Budget Deficits, National Saving, and Interest Rates

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ABSTRACT

This paper provides new evidence that sustained budget deficits reduce national saving and raise interest rates by economically and statistically significant quantities. Using a series of econometric specifications that nest Ricardian and non-Ricardian models, we obtain evidence of strong non-Ricardian behavior in aggregate consumption. Consistent with several recent studies, we find that projected future deficits affect long-term interest rates, but current deficits do not. Our estimates suggest that each percent-of-GDP in current deficits reduces national saving by 0.5 to 0.8 percent of GDP. Each percent-of-GDP in projected future unified deficits raises forward long-term interest rates by 25 to 35 basis points, and each percent-of-GDP in projected future primary deficits raises interest rates by 40 to 70 basis points.

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I. Introduction

Economic analysis of the aggregate effects of fiscal policy dates back at least to the work of David Ricardo. Modern academic interest was reinvigorated by the work of Barro (1974) and others, and by the large U.S. federal budget deficits in the 1980s and early 1990s. These factors led to a substantial amount of research that is summarized in several excellent surveys.[1] The rapid but short-lived transition to unified budget surpluses in the late 1990s, followed by the sharp reversal in budget outcomes since 2000, has raised interest in this question again.

Economists tend to view the aggregate effects of fiscal policy from one of three principal perspectives. To sharpen the distinctions among the models, it is helpful to consider deficits induced by changes in the timing of lump-sum taxes, holding the path of government purchases constant. Under the Ricardian Equivalence hypothesis, such deficits are fully offset by increases in private saving and have no effect on national saving, interest rates, exchange rates, future domestic production, or future national income. A second model, the small open economy view, suggests that budget deficits reduce national saving, but that international capital inflows finance the entire reduction in national saving. In this model, budget deficits increase borrowing from abroad and therefore reduce future national income, but they do not affect interest rates or future domestic production. A third model, which we call the conventional view, suggests that deficits reduce national saving and that the reduction in national saving is at least partly reflected in lower domestic investment. In this model, budget deficits partly crowd out private investment and partly increase borrowing from abroad, both of which reduce future national income and future domestic production. The reduction in domestic investment in this model is facilitated by an increase in interest rates, establishing a connection between deficits and interest rates.

We emphasize throughout this paper that the distinction between the first model and the latter two is the most fundamental: that is, the relationship between deficits and national saving is central to analysis of the economic effects of fiscal policy. National saving, which is the sum of private and government saving, finances national investment, which is the sum of domestic investment (the accumulation by Americans of assets at home) or net foreign investment (the net accumulation by Americans of assets abroad). The accumulation of assets associated with national saving means that the capital stock owned by Americans rises. The returns to those additional assets raise the income of Americans in the future.

An increase in the budget deficit reduces national saving unless it is fully offset by an increase in private saving. If national saving falls, then national investment and

[1] See Barro (1989), Barth et al (1991), Bernheim (1987, 1989), Elmendorf and Mankiw (1999), and Seater (1993).

future national income must fall as well, all else equal. In other words, to the extent that budget deficits reduce national saving, they reduce future national income. This reduction in future national income occurs even if the reduction in national saving associated with budget deficits manifests itself solely in increased borrowing from abroad (as under the small open economy view), with no increase in domestic interest rates.

If national saving falls, a second question is how the elements of the identity that national saving equals national investment come back into alignment. The possibilities are limited: either domestic investment falls and/or net foreign investment falls. These changes in investment quantities can occur through different combinations of changes in prices (interest rates and exchange rates), but they must occur even if one of the prices does not move. This is the sense in which the effect of deficits on interest rates and exchange rates (the distinction between the small open economy view and the conventional one) is subsidiary to the question of the effects on national saving (the Ricardian view versus the other two).

A key objective of this paper is to distinguish among the three models empirically. We test the Ricardian view against the small open economy and conventional views by estimating the effect on national saving of budget deficits associated with tax reductions, controlling for government purchases, transfers, marginal tax rates, and other factors. Our empirical results imply that such budget deficits substantially reduce national saving, suggesting that the Ricardian view is not a reasonable approximation to reality. We then test the small open economy view against the conventional one by examining whether deficits affect interest rates. Our results suggest that projected budget deficits raise long-term interest rates in the United States. (Indeed, despite a rancorous public debate, there appears to be a surprising degree of convergence in recent estimates of the effects of sustained budget deficits on interest rates.) The relationship between deficits and interest rates not only provides further evidence against the Ricardian view, but also implies that the conventional view is a better description of reality for the United States than the small open economy view.

A second objective is to apply the findings to analysis of recent and projected fiscal policy actions. Under plausible assumptions described below, the unified deficit over the next decade will average about 3.5 percent of GDP. Our estimates suggest that these deficits will reduce national income by about 1 to 2 percent, on an ongoing basis, by 2015. In addition, in conjunction with other information, the estimates imply that making the 2001 and 2003 tax cuts permanent would raise the cost of capital for new investment, and reduce long-term investment and economic growth.

Section II provides information on historical patterns and projections for federal debt, deficits, and components. Section III provides a framework for evaluating fiscal policy by comparing the three models noted above and discussing other, less traditional, ways that deficits can affect economic performance. Section IV provides preliminary empirical analysis that generally supports the conventional view, and simulates the likely magnitude of fiscal policy effects in the conventional approach. Section V examines the effects of deficits on aggregate consumption. Section VI explores links between deficits and interest rates. A final section discusses some of the implications of our findings.

II. Fiscal Policy: Trends and Projections

The federal budget deficit in any year can be measured in a variety of ways; the most appropriate measure is likely to be dependent on the particular model or application employed. The most widely-used measure, the unified budget balance, is fundamentally a cash-flow metric that includes both the Social Security and non-Social Security components of the Federal budget. To a first approximation, the unified deficit shows the extent to which the government borrows or lends in credit markets.[2] For some purposes, it is more informative to examine the primary budget, which excludes interest payments from unified budget. The standardized budget balance adjusts the unified budget for the business cycle and special items.[3] We focus primarily on these traditional cash-flow measures. In particular, while we recognize the importance of the implicit debt created by promises of future government benefits, we do not incorporate these promises directly into our analysis, in part because historical time series are not generally available and in part because it is unclear how the market and households value this implicit debt relative to the government's explicit debt.[4]

Figure 1 shows the evolution since 1962 of the surplus or deficit in the unified budget and the Congressional Budget Office's (2004b) standardized surplus or deficit. Both measures clearly show a rise in the deficit relative to GDP in the early and mid-1980s, a dramatic correction over the course of the 1990s, and an equally dramatic deterioration since 2000. In fiscal year 2004, the unified deficit is projected to be about 4 percent of GDP, while the standardized surplus is projected to be only slightly smaller. As the figure shows, deficits of this magnitude are substantial relative to historical norms. Even so, the current budget situation would not be a concern if future fiscal prospects were auspicious. Unfortunately, the budget outlook is dismal.

The top line of Figure 2 shows CBO's (2004a) baseline projections for the deficit in the unified budget as of March 2004. The projections assume that the 2001 and 2003 tax cuts expire as scheduled. CBO projects a 10-year baseline unified budget deficit of $2.0 trillion, or 1.3 percent of GDP, for fiscal years 2005 to 2014, with the deficits shrinking over time and almost disappearing by 2014.

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[2] The unified budget is not recorded entirely on a cash-flow basis, and so the unified deficit does not precisely match the increase in debt held by the public. For example, only the subsidy cost of direct loan transactions are now recorded in the unified budget. The government must, however, finance the full value of the loan. Therefore, the unified budget deficit (which reflects only the subsidy cost of a direct loan) is smaller than the increase in debt held by the public (which reflects the full value of the direct loan).

[3] These include losses due to deposit insurance, receipts from auctions of licenses to use the electromagnetic spectrum, timing adjustments, and contributions of Allied Nations for Operation Desert Storm (CBO 2004b).

[4] Auerbach, Gale, Orszag, and Potter (2003) discuss the relationship between the cash-flow measures, accrual accounting, generational accounting and other ways of measuring the fiscal status of the government.

The baseline projection is intended to provide a benchmark for legislative purposes. It is explicitly not intended to be a projection of actual or likely budget outcomes, or a measure of the financial status of the federal government (CBO 2004a). Thus, adjustments to the baseline are required to generate a more plausible budget scenario and to develop more meaningful measures of the fiscal status of the government.[5] One concern is that the baseline holds real discretionary spending constant over time. In a growing economy with an expanding population and evolving security needs, this assumption is not credible. A second concern is that the baseline assumes that all temporary tax provisions expire as scheduled, even though most have been routinely extended in the past.[6] A third concern is that the alternative minimum tax grows exponentially under the baseline, a development that few observers regard as plausible.[7] Finally, the baseline uses cash-flow accounting, which is appropriate for many programs, but which can distort the financial status of programs with liabilities that increase substantially outside the projection period.

Adjusting for these factors has an enormous impact on 10-year budget projections. Figure 2 shows that if (a) discretionary spending is allowed to grow with inflation and population, (b) the expiring tax provisions that are not related to extension of the 2001 and 2003 tax cuts are extended, and (c) the AMT problem is resolved by indexing the AMT for inflation,[8] the adjusted unified budget deficit rises to 2.3 percent of GDP over the decade and 1.4 percent of GDP in 2014. If, in addition, the 2001 and 2003 tax cuts are made permanent, the adjusted unified deficit would average 3.5 percent of GDP over the decade and would equal 3.6 percent of GDP (almost $700 billion) in 2014.[9]

One way to gauge the implications of the adjusted unified baseline is to examine the implied ratio of public debt to GDP, as in Figure 3. Under the adjusted baseline, the

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[5] See Auerbach, Gale, Orszag, and Potter (2003) for an extended discussion of these issues.

[6] The statement regarding past practice refers to a number of provisions (often dubbed "the extenders" and including items such as tax credits for work opportunity or for research and experimentation) that have existed for years, are narrow in scope, have relatively minor budget costs, and for which extensions occur as a matter of routine. The "temporary" provisions having to do with 2001 and 2003 tax cuts are quite different in nature and scope. Whether they are extended is a major fiscal policy choice, not a matter of routine. See Gale and Orszag (2003b) for further discussion of expiring provisions and Gale and Orszag (2004a) on the effects of making the tax cuts permanent.

[7] See Burman, Gale, and Rohaly (2003) for discussion of AMT projections and trends.

[8] To distinguish the AMT adjustments required from making the 2001 and 2003 tax cuts permanent from those that would have been required under pre-2001 law, our calculations of the cost of indexing the AMT use pre-2001 law to calculate the cost of indexing the AMT for inflation. The AMT adjustments required from making the 2001 and 2003 tax cuts permanent are counted as part of the cost of making the tax cuts permanent (see Gale and Orszag 2004a).

[9] The estimate of the cost of making the 2001 and 2003 tax cuts permanent comes from Gale and Orszag (2004a) and includes an adjustment to keep the number of AMT taxpayers the same as it would have been under pre-2001 law.

debt-GDP ratio would rise steadily throughout the decade and by 2014 would equal 55 percent, well above the most recent high of 49 percent in 1992 and the highest level since 1955. The debt-GDP would continue to rise thereafter.

The ratio of marketable public debt to GDP only tells part of the long-term budget story, however. Social Security, Medicare Part A, and government employee pensions programs are projected to run surpluses over the next decade but face shortfalls in the long term. One way to control for these effects is to examine a 10-year horizon and separate the retirement trust funds from the rest of the budget. For example, Figure 2 shows that omitting retirement funds, the rest of the budget would face deficits of 5.4 percent of GDP over the decade (and 5.4 percent of GDP in 2014) under the assumptions above.

An alternative way to incorporate the entitlement trust funds is to extend the time horizon of the analysis so that future shortfalls are included. To do this, we report estimates of the fiscal gap, the size of the immediate and permanent increase in taxes and/or reductions in non-interest expenditures that would be required to establish the same debt-GDP ratio in the long run as holds currently.[10] Auerbach, Gale, and Orszag (2004) estimate that under the adjustments made in Figure 2, the nation faces a long-term fiscal gap in 2004 of 7.1 percent of GDP through 2080 and 10.3 percent of GDP on a permanent basis.[11] Gokhale and Smetters (2003) and the Bush Administration (OMB 2004) have made similar projections.

The main drivers of the fiscal gap, under the assumptions made, are the revenue losses from making the 2001 and 2003 tax cuts permanent and the spending growth from Medicare, Medicaid, and Social Security. The recent tax cuts, if extended and not eroded over time by the alternative minimum tax, would cost roughly 2 percent of GDP over the long term (Gale and Orszag 2004a). To help put these figures in context, over the next 75 years, the actuarial deficit in Social Security is 0.7 percent of GDP under the Trustees' assumptions and 0.4 percent of GDP under new projections issued by CBO (2004c).[12] The deficit in Medicare's Hospital Insurance (Part A) program is 1.4 percent of GDP over the next 75 years. Thus, extending the tax cuts would reduce revenue over the next 75 years by an amount about as large as the entire shortfall in the Social Security and

[10] See Auerbach (1994). Over an infinite planning horizon, the requirement is equivalent to assuming that the debt-GDP ratio does not explode. Alternatively, the adjustments set the present value of all future primary surpluses equal to the current value of the national debt, where the primary surplus is the difference between revenues and non-interest expenditures. Auerbach, Gale, Orszag, and Potter (2003) discuss the relationship between the fiscal gap, generational accounting, accrual accounting and other ways of accounting for government.

[11] In perhaps more familiar terms, the primary deficit would be 4.1 percent of GDP in 2030, 5.5 percent in 2060 and 5.8 percent by 2080; the unified deficit would rise much faster because of accruing interest payments and would be 13 percent of GDP in 2030, 37 percent by 2060 and 64 percent by 2080. Public debt would be 139 percent of GDP in 2030, 505 percent in 2060 and 942 percent in 2080.

[12] The actuarial deficit in Social Security over an infinite horizon amounts to 1.2 percent of GDP under the Trustees' assumptions.

Medicare Part A trust funds over the same period.

Even if the tax cuts are not made permanent, though, the fiscal gap would be 5.1 percent of GDP through 2080 and 8.2 percent on a permanent basis. A primary reason is substantial projected increases in entitlement costs. Figure 4 shows the projected increases in Social Security, Medicare -- including Part A (Hospital Insurance), Part B (Supplementary Medicare Insurance) and Part D (Prescription Drug Benefits) -- and Federal Medicaid costs as a share of GDP over the long term (Auerbach, Gale, and Orszag 2004). The projected retirement of the baby boomers, ongoing increases in life expectancy, and growth in health care costs per beneficiary that exceed per capita GDP combine to drive Federal expenditures on these three programs from 8.1 percent of GDP in 2004 to a projected 10.2 percent by 2015, 13.3 percent by 2025, and 22.7 percent by 2075. [13] Figure 4 also shows that the vast majority of the growth occurs in the health-related programs, not in Social Security. Indeed, after about 2030, Social Security costs are roughly stable relative to GDP. Unfortunately, the health-related programs are much more difficult to reform than Social Security.

To be sure, substantial uncertainty surrounds the short- and long-term budget projections described above. Much of the problem stems from the fact that the surplus or deficit is the difference between two large quantities, taxes and spending. Small percentage errors in either one can cause large percentage changes in the difference between them. Furthermore, small differences in growth rates sustained for extended periods can have surprisingly large economic effects. Variations in assumed health care cost inflation, in particular, can have a substantial effect on the precise projections (CBO 2003). Nonetheless, almost all studies that have examined the issue suggest that even if major sources of uncertainty are accounted for, serious long-term fiscal imbalances will remain.[14]

III. The Economic Effects of Budget Deficits

A. Traditional Models

Figure 5 provides a summary of the three distinct views of deficits (at least, of deficits created by changes in the timing of lump-sum taxes, holding the path of government purchases constant) described earlier. Under Ricardian Equivalence, private saving rises by the same amount as government saving falls (i.e., by the same amount as the deficit rises), national saving is constant and no further adjustments would be required or expected (Barro 1974).

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[13] Although it is clear that entitlement spending is a major factor in generating long-term fiscal shortfalls, it is not straightforward to determine how much of the fiscal gap is due to such programs because to a large extent they are supposed to be funded from general revenues. Auerbach, Gale, and Orszag (2004) examine different ways of decomposing the long-term fiscal gap.

[14] Lee and Edwards (2001) and Shoven (2002).

If private saving rises by less than the full amount that public saving falls, then national saving falls, and further adjustments are required to bring national saving and the sum of domestic and net foreign investment back into balance.[15] If private saving does not fully offset the change in public saving, but the flow of capital from overseas is infinitely elastic, the entire quantity adjustment occurs through higher capital inflows. In this case, net foreign investment declines, but the domestic capital stock remains constant. Since the domestic capital stock remains the same, domestic output (Gross Domestic Product) is constant. Americans' claims on that output, however, decline because the increased borrowing from abroad must be repaid in the future. In other words, the repayments effectively create a mortgage against future national income; as a result, future Gross National Product declines even though Gross Domestic Product is constant.[16] Because the capital inflow in this example is assumed to be infinitely elastic, interest rates do not change. Notably, even though interest rates do not change in this scenario, higher deficits still reduce future national income (GNP). We refer to this scenario as the small open economy view.

A third possibility is that the supply of international capital is not infinitely elastic. In this case, the relative price and quantity adjustments are different than under the small open economy model, but the end result -- a decline in future national income -- remains the same. In the absence of perfect capital mobility, the reduction in national saving implies a shortage of funds to finance investments given existing interest rates and exchange rates. That imbalance puts upward pressure on interest rates as firms compete for the limited pool of funds to finance investments. The increase in interest rates serves to reduce domestic investment. In a closed economy, the entire adjustment to the reduction in national saving occurs through domestic investment. In an open economy with imperfect capital mobility, the decline in national saving and the resulting rise in interest rates induce some combination of a decline in domestic investment and a decline in net foreign investment (i.e., increases in capital inflows). These changes must be sufficient to ensure that the change in national investment equals the change in national saving. Following Elmendorf and Mankiw (1999), we refer to this scenario as the conventional view.

B. Non-traditional effects

Beyond their direct effect on national saving, future national income, and interest

[15] The effects described in the text, in response to a change in the deficit, would occur simultaneously. Our ordering of the discussion is intended merely to provide a way of thinking about the channels through which deficits affect the economy. It does not imply or require that the particular changes discussed occur in some particular order over time.

[16] The distinction between domestic investment and net foreign investment is of secondary importance in determining national income (GNP), though it clearly affects domestic income (GDP). Elmendorf and Mankiw (1999, page 1637) note that "As long as the returns to wealth are the same at home and abroad, the location of the...[change in] wealth does not affect our income… Tomorrow's national output and income depend on today's national saving, wherever this saving is ultimately invested." They also note several caveats to this statement, including differential tax implications of investment abroad relative to investment at home and income distributional implications.

rates, deficits can affect the economy in other ways. For example, increased deficits may cause investors gradually to lose confidence in U.S. economic leadership. As Truman (2001) emphasizes, a substantial fiscal deterioration over the longer-term may cause "a loss of confidence in the orientation of US economic policies..." Such a loss in confidence could then put upward pressure on domestic interest rates, as investors demand a higher risk premium on dollar-denominated assets. The costs of current account deficits -- which are in part induced by large budget deficits -- may even extend beyond narrow economic ones. More broadly, Friedman (1988) notes that, "World power and influence have historically accrued to creditor countries. It is not coincidental that America emerged as a world power simultaneously with our transition from a debtor nation…to a creditor supplying investment capital to the rest of the world."

Both the traditional models and the non-traditional effects noted above focus on gradual negative effects from reduced national saving. This focus may be too limited, however, in that it ignores the possibility of much more sudden and severe adverse consequences (Rubin, Orszag, and Sinai 2004). In particular, the traditional analysis of budget deficits in advanced economies does not seriously entertain the possibility of explicit default or implicit default through high inflation.[17] If market expectations regarding the avoidance of default were to change and investors had difficulty seeing how the policy process could avoid extreme steps, the consequences could be much more severe than traditional estimates suggest. The role of financial market expectations in this type of scenario is central. In particular, one of the key triggers would occur if investors begin to doubt whether the strong historical commitment to avoiding substantial inflation in order to reduce the real value the public debt would be weakened. As Ball and Mankiw (1995, page 117) note, "We can only guess what level of debt will trigger a shift in investor confidence, and about the nature and severity of the effects. Despite the vagueness of fears about hard landings, these fears may be the most important reason for seeking to reduce budget deficits…as countries increase their debt, they wander into unfamiliar territory in which hard landings may lurk. If policymakers are prudent, they will not take the chance of learning what hard landings in G-7 countries are really like."

Although we do not explicitly incorporate non-traditional effects in our analysis below, they serve as an important reminder of why the effects of deficits, especially chronic deficits, could prove important. Our focus on traditional effects is certainly justifiable in the context of historical analysis of post-war data from United States. That does not imply, however, that ignoring such issues is appropriate when examining the likely impacts of future deficits. The nation has never before faced substantial deficits that are projected to be sustained and indeed grow over many decades.

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[17] The traditional view also suggests that the exchange rate would either stay constant or appreciate in response to the inflow of capital from abroad. The sign of the exchange rate change, however, is unclear if a country-specific risk premium exists. If that premium increases as a nation's net international indebtedness (or flow of new international borrowing) increases, the exchange rate could depreciate. In other words, while non-traditional effects are likely to accentuate the impact of deficits on interest rates, they may alter even the sign of the exchange rate dynamics.

IV. Preliminary Evidence and Benchmark Calculations

A. A Preliminary Examination of the Data

Figure 6 shows net national saving and net federal government saving as shares of net national product (NNP) since 1950.[18] Federal saving has fluctuated significantly over time. The variation in Federal saving is visibly correlated with swings in national saving. Both series follow a secular decline from 1950 to 1975, rise somewhat in the late 1970s, and then fall through the mid-1980s. The correlation is even more apparent in the last two years. The two series both rise moderately in the mid-1980s, decline from the late 1980s to early 1990s, rise significantly during the 1990s, and then decline again over the past few years. Over the whole period, a regression of national saving on federal saving (with each expressed as a share of NNP) yields a coefficient of 1.02 (t=7), and a regression of changes in national saving/NNP on changes in federal saving/NNP yields a coefficient of 0.86 (t=9).[19]

Figure 7 shows net national saving and net domestic investment as a share of net national product (NNP) since 1950.[20] The two series follow very similar patterns over time. Domestic investment has declined by less than national saving over the past 20 years and has exceeded national saving in every year since the early 1980s. The difference is reflected in chronic current account deficits (not shown) and a substantial decline in the nation's net international investment position.[21] The decline in national saving over the past few years has been much sharper than the decline in net domestic investment. Between 1998 and 2003, national saving declined by 6 percent of NNP, with about half of the decline made up by increased capital inflows, and half by reduced net domestic investment. A regression of net domestic investment/NNP on net national saving/NNP yields a coefficient of 0.57 (t=15). In first-differences, the coefficient is 0.83 (t=10).

