GNP).

The paper is organized as follows. Section II reviews the evolution of the U.S. public debt and aggregate savings both over time and across industrial countries. Section III reviews the historical correlation in the savings-investment relationship. Section IV discusses the relationship between the decline in savings and the external debt buildup. Section V summarizes a simple accounting framework for the government's solvency constraint. In such a framework, permanent effects of public debt changes can be assessed. Section VI contains a multi-scenario study that yields (upper bound) calculations on the effects of several fiscal correction scenarios on economic growth. That study uses alternative estimates of the outstanding U.S. debt to GDP ratio, gross and net of accrued pension obligations to Federal employees and adjusted present value figures of social security liabilities. Section VII concludes. Appendix I reviews the main accounting relationships of government budget analysis while Appendix II contains the key ingredients of the extended model used in the growth effects computations of Section VI.

II. The Growth of the Public Debt and the Decline in Aggregate Savings in the United States versus Historical and International Benchmarks

The recent growth in the U.S. public debt becomes of greater concern the greater the extent to which government dissaving, implied by the growing public debt during the past decade, has passed through to aggregate savings. 1/ 2/

1/ In part, this concern stems from the strong relationship between domestic savings and investment (historically documented in Section III).
2/ The notions of savings used are made precise below.

1. <u>The growth of the public debt in the United States: historical features</u>

The public debt to GDP ratio is the most widely used statistic in assessing the size of the public debt (specifically, Gross Federal Debt held by the public). Over the past twelve-year period, this ratio has increased from approximately 25 percent in 1980 to roughly 50 percent at the end of 1992. The following features are evident from looking at the evolution of the U.S. public debt to GDP ratio since 1790 (Buiter (1993)):

-- The debt to GDP ratio has increased during peace-time only in one other period. That period was 1930-35 when the increase in the ratio mostly resulted from the output collapse rather than from an increase in indebtedness;

-- While growth in public sector indebtedness over the past twelve years is evident in alternative measures of indebtedness, there is considerable variation in their levels. For example, the Federal government's net financial debt to GDP ratio has exceeded the Federal government's net financial liabilities 1/ to GDP ratio by more than 20 percent since 1970. This excess has resulted mainly from accrued pension liabilities of Federal government employees included in the net financial debt figures;

-- The behavior of the Federal Government as the driving factor behind changes in the General government 2/ debt to GDP ratio is evident from the series for general government net financial liabilities (Economic Report of the President (1993, Table B-110).

2. The growth of the public debt in the United States: <u>international comparison</u>

-- The U.S. debt to GDP ratio is close to the median within the group of industrial countries (37 percent in 1992, see Table 2 (taken from Buiter (1993)). 3/ Interestingly, this ratio increased during the 1980's for all countries except Japan, Norway and the United Kingdom.

-- Between 1980 and 1990, the deficit to GDP ratio (3.4 percent of GDP in 1990) not only increased for the U.S. but also for France, Canada and the United Kingdom while remaining above 10 percent of GDP for Italy. 4/

1/ These include the Federal Reserve System and certain sponsored credit agencies (Economic Report of the President (1993, Table B-110)).

2/ The General Government is the Federal plus State and Local governments.

3/ Net figures subtract general government financial assets from the financial liabilities or gross debt.

4/ See the O.E.C.D. Economic Outlook, 52, December 1992.

3. The decline in aggregate savings in the United States: historical evidence and international comparison

Historically, savings and investment have been highly correlated (see e.g., Feldstein and Horioka (1980), Baxter and Crucini (1993)). The latter explains the importance of studying the decline in the U.S. savings rate. While the correlation between savings and investment has been strong over time and across countries, the degree of correlation has declined in the last several years as evidenced by the burgeoning current account imbalances of the 1980s. 1/

In general, savings rate movements across industrial countries have been quite uniform during the 1980's even though savings rate levels differ significantly. Table 3 summarizes these features (Elmeskov, Shafer and Tease (1991)):

-- Notwithstanding a number of adjustments to savings data, 2/ most countries' savings rates were lower in the 1980's than in the 1960's and 1970's;

-- There does not appear to exist a close offsetting relationship between public and private savings, perhaps with the exception of Canada and the United Kingdom (Nicoletti (1988)). This is so in spite of the ability to account for the decline in savings from the 1960s to the 1980s not only from a reduction in government savings 3/ but also from variations in the household savings rate. 4/

-- Private sector savings have been more stable, on average, than its component parts (household and corporate savings), especially in the United States and Germany. This offsetting relationship between corporate and household savings could be attributed, at least partly, to households' seeing through the corporate veil (Poterba (1987), Schultze (1988));

1/ See Aghevli et. al., (1990) and Dean et. al., (1990) for a documentation of these developments.

2/ Elmeskov, Shafer and Tease (1991) apply three broad types of adjustments to savings data (adjusting for valuation effects--such as changes in inflation and asset prices, reclassification effects--such as education, consumer durables, research and development, and depreciation, and coverage effects--such as household production, underground economies and the depletion of natural resources and environmental degradation).

3/ See Table 3. In fact, between the 1960s and the 1980s government savings declined in every large industrial country and every O.E.C.D. country except Norway.

4/ In fact, Elmeskov, Shafer and Tease(1991) find that between 40 and 70 percent of the variation in the decade-average national savings rates across fourteen O.E.C.D. countries can be attributed to changes in household savings rates.

The evidence appears to challenge standard lifetime-consumption theories of consumer behavior to the extent to which consumption appears to track income quite closely (Bosworth (1990)). Nevertheless, the evidence suggests that any effort to increase aggregate savings would require policies that increase government savings. 1/

III. The Historical Correlation in the Savings-Investment Relationship

National savings and national investment appear to be strongly positively correlated across countries, over time and at different time frequencies 2/ (see e.g., Feldstein and Horioka(1980), Murphy (1984), Obstfeld (1986) and Tesar (1991)). 3/

This finding has been taken to imply the presence of substantial barriers to the mobility of capital (see e.g. Wong (1990) and Dooley, Frankel and Mathieson (1987) for a discussion of this issue). That interpretation has been criticized on multiple grounds. First, the result has been obtained in studies using data for the 1960s and 1970s (e.g., Feldstein and Horioka (1980)). While the association between savings and investment remained strongly positive for the U.S. during the 1980s, it was weaker than during the 1960s and 1970s. Second, a positive relationship between net (or national) savings and net investment (implying small net external borrowings for the country) does not necessarily imply that gross external borrowings are small (or that there exist barriers to borrow abroad). 4/

The close empirical association between savings and investment has important implications for the effects of a large public debt on economic growth. Moreover, the finding that such relationship is not just a long-run phenomenon makes public debt policy relevant not just for its long- but also for its short-term effects on economic growth (Baxter and Crucini (1993)).