Figure 8 plots annuals observations of the projected 5-year ahead, long-term interest rate on Treasury bonds, and the Congressional Budget Office's projected deficits

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[18] Net national saving is defined as gross saving minus depreciation of the capital stock, and is taken from the National Income and Product Accounts Table 5.1, line 2. Net federal saving is defined as gross Federal saving minus depreciation on the Federal government's physical capital stock and is taken from Table 5.1, line 11.

[19] The regressions include a constant, as do the regressions mentioned in the subsequent two paragraphs.

[20] Net domestic investment is equal to gross investment minus depreciation of the capital stock, and is taken from the National Income and Product Accounts, Table 5.1, line 31.

[21] The current account, as defined by the "net lending" series published by the Bureau of Economic Analysis, ran a small surplus in 1991, in part because of capital account transactions and in part because of a large statistical discrepancy. The U.S. has gone from being a creditor nation in 1980, with a net international investment position (NIIP) of 10 percent of GDP, to a debtor nation, with a NIIP of about -25 percent of GDP in 2001.

as a share of GDP five years ahead.[22] Figure 9 shows similar observations for forward long-term rates and projected publicly held debt. Both figures show a clear association between projected fiscal policy outcomes and forward long-term real interest rates. For example, a regression of the forward rate on the 5-year ahead projected ratio of the unified deficit to GDP implies that a one percent of GDP increase in the projected deficit is associated with an increase of the forward rate of about 27 basis points (t=5).

Figures 6-9 suggest a very simple story: Increases in current Federal budget deficits reduce net national saving, which reduces net domestic investment. Increases in projected future federal deficits raise long-term interest rates, which explains how reductions in national saving serve to reduce domestic investment. These patterns are consistent with the conventional view, but not with the Ricardian or small open economy view. A primary goal of the paper is to see robust these simple relationships are to more formal analysis.

B. Magnitude of conventional effects in two simplified models

To generate some intuition about the potential magnitudes involved in the conventional approach, we first follow Shapiro (2004) and examine the effects of sustained budget deficits in the context of the Solow growth model. Based on Mankiw (2000, page 123), we assume that the economy's growth rate (n+g) is equal to 3 percent per year, the depreciation rate (δ) is 4 percent per year, and the capital share of output is 30 percent. We also assume that the initial saving rate is 17.5 percent.[23] This saving rate, for example, could reflect a private gross saving rate of 20 percent of output and a unified budget deficit of 2.5 percent, which are the values we assume for illustrative purposes. These assumptions generate an initial steady-state with a capital-output ratio of 2.5 and a gross marginal product of 12 percent, which are reasonable values for the United States (Table 1).

Now assume that the unified budget deficit rises by 1 percent of output on a sustained basis.[24] Suppose that one-quarter of the decline in public saving is offset by an increase in private saving; this response is somewhat more than might be expected based on the data patterns in Figure 6, but somewhat less than the typical estimate we provide below. With this private sector saving response, the budget deficit rises to 3.5 percent of output, private saving rises to 20.25 percent of output, and the national saving rate declines to 16.75 percent.[25] Given the reduction in national saving, output per capita in the new steady-state is reduced by 1.9 percent. The marginal product of capital is 54 basis points higher. If we assume that the change in the government borrowing rate is equal to the change in the marginal product of capital, the implication is that the increase

[22] The data employed in the figure are described in more detail in section VI and Appendix Table 4.

[23] Mankiw assumes a capital-output ratio of 2.5, and then solves for the saving rate. The implied saving rate is 17.5 percent.

[24] Note that this simplified model does not impose a government budget constraint.

[25] The example assumes a closed economy, so we do not take into account net foreign investment changes.

in the unified budget deficit raises the interest rate by 54 basis points.

These results provide one way of calibrating the traditional effects of changes in the budget deficit. Under our base case assumptions, holding other factors constant, a sustained increase in the unified deficit of 1 percent of GDP reduces output by about 2 percent, and raises interest rates by about 50 basis points. If, instead, half of the decline in public saving is offset by an increase in private saving, output per capita falls by 1.2 percent and interest rates rise by 35 basis points. If there is no private saving response, output per capita is reduced by 2.5 percent and the marginal product of capital rises by 73 basis points (Table 1).

The analysis can also be undertaken with regard to the stock variable (government debt) rather than the flow variable (the deficit). In a steady state, the debt-GDP ratio is equal to the unified deficit-GDP ratio divided by the GDP growth rate.[26] Assuming a 3 percent growth rate as in the Solow model exercise above, an increase in the unified deficit-GDP ratio of 1 percent of GDP would thus raise the steady-state debt-GDP ratio by approximately 33 percentage points.

To map this increase in the debt-GDP ratio into a change in income and interest rates, we follow the basic contours of the "debt fairy" calculation in Ball and Mankiw (1995). First, as in the Solow model above, we assume the initial steady-state for the economy involves a capital-output ratio of 2.5. The change in the capital-output ratio depends on how much of the debt increase is offset by increased private capital accumulation; as in the base case above, we assume a 25 percent offset. The reduction in capital is thus equal to 25 percent (=33*0.75) of initial GDP. Assuming a marginal product of capital equal to 12 percent, the reduction in the capital stock causes income to decline by about 3 percent. Second, to map the change in the capital-output ratio into a change in the marginal product of capital, a specific form of the aggregate production function is necessary. With a Cobb-Douglas production function, the percentage increase in the marginal product of capital is equal to the percentage decline in the capital-output ratio. The capital-output ratio falls by 7 percent, from 2.50 to 2.32. The marginal product of capital would thus rise by 7 percent, from 12.0 to 12.8. Finally, we again assume that the change in the long-term government borrowing rate is equal to the change in the marginal product of capital. The debt perspective thus suggests that a sustained increase in the unified deficit equal to 1 percent of GDP would reduce income by 3 percent and raise steady-state long-term interest rates by about 80 basis points.

Thus, the deficit exercise and the debt exercise are basically consistent: A sustained increase in the unified deficit equal to one percent of GDP would reduce income by 2 to 3 percent and raise long-term interest rates by roughly 50 to 80 basis points under the base-case assumptions.

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[26] If the unified deficit is a constant share of GDP, then (rD+p)/Y=k, where r is the interest rate, D is government debt, p is the primary budget balance, and Y is GDP. A constant debt-GDP ratio requires that D grow at rate g, or that (rD+p)/D=g, where g is the growth rate of Y. Therefore, in a steady state with a constant debt-GDP ratio, D/Y=k/g.

To be sure, it is challenging to move from these simplified models to real-world results. The models, for example, effectively assume a closed economy. The U.S. economy, however, is usually considered large and open. One would therefore expect capital inflows to mitigate the interest rate and domestic production effects to some degree, even though the effect on national income should be largely unaffected by the assumption of a closed economy.

Another key consideration is that the results above consider only the effects of increased budget deficits or debt *per se*. A full analysis of the effects of public policies on economic growth should take into account not only the effects of increased deficits and debt, but also the direct effects of the spending programs or tax reductions that cause them. The effects of fiscal policies on both economic performance and interest rates depend not only on the deficit but also on the specific elements of the policies generating that deficit. For example, spending $1 on public investment projects would increase the unified budget deficit by $1, but the net effect on future income would depend on whether the return on the public investment project exceeded the return on the private capital that would have instead been financed by the national saving crowded out by the deficit. Similarly, a deficit of one percent of GDP caused by reducing marginal tax rates will generally have different implications for both national income and interest rates than a deficit of one percent of GDP caused by increasing government purchases of goods and services. We return to this issue in the conclusion.

V. Deficits and Consumption

Our goal in measuring the effects of fiscal policy on consumption is to distinguish the Ricardian view from the other two views. A wide variety of research tends to reject various *indirect* implications of Ricardian Equivalence. For example, previous studies have generally found that: motives for bequests are neither universal nor purely altruistic; consumer spending responds to temporary tax cuts; anticipated changes in income do not affect consumption until the changes actually occur (although there is mixed evidence on this point); and aggregate consumption is sensitive to the age distribution of the population.[27]

We focus on a different set of tests: those using aggregate time-series data to examine the impact of tax revenues on consumption, holding other factors constant. Despite the numerous rejections of Ricardian Equivalence in the indirect tests noted above, the time has come to revisit the aggregate time-series effects of fiscal policy on consumption for several reasons. First, these analyses provide a direct test of whether the timing of tax collections affects the economy, controlling for other factors. Second, the aggregate time series tests provide a direct measure of the *magnitude* of the effects in question. This is particularly important because virtually no one claims that Ricardian Equivalence is literally true. Rather, the controversy is over the extent to which Ricardian Equivalence is a good approximation of the aggregate impact of fiscal policies. The indirect tests noted above can be helpful in distinguishing whether the literal

[27] See, for example, the discussion in Bernheim (1987), Elmendorf and Mankiw (1999) and Seater (1993).

implications of Ricardian Equivalence hold, but they are often uninformative about the quantitative importance of any particular rejection of the theory. Third, there has been little work on these issues using data beyond the early 1990s. The past 10 years, however, have witnessed dramatic fiscal policy shifts in both directions. These shifts have raised the prominence of policy concerns about budget deficits, and should provide useful variation from an econometric perspective. Fourth, despite the rejection of many of the indirect implications of Ricardian Equivalence noted above, at least some lines of previous research using aggregate time series data has proven somewhat more favorable to the Ricardian view. This may be due to problems that are unique to time-series analysis, but it may also be that Ricardian Equivalence is more robust -- in particular as a working approximation -- than the indirect tests suggest.

A. Previous Research

Authors of earlier literature surveys note the wide variety of research findings from studies of aggregate consumption and fiscal policy, and emphasize the daunting econometric problems inherent in such studies, but come to different conclusions about what the literature shows. Barro (1989) and Elmendorf and Mankiw (1999) conclude the literature is inconclusive. Seater (1993) concludes that once the studies are corrected for econometric problems, Ricardian Equivalence is corroborated -- or at least that it is not possible to reject Ricardian Equivalence. Bernheim (1989) concludes that once the studies are normalized appropriately, Ricardian Equivalence should be rejected.

Previous studies of the effects of fiscal policy on consumption have taken three general approaches. A variety of studies provide reduced form analysis of consumption and saving patterns in United States and other countries.[28] Like figures 6 and 7 above, these studies generally appear to support non-Ricardian interpretations of the data.

A second strand of the literature, and by far the largest segment, specifies consumption functions and then tests for the effects of fiscal policy given the consumption function (Feldstein 1982, Seater and Marianno 1985, Kormendi, 1983). Perhaps the best-known study in this area is Kormendi (1983), who finds no evidence of non-Ricardian effects. This work has spawned significant research, including three sets of exchanges in the *American Economic Review*. At the risk of oversimplifying, the work of Kormendi (1983) and Kormendi and MeGuire (1986, 1990, 1995) has survived the challenges well enough to continue to serve as the bulwark of empirical evidence for the Ricardian view of the world (as in, for example, the survey by Seater 1993).[29]

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[28] See, for example, Summers (1985), Carroll and Summers (1987), Poterba and Summers (1986, 1987), and Serres and Pelgrin (2003).

[29] A comprehensive review of the literature following Kormendi (1983) is beyond the scope of this paper, but some highlights include the following. Barth, Iden, and Russek (1986) update the data, correct some data problems, and obtain results broadly similar to Kormendi (1983). Modigliani and Sterling (1986) argue that Kormendi's results are flawed because of data problems, a failure to distinguish temporary and permanent taxes, and inappropriate first-differencing of the data. They develop an aggregate consumption function derived from the life-cycle model that contains Ricardian Equivalence as a special case. Their empirical results show strongly non-Ricardian results. Kormendi and MeGuire (1986) note significant

A third strand of the literature focuses on Euler equation tests. There have been very few Euler equation tests of Ricardian Equivalence. Aschauer (1985) examines the effects of fiscal policy assuming utility maximization and rational expectations, but his model does not nest a non-Ricardian specification (Bernheim 1987, Graham and Himarios 1991). Graham and Himarios (1991) nest Ricardian and non-Ricardian views in a model that builds off of Hayashi (1982) and find non-Ricardian results using a non-linear instrumental variables procedure. A substrand of the literature aims to test the Blanchard (1985) model, which nests Ricardian and non-Ricardian alternatives. Evans (1988, 1993) and Evans and Hasan (1994) obtain results that are generally consistent with Ricardian Equivalence, while Graham and Himarios (1996) correct several data and econometric issues in Evans' work and find strong non-Ricardian effects.

The relative value of consumption function versus Euler equation approaches is a recurring theme in the literature. The advantage of using the Euler equation approach is that Ricardian equivalence requires a combination of utility maximization and rational expectations that can be explicitly incorporated in the Euler equation. The disadvantage is that Euler equation models can (and do) fail for reasons unrelated to Ricardian Equivalence, and Ricardian Equivalence can fail in ways that do not affect the Euler equation (Bernheim 1987). Flavin (1987) argues that the consumption function approach is fundamentally inconsistent with Ricardian Equivalence and therefore can not be used to test the theory. On the other hand, the strongest evidence in favor of Ricardian Equivalence comes from the consumption function studies by Kormendi (1983) and Kormendi and MeGuire (1986, 1990), which Seater (1993) claims is the best available evidence on the issue. Rather than attempting to resolve this debate, we estimate both consumption function and Euler equation models. We also show that the two specifications are closely related, so that the difference between them in practice may not be large, even though the conceptual frameworks are quite different.

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problems with how Modigliani and Sterling have defined temporary taxes. They show that imposing the condition that taxes and transfers have effects of equal magnitude and opposite sign (as Modigliani and Sterling do) is not supported by the data, and that when the restriction is released, taxes and government debt continue to have Ricardian effects. Feldstein and Elmendorf (1990) work within the Kormendi framework and evaluate the effects of removing war years, extending the sample, other specification changes, and instrumenting for endogenous explanatory variables. After reproducing Kormendi's estimates, they find that their extensions fundamentally alter the findings, and obtain very strong non-Ricardian results. Kormendi and MeGuire (1990), however, show that Feldstein and Elmendorf's results only obtain as the joint consequence of using what they view as the wrong deflators and failing to incorporate the improved definitions of variables that came out of the 1986 exchanges. Graham (1995) makes two adjustments to the Kormendi and MeGuire framework, extended to 1991. He allows state and local variables to have different effects than federal variables. He also claims that theory suggests that labor and capital income should have distinct effects and proposes a decomposition of aggregate income and taxes into those due to labor and those due to capital. His re-estimates suggest some non-Ricardian results, but not for tax revenues. Kormendi and MeGuire (1995) challenge the decomposition of income into labor and capital and show that an alternative definition generates Ricardian results.

B. Consumption Function Specification

Our consumption function specification replicates, updates and extends the work by Kormendi and MeGuire and their critics. Kormendi (1983) specifies an aggregate consumption function of the form:

(1) $$Ct = \alpha_0 + \alpha_{11}Y_t + \alpha_{12}Y_{t-1} + \alpha_2 GS_t + \alpha_3 W_t + \alpha_4 TR_t + \alpha_5 TX_t + \alpha_6 RE_t + \alpha_7 GINT_t + \alpha_8 GB_t + \varepsilon_t,$$

where t indexes time periods; C is a measure of consumption; Y is net national product; W is a measure of private net worth, not including government debt; GS is government purchases of goods and services; TR is government transfer payments; TX is tax revenue; RE is corporate retained earnings; GINT is government interest payments; and GB is outstanding value of government debt.

Ricardian and Non-Ricardian Hypotheses Although the equation is not specified in a structural manner, Kormendi (1983) argues that this framework nests both Ricardian and non-Ricardian hypotheses. The Ricardian view is that consumption depends on current wealth, expected future income, and the burdens imposed by government purchases. If current and lagged NNP serve as proxies for future income, then the expected coefficients on NNP and lagged NNP should be between zero and one. Likewise, in this formulation, the coefficient on wealth represents the marginal propensity to consume out of wealth.

Current government purchases is intended to be a proxy for expected future government purchases. The key point, however, is that even if current purchases are an accurate proxy for expected future purchases, the coefficient does not provide a test of Ricardian Equivalence. Ricardian Equivalence is a statement about how variations in the timing of taxation affect consumption, holding expected purchases constant. It has no necessary implications for the effects of purchases on consumption, since the items the government purchases could be substitutes or complements for private consumption.[30] Thus, while it is important to control for expected government purchases, the coefficient on the purchases variable does not provide information that can test the theory.

Instead, the central tests between Ricardian and non-Ricardian views have to do with the coefficients on current taxes and current transfers. Ricardian equivalence implies that $\alpha_4 = \alpha_5 = 0$; that is, that transfers and taxes should not affect consumption, given the path of government purchases. The values of these coefficients, if they are not

[30] Kormendi (1983) obtains a negative coefficient on government purchases and interprets this finding as evidence in favor of Ricardian Equivalence. Kormendi and MeGuire (1990), however, acknowledge that the coefficient on government spending is essentially uninformative in testing Ricardian and non-Ricardian views.

zero, provide a quantitative measure of the extent to which Ricardian equivalence fails as a description of reality.[31]

Of course, Ricardian equivalence also implies that $\alpha_8 = 0$; that is, that government bonds are not treated as net wealth by consumers.[32] Although this channel for non-Ricardian effects has attracted an enormous amount of attention over the past several decades, it is unlikely to be the major channel through which non-Ricardian effects occur. For example, Poterba and Summers (1987) and Evans (1991) show that, if Ricardian Equivalence is violated solely because forward-looking, life-cycle consumers treat government bonds completely as net worth, the effects of fiscal policy on short-run consumption are likely to be small. In addition, as discussed further below, there are both data and conceptual problems with interpreting the government bonds (and wealth) variables. As a result, we do not emphasize this channel for testing between the different models.

Data Details on the data construction are provided in Appendix Table 1. All of the variables are first transformed into real, per capita levels. To deal with stationarity issues, Kormendi and MeGuire (1990) and Feldstein and Elmendorf (1990) estimate regressions in first differences of the levels and in first differences of the ratios of each term divided by NNP per capita. Following Campbell and Mankiw (1990), we also adjust for stationarity a third way, dividing the first differences in the levels by lagged NNP per capita.[33]

We use two measures of consumption. The first is the one developed by Kormendi (1983): expenditures on non-durables and services, plus 10 percent of current durable expenditures plus 30 percent of the existing stock of durable goods. The second measure is the more common nondurables plus services used in many studies of aggregate consumption.

The wealth variable used in Kormendi (1983), Kormendi and MeGuire (1990) and other papers in this literature is an amalgam of different series with several extrapolations. Instead, we use data on household wealth from the Federal Reserve Board's Flow of Funds. We use household net worth rather than private net worth, because the household measure contains the market value of corporate equities held by

[31] Note, however, that there is an inconsistency in the specification in that current levels of government purchases are intended to proxy for permanent levels, but current levels of taxes and transfers are not intended to proxy for permanent levels of those items.

[32] The coefficients on government interest payments and retained earnings should be zero under Ricardian equivalence, but this test is not particularly interesting, because the coefficients should also be zero under other hypotheses. For example, the view that households pierce the corporate veil suggests that retained earnings should not affect consumption. Likewise, if government interest payments accrue mainly to high-income households who tend to save the funds, they will not affect consumption.

[33] Campbell and Mankiw (1990) divide by lagged disposable income, rather than NNP, but the difference is unimportant empirically. We divide by NNP in order to maintain consistency with the first difference in ratio specification.

households, whereas the private sector measure removes those values and replaces them with book values of corporate equity. Since we want to capture the influence of wealth on consumption, we believe that the market value of equities is the more appropriate measure to include. Likewise, for data on the market value of government bonds, we use updated and unified data from the Federal Reserve Bank of Dallas. For state data, we use the same methodology as Seater (1981), but we obtain more recently available data. Generally, the data under the new definitions track the data under the old definitions very closely for the years in which values of both are present.[34]

With these specifications, we have almost exactly the specification employed by Kormendi (1983) and Kormendi and MeGuire (1986, 1990, 1995). In earlier work (Gale and Orszag 2003c), we almost exactly replicate their results for earlier time periods dating from as far back as 1931 up to 1992.

Extending the Kormendi-MeGuire Approach Our analysis here focuses on three extensions of this framework. First, we extend the sample period to 2002. The added 10 years of data provide valuable variation in fiscal policy and national saving.

Second, we alter the treatment of government taxes and transfers. In the Kormendi specification, all government variables (taxes, transfers, purchases, interest payments, and debt) represent the combined values of federal, state, and local governments. But Federal and state variables are likely to have different effects on aggregate consumption. First, states face balanced budget rules, which implies that the cyclical dynamics of changes in state taxes or spending may be different than for federal taxes or spending, which implies in turn that the behavioral response to such changes might be different. Second, to the extent that state and local taxes are capitalized into local real estate prices, they are likely to have different effects than federal taxes. Perhaps most importantly, the states collect a significant share of their revenue through consumption taxes, which would be expected to vary *positively* with consumption, whereas other taxes would be expected, at least in non-Ricardian theory, to vary negatively.[35] At the very least, tests of the robustness of the results to specifications that allow for independent effects of federal and state variables are a reasonable specification check.

Third, in some specifications, we include a marginal tax rate as a control variable.

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[34] The data from the Federal Reserve Bank of Dallas appears to follow the same procedures as those developed in Cox (1985). The market value of state debt is calculated by multiplying the outstanding par value of state and local bonds (taken from the Statistical Abstract of the United States) by the ratio of market to par value for municipal bonds (taken from Standard and Poors 2003).

[35] Likewise, state and federal governments typically allocate their purchases of goods and services differently, with a large share of federal purchases going to defense, while state purchases are dedicated more to education, police and health care. The balanced budget rules also imply that state debt may be paid off at a different rate than federal debt, which again could influence behavior. Finally, mobility across states is much higher than emigration out of the United States; the basic Ricardian story does not hold when individuals (and their offspring) can escape the future burden of taxation by moving.

Not controlling for marginal tax rates probably biases the tax coefficient toward a Ricardian outcome. For example, holding government spending constant, lump sum taxes are cut. The conventional view is that consumption rises (saving rises by less than the full amount of the tax cut). The Ricardian view is that consumption is not affected (saving rises by the full amount of the tax cut). Both views, though, allow that a cut in marginal tax rates could raise labor income or saving. Thus, the same tax cut, enacted through cuts in marginal tax rates rather than lump sum taxes, would raise saving by more than would a lump sum tax cut, in either model. (It will also raise labor supply, but recall that the equations control for net national product.) Thus, the coefficient on the revenue variable will be biased in a pro-Ricardian direction if the marginal tax rate is not controlled for.