1/ Clearly, any decision to increase government savings (as it affects aggregate savings) should be grounded on the finding that the ongoing government savings (as it relates to aggregate savings) is somehow suboptimal. This issue is discussed in the Conclusion.

2/ See e.g., Tesar (1991) who finds similar estimates for 25-, 5-, 3- and 1-year averages. Similar estimates are found by Obstfeld (1986) who employs quarterly data from seven OECD countries.

3/ Typically, studies regress yearly averages of the investment-to-output ratio on the savings-to-output ratio. For the U.S., the savings ratio coefficient estimate ranges from .7 to close to 1.

4/ Frankel (1986)'s study on the openness of the U.S. economy finds a large degree of capital mobility with the rest of the world.

IV. The Decline in Savings and the External Debt Buildup

The United States has become the world's largest debtor. 1/ The latter underscores the importance of the domestic/foreign composition of the U.S. public debt. 2/

The deteriorating U.S. current account balance during the 1980s can be linked to a trend decrease in gross national savings, not to an increase in investment expenditures. 3/ While the data indicates a positive association between fiscal deficits and current account deficits, there have been several significant deviations which demonstrate that private sector response or shocks other than fiscal deficits make that association a not very strong one. 4/ For example, while the fiscal deficit declined between 1983 and 1984, the current account deficit deteriorated further. Also, while the fiscal deficit increased between 1989 and 1990, the current account deficit decreased in that period.

From the identity relationship of the current account balance as gross national savings minus gross national investment, it is important to emphasize that sustained current account deficits do not necessarily imply a reduction of domestic wealth. To see this, just note that a current account deficit implies nothing more than a net decumulation of foreign assets by the country as a whole while implying nothing about changes in the country's holdings of domestic assets. Thus it is conceivable that while decumulating foreign assets during a period of current account deficits, a country's residents increase their holdings of domestic assets leaving total domestic wealth unaffected in the process.

1/ For example, liabilities to foreigners amounted to US $ 746 billion in 1991 (OECD, Main Economic Indicators, January 1993).

2/ In this setting, the terms 'domestic' and 'foreign' debt refer to domestically issued U.S. public debt held by domestic and foreign residents, respectively.

3/ By contrast, Germany's and Japan's current account surpluses increased substantially after 1983 while savings rates increased correspondingly.

4/ Under the well-known Ricardian Approach to Budget Deficits (Barro (1989)), fiscal deficit increases (or reductions in government savings) are offset entirely by increases in private savings. This offset follows from the foresight attributed to (infinitely lived or completely altruistic-vis-a-vis all their descendants) private agents. These are assumed to see that fiscal deficit increases are met in the future by accompanying taxes required to fund repayment of the debt. Thus, at the margin, for each dollar increase in government indebtedness private savings increase by one dollar. Theoretically, the Ricardian Approach assumes a number of rather unrealistic conditions (e.g., complete altruism, perfect capital markets so that the government and private agents can borrow and lend at the same rate, the presumption that fiscal deficit increases will not be met by reductions in government expenditures). For a critique of the Ricardian Approach see Bernheim (1989).

V. The Government's Solvency Budget Constraint

The government's budget identity can be expressed as follows: 1/ 2/ Money creation plus sales of public sector assets plus debt sales equal debt interest plus public spending (including current and gross capital formation) minus taxes minus net income on public assets. Sales of public sector assets typically correspond to privatization of government enterprises. The public sector's solvency constraint is obtained by summing up (and discounting) the infinite sequence of single period budget identities. The resulting expression (brought into today's dollars) has the present value (PV) of public spending equal to the sum of today's public sector assets plus today's public sector debt plus the PV of taxes plus the PV of seigniorage revenue plus the PV of public sector capital formation minus the PV of terminal net liabilities (net indebtedness). The latter sum corresponds to the government's net worth. Government solvency requires the present value of its expected net liabilities at the end of the planning horizon to be zero.

The government's solvency constraint is a meaningful restriction on the path of government deficits inasmuch as successive governments honor debt commitments inherited from their predecessors. Moreover, it can be verified that obeying the solvency constraint requires the long-run growth rate of the economy to be lower than the rate of interest. This does not necessarily imply that there cannot be short- or medium-term paths along which the opposite occurs.

A positive outstanding stock of debt implies that on average the government will have to run surpluses in the future so as to meet its solvency constraint. The permanent primary gap is a useful construct in cases in which the outstanding debt and the expected future government surpluses are such that the solvency constraint is violated (see Buiter (1983, 1985, 1993), Blanchard (1990) and Blanchard, Chouraqui, Hagemann and Sartor (1990)). That construct provides a sensible assessment of the size of the permanent fiscal correction needed, as a fraction of GDP, for the government to avert a violation of the solvency constraint. 3/

In defining the permanent primary gap, it is helpful to introduce the following notation: $g(t)$, the permanent primary gap at time t (expressed as a fraction of GDP), r, the long-run real rate of interest, G, the long-run growth rate of GDP, $b(t)$, the GDP ratio of interest-bearing government debt at time t, and $s(t)+\omega(t)$, the constant value equivalent (in present discounted value terms) of the path of the GDP ratios of the primary

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1/ This section draws on Buiter (1993) and Buiter (1985), which provides a useful guide to public sector accounting of debt and deficits.

2/ The following neglects foreign assets and liabilities.

3/ Such a violation of the government solvency constraint could be met, for example, either by outright repudiation or repudiation via deflation of the real value of the debt with inflation.

surpluses and seigniorage revenue associated with the ongoing, insolvent, plan.

The above lead to the following expression for the permanent primary gap at period t, g(t), as (see Appendix I for a derivation):

$$g(t) = (r-G)\ b(t) - (s(t)+\omega(t)) \qquad (1)$$

The baseline parameter values used in Section VI yield permanent primary gap figures ranging from 1 to 8 percent of GDP. The parameter values used include: a debt to GDP ratio ranging from 45 to 250 percent, long-run real rates of interest ranging from 3 to 6 percent, long-run growth rates of GDP ranging from 1 to 2 percent, and long-run primary surpluses and seigniorage revenues of -0.75 percent.

Section VI exploits the permanent primary gap construct in studying the effects of the outstanding debt to GDP ratio on economic growth. Section VI uses endogenous growth models. Consequently, fiscal policy can affect both sides of expression (1); namely, the period t permanent primary gap g(t) itself, the long-run rate of interest r, and, of course, the economy's long-run rate of growth G.

VI. Growth Effects of Fiscal Policy in Endogenous Growth Models of the U.S. Economy

In studying the implications of fiscal policy on economic growth, it is central to distinguish between level and growth rate effects. Standard neoclassical growth models account for (negative) level effects of fiscal policy on the capital stock. In particular, in those models increases in proportional tax rates on capital income lead to decreases in steady state levels of capital stock through standard distortionary effects of taxation. However, those models are unable to account for growth rate effects of fiscal policy since in they imply that the economy's long-run rate of economic growth is solely driven by exogenous technological progress. On the other hand, the growth rate in endogenous growth models is, as its name reads, endogenous. 1/

The effects of fiscal policy on economic growth in calibrated models of the U.S. economy have been the focus of recent research (see e.g. Jones and Manuelli (1990), King and Rebelo (1990), Lucas (1990), Rebelo (1991), Kim (1992), Jones, Manuelli, and Rossi (1993), and Rebelo and Stokey (1993)). Those sutdies substantially differ in terms of the quantitative effects of tax policy reform on economic growth. For example, considering a tax policy reform changing current tax rates to their optimal (Ramsey) levels, Jones,

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1/ The endogenous growth literature, advanced by Arrow (1962), has grown quite dramatically since the work by Romer (1986). Sala-i-Martin (1990) and Brander (1992) are excellent surveys of this literature.

Manuelli and Rossi (1993) find the U.S. economic growth rate increases by eight percentage points while, for the same exercise, Lucas (1990) finds the increase to be only three hundredths of a percentage point. 1/

For the case of a common tax rate levied on all income, the different conclusions among the different endogenous growth models mentioned above result from different parameter values for: labor supply elasticity, intertemporal elasticity of substitution, depreciation rates, and tax treatment of depreciation. For the case of different tax rates levied on different income sources, different conclusions of different models result from parameter values for, in addition to those for the common tax rate case: factor shares and depreciation rates, and elasticities of substitution in production (Rebelo and Stokey (1993)).

This section studies multiple fiscal correction scenarios and their implied effects on economic growth. It does so by combining the model of Rebelo and Stokey (1993) with the permanent primary gap construct of Section V. The Rebelo and Stokey model is attractive inasmuch as it can accommodate the models of Lucas (1990), King and Rebelo (1990), Kim (1992) and Jones, Manuelli and Rossi (1993) as special cases. This generality is exploited in this section by including those models in our fiscal correction scenarios.

Rebelo and Stokey consider a setting in which stocks of physical and human capital are used in the production of human capital, physical capital and a consumption good. Human and physical capital are owned by households who supply these to firms. 2/ Firms interact with one another in a perfectly competitive manner. Households buy the consumption good and the two assets (physical and human capital). The three goods are taxable and revenue from all taxes is rebated to households in a lump-sum fashion. Rebelo and Stokey also consider an elastic labor supply case which is identical to the inelastic case except that preferences are defined not only

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1/ Rebelo and Stokey(1993) argue that the assumptions used by Jones, Manuelli and Rossi(1993) significantly overstate the potential growth implications of tax policy reform. Also, Lucas' findings that the effects of tax reform on economic growth are of a trivial magnitude materially depend on the technology used in his model for the sector producing human capital.

2/ There are three types of firms (those which produce new physical capital, new human capital and the consumption good) with access to constant returns to scale technologies.

over the consumption good but also over leisure. 1/ In what follows, we consider the inelastic labor supply case to derive upper bound calculations on the effects of several fiscal correction scenarios on economic growth.

The minimal notation needed for the analysis is the following: δ_1 and δ_2, the (constant) rates of depreciation of physical and human capital, respectively; σ, the inverse of the (constant) elasticity of intertemporal substitution of preferences (which corresponds to the coefficient of relative risk aversion in the stochastic case); ρ, the household's (constant) rate of time preference; G, the rate of economic growth; A and B, the autonomous coefficients of the (production) functions in the physical capital- and human capital-production sectors; r, the rate of interest; τ_{ij}, the (constant) flat-rate tax on income earned by factor i=1,2 (physical and human capital, respectively), employed in sector j=1,2,3 (the physical capital-, human capital- and consumption good-production sectors, respectively); z_1 (z_2), *the ratio of human to physical capital employed in* the production of physical- (human-) capital, respectively; w and v, factor shares for capital in the physical- and human-capital production sectors, respectively. 2/

The equilibrium conditions of the model are rather simple (see Appendix II). By definition, along a competitive equilibrium balanced growth path, consumption and both kinds of capital grow at a common, constant rate G (and the economic growth rate, the interest rate and the sectoral factor composition are constant).

The methodology we use in our calculations is the following. First, we choose benchmark figures for the permanent primary gap (as a fraction of GDP) using: alternative estimates for the public debt to GDP ratio (including and excluding accrued pension liabilities of Federal employees and Social Security liabilities), estimates of the difference between the current long-run real rate of interest and the long-run growth rate of GDP, and estimates for the planned primary surpluses and seigniorage revenue. Second, for each of the benchmark permanent primary gap figures chosen, we consider multiple factor tax combinations (using existing income share estimates for capital and labor for the United States) that meet the

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1/ For the inelastic labor supply case, Rebelo and Stokey find the response of the steady-state interest rate and rate of economic growth to fiscal reform to be sensitive to the factor share parameters of the input producing sectors and insensitive to the elasticity parameters. Rebelo and Stokey also find steady-state revenues to be insensitive to the elasticity parameters. For the elastic labor supply case, and measuring leisure time in 'raw hours', Rebelo and Stokey find the interest rate and economic growth rate effects of taxation to depend on the elasticity of labor supply.

2/ In particular, w (v) corresponds to the ratio of the rental ratio (of physical to human capital) divided by the sum of the rental ratio and the ratio of human to physical capital in the physical- (human-) capital production sector, respectively.

corresponding permanent primary gap figures (net of the change in the required permanent primary surplus (r-G)b). 1/ Third, for each budget balancing combination considered, we calculate the corresponding effects on economic growth. We pursue each of these steps below.

First, the benchmark figures we use in our analysis are the following: for the public debt to GDP ratio we consider 0.45 (corresponding to end 1992 general government net non-monetary debt), 0.85 (significantly higher than the end 1992 figure of 0.65 for the non-monetary net debt of the Federal government inclusive of the present value of accrued pension obligations to Federal employees (see Bohn (1992)), and the larger figures of 1.25 and 2.50 allowing for adjustments exceeding current estimates of the adjusted present values of social-security liabilities (estimates for these in 1990 range between 50 and 90 percent of GNP -see Bohn (1992, p.5)); for estimates of the difference between the current long-run real rate of interest and the long-run growth rate of GDP, we use the benchmark figures of 0.012, 0.0241, 0.03, and 0.049; 2/ for the current planned primary surpluses and seigniorage revenue to GDP ratio we consider -0.0075 (computed using the OECD (1992) figure for the 1992 cyclically corrected primary surplus of -0.01 and Buiter's (1993) 0.0025 figure for the assumed permanent seigniorage as a fraction of GDP).