Almost all previous studies of Ricardian Equivalence omit marginal tax rates except for Seater and Mariano (1981) and even they omit corporate tax rates. Seater (1993) suggests that any bias arising from the omission of marginal tax rates is not important. Barro (1989,**)**, Bernheim (1989), Plosser (1987) and others believe that controlling for marginal tax rates is essential. This view is buttressed by the work of Judd (1985, 1987a, 1987b) and Auerbach and Kotlikoff (1987) who show that the short-term dynamics of tax cuts are strongly affected by private responses to marginal tax incentives. Notably, a number of these papers emphasize the importance of including a broad-based measure of taxation. Accordingly, we include a measure of the average economy-wide marginal effective tax rate on new capital investment, as determined in Gravelle (1994) and updated through 2002 in Gravelle (2004).[36]

C. Consumption Function Results

Table 2 shows ordinary least squares results for the specification above. We estimate regressions for three time periods, two measures of consumption, three transformations of the dependent variable, and three specifications of the explanatory variables.

The first panel follows the Kormendi and MeGuire (1990) specification of explanatory variables. In the first part of the panel (with estimates in first-difference form), the second column shows that when the sample is restricted to 1954-1992, consumption does not respond to changes in taxes in a statistically significant fashion. This finding replicates and confirms the basic Kormendi and MeGuire (1990) estimates. The first column, however, shows that merely updating the data through 2002 alters the conclusion, even with no further changes in specification. When the data are updated through 2002, the coefficient on the tax variable implies that controlling for other factors, between 27 and 39 percent of a tax cut is spent in the year it occurs, whereas the Ricardian benchmark would be zero and the pure Keynesian benchmark would be close to 100 percent. These conclusions are not particularly sensitive to the starting point for the data (not shown), but they are sensitive to the ending date. In particular, the third column shows that the statistical significance of the tax coefficient is dependent on

[36] We thank Jane Gravelle for updating the series on a timely basis.

including 2001 and 2002. This sensitivity to excluding 2001 and 2002 is not present when the specification is improved, as shown below. The other specifications in the first panel (with different transformations of the dependent variable) yield similar though slightly weaker results.

The second panel splits federal and state tax variables, for reasons noted above. This has several effects on the results. First, the absolute value of the coefficients and t-statistics on Federal taxes is larger than were the corresponding items for all taxes in the first panel. The estimates suggest that between 25 and 46 cents of every dollar in federal tax cuts is consumed in the first year, controlling for other factors. Second, the statistical significance of the results are no longer sensitive to whether the last two years are included. Third, although not shown for the regressions in the second panel, the coefficients on the state tax variables are positive, large and precisely estimated. This buttresses the view that federal and state taxes can have different effects on the economy, and it points out an important source of aggregation bias (between federal and state tax revenues) in previous work on this subject.[37]

The third panel shows the results when the tax variables are split between Federal and state components and when the marginal tax rate on capital income is included. The regressions are now strongly non-Ricardian, regardless of the time period employed, the consumption measure, or the transformation employed. The estimates suggest that between 32 and 53 cents of every dollar of tax cuts is spent in the year of the tax cut. These coefficients are statistically different from the Ricardian value of zero.

Table 3 reports coefficient estimates for the six regressions in the third panel of table 2 that include the marginal tax rate on capital and cover the full sample period (1954-2002). Several results are worth highlighting. The coefficients on NNP and lagged NNP are similar to those reported by Kormendi and MeGuire (1990). Government purchases enter with a small, positive, statistically insignificant coefficient.[38] The contrast between the effects of federal and state taxes is stark. State taxes enter with a positive, precisely estimated coefficient that hovers around 1.0. Government transfers always have a positive effect that is usually significant.[39] The marginal tax rate on capital generally enters with a positive, statistically significant, but economically small, effect. The coefficient on government bonds is negative and insignificant in each of the specifications. It is difficult to interpret this result, however, in light of the fact that the private wealth coefficient is also small and usually insignificant.

One possible issue in all of these equations is that Ricardian consumers should care about expected future government purchases. The specification in (1) assumes that

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[37] The results are similar when all the fiscal variables, not just taxes, are split into Federal and state components (not shown).

[38] In Gale and Orszag (2003c), we show that in earlier time periods, the coefficient on the purchases variable is larger and precisely estimated, consistent with other results in the literature.

[39] In the regressions that exclude the marginal tax rate on capital, the transfer coefficient is always large and statistically significant.

the current change in government purchases is a good proxy for the future change in government purchases. We have run regressions with future government purchases entered instead of current values, and with CBO projections of five-year-ahead government spending. In both cases, the added variables had very small, imprecisely estimated coefficients and had trivial effects on the other coefficients in the model.

In summary, the results above demonstrate that, within the framework that has been viewed by supporters of Ricardian Equivalence as providing the most credible evidence in their favor, updated data and an improved specification reveal robust non-Ricardian effects. The evidence using these updated and improved specifications suggests that about 40 to 50 cents of every dollar in Federal tax cuts in spent in the same year.

Nevertheless, there are significant concerns with this specification. Most notably, the equations are not derived from a well-defined economic model, and many of the key explanatory variables are likely to be endogenous. While it is possible to use instrumental variable techniques to remove endogeneity, such an effort raises special problems in the consumption function approach (see Flavin 1987) and there are a very large number of potentially endogenous variables in the consumption function specification above. For these reasons, we turn to Euler equations, which we estimate in both ordinary least squares and instrumental variable forms.

D. Euler Equation Specification

This section develops an Euler equation specification that nests Ricardian and non-Ricardian alternatives. In the standard specification, permanent-income consumers adjust their consumption in each period so that the marginal utility of consumption follows a random walk (Hall 1978). With a few simplifying assumptions, consumption itself follows a random walk, which implies that the change in consumption is unpredictable, or that

(2) $$\Delta C_t = \alpha + \varepsilon_t,$$

where ε_t is a forecast error that is uncorrelated with all information in periods t-1 and before but may be correlated with current-period information.

Our goal is to expand on the model in (2) to account explicitly for Ricardian consumers, and consumers who exhibit any of a variety of types of non-Ricardian behavior. Campbell and Mankiw (1989, 1990) specify a model in which a share (λ) of all disposable income (YD) goes to rule-of-thumb consumers who immediately consume the resources. The remainder of income accrues to "far-sighted" consumers, who behave according to (2). This generates a consumption equation of the form:

(3) $$\Delta C_t = \alpha + \lambda^*\Delta YD_t + (1-\lambda)^*\varepsilon_t.$$

Blanchard (1985) develops a model of far-sighted, life-cycle consumers that also contains Ricardian Equivalence as a special case (where consumers have an infinite horizon). Based on Blanchard (1985), Evans (1988), and Graham and Himarios (1996), the model implies that aggregate consumption can be written as:

(4) $$\Delta C_t = \alpha + \beta_1 * \Delta W_{t-1} + \beta_2 * \Delta B_{t-1} + v1_t,$$

where W is private net worth and B is the real outstanding stock of government bonds. As shown in Evans (1988), life-cycle consumers will generate *negative* values for β_1 and β_2. In the limiting case of Ricardian equivalence, β_1 and β_2 are zero and the equation collapses to (2). This, if a proportion μ_1 (μ_2) of private wealth (government bonds) is held by life-cycle consumers and the remaining share is held by Ricardian consumers, equations (3) and (4) can be combined to allow for both rule-of-thumb and life-cycle consumers:

(5) $$\Delta C_t = \alpha + \lambda * \Delta YD_t + \gamma_1 * \Delta W_{t-1} + \gamma_2 * \Delta B_{t-1} + v2_t,$$

where $\gamma_i = \beta_1 \mu_i$.

Finally, Ricardian consumers should not be influenced by changes in disposable income or past changes in wealth, but they may be affected by changes in expectations regarding future government purchases (although as noted above, the sign of the effect is not clear). Moreover, for all groups, with the possible exception of strict rule-of-thumb consumers, changes in the marginal tax rate may affect consumption choices. These considerations generate an Euler specification of the following form:

(6) $$\Delta C_t = \alpha + \lambda * \Delta YD_t + \gamma_1 * \Delta W_{t-1} + \gamma_2 * \Delta B_{t-1} + \varphi_1 * \Delta GS + \varphi_2 * \Delta MTR + u_t,$$

where u_t is uncorrelated with all variables in earlier time periods.

The Euler equation (6) has a number of interesting properties. First, it allows for the presence of rule-of-thumb consumers and life-cycle consumers, and contains Ricardian equivalence as the special case, where $\lambda = \gamma_1 = \gamma_2 = 0$. These restrictions derive directly from the Blanchard (1985) and Campbell and Mankiw (1989, 1990) models. Thus, the equation allows for testing of Ricardian equivalence in a utility-maximizing framework that nests both Ricardian and several non-Ricardian hypotheses and also shows the quantitative importance of any deviations from Ricardian Equivalence.

Second, with a little transformation, the equation is not that different from the consumption function specification developed by Kormendi (1983) and reported in equation (1). In the notation of section B above, disposable income can be written as YD = NNP – TX – RE + TR + GINT. When that expression is substituted into (5) and the coefficients on each component of disposable income are allowed to vary, the resulting equation differs from equation (1) only in that (1) contains a lagged NNP term.

To isolate the effects of federal taxes on consumption, we decompose the disposable income term in (6) into pre-tax income (YP), federal taxes, and state and local taxes. This yields equation (7), which is estimated by OLS and instrumental variables in the next section:

$$(7)\quad \Delta C_t = \alpha + \lambda_1 * \Delta YP_t + \lambda_2 * \Delta TXF_t + \lambda 3 * \Delta TXSL_t + \gamma_1 * \Delta W_{t-1} + \gamma_2 * \Delta B_{t-1} + \varphi_1 * \Delta GS + \varphi_2 * \Delta MTR + u_{t.}$$

E. Euler Equation Results

Table 4 presents estimates of (7). The first panel presents ordinary least squares regressions, for comparison with Table 2. The results using first differences and first differences scaled by lagged income are somewhat smaller than those in Table 2, and suggest that between 22 and 44 cents of each dollar in federal tax cuts is consumed in the year the tax cuts occur. The results using the first difference in ratios are substantially larger, suggesting that between 65 and 80 cents per dollar of tax cuts are consumed in the first year. Thus, the results show no obvious bias relative to the findings in Table 2.

These results, of course, still suffer from endogeneity problems. The direction of the bias created from endogenous explanatory variables is unclear on *a priori* basis. Barro (1989) claims it biases findings against Ricardian Equivalence. Bernheim (1987) claims it biases findings in favor of Ricardian Equivalence. Cardia (1997) shows that removing the endogeneity of income has a crucial impact on the ability of regressions to isolate an effect of taxes or bonds on consumption.

As Campbell and Mankiw (1989) note, any lagged stationary variable is a valid instrument, provided it predicts the right-hand-side variable well. We follow Campbell and Mankiw (1989, 1990) in using lagged values of the right-hand-side variables as instruments for their current value, and lagged values of consumption itself as an instrument for current income. In models where agents are forward-looking, lagged consumption will help to predict current income, but is not correlated with the stochastic component of current consumption. For reasons discussed in Hall (1988), Campbell and Mankiw (1989) and elsewhere, we avoid using once-lagged variables as instruments, and instead use variables that are lagged twice and three times.

Table 4 reports the instrumental variable estimates. In the equations that exclude the marginal tax rate on capital, we instrument for current gross income, federal taxes, state taxes, and government purchases. In the equations that include the marginal tax rate, the lagged values are used as instruments and the current value is instrumented.

The results are shown in the bottom panel of Table 4. and provide strong support for non-Ricardian views. Of the 12 regressions, 10 report large and precisely estimated negative effects of current taxes on aggregate consumption, controlling for other factors. All six regressions that do not control for the marginal tax rate on capital find large negative effects, ranging from 50 to 81 percent of the tax cut being consumed in the first year. In the regressions that control for the tax rate, the specifications that use first differences, or first differences scaled for lagged income report results in roughly the same range – 44 to 82 percent. The only exception is that the equations using first differences of ratios generate estimates of about 31 to 36 cents, which are not statistically significant.

F. Summary

The OLS regressions demonstrate robust non-Ricardian effects even within the basic specification that has previously suggested the strongest support for Ricardian Equivalence. When the sample period is extended, Federal and state tax variables are split, and a marginal tax rate variable is included, the results suggest that about 40 to 50 cents of every dollar in tax cuts in spent in the same year.

The OLS regressions likely suffer from severe simultaneity problems, however. When IV regressions are used in the Euler specification, with twice- and three-times lagged variables as instruments, the results are generally more strongly non-Ricardian. The coefficients from this specification, which is our preferred one, suggest that a range of about 50 to 80 cents of every dollar in tax cuts is spent in the first year. This range is consistent with some previous assessments,[40] but it is inconsistent with the Ricardian prediction of a full offset from private saving and the difference, as discussed further in the conclusion, is economically important.

VI. Deficits and Interest Rates

A. Previous Research

For a number of well-known reasons, the effects of fiscal policy on interest rates have proven difficult to pin down statistically. The issues include the appropriate definition of deficits and debt, whether deficits or debt should be the variable of interest, the difficulty of distinguishing expected and unexpected changes, and the potential endogeneity of many of the key explanatory variables. We discuss many of these issues below; Bernheim (1987), Elmendorf and Mankiw (1999), and Seater (1993) provide comprehensive analyses. In part because of these statistical issues, the evidence from the empirical literature as a whole is mixed.[41]

[40] For example, Bernheim (1987) and the Congressional Budget Office (1998) conclude that private saving would rise by between 20 and 50 percent of an increase in the deficit (i.e., consumption would rise by between 50 and 80 percent of the increase in the deficit). Elmendorf and Liebman (2000) conclude that that private saving would offset 25 percent of the increase in the deficit. Gale and Potter (2002) estimate that private saving will offset 31 percent of the decline in public saving caused by the 2001 tax cut.

[41] Previous analyses reach widely varying conclusions about the effects of deficits on interest rates. For example, Barth et. al (1991) surveys 42 studies through 1989, of which 17 found a "predominately significant, positive" effect of deficits on interest rates (that is, larger deficits raised interest rates); 6 found mixed effects; and 19 found "predominately insignificant or negative" effects. Barth et al (1991) conclude that "Since the available evidence on the effects of deficits is mixed, one cannot say with complete confidence that budget deficits raise interest rates…But, equally important, one cannot say that they do not have these effects. Other reviewers of the literature have reached similar conclusions. Elmendorf and Mankiw (1999) note that "Our view is that this literature...is not very informative." Bernheim (1989)

Projected deficits and interest rates Our contribution to interpreting the literature has been to highlight the key role of using expected deficits rather than current deficits (Gale and Orszag 2002, Gale and Orszag 2003a).[42] As Feldstein (1986a) has written, "it is wrong to relate the rate of interest to the concurrent budget deficit without taking into account the anticipated future deficits. It is significant that almost none of the past empirical analyses of the effect of deficits on interest rates makes any attempt to include a measure of expected future deficits." Since financial markets are forward-looking, excluding deficit expectations could bias the analysis toward finding no relationship between interest rates and deficits.[43]

Studies that incorporate more accurate information on expectations of *future* sustained deficits tend to find economically and statistically significant connections between anticipated deficits and current interest rates. Gale and Orszag (2003a) combine the papers reviewed in Barth et. al. (1991) with more recent papers. Appendix Table 3 shows that of the 19 papers incorporating timely information on projected deficits, 13 find predominantly positive, significant effects between anticipated deficits and current interest rates, 5 find mixed effects, and only one finds no effects. The studies that find no significant effect are disproportionately those that do not take expectations into account at all or do so only indirectly through a vector auto-regression. Thus, while the literature as a whole, taken at face value, generates mixed results, the literature that focuses on the effects of anticipated deficits tends to find a positive and significant impact on interest rates.

The challenge in incorporating market expectations about future deficits is that such expectations are not directly observable. Researchers have used different strategies in the face of this challenge. One approach is to use published forecasts of the deficit as a proxy for market expectations. To the extent this proxy is imperfect, the coefficient on the projected deficit will tend to be biased toward zero because of classical measurement error. This bias would reduce the estimated impact of deficits on interest rates.

As some examples of this approach, Elmendorf (1993) uses deficit forecasts from Data Resources, Inc., and finds that an increase in the projected deficit of one percent of GNP raises five-year bond yields by 43 basis points. Canzoneri, Cumby, and Diba (2002) use CBO projected surpluses and find that an increase in projected future deficits

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writes that "it is easy to cite a large number of studies that support any conceivable position." Appendix Table 3 updates the Barth et. al (1991) survey and shows that of more than 60 studies, roughly half found a predominately significant, positive effect and the other half found either no effect or mixed effects.

[42] One recent study expands the literature along a different dimension: Kiley (2003) examines the relationship between current government debt and the return to capital in the nonfinancial corporate sector. Kiley finds that a one percentage point increase in the debt-GDP ratio is associated with a 10 basis point increase in the return to capital.

[43] Bernheim (1987) notes that if households perfectly anticipated future deficits, one may well find no empirical relationship between the current deficits and interest rates, even though the path of interest rates and economic activity would be substantially different in the absence of the deficits.

averaging one percent of current GDP is associated with an increase in the long-term interest rate relative to the short-term interest rate of 53 to 60 basis points.

Laubach (2003) uses CBO and OMB projections and finds that a one percentage point increase in the projected deficit-to-GDP ratio raises forward long-term interest rates by between 24 and 40 basis points and that a one percentage point in the projected debt-to-GDP ratio raises long-term rates by 3.5-5.5 basis points. Laubach's work is important because it proposes a novel and sensible solution to one concern about several of the previous studies: that the business cycle could be affecting both projected deficits and yield spreads.[44] To mitigate such problems, Laubach examines the relationship between projected deficits (or debt) and the level of real *forward* (5-year ahead) long-term interest rates.

Following Laubach, Engen and Hubbard (2004) use CBO projections and find that an increase in the projected deficit equal to one percent of GDP raises long-term rates (either the current long-term rate or the forward long-term rate) by between 18 and 24 basis points. They also find that an increase in the projected *debt* equal to one percent of GDP raises long-term rates by between 2.8 and 3.3 basis points. The debt-based result is not too dissimilar from the deficit-based results. Consider, for example, an increase in the budget deficit equal to one percent of GDP in each year over the next 10 years. After 10 years, that would raise government debt by roughly 10 percent of GDP. The deficit-based results from Engen-Hubbard would suggest an increase in long-term rates of roughly 20 basis points. The debt-based results would suggest an increase of roughly 30 basis points (ten times the effect for an increase of one percent of GDP).

A second approach to incorporating expected deficits involves "event analysis" of news reports about deficit reduction legislation or budget projections. This approach examines the change in interest rates (or other variables) on the day in which deficit news is released. For example, Elmendorf (1996) examines financial market reactions to events surrounding passage of the Gramm-Rudman-Hollings legislation in 1985 and the Budget Enforcement Act of 1990 and concludes "higher expected government spending and budget deficits raised real interest rates…while lower expected spending and deficits reduced real rates."[45] Unfortunately, given the inability to measure market expectations, this approach does not yield a mapping between the size of the unanticipated deficit and the interest rate effect.[46]

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[44] For example, in a recession, the projected unified deficit could increase merely because of the lingering effects from the rise in debt during the downturn; at the same time, the yield curve could steepen as short-term interest rates are depressed by Federal Reserve policy. This could potentially introduce an artificial relationship, actually driven by the business cycle and monetary policy, between the yield spread and the projected unified deficit.

[45] The Council of Economic Advisers (1994) studies the events surrounding passage of the Omnibus Budget Reconciliation Act of 1993. Its concludes that event analysis "linking the announcement and enactment of credible budget reduction to changes in the long-term interest rate provides support for the view that the interest rate declines were largely due to budget policy."

[46] Several other recent papers examine interest rate changes surrounding the release of new budget projections. Thorbecke (1993) uses OMB and CBO projections and finds that a $100 billion increase in the

Notably, most of the studies using either of the two approaches to incorporating anticipated deficits are consistent with the range of 20 to 60 basis points for an increase in projected deficits equal to 1 percent of GDP over 10 years mentioned by Gale and Orszag (2003a), and the range of 30 to 60 basis points proposed by Rubin, Orszag, and Sinai (2004).[47] This range is also consistent with the results from macroeconometric models.[48] The simplified Solow model and debt calculation discussed above generate somewhat larger numbers, but those calculations assume a closed economy. In a large open economy like the United States, the effect of deficits on interest rates would be expected to be somewhat smaller, which is consistent with the empirical evidence summarized above.

<u>Vector auto-regressions</u> Some of the most heavily cited papers finding no effect of deficits on interest rates, including Evans (1987a, b) and Plosser (1982, 1987a), employ vector autoregressions (VARs) that use past variables to predict current or future deficits.[49] The VARs are typically based on a very limited number of variables, ignore

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deficit (relative to the previously projected level) is associated with an immediate increase in 10-year interest rates of 14 to 26 basis points. Quigley and Porter-Hudak (1994) use CBO and OMB projections and find that a one-percent increase in the deficit itself (not as a percentage of GDP) raises short-term interest rates by 0.37 to 0.87 basis points. Assuming a baseline deficit of 2 percent of GDP, their result implies that an increase in the deficit of one percent of GDP (a 50 percent increase in the deficit) would raise short-term interest rates by 18.5 to 43.5 basis points. Kitchen (1996) uses changes in OMB forecasts and finds a statistically significant but quite modest effect -- an increase in the deficit projection of one percent of GDP raises 10-year bond yields by 3.4 basis points for one-year budget projections. He finds even smaller effects for multi-year budget projections on long-term interest rates. Calomiris, Engen, Hassett, and Hubbard (2004) examine announcement effects about previous deficits, rather than announcement effects about future deficits or future legislation. They find no effects on current interest rates of the announcement of the previous month's deficit. Their deficit measure, however, is based on the monthly budget updates provided by the CBO and Department of Treasury. These monthly updates are quite noisy, and depend on factors such as the timing of defense contract payments. The variation in the monthly data is thus unlikely to provide significant information about the budget outlook.

[47] Brook (2003) similarly concludes that "most empirical work conducted in the past ten years estimates the impact on US real long-term interest rates of a sustained 1 percentage point decrease in the US fiscal position to be in the range of 20-40 basis points, and the impact on the slope of the yield curve to be in the range of 10-60 basis points."

[48] Almost all major macroeconometric models imply an economically significant connection between changes in budget deficits and in long-term interest rates. The precise effects depend on a wide variety of factors, including whether the change in the deficit is caused by a change in taxes or a change in spending, how monetary policy reacts, and how foreign governments react. The results vary widely, in part because different policies are simulated and standardization is difficult, but the findings suggest that a sustained increase in the primary (non-interest) deficit of 1 percent of GDP would raise interest rates by 40-50 basis points after 1 year and 50-100 basis points after 10 years (See Gale and Orszag 2002).

[49] These are also some of the most heavily criticized studies, along the grounds that: the results are not robust to changes in sample period or specification; the models contain a variety of strong and unusual maintained assumptions; the equations explain only a small portion of the variance, which suggests either measurement error or that missing variables explain much of the residual and are being proxied by the variables in the regression. Perhaps most importantly, the tests have very little power, and in some cases are even unable to reject the hypothesis that expected inflation has no effect on nominal interest rates. For

information that is not reflected in such variables but may be widely known to market participants, and assume that the relationships among the variables do not change over time. Bernheim (1987), Cohen and Garnier (1991), and Elmendorf (1993) show that VAR-based projections are inferior to those produced by OMB or DRI. The implication is that VAR-based projections are more likely to suffer from measurement error and thus to be biased toward showing no effects of deficits on interest rates.