Second, we construct the budget balancing combinations as follows. We consider tax rate perturbations $(\underline{\tau}_{11}+\Delta\tau_{11}, \underline{\tau}_{12}+\Delta\tau_{12}, \underline{\tau}_{21}+\Delta\tau_{21}, \underline{\tau}_{22}+\Delta\tau_{22})$ that are sufficiently large that the change in the tax revenue to GDP ratio (the left-hand side in (2)) equals to the permanent primary gap net of the change in the required permanent primary surplus 3/ (the right-hand side in (2)). These tax rate perturbations are chosen for given 1993 estimates of: the permanent primary gap, $\underline{g}$, outstanding tax rates $(\underline{\tau}_{11}, \underline{\tau}_{12}, \underline{\tau}_{21}, \underline{\tau}_{22})$, outstanding debt to GDP ratio $\underline{b}$, planned primary surpluses and seigniorage revenue $\underline{s+\omega}$, and the difference between the long-run real rate of interest and GDP growth rate $\underline{r-G}$,

$$\Phi_{11}\,\Delta\tau_{11} + \Phi_{12}\,\Delta\tau_{12} + \Phi_{21}\,\Delta\tau_{21} + \Phi_{22}\,\Delta\tau_{22} = \underline{g} + b\,\frac{\Delta(r-G)}{\Delta(\tau_{11},\tau_{12},\tau_{21},\tau_{22})}\,\Delta(\tau_{11},\tau_{12},\tau_{21},\tau_{22}) \qquad (2)$$

1/ We call these budget balancing combinations.

2/ These are used by King and Rebelo (1990), Kim (1992), Jones, Manuelli and Rossi (1993) and Lucas (1990), respectively.

3/ This changes as the GDP growth and interest rates change from the required fiscal correction.

We call such perturbations <u>budget balancing combinations</u>, where Φ_{ij} denotes the GDP income share of factor i in sector j.

Third, our computational task is as follows. For economy of notation, we denote all variables under the perturbation scenario by subscript $\Delta\tau$ (where $\Delta\tau$ corresponds to $\Delta(\tau_{11},\tau_{12},\tau_{21},\tau_{22})$). Starting with benchmark figures $\underline{r}$-$\underline{G}$ and $\underline{G}$, and assuming equal rates of depreciation for human and physical capital, note (using equation (B6) in Appendix II) that

$$\frac{r_{\Delta\tau}+\delta}{\underline{r}+\delta}=\Big\{\Big[\frac{1-\underline{\tau}_{11}-\Delta\tau_{11}}{1-\underline{\tau}_{11}}\Big]^{w/(1-w)}\Big[\frac{1-\underline{\tau}_{21}-\Delta\tau_{21}}{1-\underline{\tau}_{21}}\Big]\Big[\frac{1-\underline{\tau}_{12}-\Delta\tau_{12}}{1-\underline{\tau}_{12}}\Big]\Big[\frac{1-\underline{\tau}_{22}-\Delta\tau_{22}}{1-\underline{\tau}_{22}}\Big]^{((1-v)/v)}\Big\}^{((1-w)v)/(1-w+v)} \quad (3)$$

Denoting $(r_{\Delta\tau}+\delta)/(\underline{r}+\delta)$ by Λ, and using the equilibrium equation (B1) (in Appendix II) by subtracting δ from both sides and dividing, we obtain (4) below which gives us the growth rate $G_{\Delta\tau}$ that results from the fiscal correction $\Delta\tau$.

$$G_{\Delta\tau}=\Lambda\underline{G}+(\rho/\sigma)(\Lambda-1)-(\delta/\sigma)(\Lambda-1) \quad (4)$$

With an estimate for $G_{\Delta\tau}$ and noting that $r_{\Delta\tau}=\Lambda(\underline{r}+\delta)-\delta$, we can compute $(r_{\Delta\tau}-G_{\Delta\tau})-(\underline{r}-\underline{G})$ which corresponds to $\frac{\Delta(r-G)}{\Delta(\tau_{11},\tau_{12},\tau_{21},\tau_{22})}\Delta(\tau_{11},\tau_{12},\tau_{21},\tau_{22})$

in the right hand side of (2).

To sum up: first, we start with benchmark figures $(\underline{\Phi}_{ij},\underline{\tau}_{ij},\underline{r},\underline{G},\underline{s},\underline{\omega},\underline{b},\underline{w},\underline{v},\underline{\sigma},\underline{\rho},\underline{\delta})$; second, we consider budget balancing combinations $\Delta(\tau_{11},\tau_{12},\tau_{21},\tau_{22})$ (i.e. combinations that satisfy (2)); third, we compute equilibria and the resulting effects on economic growth by using (2), (3) and (4).

Tables 5, 6, 7 and 8 report long-run fiscal correction equilibria and were constructed as follows.

First, for baseline parameters common with those used in the models of Lucas (1990), King and Rebelo (1990), Kim (1992) and Jones, Manuelli and

Rossi (1993), we choose those authors' figures (in Tables 5, 6, 7 and 8, respectively). Similarly, for several benchmark indicators (the initial long-run interest and economic growth rates). For the other major benchmark indicators, we take -0.0075, as explained above, for the current planned primary surpluses and seigniorage revenue and (0.45, 0.85, 1.25 and 2.50) for the current debt to GDP ratio (so as to more than account for the impact of social security liabilities and accrued pension obligations to Federal employees). For the factor income ratios, we use 0.35 and 0.65 for physical and human capital, respectively, the usual values used in the literature. 1/

Second, in computing equilibria (that is, budget balancing combinations and long-run interest and rates of economic growth that solve (2), (3) and (4)) we held $\Delta\tau_{21}$ and $\Delta\tau_{22}$ fixed at five percent (0.05) throughout. Thus, the results reported in the Tables can be interpreted by thinking of the government committing to a fiscal reform whereby taxes on human capital will (permanently) increase by five percent. Moreover, looking at Table 5, for example, the figures reported in the tables are long-run 'fiscal correction' equilibria in the sense that if the government decides to (permanently) increase taxes on human capital by five percent and for a debt to GDP ratio b of 0.85 (eighty-five percent): the government would have to increase taxes on physical capital by five percent, with a resulting decrease in the economic growth rate from 1.5 percent (the benchmark figure) to 1.39 percent and a decrease in the interest rate from 6.4 percent to 5.9 percent.

It is important to stress our results as upper (or least unfavorable) bounds of effects of fiscal corrections on long-run economic growth. This follows as in the model households inelastically supply human and physical capital. Thus, one hundred percent of the tax burden is borne by households (the owners of physical and human capital).

Depending on the magnitude of the change in the factor demands, 2/ the interest rate may decrease or increase following a tax increase. Changes in the long-run rate of interest determine in turn (via equation (4)) changes in the long-run rate of economic growth. Interestingly, the effects can be of either sign. For example, in Table 7, the interest rate decreases (from 3.7 to 3.6 percent) and the economic growth rate also decreases (from 1.44 to 1.43 percent) when the debt to GDP ratio increases from 125 to 250 percent. On the other hand, in Table 6, the interest rate decreases from 2.91 to 2.90 percent and the economic growth rate increases from 2.14 to 2.15 percent when the debt to GDP ratio increases from 85 to 125 percent.

1/ See e.g. Romer(1989), Maddison(1987), and Kendrick(1961, 1973).

2/ This magnitude, in the context of the model, depends principally on the parameter values for v and w as can be seen either in (B2) and (B3) or in (B6) which summarizes the equilibrium system.

That interest rate changes can yield changes in the rate of economic growth of different sign is evident from the equilibrium equation (4). In particular, it can be seen from (4) that, for an increase in tax rates, 1/ the sign of the association between changes in the interest rate and changes in the growth rate is given by the sign of $\underline{G}+(1/\sigma)(\rho-\delta)$. The intuition behind this is straightforward. In particular, for 'large' rates of depreciation (the latter expression is negative), the present value effects (of increased tax rates) on demand for capital outweigh present value supply effects. A similar reasoning applies to the case of 'small' rates of depreciation and $\underline{G}+(1/\sigma)(\rho-\delta)$ positive. In this regard, it can be verified that for the baseline parameter values used in Lucas (1990), King and Rebelo(1990), Kim(1992) and Jones, Manuelli and Rossi (1993), the latter expression is positive (0.008), negative (-0.068), positive (0.015) and negative (-0.03), respectively.

Concluding this section, we find the results reported in Tables 5,6,7 and 8 to be of interest for two reasons: by providing bounds, the results provide benchmarks against which one can rule out some plans, and; because of the sensitivity of economic growth effect calculations obtained in non-debt settings. The results suggest that while higher levels of the public debt may negatively affect long-run growth (Tables 5 and 7), the order of magnitude is not large enough to be a cause for serious concern. Moreover, for the scenarios studied in this paper, negative effects of fiscal corrections on economic growth amount to at most a ten percent reduction in the economic growth rate. Furthermore, this occurs at high levels of the debt to GDP ratio (in the 200 to 250 percent range).

VII. Conclusion

Recent developments of the U.S. public debt include:

-- The General government debt to GDP ratio has been driven by the behavior of the Federal government. Therefore, any fiscal tightening should likely fall mostly on the Federal government (see Section II.1);

-- The U.S. net debt to GDP ratio lies close to the median within the group of industrial economies (for 1992; see Section II.2). More interestingly, this ratio increased during the 1980's for all countries except Japan, Norway and the United Kingdom. Thus the evolution of the U.S. public debt to GDP ratio has not been unusual when compared with countries of comparable levels of development;

-- There does not appear to exist a close offsetting relationship between public and private savings for the United States, while, on average, private sector savings have been more stable than its component parts

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1/ It is clear from (B1) that in the absence of fiscal policy changes, changes in the interest and growth rates are positively related.

(household and corporate savings, Section II). This suggests that efforts to increase aggregate savings would require policies that increase government savings;

-- While the U.S. savings and investment remained strongly positively correlated during the 1980's, this correlation is weaker than during the 1960's and 1970's. Moreover, the finding that the close positive association between savings and investment is not just a long-run phenomenon makes public debt policy relevant not just for its long- but also for its short-term effects on economic growth (see Section III).

These features are used in quantitatively examining the effects of the current U.S. public debt on long-run economic growth. Section VI finds that while further increases in the U.S. public debt may negatively affect long-run economic growth, the order of magnitude of such effects: is likely to be rather small, and; is likely to be highest at debt to GDP ratios substantially higher than the present one.

These conclusions should be complemented with a brief discussion of other factors of relevance in the debt/growth discussion. We discuss one of these below: the adverse expectational effects of a large public debt. 1/

Increases in the public debt may lead to negative growth effects through expectational considerations. In this sense, substantial increases in the public debt to GDP ratio could be a source of market instability. For example, Asilis and Ghosh (1992) study conditions in which either because of a large public debt or because of intermediation costs, the economy can end up at a savings/investment trap equilibrium. This can occur since savers/investors see through the size of the public debt and expect large future taxes needed so that the government does not violate its solvency constraint. Expectations of higher future taxes may lead to a savings/investment trap since savers/investors, in expecting a small number of individuals to save/invest, may find optimal not to save/invest. Consequently, aggregate savings/investment would also be small and the economy would not grow or just grow by a little (compared to its potential).

Finally, it can be argued that part of the average surpluses the U.S. government will need to run in the future will come from seigniorage revenue. However, the evidence strongly suggests that the maximum long-run seigniorage resources the U.S. government would be able to extract are

1/ These effects were not included in the simulations and could increase the implied growth effects of fiscal consolidation.

rather miniscule. 1/ Another channel through which inflation benefits government finances is through the reduction in the real value of the government's nominal liabilities (nominal debt). However, because of the dangers associated with the systematic recourse to the inflation tax, 2/ the use of inflation for these purposes is unlikely. 3/ 4/

1/ In particular, estimates of the semi-elasticity of long-run money demand with respect to the annual rate of inflation (approximately equal to -7.5; see e.g. Buiter (1993)) imply that the long-run seigniorage revenue maximizing annual rate of inflation is approximately 10 percent or at most 0.45 percent of GNP. It should be pointed out, however, that to the extent to which the tax system is on an historical cost accounting basis, the latter figure underestimates seigniorage gains to the government (for example, in 1985 Hans-Werner Sinn found for West Germany that a 6 percent inflation rate raised government revenue by nearly 5 percent of GNP; however, it is clear that taking those figures as annualized steady state averages would lead to a, possibly gross, overstatement of the true seigniorage gains (as over a long horizon it is hard to justify a tax system that operates on an 'historical' cost accounting basis)).

2/ These could emerge, for example, via dislocations in the financial system--arising, for example, through serious mismatches in the asset--liability positions of financial institutions possibly leading to a surge of bankruptcies in the industry.

3/ This does not imply that at times the real tax revenue consequences of inflation are not substantial.

4/ The taxation of government debt via inflation is a form of (partial) debt repudiation which becomes more likely the bigger the costs of meeting those obligations via more conventional forms of (typically distortionary) taxation. This is so since taxing government debt via inflation is one of the closest forms of lump-sum (non-distortionary) taxation in the real world. In spite of this lump-sum feature, however, taxing government debt via inflation may be suboptimal for the government on reputational grounds (since this would be equivalent to breaking a 'social contract'). The latter may imply that long-run losses to the government from losing reputation/ credibility could exceed the short-run gains associated with the use of this 'lump-sum' tax (Barro and Gordon(1983)).