Despite these limitations, several recent papers have applied the VAR methodology to examine the connection between deficits and interest rates. For example, Canzoneri, Cumby, and Diba (2002) include both the Federal funds rate and the 10-year bond rate in a structural VAR; they find that the ten-year yield rises by 45 basis points immediately, and by roughly 40 basis point in the long run, in response to a spending shock equal to one percent of GDP. Engen and Hubbard (2004) use a VAR framework that includes *anticipated* deficits to estimate that an increase in the federal deficit equal to one percent of GDP causes the real interest rate to rise by 12 basis points. Dai and Philippon (2004) estimate a structural VAR that uses information provided by no-arbitrage restrictions on the yield curve. They conclude that a one percent of GDP increase in the unified deficit raises 10-year bond yields by 41 basis points.

B. Specification

To examine these issues, we follow Laubach (2003) and Engen and Hubbard (2004) and undertake reduced-form regressions of the generic form:

$$i_t = \alpha + \beta f_t + \Gamma Z + \varepsilon_t$$

where i is a measure of the interest rate, f is a measure of fiscal policy (e.g., the deficit), and Z is a vector of control variables. Our primary interest is in the coefficient β, which provides an estimate of the effect of fiscal policy variables on interest rates.

We examine the role of four fiscal variables (as a share of GDP) at different time periods: federal publicly held debt; the unified deficit; the primary deficit (excluding interest payments); and primary outlays and revenue. Appendix Table 4 provides full details on these and the other variable definitions used in the interest rate regressions.

We do not take a firm *a priori* view on whether the "stock" view of an interest rate effect (through government debt) or the "flow" view of such an effect (through government deficits) on the level of interest rates is the analytically correct one. The model in Ball and Mankiw (1995) and Engen and Hubbard (2004) underscores the role of debt in affecting the level of interest rates. The Solow model and simple IS-LM models underscore the role of the deficit in affecting the level of interest rates. Indeed, since it is conceivable that both stocks and flows matter, we include both debt and deficits in some of the regressions. The regressions that separate primary outlays and revenue are insightful to the extent that, as noted in the discussion of Ricardian Equivalence above,

further discussion, see Bernheim (1987) and Elmendorf and Mankiw (1999).

changes in outlays could have different effects on national saving and thus on interest rates than changes in revenue.[50] We undertake several different version of our generic regression, for the years 1976 to 2004:

Effects of projected fiscal policy on forward interest rates Our preferred specifications examine the relationship between forward long-term interest rates and projected fiscal policies. This specification comes closest to eliminating the conflating effect between interest rates and deficits from current macroeconomic conditions: Most projections assume that the economy will be operating at full employment within a relatively short projection period into the future. In these specifications, i_t reflects the simple average of one-year forward interest rates from 5 to 14 years ahead, calculated from the zero-coupon yield curve.[51] This provides a forward 10-year interest rate. The fiscal policy measures, f_t, are measured five years ahead, as a share of projected GDP in that year, taken from the CBO baseline projections. The months in which the CBO projections were issued are listed in Appendix Table 5.

Effects of projected fiscal policy on current interest rates In these regressions, i_t is the current 10-year constant maturity Treasury yield, rather than the forward yield. The fiscal measures f_t are the same as above.

Effects of current fiscal policy on current interest rates In these regressions, we examine current long-term rates and current fiscal policy outcomes (rather than projected fiscal policy outcomes, as above). The fiscal measures, f_t, are all measured for the current year.

We run (but do not always report) each regression in both real and nominal terms. We compute the real rate by adjusting the nominal rate for the long-term inflationary expectations series incorporated in the Federal Reserve Board's FRB/US model.[52] In the regressions explaining the nominal interest rate, the inflationary expectations series is included as an explanatory variable.

All regressions include a constant term and an estimate of the GDP growth rate. The equations using projected fiscal policy use the growth rate projected by CBO five years ahead. The equations using current fiscal policy measures use the current growth rate.

[50] Ricardian equivalence is a statement about the effects of variations in the timing of lump-sum tax payments, holding constant both the path of transfers and government purchases. Our regressions separate tax revenues from purchases and transfers.

[51] These variables and some of the other data used in this study come from Thomas Laubach and Eric Engen. We are grateful to them for sharing their data. The forward interest rate is computed from the zero-coupon yield curve as the last trading day for the month of the CBO projection.

[52] Since 1991 Q3, this series is based on the Survey of Professional Forecasters published by the Federal Reserve Bank of Philadelphia. Laubach (2003, appendix) describes this series before 1991 Q3.

We include several additional control variables, since macroeconomic conditions can affect the level of interest rates associated with any given fiscal policy outcome. We include a dummy for an NBER-defined recession, which is entered on its own and also interacted with the fiscal measures. The purpose of this dummy and interaction term is to examine whether, even controlling for projected GDP growth, future fiscal policy outcomes have a different effect on interest rates during a recessionary period than during a recovery period; such a possibility was raised in Rubin, Orszag, and Sinai (2004).

Following Laubach (2003) and Engen and Hubbard (2004), we include a measure of the equity premium, which is intended to control for changes in risk aversion, which in turn could affect interest rates. The measure is defined as dividend income from the National Income and Product Accounts divided by the market value of corporate equities held by households from the Federal Reserve's Flow of Fund Accounts, plus the trend growth rate in real GDP, minus the real 10-year Treasury yield (Laubach 2003).

We follow Engen and Hubbard (2004) in controlling for Federal Reserve holdings (in the debt equations) and purchases (in the deficit equations) of Treasury securities as a share of GDP, as a way of controlling for monetary policy.

Engen and Hubbard (2004) include an oil price variable, citing the evidence in Barro and Sala-i-Martin (1991) and Barro (1991) that real oil prices affect real interest rates. We include the spot price for West Texas Intermediate crude oil, adjusted by the GDP deflator.[53]

Lastly, Engen and Hubbard (2004) include a dummy variable for changes in defense spending, defined as the Ramey and Shapiro (1998) defense dummy variable augmented to include the military buildup in 2002. We are skeptical that this is capturing significant shifts in defense spending, however. Defense spending over the sample period is shown in Figure 10. The Engen-Hubbard indicator variable is set equal to one only in 1980 and 2002. Yet the increases in defense spending as a share of GDP were larger in 1981, 1982, 1983, and 2003 than in 1980. A sustained defense build-up should have lasting effects on interest rates, not a one-year effect. In addition, the decline in defense spending following the collapse of the Soviet Union might rightfully also be considered a noteworthy event in trends in defense spending.[54] For these reasons, we use actual defense spending as a share of GDP as a control variable, rather than the dummy variable.

Because some of the regression results suggested evidence of first-order auto-correlation in the error term, we use robust standard errors when estimation is undertaken

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[53] The oil price series we use, which is commonly used in various empirical studies, is slightly different from that in Engen and Hubbard (2004). The empirical results are unaffected by this difference.

[54] In addition, Ramey and Shapiro (1998, Figure 6d) show that the expected effect on interest rates of a defense spending shock in their model dies out after 5 years, so there ought not be an impact on the 5-year ahead, 10-year interest rate in the first place.

using ordinary least squares (OLS) and also present the results using maximum likelihood to estimate an AR(1) model.[55]

C. Results

Projected Fiscal Policy and Forward Interest Rates Table 6 shows OLS regressions with the real forward long-term rate as the dependent variable and leaves two broad impressions. First, the table shows a robust, economically and statistically significant relationship between forward long-term real interest rates and projected fiscal imbalances. Second, the R-squared statistics show that there is more information in the projected deficit variables than in the projected debt variables.

In the simplest formulation, including only projected fiscal policy and projected GDP growth rate as control variables, an increase in the projected debt after 5 years of 1 percent of GDP raises the real forward long-term rate by 4.9 basis points; the coefficient is significantly above zero. An increase in the projected unified deficit equal to 1 percent of GDP raises the forward long-term real interest rate by 29 basis points. An increase in the projected primary deficit of 1 percent of GDP is associated with a larger impact on the forward long-term rate: 40 basis points. When revenue and primary outlays are entered separately, a projected reduction in revenue after 5 years of 1 percent of GDP is estimated to raise the forward long-term rate by 42 basis points, and a projected increase in outlays of the same magnitude raises the forward long-term rate by 37 basis points.

Adding a recession dummy and interacting the recession dummy with the fiscal policy variable slightly raises the estimated coefficients on the fiscal variable: The coefficient on the projected primary deficit, for example, rises from 40 to 45 basis points. The interactions between the recession dummy and the projected fiscal measures suggest that a given fiscal projection has a smaller (in absolute value) effect on interest rates during a recession than during a period of full-employment. Four of the five interaction terms have p-values below .12 and one of those is significant at the 1 percent level. This suggests that the effect of a projected deficit on forward long-term rates may be smaller if the economy is *currently* in recession than if it is not. This presents a puzzle, since it is unclear why a current recession should affect the relationship between the two future variables.[56]

Adding the other control variables (monetary policy, defense, oil, and equity premium) reduces the estimated coefficients on the fiscal variables slightly: The coefficient on the projected primary imbalance, for example, declines to 39 basis points. The interaction between the recession dummy and projected unified or primary deficits

[55] Estimation is undertaken using the “arima” command in STATA.

[56] Rubin, Orszag, and Sinai (2004) hypothesize, based mostly on Rubin’s experience with real-world financial markets, that “it is possible during economic downturns that financial markets do not focus on long-term fiscal issues; if this is the case, the effect of the fiscal deterioration on long-term interest rates will manifest itself only as the economy recovers.” We have not evaluated whether arbitrage based on this evidence would generate expected profits after taking into account trading costs and other factors.

remains statistically and economically significant. Many of the additional control variables enter with the expected sign, but few are statistically significant, other than the equity premium, which enters negatively, as in Laubach (2003) and Engen and Hubbard (2004). The coefficient on real oil prices is positive and significant in the debt equation, but not statistically significant in the others. The coefficient on Federal Reserve open-market purchases is negative, but not statistically significant. Defense spending enters with a negative coefficient, which may be considered a surprise, but it is not statistically significant. Moreover, because the regressions already control for expected future deficits or future outlays, the informational value of the defense variable is unclear.

Running the same regressions using the nominal forward long-term rate as the dependent variable and including inflationary expectations as a right-hand-side variable (in Table 7) generates slightly smaller fiscal effects. The coefficient on the projected primary deficit, for example, ranges between 33 and 46 basis points. The results in Tables 6 and 7 underscore a robust, statistically significant connection between forward long rates and projected fiscal policy outcomes.

Table 8 includes both projected debt and projected primary deficit variables in the same regressions. To avoid double-counting, we use projected debt as a share of GDP at the end of year t+4 and primary budget measures in year t+5.[57] In this "horse race" between stocks and flows, the deficit variables dominate. Indeed, the coefficient on the projected debt variable becomes statistically insignificant (and slightly negative) and the estimated effect of the projected deficit *increases*: Relative to the results in Table 5 that show an effect of 29 to 45 basis points per percent of GDP in projected primary variables (primary deficit, primary outlays, or revenue), Table 8 shows an effect of 40 to 67 basis points once the analysis controls for projected debt-GDP ratios. The recession interaction is statistically significant in one of the regressions, but insignificant in others. Of the other variables, only the equity premium remains statistically significant. All the results in Table 7 are similar when using the nominal forward interest rate as the dependent variable and including inflationary expectations on the right-hand-side (not shown).

Table 9 shows the same specification as Table 8 but uses an AR(1) model for estimation, because some of the results (in particular, when the additional control variables are included) suggest autocorrelated errors. In Table 9, the coefficient on the projections of primary deficit, primary outlays, and revenues ranges between 44 and 67 basis points. Again, the coefficients on the debt variables are generally small, negative, and statistically insignificant, and some of the recession interaction terms are significant.

The Appendix text and Appendix Table 6 discuss additional sensitivity analysis for regressions that examine the impact of projected future fiscal policy on forward, long-term interest rates.

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[57] Using projected debt at the end of t+5 and the deficit in t+5 would double count the deficit in t+5. Likewise, using debt at the end of t+4 and the unified deficit in t+5 would effectively double count interest payments in t+5, since they are already implied by the debt level at the end of t+4.

Projected Fiscal Policy and Current Long-Term Rates Table 10 shows regressions of the *current* 10-year interest rate on projected future fiscal variables. With only fiscal variables entered or only fiscal and recession variables entered, the coefficients on the fiscal variables tend to be somewhat smaller than when the forward long-term rate is used (in Table 6) but are still statistically significant. For example, the coefficient on the projected primary deficit is between 30 and 36 basis points. The coefficients become smaller and statistically insignificant when the additional control variables are included. The coefficient on primary deficits falls to 17 basis points.

Notably, the Federal Reserve holdings or purchases of Treasury securities, which did not affect long-term forward rates, has an economically significant and statistically precise effect on current rates. Federal reserve purchases of Treasury securities are a statistically significant factor in all of the regressions in Tables 10-13 in which the variable enters, suggesting that different factors may affect current and forward long-term rates.

When nominal long-term rates are used as the dependent variable (Table 11), the regressions that include all of the control variables, unified deficits and primary deficits enter with a statistically significant coefficient of about 20 basis points (specifications 10 and 11).

When real current rates are used and both the projected debt and primary deficit variables are included (Table 12), the estimated coefficient on the primary deficit variables increases to over 50 basis points in the specifications that include only fiscal variables or only fiscal and recession variables, but disappears when all control variables are included. The results are similar when nominal rates are used, and when an AR(1) model is estimated.

Current Fiscal Policy on Current Long-Term Rates Table 13 presents regressions of the real current long rate on *current* fiscal variables. The fiscal variables are generally not statistically significant in these specifications, and remain insignificant when the nominal rate is used, when an AR(1) model is estimated, and when both debt and deficit variables are entered simultaneously.

D. Summary

In the preferred specifications (Tables 8 and 9), which allow both debt and deficits to affect interest rates, the estimated effect on forward long-term rates from a 1-percent-of-GDP shift in projected primary budget variables ranges between 40 and 67 basis points, depending on the specification and whether the fiscal variable is the primary deficit or revenue and primary outlays separately. Our effects are larger than those found in Laubach (2003) and Engen and Hubbard (2004) because we estimate regressions containing projected debt and deficits and because we include measures of whether the economy is currently in recession. The results show that the effects of projected deficits are *larger* when projected debt is included, and that the effect of a given future deficit also tends to be larger if the economy is currently not in a recession than if it is.

In sharp contrast, the projected debt-to-GDP ratio never exerts a positive and significant effect on future interest rates when it is entered in a regression that also includes projected deficits. The projected deficit thus seems a more informative measure than projected debt. This is reflected in table 6, where the deficit equations had significantly higher R-squared than the debt equations, and most strikingly in tables 8 and 9, where, when both variables are entered, deficits have large effects and the debt has none.

Our estimates for an increase in the projected unified budget deficit of one percent of GDP are somewhat smaller -- 25 to 35 basis points per percent of GDP – than the effect of a primary deficit of one percent of GDP. This should be expected, since a shift of one percent of GDP in the primary deficit is more substantial than a shift of one percent of GDP in the unified deficit. Finally, our results when debt is entered by itself suggests that each percent-of-GDP increase in projected debt raises long-term rates by between 3 and 6 basis points. We find smaller and less significant effects of projected fiscal policy or current fiscal policy on current interest rates.

All of the estimates above may understate the true effects for at least two reasons. First, as Rubin, Orszag, and Sinai (2004) note, the effects would be larger if sustained deficits cause investors to lose confidence in the ability of policy-makers to avoid a fiscal crisis. Second, because the projected fiscal policy variables are only approximations of investors' expectations, rather than investors' true expectations, the regressions suffer from classical measurement error, which biases the coefficient toward zero.

VII. Conclusion

According to Suskind (2004), Vice President Cheney has declared that "Reagan proved that deficits don't matter." The evidence presented in this paper firmly indicates the opposite, at least as an economic matter. The empirical evidence shows that deficits reduce national saving, reduce future national income, and raise long-term interest rates. Reasonable rules of thumb based on our estimates are that each percent-of-GDP in current deficits reduces national saving by 0.5 to 0.8 percent of GDP, that each percent-of-GDP in anticipated future unified deficits raises forward long-term interest rates by 25 to 35 basis points, and that each percent-of-GDP in projected future primary deficits raises interest rates by 40 to 70 basis points.

These findings carry substantial implications. First, both the consumption and the interest rate results reject the Ricardian view of the world. It may be argued that the consumption results apply only to the short-term effects of changes in the timing of taxes and that it is still possible, conceptually, that in the long run, changes in the timing of taxes do not affect the level of national saving. (See, for example, Smetters 1999). The consumption results, however, rule out this criticism when taken in conjunction with the interest rate results. In particular, if tax-cut induced deficits did not affect long-term national saving, they should have no effect on forward, long-term interest rates. The presence of strong and systematic positive effects of projected revenues on forward, long-term interest rates only makes sense if the effects of deficits on consumption and national saving are persistent and negative. Second, the results reject the small open economy view, at least as it applies to the U.S. economy. The key distinguishing test between the small open economy view and the conventional view is the impact of interest rates, which is shown to be positive in the analysis above.

Third, the results suggest that the sustained deficits facing the nation will impose significant economic costs. Under the assumptions described in Section II, the unified budget deficit over the next decade is projected to average about 3.5 percent of GDP. First, our results suggest that these deficits will reduce annual national saving by 2 to 3 percent of GDP. As a result, by the end of the decade, the assets owned by Americans will be lessened by roughly 20 to 30 percent of GDP compared to their level if we balanced the unified budget over the next decade. Those missing assets will reduce national income by 1 to 2 percent in 2015. The increase in unified deficits will raise interest rates by 80 to 120 basis points.

Fourth, our results suggest that making the 2001 and 2003 tax cuts permanent would raise the cost of capital for new investments, reduce long-term investment, and reduce long-term economic growth. Tax cuts have offsetting effects on the cost of new investments, with marginal tax rate cuts reducing, and higher interest rates from deficits increasing, the cost of capital. Gale and Potter (2002) show that if the 2001 tax cut were to raise interest rates by 50 basis points, the cost of capital would rise for corporate equipment and structures, non-corporate equipment and structures, and owner-occupied housing. By 2014, EGTRRA, if extended, would increase the public debt by just over $3.4 trillion, or about 19 percent of GDP in 2014. This implies an interest rate increase of 57 basis points using the Engen and Hubbard (2004) estimates noted above, and even larger amounts using our estimates. Alternatively, making EGTRRA permanent would reduce revenues by about 1.7 percent of GDP on a permanent basis (assuming the tax cuts are not overrun by the AMT). Using our estimates for primary deficits, this implies that interest rate will rise by 70 and 120 basis points. Both sets of estimates imply that the 2001 tax cut will end up *reducing* long-term investment. It might be thought that the 2003 tax cut would have more beneficial effects on investment, since it focused on dividend and capital gains tax cuts. In recent work, however, Gale and Orszag (2004b) show that the net effect of making EGTRRA and JGTRRA permanent would be to raise the cost of capital once the interest rate effects are taken into account (even using the Engen-Hubbard (2004) estimates). These findings imply that making the tax cuts permanent would reduce the long-term level of investment, which is consistent with a negative effect on national saving.

Finally, after 2014, the budget outlook grows steadily worse as costs associated with retirement and health programs mount. Under reasonable projections and in the absence of policy changes, the nation thus faces a long period of sustained high budget deficits. In this context, the negative long-term effects of deficits presented in this paper, substantial though they are, may provide an unduly auspicious perspective on the adverse consequences of fiscal deficits.

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Appendix

Sensitivity Analysis for Effects of Projected Fiscal Policy on Forward Long-Term Rates

In addition to the regressions reported in the text, we have undertaken a variety of additional sensitivity analysis of the relation between projected fiscal policy outcomes and forward long-term rates. First, controlling for the actual current or lagged budget surplus (as a share of GDP) or the current or lagged standardized surplus had important effects in specifications 1-4 (in Tables 6-9), which control only for projected future fiscal variables and projected growth rates, and specifications 5-8, which control for those variables and recession indicators. The coefficients on the current and lagged actual and standardized surplus was positive and large, and the coefficients on future fiscal variables *rose*. When all control variables were entered, however, (specifications 9-12), the coefficients on the current or lagged actual or standardized budget went to zero and the coefficients on the other variables were almost identical to those in Tables 6-9.

Estimates of the regressions in tables 6-9 in first-difference form yield similar coefficients but large standard errors. We also experimented with using the Federal funds interest rate or the 3-month Treasury rate as an alternative to Federal Reserve purchases or holdings of Treasury securities, but the results are not materially affected.

The remainder of our sensitivity analysis focuses on two variables: the equity premium and the recession dummy.

The equity premium variable is potentially problematic in a number of ways. First, it is not clear whether changes in the ratio of current dividend yield to market value should be taken to represent a change in the return of all assets, or a shift in preferences for stocks versus bonds. Second, the equity premium variable includes a measure of current long-term interest rates, which affect interpretation of the results. For example, the results in tables 5-8, taken literally, represent the effect on fiscal policy on 5-year ahead long-term rates after already controlling for current long-term rates (through the equity premium). To examine sensitivity of the results to these issues, we enter the dividend/market value ratio in lieu of the equity premium variable or leave all of the risk variables out of the equation.

As a measure of current economic activity, the recession variable may also raise concerns, since it is a dummy variable that takes the value of 1 only in 1980, 1981, 1982, and 1991. (Although there was a recession in 2001, it started after the January 2001 CBO forecast and ended before the January 2002 CBO forecast.) To explore other options, we alternatively include the GDP gap, the lagged GDP gap, or no control for the current state of the economy. It is important to note, however, that our goal in including the recession variable was not just to control for the state of the economy, but also to explore whether the effects of future projected fiscal policy outcomes were systematically different in a recession, perhaps because participants in financial markets have shorter horizons during such periods. Controlling for the GDP gap instead of using the recession dummy may not provide as clean a test of that hypothesis. Also, note that the GDP gap is measured in fiscal years, so the lagged GDP gap is for the fiscal year that ends approximately 4 months before the CBO projection.

Appendix Table 6 reports the results from using 12 alternative specifications to the regression shown in Table 9, specification 11, which is replicated in the first column of Appendix Table 6. In all 12 specifications, projected primary deficits in year t+5 have positive, precise and substantial impacts on forward long-term rates. In contrast, projected ratios of public debt to GDP never show a positive significant effect on forward long-term rates.

The first set of robustness checks examines the recession dummy. The second column replaces the recession dummy and interaction with the GDP gap, which is entered by itself and also interacted with the fiscal variables. The estimated coefficient on the primary deficit is largely unaffected by this change (52 basis points versus 53). The interaction term on the projected primary deficit remains negative and statistically significant. The coefficient suggests that for every 1 percentage point increase in the *current* GDP gap, the effect of the projected deficit on the forward long-term rate is reduced by 11 basis points. The third column replaces the recession dummy and interaction with the lagged GDP gap. In this specification, the coefficient on the projected primary deficit declines somewhat, to 35 basis points, and the interaction term on the lagged GDP gap and the projected primary deficit is also somewhat smaller (7 basis points).

The fourth column leaves out the recession indicator and interactions altogether and shows an effect of only 22 basis points. However, given that the previous three columns show that the interaction between the economic activity indicator and projected primary deficits is statistically significant, and the previous two regressions show that the economic activity indicator itself is statistically significant, the fourth column shows the importance of controlling for the level of economic activity. Studies that do not (e.g., Engen and Hubbard 2004) are likely to obtain smaller effects of deficits on projected fiscal policy.

The second set of robustness checks involves the equity premium variable. Specifications 5-8 replace the equity premium with the ratio of dividends to the market value of stocks held by households. Specifications 9-12 leave out all variables associated with risk. The results in these specifications are very similar to those in 1-4 and the coefficients on the ratio of dividends to market value are small and insignificant.

Table 1
Steady-State Effects of Deficits in the Solow Model

	Initial	New steady state with private saving offset of:		
		25%	0%	50%
Capital share	0.3	0.3	0.3	0.3
Depreciation rate	0.04	0.04	0.04	0.04
Growth rate	0.03	0.03	0.03	0.03
Saving rate	0.175	0.1675	0.165	0.17
Private saving rate	0.200	0.2025	0.200	0.205
Budget deficit	0.025	0.035	0.035	0.035
Income per capita	1.48	1.45	1.44	1.46
Capital-output ratio	2.5	2.39	2.36	2.43
Marginal product of capital	0.120	0.125	0.127	0.124

Table 2
Effects of Taxes on Aggregate Consumption
(Consumption Function Estimates, Ordinary Least Squares)

	First Difference of Levels			First Difference of Ratios			First Difference of Levels, Scaled		
	1954-02	1954-92	1954-00	1954-02	1954-92	1954-00	1954-02	1954-92	1954-00
A. Kormendi-Meguire RHS Specification (Effects of all taxes)									
PC*	**-0.39**	**-0.14**	**-0.23**	**-0.22**	**-0.09**	**-0.19**	**-0.24**	**-0.14**	**-0.23**
	-0.14	0.16	0.17	0.13	0.15	0.14	0.12	0.14	0.13
NDS**	**-0.27**	**-0.15**	**-0.23**	**-0.18**	**-0.10**	**-0.18**	**-0.21**	**-0.15**	**-0.22**
	0.12	0.16	0.16	0.13	0.15	0.14	0.12	0.14	0.13
B. With Federal and State/Local Taxes Split (Effects of Federal Taxes)									
PC	**-0.46**	**-0.21**	**-0.30**	**-0.28**	**-0.17**	**-0.26**	**-0.31**	**-0.25**	**-0.31**
	0.13	0.16	0.16	0.12	0.15	0.13	0.11	0.12	0.12
NDS	**-0.34**	**-0.23**	**-0.29**	**-0.25**	**-0.20**	**-0.26**	**-0.27**	**-0.27**	**-0.31**
	0.11	0.16	0.14	0.11	0.14	0.12	0.11	0.12	0.12
C. And with Marginal Tax Rate on Capital included (Effects of federal taxes)									
PC	**-0.53**	**-0.32**	**-0.40**	**-0.38**	**-0.30**	**-0.37**	**-0.40**	**-0.35**	**-0.43**
	0.14	0.17	0.17	0.13	0.15	0.14	0.12	0.13	0.13
NDS	**-0.41**	**-0.34**	**-0.40**	**-0.35**	**-0.32**	**-0.37**	**-0.38**	**-0.37**	**-0.42**
	0.12	0.16	0.15	0.12	0.15	0.14	0.12	0.14	0.13

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

*PC is real per-capita consumption of nondurables and services, plus 10 percent of expenditures on durable goods plus 30 percent of the stock of durable goods.

**NDS is real per-capita expenditures on nondurables and services multiplied by the sample period mean ratio of total consumption expenditures to nondurable and services expenditures.

Table 3
Coefficient Estimates
(Consumption Function Estimates, Ordinary Least Squares --- 1954-2002)

	First Difference of Levels		First Difference of Ratios		First Difference of Levels, Scaled	
	PC*	NDS**	PC	NDS	PC	NDS
NNP(t)	**0.35**	**0.32**	**0.39**	**0.36**	**0.26**	**0.30**
	0.08	0.07	0.10	0.09	0.06	0.06
NNP(t-1)	**0.13**	**0.09**	**0.08**	**0.07**	**0.04**	**0.03**
	0.05	0.04	0.04	0.04	0.04	0.04
Government Purchases	**0.09**	**0.04**	**0.02**	**-0.02**	**0.01**	**-0.01**
	0.14	0.12	0.10	0.10	0.10	0.10
Federal Taxes	**-0.53**	**-0.41**	**-0.38**	**-0.35**	**-0.40**	**-0.38**
	0.14	0.12	0.13	0.12	0.12	0.12
State/Local Taxes	**0.90**	**1.02**	**0.90**	**1.05**	**0.98**	**1.04**
	0.50	0.44	0.39	0.38	0.39	0.38
Government Transfers	**0.67**	**0.43**	**0.55**	**0.53**	**0.18**	**0.16**
	0.29	0.25	0.19	0.19	0.27	0.26
Government Interest Paid	**0.02**	**0.12**	**-0.08**	**0.10**	**-0.16**	**0.01**
	0.29	0.25	0.26	0.25	0.26	0.25
Government Debt(t-1)	**-0.03**	**-0.02**	**-0.03**	**-0.02**	**-0.02**	**-0.01**
	0.02	0.02	0.02	0.02	0.02	0.02
Wealth(t-1)	**0.02**	**0.02**	**0.01**	**0.01**	**0.01**	**0.01**
	0.01	0.01	0.01	0.01	0.01	0.01
Retained Earnings	**0.17**	**0.13**	**0.17**	**0.16**	**0.01**	**0.00**
	0.16	0.14	0.15	0.15	0.00	0.00
Marginal Tax Rate on Capital* **	**0.69**	**0.72**	**0.04**	**0.04**	**0.04**	**0.04**
	0.56	0.48	0.04	0.02	0.02	0.02
Constant	**0.07**	**0.07**	**0.01**	**0.00**	**0.00**	**0.01**
	0.05	0.04	0.00	0.00	0.00	0.00

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.
*PC is real per-capita consumption of nondurables and services, plus 10 percent of expenditures on durable goods plus 30 percent of the stock of durable goods.
**NDS is real per-capita expenditures on nondurables and services multiplied by the sample period mean ratio of total consumption expenditures to nondurable and services expenditures.
*** Coefficient and standard error multiplied by 100.

Table 4
Effects of Taxes on Aggregate Consumption
(Euler Equation Specification)

	First Difference of Levels		First Difference of Ratios		First Difference of Levels, Scaled	
Marginal Tax Rate Included?	No	Yes	No	Yes	No	Yes
A. OLS (1954-2002)						
PC	**-0.38**	**-0.44**	**-0.70**	**-0.79**	**-0.25**	**-0.33**
	0.14	0.15	0.16	0.18	0.13	0.13
NDS	**-0.27**	**-0.31**	**-0.65**	**-0.71**	**-0.22**	**-0.27**
	0.12	0.13	0.15	0.17	0.12	0.12
B. IV (1957-2002)						
PC	**-0.81**	**-0.82**	**-0.54**	**-0.36**	**-0.56**	**-0.56**
	0.26	0.24	0.25	0.34	0.25	0.23
NDS	**-0.66**	**-0.65**	**-0.51**	**-0.31**	**-0.55**	**-0.44**
	0.22	0.22	0.23	0.32	0.25	0.23

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Table 5
Coefficient Estimates
(Euler Equation Specification, Instrumental Variable Estimates, 1957-2002)

	First Difference of Levels		First Difference of Ratios		First Difference of Levels, Scaled	
	PC	NDS	PC	NDS	PC	NDS
Pre-Tax Income	**0.47**	**0.39**	**0.98**	**0.90**	**0.34**	**0.31**
	0.22	0.21	0.32	0.29	0.19	0.20
Government Purchases	**0.30**	**0.24**	**0.30**	**0.23**	**0.23**	**0.25**
	0.37	0.33	0.37	0.35	0.26	0.27
Federal Taxes	**-0.82**	**-0.65**	**-0.36**	**-0.31**	**-0.56**	**-0.44**
	0.24	0.22	0.34	0.32	0.23	0.23
State/Local Taxes	**0.97**	**1.47**	**0.57**	**0.64**	**1.31**	**1.70**
	1.13	1.06	1.49	1.45	0.92	0.99
Government Debt(t-1)	**0.01**	**0.01**	**0.06**	**0.06**	**0.01**	**0.01**
	0.03	0.03	0.04	0.04	0.03	0.03
Wealth(t-1)	**0.03**	**0.03**	**-0.01**	**-0.01**	**0.02**	**0.02**
	0.01	0.01	0.01	0.01	0.01	0.01
Marginal Tax Rate on Capital*	**1.97**	**1.15**	**-0.09**	**-0.10**	**0.06**	**0.02**
	1.77	1.57	0.12	0.11	0.07	0.07
Constant	**0.09**	**0.05**	**0.00**	**0.00**	**0.01**	**0.00**
	0.07	0.06	0.00	0.00	0.00	0.00

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.
* Coefficient and standard error multiplied by 100.

Table 6

Regression Results for Real 5-Year-Ahead 10-Year Treasury Rate Using Projected Fiscal Variables, OLS (1976-2004)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Debt(t+5)/GDP	**0.049**				**0.056**				**0.038**			
	0.016				0.018				0.012			
Deficit(t+5)/GDP		**0.293**				**0.315**				**0.282**		
		0.068				0.070				0.072		
Primary Deficit(t+5)/GDP			**0.395**				**0.445**				**0.388**	
			0.100				0.091				0.099	
Revenues(t+5)/GDP				**-0.424**				**-0.531**				**-0.292**
				0.203				0.130				0.133
Primary Outlays(t+5)/GDP				**0.370**				**0.391**				**0.430**
				0.113				0.141				0.219
Recession					**2.913**	**1.615**	**1.128**	**-6.731**	**0.870**	**0.897**	**0.719**	**6.555**
					0.554	0.396	0.484	4.350	1.031	0.344	0.334	6.634
Rec*Debt(t+5)/GDP					**-0.043**				**-0.012**			
					0.025				0.023			
Rec*Deficit(t+5)/GDP						**-0.178**				**-0.099**		
						0.109				0.053		
Rec*Primary Deficit(t+5)/GDP							**-0.258**				**-0.152**	
							0.147				0.075	
Rec*Revenues(t+5)/GDP								**0.380**				**0.030**
								0.127				0.157
Rec*Primary Outlays(t+5)/GDP								**0.057**				**-0.356**
								0.173				0.229
Oil Price									**0.048**	**0.023**	**0.015**	**0.023**
									0.017	0.019	0.020	0.022
Equity Premium									**-0.283**	**-0.293**	**-0.338**	**-0.377**
									0.161	0.134	0.143	0.175
Defense Spending/GDP									**-0.041**	**-0.079**	**0.012**	**-0.028**
									0.179	0.141	0.148	0.195
Treasury Holdings									**-0.208**			
									0.345			
Treasury Purchases										**-0.743**	**-0.690**	**-0.602**
										0.755	0.741	0.821
GDP growth rate(t+5)	**0.555**	**0.278**	**0.185**	**0.204**	**0.296**	**0.034**	**-0.053**	**-0.001**	**0.152**	**0.346**	**0.363**	**0.311**
	0.438	0.300	0.289	0.264	0.406	0.233	0.205	0.208	0.585	0.521	0.526	0.554
Constant	**1.335**	**3.666**	**4.809**	**5.767**	**1.629**	**4.168**	**5.377**	**7.880**	**3.522**	**4.261**	**4.999**	**2.586**
	1.593	0.806	0.799	4.878	1.687	0.689	0.494	3.684	2.276	0.924	0.880	5.275
Adjusted R-squared	**0.213**	**0.436**	**0.408**	**0.386**	**0.463**	**0.642**	**0.641**	**0.636**	**0.679**	**0.779**	**0.773**	**0.758**

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Table 7

Regression Results for Nominal 5-Year-Ahead 10-Year Treasury Rate
Using Projected Fiscal Variables, OLS
(1976-2004)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Debt(t+5)/GDP	**0.035**				**0.056**				**0.038**			
	0.019				0.020				0.011			
Deficit(t+5)/GDP		**0.250**				**0.351**				**0.281**		
		0.096				0.085				0.073		
Primary Deficit(t+5)/GDP			**0.329**				**0.464**				**0.384**	
			0.127				0.112				0.098	
Revenues(t+5)/GDP				**-0.400**				**-0.527**				**-0.229**
				0.180				0.126				0.123
Primary Outlays(t+5)/GDP				**0.245**				**0.398**				**0.458**
				0.147				0.256				0.238
Recession					**2.874**	**1.850**	**1.201**	**-6.515**	**1.243**	**0.988**	**0.750**	**9.254**
					0.691	0.491	0.512	6.437	1.168	0.432	0.347	7.462
Rec*Debt(t+5)/GDP					**-0.042**				**-0.021**			
					0.026				0.030			
Rec*Deficit(t+5)/GDP						**-0.206**				**-0.105**		
						0.122				0.057		
Rec*Primary Deficit(t+5)/GDP							**-0.271**				**-0.149**	
							0.160				0.074	
Rec*Revenues(t+5)/GDP								**0.375**				**-0.037**
								0.130				0.159
Rec*Primary Outlays(t+5)/GDP								**0.050**				**-0.430**
								0.254				0.263
Oil Price									**0.052**	**0.027**	**0.017**	**0.031**
									0.018	0.020	0.020	0.021
Equity Premium									**-0.244**	**-0.275**	**-0.330**	**-0.370**
									0.136	0.134	0.142	0.168
Defense Spending/GDP									**0.055**	**0.011**	**0.051**	**0.056**
									0.275	0.230	0.235	0.259
Treasury Holdings									**-0.367**			
									0.412			
Treasury Purchases										**-0.786**	**-0.707**	**-0.615**
										0.702	0.733	0.804
GDP growth rate(t+5)	**-0.169**	**-0.078**	**-0.248**	**-0.265**	**0.273**	**0.274**	**0.042**	**0.011**	**0.228**	**0.393**	**0.372**	**0.335**
	0.598	0.443	0.385	0.378	0.525	0.370	0.333	0.378	0.635	0.551	0.552	0.594
Expected Inflation	**1.327**	**1.184**	**1.236**	**1.275**	**1.012**	**0.858**	**0.940**	**0.989**	**0.809**	**0.878**	**0.949**	**0.847**
	0.172	0.194	0.179	0.165	0.151	0.153	0.149	0.225	0.278	0.209	0.203	0.228
Constant	**2.740**	**4.057**	**5.088**	**7.874**	**1.678**	**3.939**	**5.340**	**7.671**	**4.103**	**3.989**	**4.883**	**0.668**
	1.907	0.875	0.722	3.774	1.851	0.739	0.506	5.871	2.050	1.157	1.123	6.100
Adjusted R-squared	**0.813**	**0.854**	**0.853**	**0.851**	**0.854**	**0.906**	**0.903**	**0.900**	**0.914**	**0.941**	**0.938**	**0.935**

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Table 8

Regression Results for Real 5-Year-Ahead 10-Year Treasury Rate Using Projected Fiscal Variables, OLS (1976-2004)

Variable	1	2	3	4	5	6
Debt(t+4)/GDP	**-0.034**	**-0.038**	**-0.042**	**-0.046**	**-0.016**	**-0.017**
	0.028	0.033	0.028	0.030	0.027	0.043
Primary Deficit(t+5)/GDP	**0.541**		**0.648**		**0.475**	
	0.176		0.156		0.177	
Revenues(t+5)/GDP		**-0.528**		**-0.661**		**-0.400**
		0.212		0.179		0.275
Primary Outlays(t+5)/GDP		**0.582**		**0.665**		**0.559**
		0.233		0.224		0.386
Recession			**1.036**	**-5.343**	**1.315**	**4.925**
			1.366	4.138	0.825	7.757
Rec*Debt(t+4)/GDP			**-0.005**	**-0.008**	**-0.016**	**-0.013**
			0.028	0.022	0.019	0.020
Rec*Primary Deficit(t+5)/GDP			**-0.349**		**-0.163**	
			0.195		0.156	
Rec*Revenues(t+5)/GDP				**0.397**		**0.083**
				0.179		0.268
Rec*Primary Outlays(t+5)/GDP				**-0.026**		**-0.280**
				0.208		0.279
Oil Price					**0.003**	**0.005**
					0.020	0.034
Equity Premium					**-0.354**	**-0.380**
					0.152	0.187
Defense Spending/GDP					**0.077**	**0.015**
					0.143	0.167
Treasury Purchases					**-0.628**	**-0.561**
					0.749	0.844
GDP growth rate(t+5)	**-0.133**	**-0.186**	**-0.446**	**-0.501**	**0.307**	**0.305**
	0.440	0.426	0.277	0.315	0.601	0.620
Constant	**7.235**	**6.547**	**8.429**	**8.676**	**5.947**	**3.337**
	2.347	4.848	1.852	3.994	2.127	5.651
Adjusted R-squared	**0.416**	**0.393**	**0.662**	**0.664**	**0.761**	**0.738**

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Table 9

Regression Results for Real 5-Year-Ahead 10-Year Treasury Rate Using Projected Fiscal Variables, ARMA (1976-2004)

Variable	1	2	3	4	5	6
Debt(t+4)/GDP	**-0.029**	**-0.038**	**-0.047**	**-0.047**	**-0.013**	**-0.010**
	0.031	0.034	0.026	0.026	0.017	0.019
Primary Deficit(t+5)/GDP	**0.455**		**0.673**		**0.534**	
	0.225		0.169		0.113	
Revenues(t+5)/GDP		**-0.442**		**-0.672**		**-0.508**
		0.219		0.171		0.154
Primary Outlays(t+5)/GDP		**0.564**		**0.669**		**0.489**
		0.227		0.201		0.213
Recession			**0.770**	**-5.549**	**0.512**	**1.688**
			1.511	3.597	0.854	4.807
Rec*Debt(t+4)/GDP			**0.003**	**-0.003**	**0.013**	**0.015**
			0.033	0.029	0.021	0.022
Rec*Primary Deficit(t+5)/GDP			**-0.385**		**-0.330**	
			0.231		0.159	
Rec*Revenues(t+5)/GDP				**0.423**		**0.295**
				0.213		0.180
Rec*Primary Outlays(t+5)/GDP				**-0.051**		**-0.368**
				0.243		0.245
Oil Price					**-0.010**	**-0.003**
					0.020	0.029
Equity Premium					**-0.447**	**-0.448**
					0.118	0.118
Defense Spending/GDP					**0.029**	**0.032**
					0.063	0.085
Fed. Reserve Treasury Purchases					**-0.330**	**-0.297**
					0.545	0.585
GDP growth rate(t+5)	**-0.150**	**-0.250**	**-0.484**	**-0.506**	**0.775**	**0.734**
	0.429	0.407	0.213	0.259	0.560	0.565
Constant	**6.941**	**5.388**	**8.748**	**8.871**	**5.365**	**5.448**
	2.346	4.761	1.701	3.375	1.332	3.147
ARMA						
L.ar	**0.331**	**0.346**	**-0.100**	**-0.061**	**-0.587**	**-0.588**
	0.308	0.280	0.210	0.214	0.239	0.232
Wald Chi-squared	**52.409**	**56.816**	**419.01**	**71263**	**2751.6**	**39604**

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Table 10

Regression Results for Current Real 10-Year Treasury Rate
Using Projected Fiscal Variables, OLS
(1976-2004)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Debt(t+5)/GDP	**0.035**				**0.045**				**0.017**			
	0.019				0.020				0.020			
Deficit(t+5)/GDP		**0.255**				**0.274**				**0.175**		
		0.097				0.076				0.100		
Primary Deficit(t+5)/GDP			**0.319**				**0.360**				**0.169**	
			0.152				0.109				0.155	
Revenues(t+5)/GDP				**-0.331**				**-0.378**				**-0.006**
				0.326				0.279				0.246
Primary Outlays(t+5)/GDP				**0.308**				**0.346**				**0.280**
				0.158				0.208				0.228
Recession					**4.393**	**2.579**	**2.141**	**-9.671**	**1.680**	**1.211**	**1.195**	**10.028**
					0.826	0.746	0.907	9.527	1.133	0.786	0.658	8.171
Rec*Debt(t+5)/GDP					**-0.063**				**-0.027**			
					0.040				0.031			
Rec*Deficit(t+5)/GDP						**-0.192**				**-0.029**		
						0.210				0.086		
Rec*Primary Deficit(t+5)/GDP							**-0.224**				**0.038**	
							0.282				0.132	
Rec*Revenues(t+5)/GDP								**0.329**				**-0.234**
								0.276				0.262
Rec*Primary Outlays(t+5)/GDP								**0.344**				**-0.250**
								0.320				0.248
Oil Price									**0.046**	**0.034**	**0.039**	**0.047**
									0.026	0.033	0.034	0.042
Equity Premium									**-0.437**	**-0.494**	**-0.506**	**-0.567**
									0.163	0.177	0.178	0.185
Defense Spending/GDP									**-0.139**	**0.075**	**0.170**	**0.076**
									0.301	0.218	0.212	0.222
Federal Holdings									**-0.985**			
									0.344			
Federal Purchases										**-2.008**	**-1.941**	**-1.809**
										0.538	0.566	0.724
GDP growth rate(t+5)	**0.783**	**0.662**	**0.558**	**0.566**	**0.386**	**0.267**	**0.177**	**0.167**	**0.462**	**0.697**	**0.514**	**0.473**
	0.508	0.410	0.408	0.400	0.410	0.279	0.277	0.356	0.664	0.658	0.659	0.730
Constant	**0.510**	**1.887**	**2.914**	**3.321**	**0.973**	**2.714**	**3.770**	**4.396**	**7.418**	**2.654**	**3.059**	**-1.652**
	1.817	1.123	1.143	7.498	1.792	0.897	0.769	7.498	2.573	0.911	0.945	5.919
Adjusted R-squared	**0.028**	**0.181**	**0.135**	**0.100**	**0.410**	**0.498**	**0.464**	**0.478**	**0.755**	**0.781**	**0.763**	**0.751**