Basic Accounting Framework to Evaluate Budgetary Position

This appendix introduces the basic accounting framework needed in the evaluation of the government's budgetary position. 1/ The expressions given below are those for a closed economy which is appropriate considering that U.S. government borrowings are denominated in U.S. dollars and the small size of the stock of U.S. official international reserve assets.

Definitions

Government: consolidated general government and Federal Reserve System;

M	:	nominal stock of base money;
ΔM	:	seigniorage; 2/
B	:	stock of interest-bearing government debt;
S	:	(nominal) value of primary budget surplus (equal to financial surplus minus net interest paid on the debt);
i	:	variable nominal interest rate paid on government debt;
P	:	general price level;
C	:	government consumption;
A	:	government gross investment;
T	:	real value of taxes minus transfers and subsidies;
K	:	government real capital stock (valued at current reproduction cost);
Ω	:	flow of sales of public sector capital to the private sector (at a price p^k per unit of privatized capital);
ρ	:	gross real rate of return on public sector capital appropriated by the government;
δ	:	physical depreciation rate of government capital;
Π	:	inflation rate ($\equiv \Delta P/P$);
Y	:	real GDP.

The above can be expressed as fractions of GDP, as follows: $m \equiv M/(PY)$; $\omega \equiv \Delta M/(PY)$; $b \equiv B/(PY)$; $s \equiv S/(PY)$; $c \equiv C/Y$; $a \equiv A/Y$; $\tau \equiv T/Y$; $\phi \equiv \Omega/Y$; $k \equiv K/Y$; $G \equiv \Delta Y/Y$ (instantaneous rate of growth of real GDP); $r \equiv i - \Pi$ (instantaneous real rate of interest).

Budget Identity of the Government (in nominal terms):

$$\Delta M(t)+\Delta B(t) \equiv -S(t)-p^k(t)\Omega(t)+i(t)B(t) \qquad \text{(A1)}$$

Primary Budget Surplus (in nominal terms):

$$S \equiv P(T+\rho K-C-A) \qquad \text{(A2)}$$

1/ This Appendix draws on Buiter (1993, Section III).
2/ Δx denotes the time derivative of x.

where

$$\Delta K = A - \delta K - \Omega \tag{A3}$$

Budget Identity of the Government (as a fraction of real GDP):

$$\Delta b = (r - G)b - s - (p^k/P)\phi - \phi \tag{A4}$$

Primary Budget Surplus (as a fraction of real GDP):

$$s = \tau + \rho k - c - a \tag{A5}$$

where

$$\phi = a - (G + \delta)k - \Delta k \tag{A6}$$

Adjusted Primary Surplus1/ (as a fraction of real GDP):

$$s = s + (p^k/P)\phi \tag{A7}$$

Solvency Constraint:

$$\lim_{v \to \infty} b(v) \exp\{-\int_t^v [r(u) - G(u)]du\} \leq 0 \tag{A8}$$

Present Value Budget Constraint of the Government: 2/

$$b(t) \leq \lim_{v \to \infty} \int_t^v [S(z) + \omega(z)] \exp\{-\int_t^z [r(u) - G(u)]du\} dz \leq 0 \tag{A9}$$

If (A9) is violated, then a measure of the Permanent Primary Gap is given by

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1/ Privatization proceeds plus primary surplus.
2/ Provided (A8) holds.

$$g(t)= \lim_{v\to\infty} \left[\int_t^v \exp\left(-\int_t^z [r(u)-G(u)]du\right)dz\right]^{-1}$$

$$\left[b(t)- \lim_{v\to\infty} \int_t^v [S(z)+\omega(z)]\exp\left(-\int_t^z [r(u)-G(u)]du\right)dz\right] \qquad \text{(A10)}$$

Denoting

$$\lim_{v\to\infty} \left[\int_t^v \exp\left(-\int_t^z [r(u)-G(u)]du\right)dz\right]^{-1}$$

as the long-run real rate of interest, $\underline{r}$, minus the long-run growth rate of real GDP, $\underline{G}$, and letting

$$\lim_{v\to\infty} \left[\int_t^v \exp\left(-\int_t^z [r(u)-G(u)]du\right)dz\right]^{-1}$$

$$\left[\lim_{v\to\infty} \int_t^v [S(z)+\omega(z)]\exp\left(-\int_t^z [r(u)-G(u)]du\right)dz\right]$$

denote the constant value of the adjusted primary surplus plus seigniorage by $\underline{s(t)+\omega(t)}$ whose present discounted value is equal to that of the path of planned (expected) adjusted primary surpluses plus seigniorage (as a fraction of GDP).

Thus, (A10) can be rewritten as

$$g(t)=(\underline{r-G})b(t)-(\underline{s(t)+\omega(t)}) \qquad \text{(A11)}$$

(A11) is equation (1) in the paper.

Equilibrium in the Rebelo/Stokey (1993) Model

This appendix discusses the equilibrium in the Rebelo/Stokey(1993) model used in Section VI. In particular, the equilibrium system has a block-recursive structure so that the following subset of equations are the only ones of interest to us. This is so as these equations are sufficient to solve for the equilibrium rates of interest and growth. In particular, for the case in which income is taxed gross of depreciation and for Cobb-Douglas production functions, we have that:

$$r = \rho + \sigma G \qquad \text{(B1)}$$

$$(1-\tau_{11})Awz_1^{1-w} - \delta_1 = r \qquad \text{(B2)}$$

$$(1-\tau_{22})B(1-v)z_2^{-v} - \delta_2 = r \qquad \text{(B3)}$$

$$\frac{(1-\tau_{21})(1-w)}{(1-\tau_{11})wz_1} = \frac{(1-\tau_{22})(1-v)}{(1-\tau_{12})vz_2} \qquad \text{(B4)}$$

The above have the following interpretation: (B1) is an (equilibrium) relationship between the interest rate and the consumption growth rate (which, recall, coincides with the economy's rate of economic growth along the balanced path); (B2) and (B3) reflect the equalization that occurs (through competitive forces) between the interest rate and the (net of tax and depreciation) real rate of return on each factor (human and physical capital); finally, (B4) is an implication of factor return equalization in all sectors.

Equations (B2)-(B4) are sufficient to determine the long-run equilibrium rate of interest r while (B1) yields the long-run rate of economic growth as a function of the long-run equilibrium rate of interest. In particular, it is straightforward to show that the equilibrium rate of interest r is a solution to (B5) below.

$$(r+\delta_1)^{1/(1-w)} \; (r+\delta_2)^{1/v} =$$

$$A^{1/(1-w)} \; B^{1/v} \; (1-\tau_{11})^{w/(1-w)} \; (1-\tau_{21})(1-w)(1-\tau_{12}) \qquad \text{(B5)}$$

$$v(1-v)^{(1-v)/v} \; (1-\tau_{22})^{(1-v)/v} \; w^{w/(1-w)}$$

Note that for the case of equal rates of depreciation of physical and human capital ($\delta = \delta_1 = \delta_2$), the rate of interest simplifies to (B6).

$$r = -\delta$$

$$+ \{A^{1/(1-w)} B^{1/v} (1-\tau_{11})^{w/(1-w)} (1-\tau_{21})(1-w)(1-\tau_{12}) \qquad \text{(B6)}$$

$$v(1-v)^{(1-v)/v} (1-\tau_{22})^{(1-v)/v} w^{w/(1-w)}\}^{((1-w)v)/(1-w+v)}$$

Table 1. Net Debt Figures: United States
(Gross of Accrued Pension Obligations to Federal Employees)
(in nominal U.S.$ billion)

Year	Net Debt
1947	219.9
1948	212.8
1949	219.7
1950	210.9
1951	203.5
1952	211.4
1953	223.6
1954	232.9
1955	232.5
1956	230.1
1957	242.8
1958	261.0
1959	265.1
1960	275.9
1961	283.5
1962	299.7
1963	311.2
1964	322.4
1965	328.0
1966	339.4
1967	359.8
1968	377.8
1969	400.3
1970	461.0
1971	518.1
1972	567.5
1973	606.1
1974	651.4
1975	787.5
1976	899.8
1977	978.8
1978	1046.7
1979	1083.7
1980	1218.5
1981	1429.8
1982	1688.4
1983	1901.7
1984	2147.4
1985	2433.1
1986	2721.5
1987	2804.2
1988	3066.7
1989	3381.1

Source: Bohn (1992, Table A1).

Table 2. General Government Net Debt
Selected OECD Countries (Percentage of GDP)

	Liabilities (+) or Assets (-)			
	1974	1979	1989	1992
High-Debt Countries				
Belgium	47.2	62.0	120.3	124.3
Italy	44.6	55.6	96.1	106.7
Ireland	57.6	73.4	107.3	97.4
Greece	20.3	27.6	73.5	81.7
Medium-Debt Countries				
Netherlands	19.0	21.8	57.2	59.7
Canada	4.9	12.1	40.3	53.7
Austria	17.6	36.0	56.9	52.1
United States 1/	21.7	19.1	30.4	37.9
Spain	..	5.8	30.4	35.8
United Kingdom	59.9	47.8	30.4	35.6
Low-Debt Countries				
Denmark	-13.6	1.8	26.0	29.1
France	8.1	13.8	24.8	28.8
Germany	-4.7	11.5	22.5	22.7
Australia	..	..	12.2	15.8
Finland	-10.6	-6.8	-1.6	11.0
Japan	-5.3	14.9	14.7	6.1
Sweden	-30.1	-19.8	-5.4	3.4
Norway	-9.2	9.8	-20.2	-16.6
Average (unweighted)	14.2	22.7	39.8	43.6

Source: Buiter (1993, Table 1) and the OECD Economic Outlook, 52, December 1992; Note: The data for Austria, Greece and Ireland refer to gross financial liabilities.

1/ Figures exclude accrued pension obligations to Federal employees. The net debt figures would be approximately 20 percent higher (of GDP) if they included accrued pension obligations to Federal employees.

Table 3. Gross Saving as a Ratio of GNP: G7 Countries

	1960s	1970s	1980s	Change between 1980s and 1960s	Change between 1980s and 1970s
United States					
National	19.7	19.4	16.3	-3.4	-3.1
Public	2.0	0.4	-2.1	-4.1	-2.5
Private	17.7	19.1	18.5	0.8	-0.6
Household	9.2	10.7	9.5	0.3	-1.2
Corporate	8.5	8.4	9.0	0.5	0.6
Japan					
National	34.5	35.3	31.6	-2.9	-3.7
Public	6.2	4.8	4.6	-1.6	-0.2
Private	28.3	30.4	26.7	-1.6	-3.7
Household	13.3	17.9	15.6	2.3	-2.3
Corporate	15.0	12.6	11.2	-3.8	-1.4
Germany					
National	27.3	24.3	22.5	-4.8	-1.8
Public	6.2	3.9	2.0	-4.2	-1.9
Private	21.1	20.4	20.5	-0.6	0.1
Household	6.9	8.7	7.8	0.9	-0.9
Corporate	14.2	11.8	12.7	-1.5	0.9
France					
National	26.2	25.8	20.4	-5.8	-5.4
Public	..	3.6	1.3	..	-2.3
Private	..	22.2	19.0	..	-3.2
Household	..	13.6	10.3	..	-3.3
Corporate	..	8.6	8.4	..	-0.2
United Kingdom					
National	18.4	17.9	16.6	-1.8	-1.3
Public	3.6	2.6	0.1	-3.5	-2.5
Private	14.8	15.3	16.6	1.8	1.3
Household	5.4	6.1	6.0	0.6	-0.1
Corporate	9.4	9.2	10.4	1.0	1.2
Italy					
National	28.1	25.9	21.9	-6.2	-4.0
Public	2.1	-5.6	-6.7	-8.7	-1.1
Private	26.0	31.2	28.3	2.2	-2.9
Household	..	24.5	21.1	..	-3.4
Corporate	..	6.6	7.5	..	0.9
Canada					
National	21.9	22.9	20.7	-1.2	-2.2
Public	3.6	2.7	-1.6	-5.2	-4.3
Private	18.2	20.1	22.3	4.1	2.2
Household	7.8	10.4	12.3	4.5	-1.9
Corporate	10.5	9.7	9.9	-0.6	0.2

Source: Elmeskov, Shafer and Tease (1991, Table 1) and O.E.C.D. National Accounts.

Table 4. The Current Account Balance, Gross National Savings and Gross National Investment in the United States: 1970-88 (In Percentage Points)

Year	CAB/GNP	Savings/GNP	Investment/GNP
1970	0.4	18.1	17.7
1975	1.4	18.1	16.7
1976	0.5	18.7	18.2
1977	-0.4	19.4	19.8
1978	-0.5	20.6	21.1
1979	0.1	20.6	20.5
1980	0.4	19.0	18.6
1981	0.3	19.6	19.3
1982	-0.1	16.5	16.6
1983	-1.0	15.7	16.7
1984	-2.4	17.1	19.5
1985	-2.8	15.7	18.5
1986	-3.2	14.7	17.9
1987	-3.4	14.4	17.8
1988	-2.4	14.9	17.3

Source: Rivera-Batiz and Rivera-Batiz (1993, Table 11-1), and United Nations, National Accounts Statistics: Main Aggregates and Detailed Tables.