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Table 11

Regression Results for Current Nominal 10-Year Treasury Rate
Using Projected Fiscal Variables, OLS
(1976-2004)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Debt(t+5)/GDP	**0.002**				**0.025**				**0.019**			
	0.022				0.024				0.017			
Deficit(t+5)/GDP		**0.108**				**0.203**				**0.178**		
		0.120				0.111				0.082		
Primary Deficit(t+5)/GDP			**0.133**				**0.251**				**0.217**	
			0.157				0.142				0.117	
Revenues(t+5)/GDP				**-0.268**				**-0.587**				**-0.272**
				0.255				0.222				0.254
Primary Outlays(t+5)/GDP				**-0.025**				**-0.105**				**0.161**
				0.188				0.341				0.214
Recession					**3.115**	**2.122**	**1.727**	**-22.057**	**0.649**	**0.778**	**0.817**	**-1.307**
					1.122	0.831	0.897	9.284	0.850	0.432	0.328	9.465
Rec*Debt(t+5)/GDP					**-0.041**				**-0.002**			
					0.038				0.022			
Rec*Deficit(t+5)/GDP						**-0.138**				**0.001**		
						0.208				0.064		
Rec*Primary Deficit(t+5)/GDP							**-0.150**				**0.010**	
							0.271				0.093	
Rec*Revenues(t+5)/GDP								**0.569**				**0.046**
								0.215				0.271
Rec*Primary Outlays(t+5)/GDP								**0.706**				**0.063**
								0.332				0.281
Oil Price									**0.035**	**0.014**	**0.012**	**0.011**
									0.021	0.025	0.027	0.034
Equity Premium									**-0.545**	**-0.578**	**-0.606**	**-0.595**
									0.169	0.161	0.171	0.195
Defense Spending/GDP									**-0.404**	**-0.351**	**-0.295**	**-0.275**
									0.293	0.181	0.189	0.203
Treasury Holdings									**-0.544**			
									0.500			
Treasury Purchases										**-1.804**	**-1.739**	**-1.758**
										0.794	0.804	0.794
GDP growth rate(t+5)	**-0.883**	**-0.569**	**-0.660**	**-0.693**	**-0.388**	**-0.200**	**-0.364**	**-0.526**	**0.252**	**0.475**	**0.397**	**0.373**
	0.646	0.586	0.520	0.480	0.669	0.573	0.516	0.498	0.670	0.610	0.610	0.658
Expected Inflation	**1.753**	**1.637**	**1.666**	**1.739**	**1.398**	**1.277**	**1.340**	**1.623**	**1.527**	**1.579**	**1.608**	**1.642**
	0.227	0.268	0.250	0.229	0.249	0.268	0.253	0.300	0.249	0.200	0.196	0.256
Constant	**3.741**	**3.240**	**3.700**	**8.984**	**2.573**	**3.161**	**3.980**	**16.428**	**5.814**	**3.948**	**4.454**	**6.400**
	2.033	1.159	0.948	5.489	2.151	1.066	0.783	8.615	3.048	1.002	0.930	7.141
Adjusted R-squared	**0.809**	**0.818**	**0.817**	**0.819**	**0.843**	**0.858**	**0.854**	**0.874**	**0.940**	**0.957**	**0.954**	**0.949**

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Table 12

Regression Results for Current Real 10-Year Treasury Rate Using Projected Fiscal Variables, OLS (1976-2004)

Variable	1	2	3	4	5	6
Debt(t+4)/GDP	**-0.052**	**-0.062**	**-0.037**	**-0.050**	**0.019**	**0.017**
	0.039	0.041	0.033	0.031	0.028	0.037
Primary Deficit(t+5)/GDP	**0.541**		**0.527**		**0.085**	
	0.276		0.194		0.198	
Revenues(t+5)/GDP		**-0.504**		**-0.479**		**0.026**
		0.344		0.344		0.348
Primary Outlays(t+5)/GDP		**0.660**		**0.655**		**0.209**
		0.312		0.281		0.304
Recession			**3.677**	**-6.378**	**4.129**	**9.496**
			2.272	9.464	1.102	9.220
Rec*Debt(t+4)/GDP			**-0.050**	**-0.056**	**-0.076**	**-0.072**
			0.047	0.026	0.022	0.024
Rec*Primary Deficit(t+5)/GDP			**-0.162**		**0.304**	
			0.309		0.174	
Rec*Revenues(t+5)/GDP				**0.180**		**-0.422**
				0.352		0.335
Rec*Primary Outlays(t+5)/GDP				**0.419**		**0.128**
				0.248		0.248
Oil Price					**0.024**	**0.026**
					0.033	0.049
Equity Premium					**-0.547**	**-0.585**
					0.200	0.207
Defense Spending/GDP					**0.238**	**0.147**
					0.228	0.242
Treasury Purchases					**-2.199**	**-2.100**
					0.656	0.787
GDP growth rate(t+5)	**0.073**	**-0.081**	**-0.251**	**-0.493**	**0.745**	**0.741**
	0.559	0.495	0.342	0.474	0.837	0.903
Constant	**6.611**	**4.615**	**6.654**	**4.636**	**1.868**	**-1.993**
	3.199	7.500	2.347	8.649	2.297	7.340
Adjusted R-squared	**0.146**	**0.119**	**0.488**	**0.537**	**0.785**	**0.767**

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

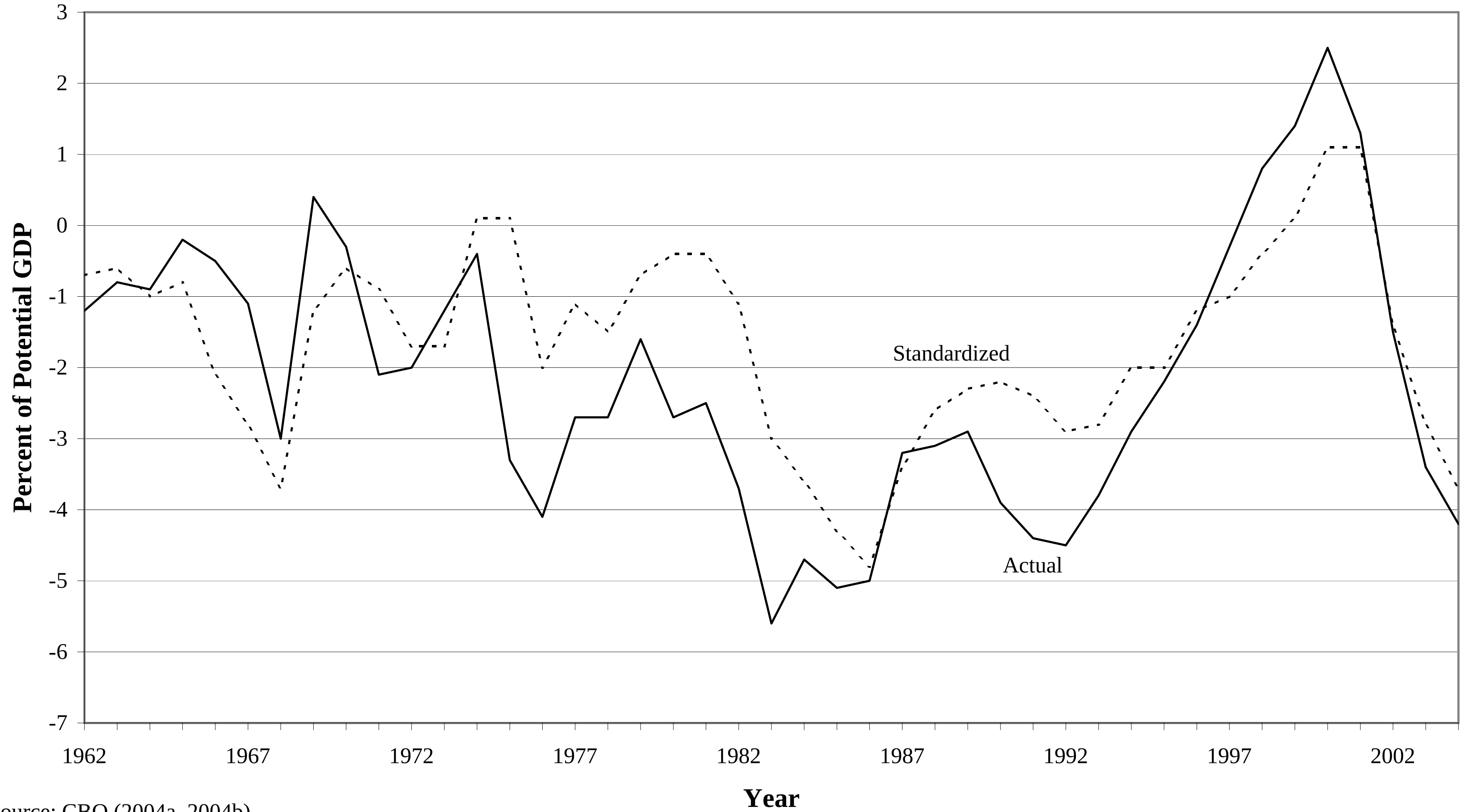
Table 13

Regression Results for Current Real 10-Year Treasury Rate
Using Current-Period Fiscal Variables, OLS
(1976-2004)

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Debt(t)/GDP	**-0.029**				**0.034**				**-0.010**			
	0.031				0.023				0.027			
Deficit(t)/GDP		**0.165**				**0.113**				**0.020**		
		0.115				0.114				0.145		
Primary Deficit(t)/GDP			**0.086**				**-0.005**				**-0.062**	
			0.111				0.108				0.137	
Revenues(t)/GDP				**0.940**				**0.667**				**0.205**
				0.114				0.287				0.288
Primary Outlays(t)/GDP				**0.878**				**0.583**				**0.269**
				0.173				0.334				0.460
Recession					**8.161**	**4.968**	**2.834**	**-23.329**	**3.776**	**2.411**	**0.336**	**-14.988**
					1.590	2.306	1.374	11.876	1.874	2.231	1.177	14.676
Rec*Debt(t)/GDP					**-0.161**				**-0.088**			
					0.040				0.039			
Rec*Deficit(t)/GDP						**-0.748**				**-0.515**		
						0.791				0.535		
Rec*Primary Deficit(t)/GDP							**-0.050**				**0.249**	
							2.052				0.929	
Rec*Revenues(t)/GDP								**-0.440**				**-0.118**
								0.859				0.949
Rec*Primary Outlays(t)/GDP								**1.667**				**0.909**
								1.106				1.044
Oil Price									**0.041**	**0.057**	**0.066**	**0.041**
									0.023	0.020	0.020	0.032
Equity Premium									**-0.410**	**-0.478**	**-0.432**	**-0.459**
									0.111	0.124	0.130	0.162
Defense Spending/GDP									**-0.022**	**0.316**	**0.338**	**0.244**
									0.271	0.297	0.249	0.292
Treasury Holdings									**-1.087**			
									0.301			
Treasury Purchases										**-1.612**	**-1.523**	**-1.620**
										0.629	0.709	0.736
GDP growth rate(t)	**-0.283**	**-0.293**	**-0.294**	**-0.086**	**0.086**	**-0.009**	**0.071**	**0.048**	**0.014**	**-0.059**	**-0.028**	**0.007**
	0.179	0.171	0.180	0.139	0.173	0.187	0.203	0.223	0.109	0.128	0.138	0.140
Constant	**6.100**	**4.617**	**5.045**	**-29.049**	**2.108**	**3.499**	**3.484**	**-19.215**	**9.752**	**3.096**	**2.476**	**-5.023**
	1.450	0.685	0.636	5.000	1.091	0.689	0.754	10.761	2.598	1.126	1.318	11.283
Adjusted R-squared	**0.090**	**0.123**	**0.081**	**0.453**	**0.351**	**0.287**	**0.245**	**0.422**	**0.771**	**0.739**	**0.731**	**0.726**

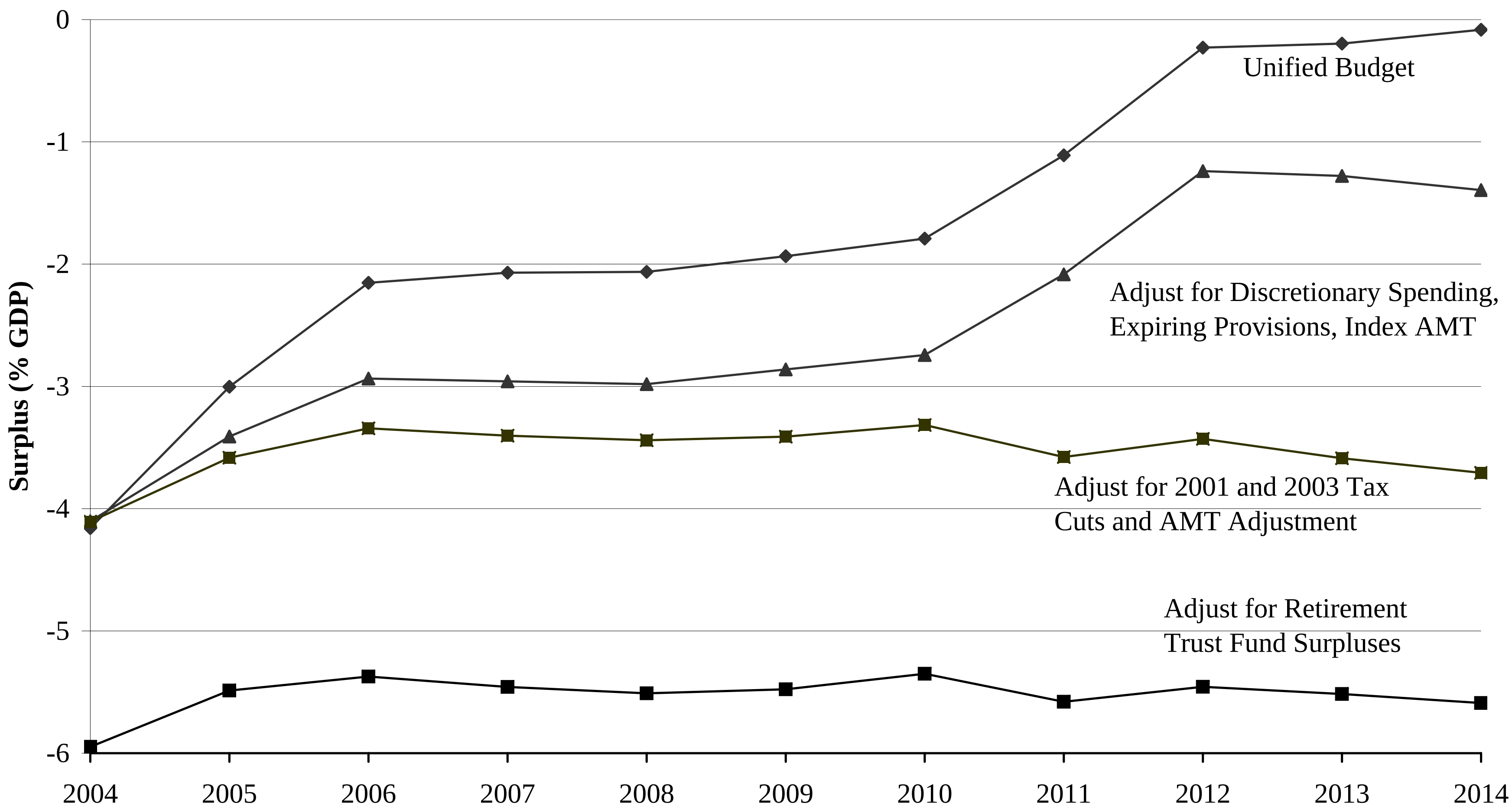
Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.

Figure 1
Standardized and Actual Federal Budget Surplus, 1962-2004
(as a share of Potential GDP)



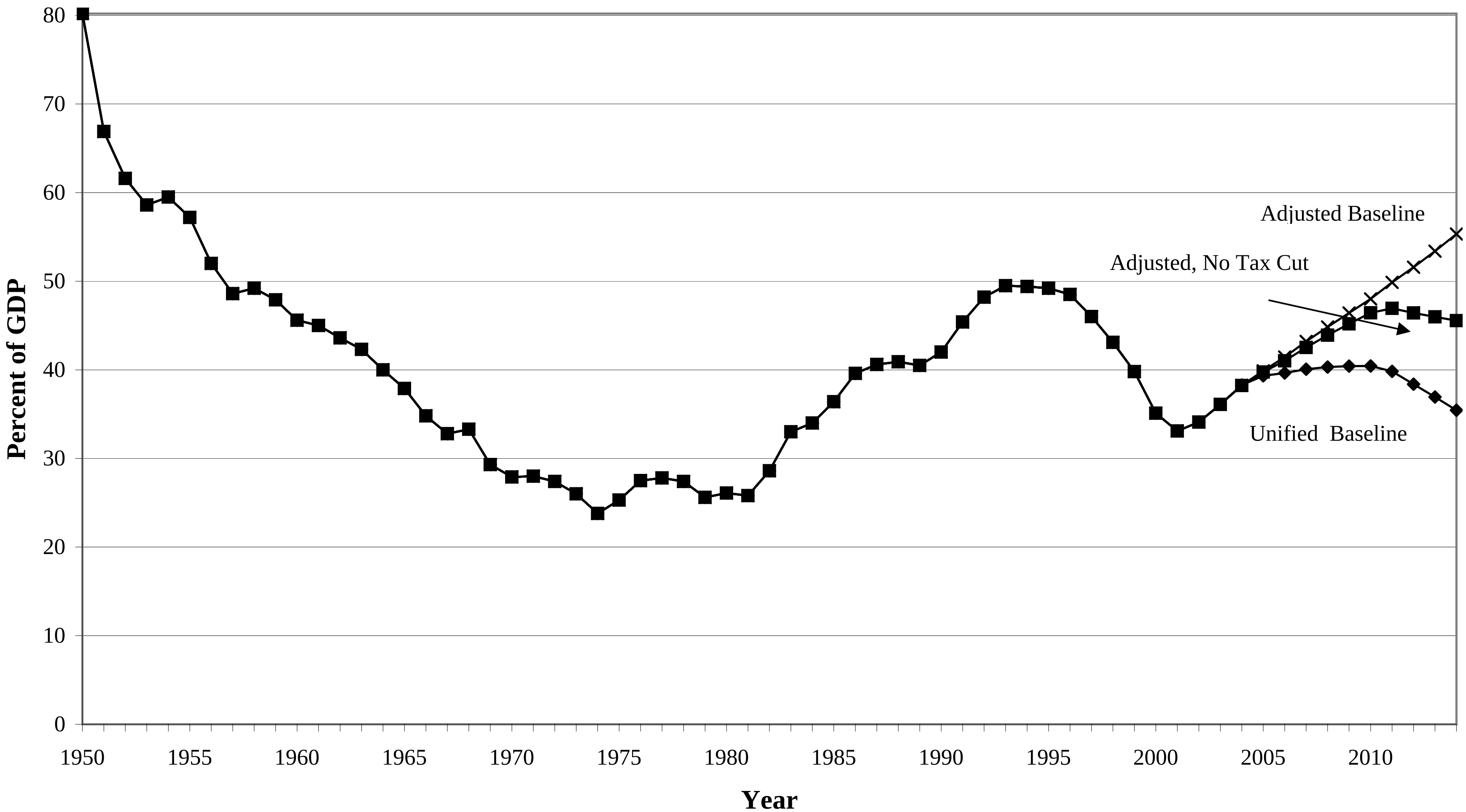
Source: CBO (2004a, 2004b).

Figure 2
Unified and Adjusted Federal Budget Projections, 2004-2014
(as a share of GDP)



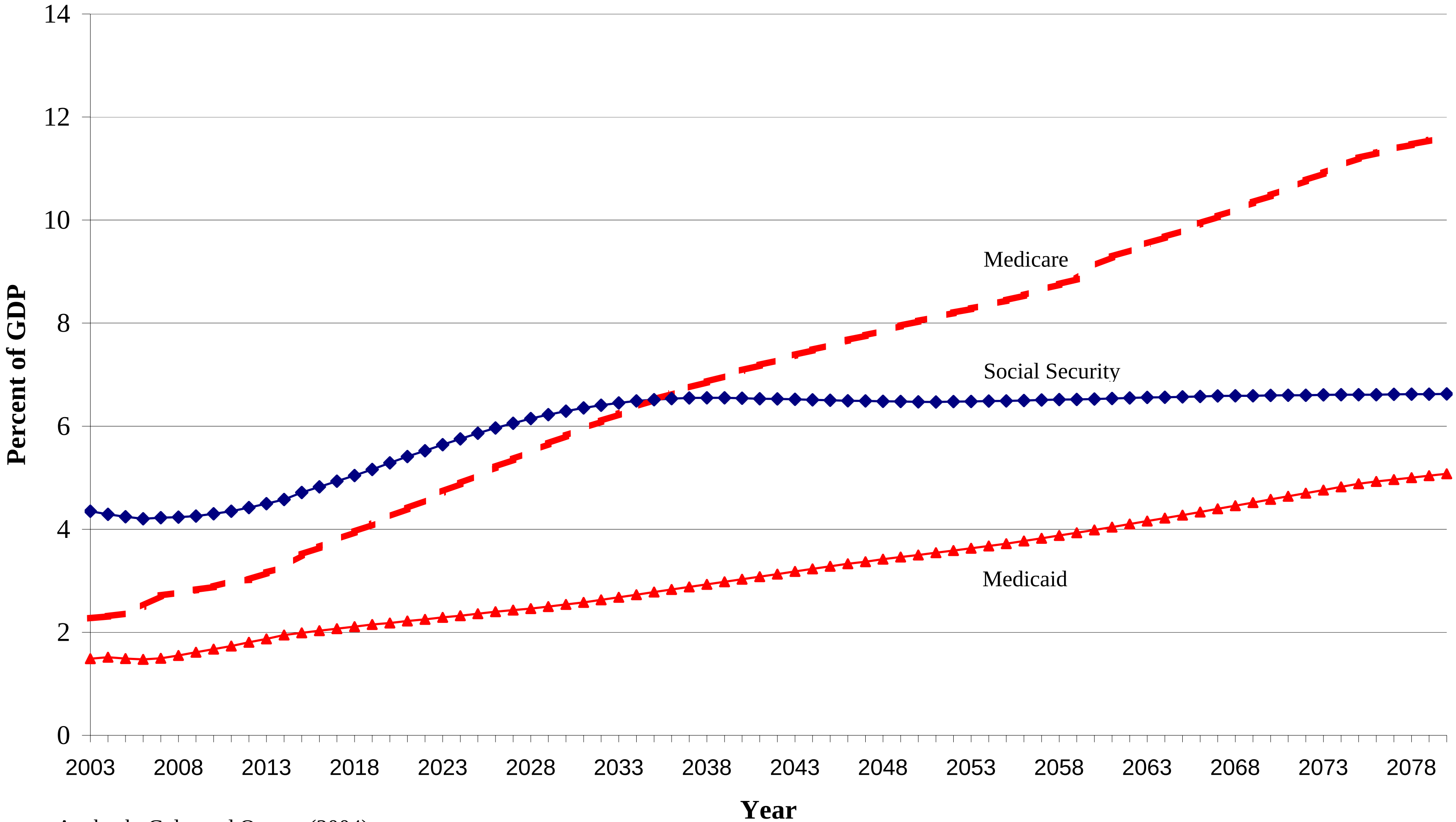
Source: Authors' calculations using CBO (2004a), imputed debt service using the CBO interest matrix, and the TPC Microsimulation Model.