CAB : Current Account Balance (from National Income Accounts Data).

Savings : Gross National Savings (National Disposable Income minus Consumption spending of Domestic Residents).

Investment: Gross Capital Formation of domestic residents.

GNP : Gross National Product.

Table 5
Upper Bounds on Long-Run Growth Effects of Fiscal Correction Scenarios
Case I

Lucas' (1990) figures for common baseline parameters with our (debt) extension of the Rebelo/ Stokey (1993) model	$\underline{\delta}=0.02$ $\underline{\sigma}=2$ $\underline{\rho}=0.034$ $\underline{\tau}_{11}=\underline{\tau}_{12}=0.26$ $\underline{\tau}_{21}=\underline{\tau}_{22}=0$ $\underline{w}=0.24$ $\underline{v}=0.001$			
Other baseline parameters	$\underline{\Phi}_{11}+\underline{\Phi}_{12}=0.35$ $\underline{\Phi}_{21}+\underline{\Phi}_{22}=0.65$			
Lucas' (1990) figures for common benchmark indicators	$\underline{r}=0.064$ $\underline{G}=0.015$			
Other benchmark indicators	$\underline{s+\omega}=-0.0075$			
Long-Run 'Fiscal Correction' Equilibria				
$\underline{b}$	0.45	0.85	1.25	2.50
$\Delta\tau_{11}=\Delta\tau_{12}$	0.04	0.05	0.25	0.26
$\Delta\tau_{21}=\Delta\tau_{22}$ 1/	0.05	0.05	0.05	0.05
$\underline{g}$	0.02955	0.04915	0.06875	0.13
$G_{\Delta\tau}$	0.0138999	0.0138995	0.0138901	0.0138895
$r_{\Delta\tau}$	0.0597996	0.059798	0.0597622	0.05976

1/ This parameter was held fixed through the computations (which used the Mathematica software package).

Table 6
Upper Bounds on Long-Run Growth Effects of Fiscal Correction Scenarios: Case II

King/Rebelo (1990) figures for common baseline parameters with our (debt) extension of the Rebelo/Stokey(1993) model	$\underline{\delta}=0.1$ $\underline{\sigma}=1$ $\underline{\rho}=0.0120$ $\underline{\tau}_{11}=\underline{\tau}_{12}=0.20$ $\underline{\tau}_{21}=\underline{\tau}_{22}=0.20$ $\underline{w}=0.33$ $\underline{v}=0.33$			
Other baseline parameters	$\underline{\Phi}_{11}+\underline{\Phi}_{12}=0.35$ $\underline{\Phi}_{21}+\underline{\Phi}_{22}=0.65$			
King/Rebelo (1990) figures for common benchmark indicators	$\underline{r}=0.0320$ $\underline{G}=0.0200$			
Other benchmark indicators	$\underline{s+\omega}=-0.0075$			
Long-Run 'Fiscal Correction' Equilibria				
$\underline{b}$	0.45	0.85	1.25	2.50
$\Delta\tau_{11}=\Delta\tau_{12}$	-0.06	-0.053	-0.056	-0.057
$\Delta\tau_{21}=\Delta\tau_{22}$ 1/	0.05	0.05	0.05	0.05
$\underline{g}$	0.0129	0.0177	0.0225	0.0375
$G\underline{\Delta\tau}$	0.02130	0.02148	0.02155	0.02165
$r\underline{\Delta\tau}$	0.02946	0.02911	0.02905	0.0290

1/ This parameter was held fixed through the computations (which used the Mathematica software package).

Table 7
Upper Bounds on Long-Run Growth Effects of Fiscal Correction Scenarios
Case III

Kim(1992) figures for common baseline parameters with our (debt) extension of the Rebelo/ Stokey(1993) model	$\underline{\delta}=0.01$ $\underline{\sigma}=1.94$ $\underline{\rho}=0.01$ $\underline{\tau}_{11}=\underline{\tau}_{12}=0.34$ $\underline{\tau}_{21}=\underline{\tau}_{22}=0.17$ $\underline{w}=0.34$ $\underline{v}=0.34$			
Other baseline parameters	$\underline{\Phi}_{11}+\underline{\Phi}_{12}=0.35$ $\underline{\Phi}_{21}+\underline{\Phi}_{22}=0.65$			
Kim(1992) figures for common benchmark indicators	$\underline{r}=0.0391$ $\underline{G}=0.015$			
Other benchmark indicators	$\underline{s+\omega}=-0.0075$			
Long-Run 'Fiscal Correction' Equilibria				
$\underline{b}$	0.45	0.85	1.25	2.50
$\underline{\Delta\tau_{11}=\Delta\tau_{12}}$	-0.05	-0.04	-0.01	0.01
$\underline{\Delta\tau_{21}=\Delta\tau_{22}}$ 1/	0.05	0.05	0.05	0.05
$\underline{g}$	0.018	0.027	0.037	0.067
$\underline{G\Delta\tau}$	0.0148	0.0146	0.0144	0.0143
$\underline{r\Delta\tau}$	0.0384	0.038	0.037	0.036

1/ This parameter was held fixed through the computations (which used the Mathematica software package).

Table 8
Upper Bounds on Long-Run Growth Effects of Fiscal Correction Scenarios:
Case IV

Jones, Manuelli and Rossi(1993) figures for common baseline parameters with our (debt) extension of the Rebelo/ Stokey(1993) model	$\delta=0.1$ $\sigma=1.5$ $\rho=0.02$ $\tau_{11}=\tau_{12}=0.25$ $\tau_{21}=\tau_{22}=0$ $w=0.36$ $v=0.17$			
Other baseline parameters	$\Phi_{11}+\Phi_{12}=0.35$ $\Phi_{21}+\Phi_{22}=0.65$			
Jones, Manuelli and Rossi(1993) figures for common benchmark indicators	$r=0.05$ $G=0.02$			
Other benchmark indicators	$s+\omega=-0.0075$			
Long-Run 'Fiscal Correction' Equilibria				
b	0.45	0.85	1.25	2.50
$\Delta\tau_{11}=\Delta\tau_{12}$	-0.04	-0.03	-0.02	0.1
$\Delta\tau_{21}=\Delta\tau_{22}$ 1/	0.05	0.05	0.05	0.05
g	0.021	0.033	0.045	0.082
$G_{\Delta\tau}$	0.021	0.021	0.021	0.022
$r_{\Delta\tau}$	0.045	0.045	0.044	0.039

1/ This parameter was held fixed through the computations (which used the Mathematica software package).

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