Figure 3
Public Debt, 1950-2014
(as a share of GDP)



Source: Authors' calculations using CBO (2004a), imputed debt service using the CBO interest matrix, U.S. Budget (2004), and the TPC Microsimulation Model.

Figure 4
Entitlement Expenditures under Current Law, 2003-2080
(as a share of GDP)



Source: Auebach, Gale, and Orszag (2004).

Figure 5

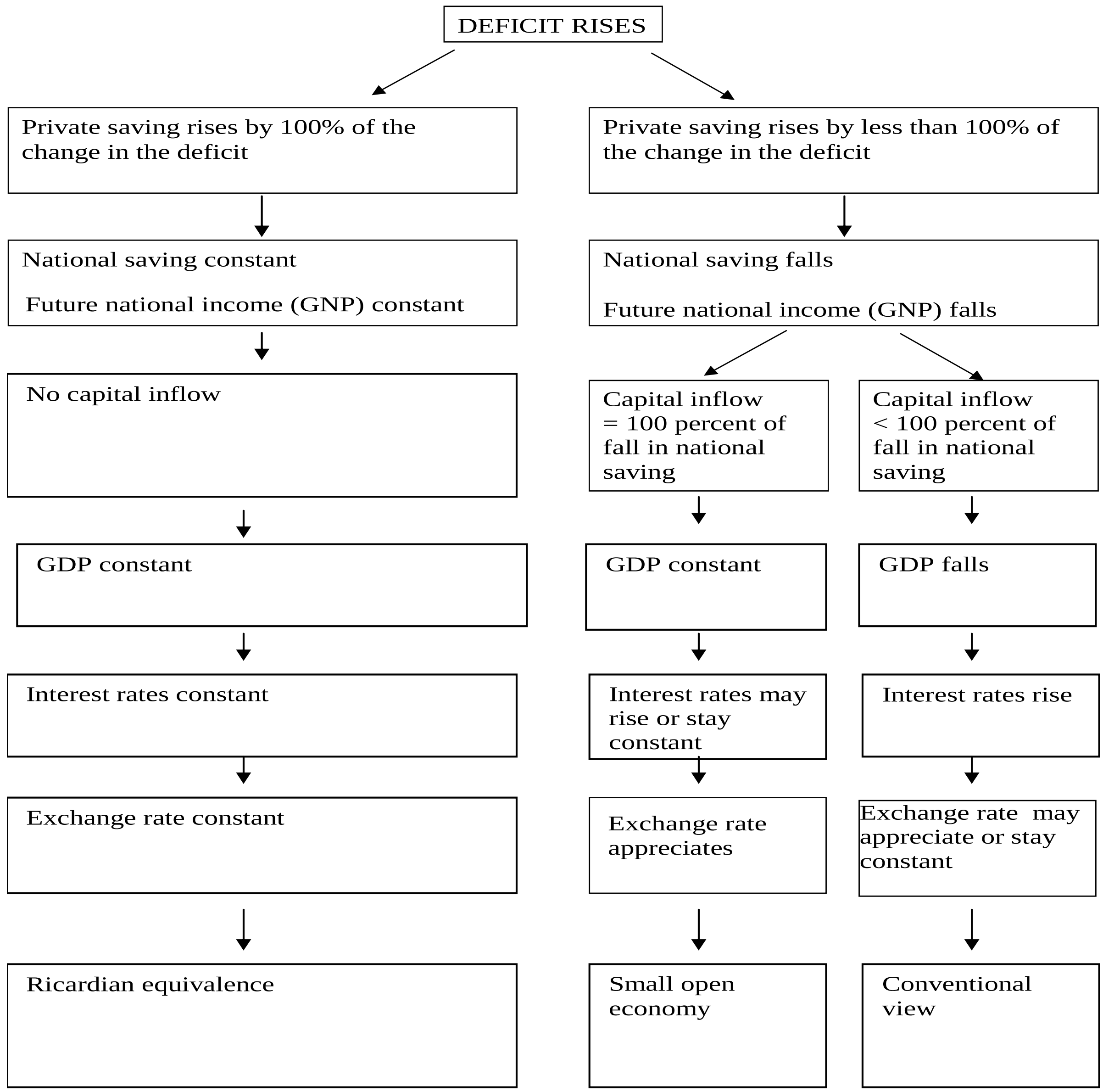
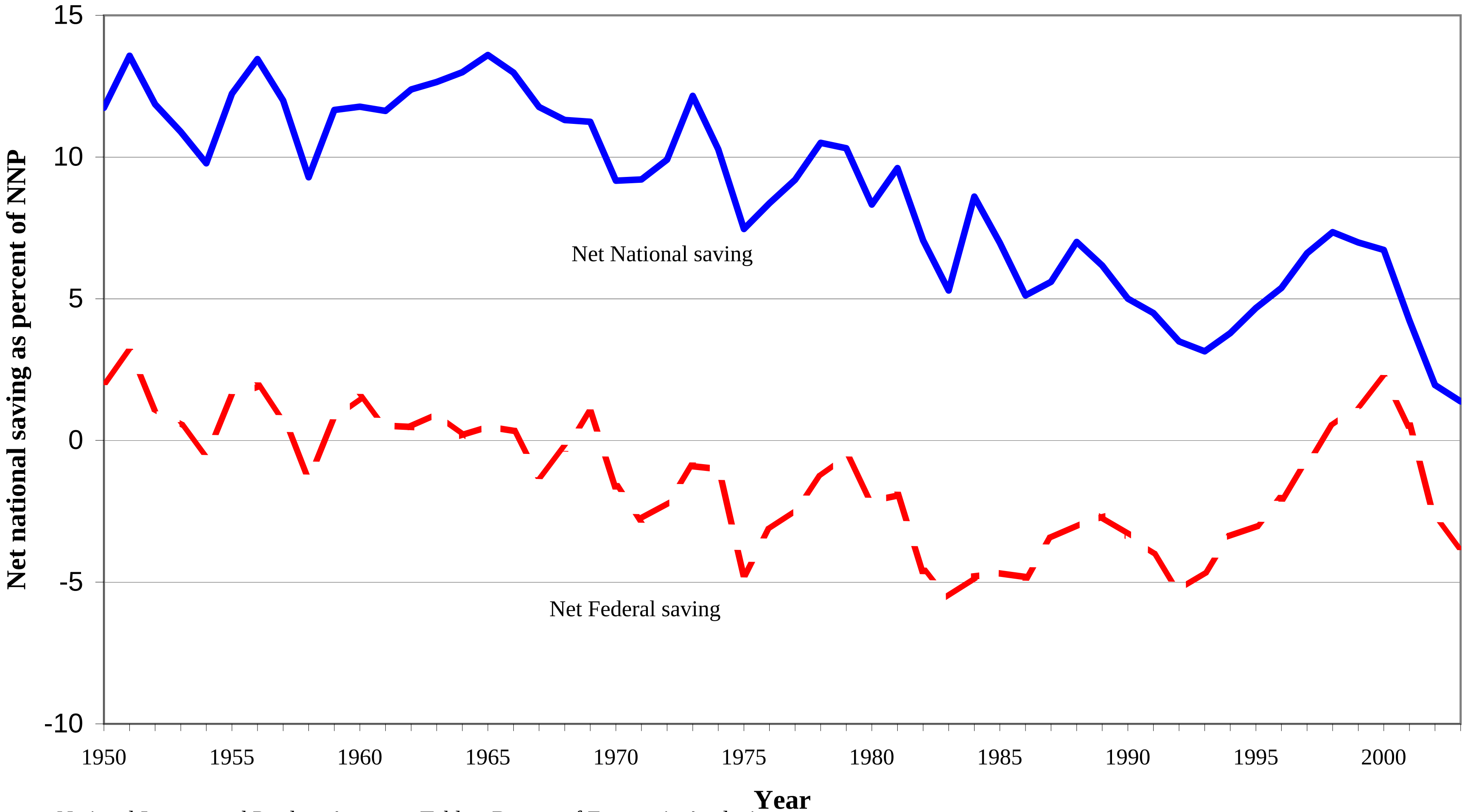
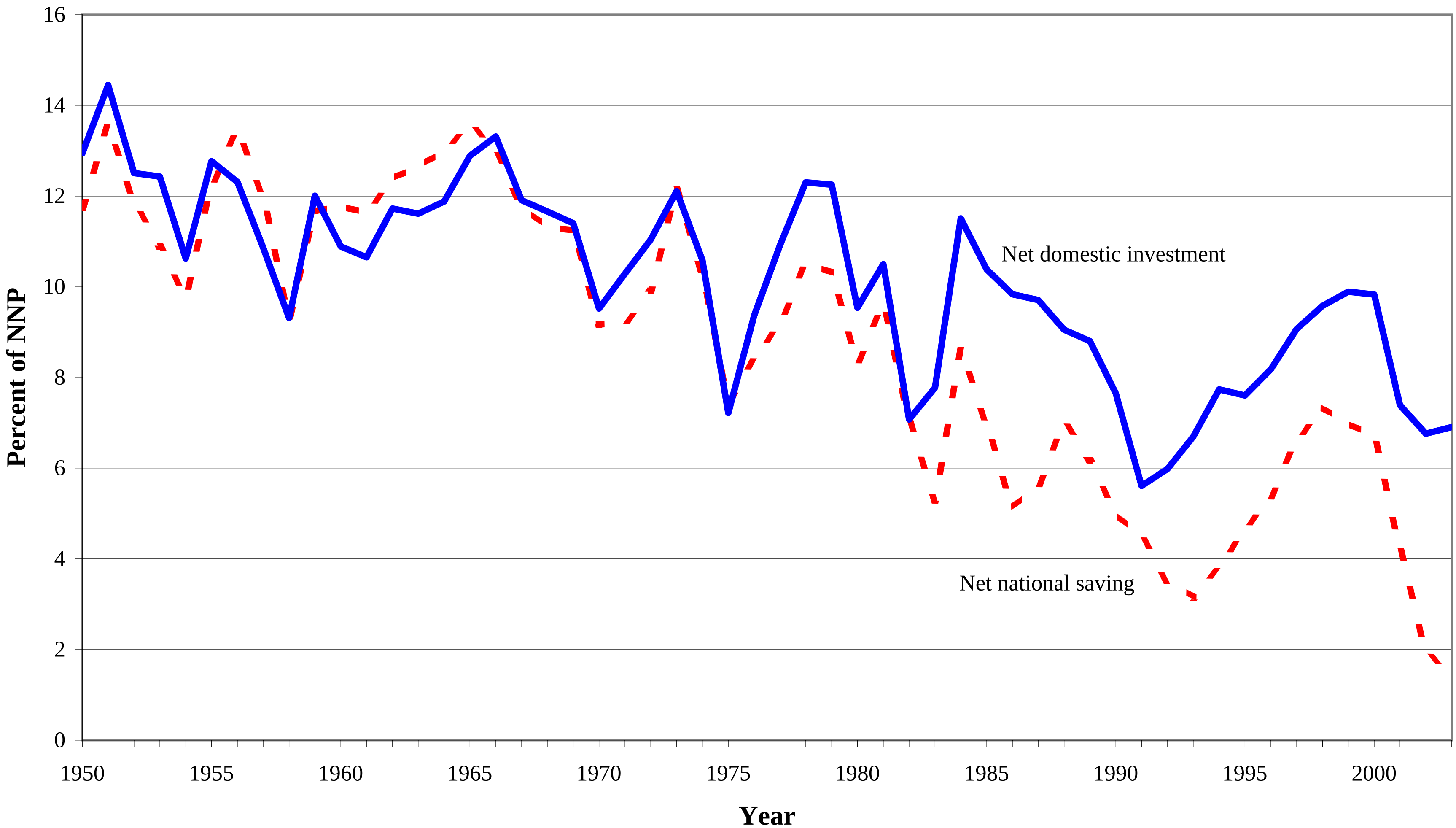

DEFICIT RISES
Private saving rises by 100% of the change in the deficit
Private saving rises by less than 100% of the change in the deficit
National saving constant
Future national income (GNP) constant
National saving falls
Future national income (GNP) falls
No capital inflow
Capital inflow = 100 percent of fall in national saving
Capital inflow < 100 percent of fall in national saving
GDP constant
GDP constant
GDP falls
Interest rates constant
Interest rates may rise or stay constant
Interest rates rise
Exchange rate constant
Exchange rate appreciates
Exchange rate may appreciate or stay constant
Ricardian equivalence
Small open economy
Conventional view

Figure 6
Net Federal and National Saving, 1950-2003
(as a share of NNP)



Source: National Income and Product Accounts Tables, Bureau of Economic Analysis.

Figure 7
Net Domestic Investment and National Saving, 1950-2003
(as a share of NNP)



Source: National Income and Product Accounts Tables, Bureau of Economic Analysis.

Figure 8
Forward 10-Year Interest Rates and Projected Deficits, 1976-2004

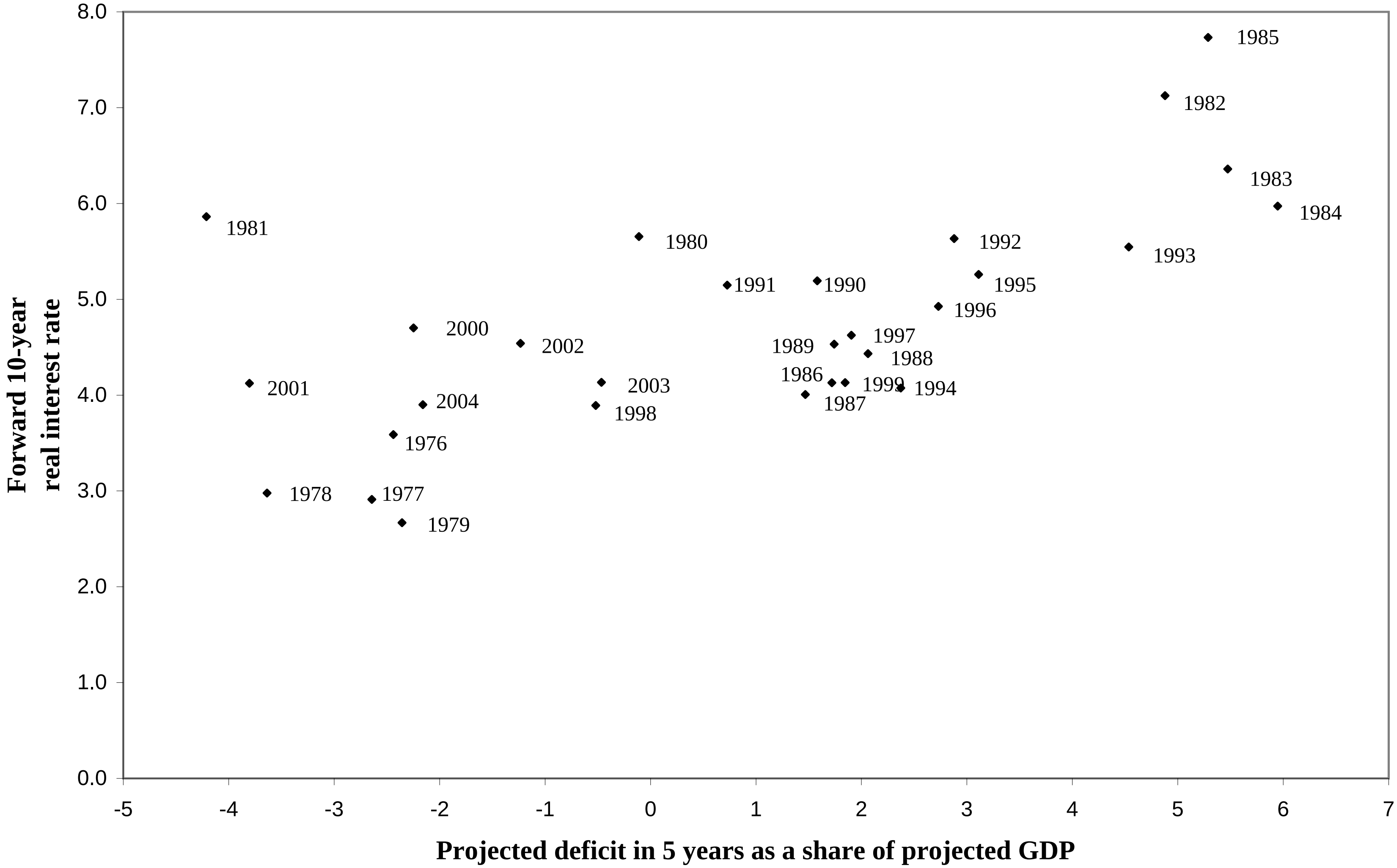


Figure 9
Forward 10-Year Interest Rates and Projected Debt, 1976-2004

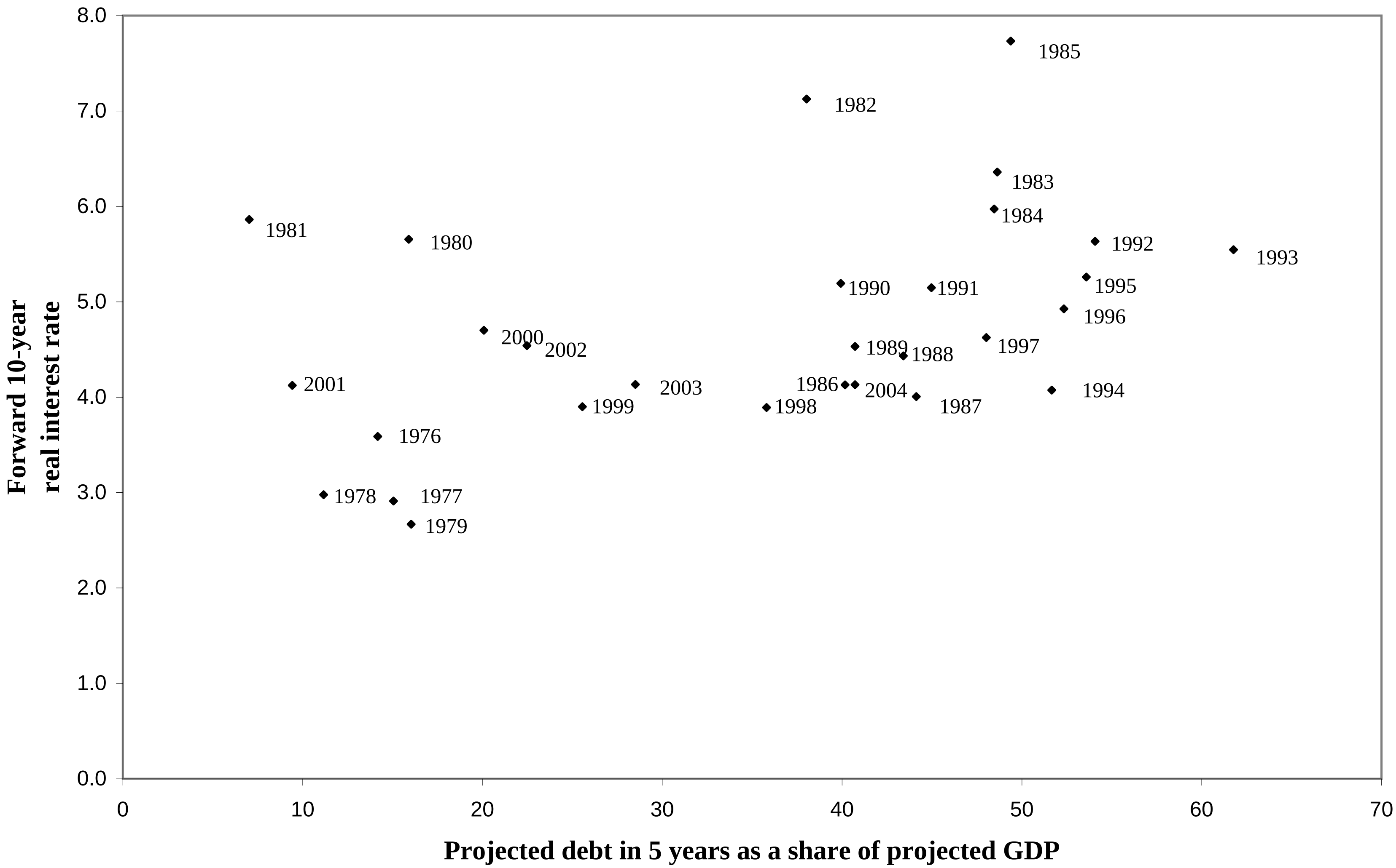


Figure 10
Defense Spending, 1976-2003
(as a share of GDP)

Appendix Table 1

Data sources for the Consumption Regressions

POP	– Total Population in millions 1929-02 [NIPA July 2004 issue, Table 2.1, line 38]
NNPN	– Net National Product in billions of current dollars 1929-02 [NIPA July 2004 issue, Table 1.7.5, line 14]
NNPR	– Net National Product in billions of 2000 dollars 1929-02 [NIPA July 2004 issue, Table 1.7.6, line 10]
CDN	– Personal Consumption Expenditure on Durable Goods in billions of current dollars 1929-02 [NIPA July 2004 issue, Table 1.1.5, line 3]
CNDN	– Personal Consumption Expenditure on Non-durables in billions of current dollars 1929-02 [NIPA July 2004 issue, Table 1.1.5, line 4]
CSN	– Personal Consumption Expenditure on Services in billions of current dollars 1929-02 [NIPA July 2004 issue, Table 1.1.5, line 5]
DURN	– Net Stock of Consumer Durable Goods in billions of current dollars, year-end values 1929-01 [BEA Fixed Assets Tables Sep 2002 issue, Table 1.1, line 13]
PCD	– Implicit Price Deflator for Personal Consumption Expenditure on Durable Goods, 2000=1 1929-02 [NIPA July 2004 issue, Table 1.1.9, line 3]
PCND	– Implicit Price Deflator for Personal Consumption Expenditure on Non-durables, 2000=1 1929-02 [NIPA July 2004 issue, Table 1.1.9, line 4]
PCS	– Implicit Price Deflator for Personal Consumption Expenditure on Services, 2000=1 1929-02 [NIPA July 2004 issue, Table 1.1.9, line 5]
TCR	– Total Personal Consumption Expenditure in billions of 2000 dollars 1929-02 [NIPA July 2004 issue, Table 1.1.6, line 2]
GSR	– Government Purchases of Goods and Services in billions of 2000 dollars 1929-02 [NIPA July 2004 issue, Table 1.1.6, line 20]
GSFN	– Federal Government Purchases in billions of current dollars 1929-02 [NIPA July 2004 issue, Table 1.1.5, line 21]
PGSF	– Implicit Price Deflator for Federal Government Purchases, 2000=1 1929-02 [NIPA July 2004 issue, Table 1.1.9, line 21]
TXN	– Total Government Receipts in billions of current dollars 1929-02 [NIPA July 2004 issue, Table 3.1, line 1 *minus* Table 3.1 line 6 *minus* Table 3.1 line 10 *minus* Table 3.1 line 14 *minus* Table 3.2 line 13 *minus* Table 3.3 line 13]

TXFN – Federal Government Receipts in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.2, line 1 *minus* line 10 *minus* line 13 *minus* line 18]

TRN – Total Government Transfer Payments to Persons in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.1, line 19]

TRFN – Federal Government Transfer Payments to Domestic Persons in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.2, line 23]

GINTN – Net interest paid by Government in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.1, line 22 *minus* Table 3.2 line 13 *minus* Table 3.3 line 13]

GINTFN – Net interest paid by Federal Government in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.2, line 28 *minus* line 13]

REN – Undistributed Corporate Profits (Retained Earnings) with Inventory Valuation and Capital Consumption Adjustments in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 5.1, line 5]

FRPROFN – Federal Reserve Bank Profits paid to the US Treasury in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.2, line 8]

GDIV – Corporate Dividends received by Government in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.1, line 10]

GINTFORN – Government Interest paid to Foreigners in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.1, line 24]

NSUBN – Government Subsidies to Businesses Net of Current Surplus of Government Enterprises in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.1, line 25 *minus* line 14]

NSUBFN – Federal Government Subsidies to Businesses Net of Current Surplus of Government Enterprises in billions of current dollars
1929-02 [NIPA July 2004 issue, Table 3.2, line 31 *minus* line 18]

TRFORN – Government Transfer Payments to Foreigners
1929-02 [NIPA July 2004 issue, Table 3.1, line 20]

GBFN – Market Value of Privately Held Gross Federal Debt in billions of dollars, Dec values
1942-01 [Federal Reserve Bank of Dallas <www.dallasfed.org/data/data/natdebt.tab.htm>]

GBSLN – Aggregate Par Value of State and Local Debt Outstanding in billions of dollars, end-of-June values
1940-02 [various issues of Statistical Abstract of the United States, Table “Indebtedness and Debt Transactions of State and Local Governments”]

MBP – Municipal Bond Price Index, Dec values
1930-01 [Standard and Poor's Statistical Service 2001, P. 328, Dec column]

NWO – Net Worth in billions of current dollars, year-end values
1945-01 [Flow of Funds Accounts of the United States (Z.1)
<www.federalreserve.gov/releases/z1/Current/data.htm> Table B100 line43]

NBAS – United States Non-Budget-Agency Government Securities Outstanding in billions of current dollars, year-end values
1945-01 [Flow of Funds Accounts of the United States (Z.1)
<www.federalreserve.gov/releases/z1/Current/data.htm> Table B100 line16 *minus* line20]

BAS – Budget Agency Securities Outstanding in billions of current dollars, beginning of period, year-end values
1945-01 [Flow of Funds Accounts of the United States (Z.1)
<www.federalreserve.gov/releases/z1/Current/data.htm> Table L210 line1]

SLS – State and Local Government Securities Outstanding in billions of current dollars, year-end values
1945-01 [Flow of Funds Accounts of the United States (Z.1)
<www.federalreserve.gov/releases/z1/Current/data.htm> Table L211 line2]

MTRK – Marginal Effective Tax Rates on Capital Income
1953-03

$$PC_t = [\,CNDN_t \,/\, PCND_t + CSN_t / PCS_t + 0.3 \times DURN_{t-1} / (0.5 \times PCD_{t-1} + 0.5 \times PCD_t) + 0.1 \times CDN_t / PCD_t\,] / POP_t$$

$$PNNP_t = NNPN_t / NNPR_t$$

$$C_t = (CNDN_t \,/\, PCND_t + CSN_t / PCS_t) \times TCCratio / POP_t$$

where

$$TCCratio = \text{Average of } [TCR / (CNDN_t \,/\, PCND_t + CSN_t / PCS_t)] \text{ in sample period}$$

$$Y_t = NNPR_t / POP_t$$

$$GS_t = [GSR_t / POP_t\,] + [(TRFORN_t + GINTFORN_t) / (PNNP_t \times POP_t)]$$

$$GSF_t = [GSFN_t / (PGSF_t \times POP_t)] + [(TRFORN_t + GINTFORN_t) / (PNNP_t \times POP_t)]$$

$$TR_t = (TRN_t + NSUBN_t) / (PNNP_t \times POP_t)$$

$$TRF_t = (TRFN_t + NSUBFN_t) / (PNNP_t \times POP_t)$$

$$TX_t = (TXN_t - FRPROFN_t) / (PNNP_t \times POP_t)$$

$$TXF_t = (TXFN_t - FRPROFN_t) / (PNNP_t \times POP_t)$$

$$RE_t = REN_t / (PNNP_t \times POP_t)$$

$$GBSL_{t-1} = MVSL_{t-1} / (0.5 \times PNNP_{t-1} \times POP_{t-1} + 0.5 \times PNNP_t \times POP_t)$$

where

$$MVSL_{t-1} = (0.5 \times GBSLN_{t-1} + 0.5 \times GBSLN_t) \times (MBP_{t-1} / 100)$$

$$GBF_{t-1} = GBFN_{t-1} / (0.5 \times PNNP_{t-1} \times POP_{t-1} + 0.5 \times PNNP_t \times POP_t)$$

$$GB_{t-1} = GBFN_{t-1} + GBSL_{t-1}$$

$$RGINT_t = (GINTN_t - GINTFORN_t - FRPROFN_t - DRB_t - GDIV_t) / (PNNP_t \times POP_t)$$

where

$$PI_t = \ln [(PNNP_{t+1} + PNNP_t) / (PNNP_t + PNNP_{t-1})]$$

$$DRB_t = PI_t \times [GBFN_{t-1} + (0.5 \times GBSLN_{t-1} + 0.5 \times GBSLN_t) \times (MBP_{t-1} / 100)]$$

$$RGINTF_t = (GINTFN_t - GINTFORN_t - FRPROFN_t - DRBF_t) / (PNNP_t \times POP_t)$$

where

$$DRBF_t = PI_t \times GBFN_{t-1}$$

$$YD_t = Y_t + TR_t + TX_t - RE_t + RGINT_t$$

$$YG_t = YD_t + TX_t$$

$$W_{t-1} = WN_{t-1} / (0.5 \times PNNP_{t-1} \times POP_{t-1} + 0.5 \times PNNP_t \times POP_t)$$

where

$$WN_{t-1} = NWO_{t-1} - NBAS_{t-1} - BAS_{t-1} - SLS_{t-1}$$

Appendix Table 2
Coefficient Estimates
(Euler Equation Specification, Instrumental Variable Estimates, 1957-2002)

	First Difference of Levels		First Difference of Ratios		First Difference of Levels, Scaled	
	PC	NDS	PC	NDS	PC	NDS
Pre-Tax	**0.38**	**0.35**	**0.58**	**0.57**	**0.35**	**0.35**
	0.09	0.08	0.16	0.15	0.08	0.07
Government Expenditure	**0.15**	**0.09**	**0.15**	**0.12**	**-0.04**	**-0.05**
	0.16	0.13	0.15	0.14	0.10	0.10
Federal Taxes	**-0.44**	**-0.31**	**-0.79**	**-0.71**	**-0.33**	**-0.27**
	0.15	0.13	-0.79	0.17	0.13	0.12
State/Local Taxes	**0.86**	**1.00**	**1.06**	**1.22**	**0.75**	**0.94**
	0.60	0.51	0.62	0.58	0.44	0.41
Government Debt(t-1)	**-0.03**	**-0.02**	**-0.01**	**0.00**	**-0.01**	**-0.01**
	0.02	0.02	0.03	0.03	0.02	0.02
Wealth(t-1)	**0.01**	**0.01**	**0.02**	**0.01**	**0.01**	**0.01**
	0.01	0.01	0.01	0.01	0.01	0.01
Marginal Tax Rate on Capital*	**0.71**	**0.54**	**0.03**	**0.03**	**0.04**	**0.03**
	0.58	0.49	0.04	0.03	0.02	0.02
Constant	**0.14**	**0.11**	**0.00**	**0.00**	**0.01**	**0.01**
	0.03	0.03	0.00	0.00	0.00	0.00

Note: Estimation coefficients in bold; robust standard errors in regular font. N=29.
* Coefficient and standard error multiplied by 100.

Appendix Table 3

Empirical studies of deficits and interest rates

Predominately positive significant effect	Mixed effect	Predominately insignificant effect
Expected or unanticipated deficit		
1. Makin and Tanzi (1984) 2. Feldstein (1986) 3. Wachtel and Young (1987) 4. Bovenberg (1988) 5. Thomas and Abderrezak (1988a) 6. Thomas and Abderrezak (1988b) 7. Barth and Bradley (1989) 8. Thorbecke (1993) 9. Elmendorf (1993) 10. Elmendorf (1996) 11. Kitchen (1996) 12. Canzoneri, Cumby, and Diba (2002) 13. Laubach (2003)	1. Sinai and Rathjens (1983) 2. Kim and Lombra (1989) 3. Cohen and Garnier (1991) 4. Quigley and Porter-Hudak (1994) 5. Engen and Hubbard (2004)	1. Bradley (1986)
VAR-based dynamics		
1. Miller and Russek (1991) 2. Tavares and Valkanov (2001) 3. Dai and Phillipon (2004)	1. Mountford and Uhlig (2000) 2. Perotti (2002) 3. Engen and Hubbard (2004)	1. Plosser (1982) 2. Evans (1985) 3. Evans (1987a) 4. Evans (1987b) 5. Plosser (1987) 6. Evans (1989)
Current deficit or debt		
1. Feldstein and Eckstein (1970) 2. Kudlow (1981) 3. Carlson (1983) 4. Hutchison and Pyle (1984) 5. Muller and Price (1984) 6. Barth, Iden, and Russek (1985) 7. de Leew and Hollaway (1985) 8. Hoelscher (1986) 9. Cebula (1987) 10. Cebula (1988) 11. Cebula and Koch (1989) 12. Cebula and Koch (1994) 13. Miller and Russek (1996) 14. Kitchen (2002) 15. Kiley (2003) 16. Cebula (2000)	1. Echols and Elliott (1976) 2. Dewald (1983) 3. Tanzi (1985) 4. Zahid (1988) 5. Coorey (1992)	1. Feldstein and Chamberlain (1973) 2. Canto and Rapp (1982) 3. Frankel (1983) 4. Hoelscher (1983) 5. Makin (1983) 6. Mascaro and Meltzer (1983) 7. Motley (1983) 8. Tatom (1984) 9. U.S. Treasury (1984) 10. Giannaros and Kolluri (1985) 11. Kolluri and Giannaros (1987) 12. Swamy et al (1988) 13. Calomiris, Engen, Hassett, and Hubbard (2004)

Appendix Table 4

Data sources for the Consumption Regressions

CBO projections (provided by Laubach)[1]

Debt(t+5)/GDP	CBO's projected 5-year-ahead debt held by the public as percent of GDP.
Debt(t+4)/GDP	CBO's projected 4-year-ahead debt held by the public as percent of GDP.
Deficit(t+5)/GDP	CBO's projected 5-year-ahead deficit (+) or surplus (-) as percent of GDP.
Primary Deficit(t+5)/GDP	CBO's projected 5-year-ahead deficit (+) or surplus (-) as percent of GDP less projected 5-year-ahead net interest payments as percent of GDP.
Revenues(t+5)/GDP	CBO's projected 5-year-ahead total revenues.
GDP Growth Rate(t+5)	CBO's projected 5-year-ahead real GDP growth.
Primary Outlays(t+5)/GDP	CBO's projected 5-year-ahead total outlays as percent of GDP less projected 5-year-ahead net interest payments as percent of GDP.

Interest rate and inflation series (provided by Laubach)

Expected Inflation	We use the expected inflation series constructed by Laubach (2003). The series consists of three different pieces. Until 1981:Q1, the series is an estimated step function based on the changepoint model developed in Kozicki and Tinsley (2001). From 1981:Q2 until 1991:Q2, the series is based on the Hoey survey of decision makers which polled participants for their expectations of CPI inflation ten years ahead. Since 1991:Q3 the series is based on the Survey of Professional Forecasters conducted by the Federal Reserve Bank of Philadelphia, in which participants are asked for their expectations of CIP inflation over the next ten years. The series is extrapolated to monthly frequency, and is sampled in the months corresponding to the yield data. (Laubach, 2003)
Nominal 10-year constant maturity Treasury yield	Conventional definition; sampled on the last trading day of the month of the CBO release. (provided by Laubach).
Real 10-year constant maturity	Nominal 10-year constant maturity Treasury yield – Expected Inflation.

1 The CBO projections data, compiled by Laubach, are based on CBO's annual publication "The Budget and Economic Outlook". For the early years, the CBO did not publish projections for federal debt held by the public; those projections are computed by adding the CBO's deficit projections for the current and next five fiscal years to the stock of debt held by the public at the end of the previous year. For the years 1976-1982 estimates are based on the assumption of no policy change. The January 1991 projections are based on the already legislated discretionary spending caps, which were the CBO's baseline for the remainder of the 1990s. (Laubach, 2003)

Treasury yield	
fw59_c	Average of one-year forward rates 5-9 years ahead, calculated from the zero-coupon yield curve, sampled on the last trading day of the month of the CBO release.
fw1014_c	Average of one-year forward rates 10-14 years ahead, calculated from the zero-coupon yield curve, sampled on the last trading day of the month of the CBO release.
Nominal 5-Year Ahead 10-Year Treasury Rate	The average of fw59_c and fw1014_c. [(fw59_c+fw1014_c)/2]
Real 5-Year Ahead 10-Year Treasury Rate	Nominal 5-Year Ahead 10-Year Treasury Rate – Expected Inflation.
Equity Premium	Calculated as the dividend component of national income, expressed as percent of the market value of corporate equity held (directly or indirectly) by households, minus the real 10-year Treasury yield, plus CBO's projected 5-year-ahead real GDP growth The value of the premium in the quarter prior to the release of the projections is used. (Laubach, 2003)
Dividend/Market Value	Equity Premium - GDP growth rate(t+5) + Real 10-year constant maturity Treasury yield.

Realized fiscal and economic variables

Debt(t)/GDP	Actual debt held by the public as percent of GDP, end of year. Data for 1976-2003 provided by Laubach. Source for 2004 projection: Budget of the U.S. Government, Fiscal Year 2005, Mid-Session Review.
Deficit(t)/GDP	Actual deficit (+) or surplus (-) as percent of actual GDP. Data for 1976-2003 provided by Laubach. Source for 2004 projection: Budget of the U.S. Government, Fiscal Year 2005, Mid-Session Review.
Primary Deficit(t)/GDP	Actual deficit less net interest payments as percent of GDP. Source for net interest series, 1976-2003: The Budget and Economic Outlook: Fiscal Years 2005-2014, Appendix F, Historical Budget Data, Table 6. Source for 2004 projection: Budget of the U.S. Government, Fiscal Year 2005, Mid-Session Review.
Revenues(t)/GDP	Actual revenues as percent of GDP. Source for 1976-2003 data: The Budget and Economic Outlook: Fiscal Years 2005-2014, Appendix F, Historical Budget Data, Table 2. Source for 2004 projection: Budget of the U.S. Government, Fiscal Year 2005, Mid-Session Review.
Primary Outlays(t)/GDP	Total outlays less net interest payments as percent of GDP. Source for 1976-2003 data: The Budget and Economic Outlook: Fiscal Years 2005-2014, Appendix F, Historical Budget Data, Table 5. Source for 2004 projection: Budget of the U.S.

	Government, Fiscal Year 2005, Mid-Session Review.
GDP Growth Rate(t)	Real GDP growth rate in current year. Source for 1976-2003 data: NIPA Table 1.1.1. (Percent Change From Preceding Period in Real Gross Domestic Product, line 1.) Source for 2004 projection: Budget of the U.S. Government, Fiscal Year 2005, Mid-Session Review.

Control Variables

Oil Price	Crude Oil Spot Price, dollars per barrel: West Texas Intermediate, average annual price (based on monthly data) for previous year. Source: The Financial Forecast Center, reprinted from Dow Jones Energy Service. Current dollars converted to 2000 dollars using implicit price deflator for GDP (NIPA table 1.1.9, line 1).
Recession	Dummy variable equal to 1 if the economy was in recession in the month of CBO release. Source for data on business cycle: National Bureau of Economic Research, available at http://www.nber.org/cycles.html/.
Defense Spending/GDP	Defense spending as percent of GDP, in current year. Source: The Budget and Economic Outlook: Fiscal Years 2005-2014, Appendix F, Historical Budget Data, Table 8.
Treasury Holdings	Monetary Authority holdings of U.S. Treasury Securities as percent of nominal GDP, end of previous year. Source: Flow of Funds Accounts of the United States, Historical Data. Table L.108 Monetary Authority, line 10 (Treasury Securities). Available at: http://federalreserve.gov/releases/z1/current/data.htm Source for nominal GDP series: NIPA table 1.1.5 (Gross Domestic Product, line 1)
Treasury Purchases	Monetary Authority net acquisition of U.S. Treasury Securities as percent of nominal GDP, end of previous year. Source: Flow of Funds Accounts of the United States, Historical Data. Table F.108 Monetary Authority, line 12 (Treasury Securities). Available at: http://federalreserve.gov/releases/z1/current/data.htm Source for nominal GDP series: NIPA table 1.1.5 (Gross Domestic Product, line 1)
GDP Gap	The difference between Actual and Potential GDP as percent of Potential GDP. Source of Actual and Potential GDP series for 1976-2003 fiscal years: The Budget and Economic Outlook: Fiscal Years 2005-2014, Appendix F, Historical Budget Data, Table 11. Forecast for 2004 Actual GDP is taken from The Budget and Economic Outlook: Fiscal Years 2005-2014, Appendix E, Table E-2. Projected Potential GDP for fiscal year 2004 estimated from CBO's report "The Cyclically Adjusted and Standardized-Budget Measures", Table 1, by averaging the implicit Potential GDP amounts from lines 1, 3, and 5.

Appendix Table 5

Date of Release of CBO Budget Projections	
Month	**Year**
January	1976
December	1976
January	1978
January	1979
February	1980
July	1981
February	1982
February	1983
February	1984
February	1985
February	1986
January	1987
February	1988
January	1989
January	1990
January	1991
January	1992
January	1993
January	1994
January	1995
May	1996
January	1997
January	1998
January	1999
January	2000
January	2001
January	2002
January	2003
January	2004

Appendix Table 6

Regression Results for Real 5-Year-Ahead 10-Year Treasury Rate
Using Projected Fiscal Variables, (1976-2004), ARMA
Sensitivity Analysis Using Alternative Measures of Economic Activity and Risk Adjustments

Variable	1	2	3	4	5	6	7	8	9	10	11	12
Debt(t+4)/GDP	**-0.013**	**-0.051**	**-0.008**	**0.009**	**-0.018**	**-0.069**	**-0.015**	**0.000**	**-0.019**	**-0.067**	**-0.016**	**0.001**
	0.017	0.020	0.025	0.023	0.021	0.017	0.022	0.018	0.023	0.020	0.023	0.018
Primary Deficit(t+5)/GDP	**0.534**	**0.520**	**0.353**	**0.224**	**0.438**	**0.573**	**0.332**	**0.238**	**0.428**	**0.572**	**0.324**	**0.241**
	0.113	0.123	0.139	0.110	0.169	0.173	0.157	0.099	0.156	0.174	0.143	0.103
Recession	**0.512**				**0.275**				**0.127**			
	0.854				1.125				1.204			
Recession*Debt(t+4)/GDP	**0.013**				**0.005**				**0.007**			
	0.021				0.023				0.025			
Recession*Primary Deficit(t+5)/GDP	**-0.330**				**-0.215**				**-0.217**			
	0.159				0.183				0.183			
GDP Gap		**-0.809**				**-0.912**				**-0.911**		
		0.209				0.305				0.302		
GDP Gap*Debt(t+4)/GDP		**0.021**				**0.023**				**0.023**		
		0.005				0.006				0.006		
GDP Gap*Primary Deficit(t+5)/GDP		**-0.112**				**-0.120**				**-0.120**		
		0.022				0.033				0.033		
GDP Gap(t-1)			**-0.636**				**-0.620**				**-0.596**	
			0.218				0.269				0.215	
GDP Gap(t-1)*Debt(t+4)/GDP			**0.015**				**0.015**				**0.015**	
			0.006				0.007				0.006	
GDP Gap(t-1)*Primary Deficit(t+5)/GDP			**-0.069**				**-0.062**				**-0.060**	
			0.030				0.034				0.031	
Equity Premium	**-0.447**	**-0.271**	**-0.310**	**-0.283**								
	0.118	0.086	0.116	0.144								
Dividend/Market Value					**-0.043**	**0.022**	**-0.037**	**0.080**				
					0.129	0.085	0.143	0.120				
Oil Price	**-0.010**	**0.057**	**0.047**	**0.052**	**0.042**	**0.075**	**0.069**	**0.065**	**0.043**	**0.076**	**0.067**	**0.069**
	0.020	0.008	0.012	0.013	0.013	0.012	0.008	0.010	0.013	0.009	0.008	0.009
Defense Spending/GDP	**0.029**	**-0.005**	**0.041**	**-0.007**	**-0.070**	**-0.073**	**-0.024**	**-0.121**	**-0.084**	**-0.069**	**-0.034**	**-0.094**
	0.063	0.068	0.096	0.103	0.089	0.086	0.116	0.102	0.095	0.088	0.108	0.105
Treasury Purchases	**-0.330**	**-1.200**	**-1.337**	**-0.879**	**-0.846**	**-1.217**	**-1.555**	**-0.903**	**-0.766**	**-1.273**	**-1.457**	**-1.040**
	0.545	0.347	0.856	0.596	0.596	0.485	1.071	0.680	0.542	0.398	0.760	0.596
GDP growth rate(t+5)	**0.775**	**-0.424**	**0.141**	**0.008**	**-0.603**	**-1.267**	**-0.694**	**-0.767**	**-0.647**	**-1.243**	**-0.724**	**-0.736**
	0.560	0.327	0.517	0.575	0.270	0.212	0.400	0.298	0.231	0.190	0.376	0.280
Constant	**5.365**	**8.281**	**5.042**	**4.445**	**7.284**	**10.287**	**6.564**	**5.905**	**7.254**	**10.234**	**6.542**	**5.949**
	1.332	1.334	1.882	1.827	1.485	1.075	1.737	1.323	1.529	1.166	1.753	1.239
ARMA												
L.ar	**-0.587**	**-0.530**	**-0.333**	**-0.218**	**-0.183**	**-0.423**	**-0.221**	**-0.050**	**-0.155**	**-0.432**	**-0.190**	**-0.105**
	0.239	0.213	0.261	0.261	0.253	0.227	0.299	0.197	0.212	0.204	0.254	0.183
Wald Chi-squared	**2751.6**	**889.6**	**679.8**	**259.5**	**703.1**	**499.8**	**416.3**	**247.1**	**588.3**	**505.3**	**320.6**	**219.6**

Note: Estimation coefficients in bold; semi-robust standard errors in regular font. N = 29.