STAFF WORKING PAPERS

DEFICITS AND INTEREST RATES: THEORETICAL ISSUES AND EMPIRICAL EVIDENCE

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PREFACE

This paper was written by George Iden and John Sturrock of the Fiscal Analysis Division. It was undertaken as technical background work in connection with ongoing studies of the effects of federal budget deficits on the economy. The views expressed in this paper are the authors' and do not necessarily reflect those of the Congressional Budget Office or other members of its staff.

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INTRODUCTION AND SUMMARY

During the 1980s real (inflation-adjusted) interest rates have been unusually high--the ex post real 91-day Treasury bill rate, for example, has averaged 4.2 percent compared to its average over the entire postwar period of 0.5 percent. In addition, long-term interest rates have been exceptionally high relative to short-term interest rates. At the same time, the federal deficit has averaged 3.9 percent of GNP, well above its postwar average of 1.1 percent. This would seem to confirm traditional theory that large deficits lead to high interest rates. But other factors influence interest rates as well. In addition, traditional theory has come under attack by a school that argues that deficits, in themselves, should have no effect on interest rates.

Resolution of the deficit-interest rate question is important not only because it would shed light on the workings of the economy, but for immediate practical reasons as well. The interest rate plays a central role in influencing the direction of economic activity, and understanding its determinants would aid in predicting its future course. This matters from the standpoint of budget deliberations, not only because it would enhance our understanding of how budget policy may affect interest rates and the economy as a whole, but also because interest costs themselves are a significant part of the deficit.

The issue is complicated by the fact that interest rates and income tend to rise and fall together over the business cycle. Because the deficit rises as income falls, interest rates tend to fall as deficits rise and vice versa. But these movements in the deficit are merely passive responses to movements in income. The question under consideration is how much an independent, policy-induced, deficit reduction will reduce the interest rate below what it otherwise would be.

To separate the influence of deficit policy on the interest rate from that of other factors requires statistical analysis, but the design and interpretation of statistical analysis require a coherent theoretical model. Therefore the paper first briefly states the principal theoretical arguments about the relation of deficits to interest rates. It then reviews a professional literature in which researchers have tried statistically to isolate other factors and test for a link between deficits and interest rates assuming those other factors remain the same.

Theoretical Issues

Most economists adhere to the traditional view that lowering deficits acts to lower interest rates because it eases competition with private demands for credit. In the long run, the magnitude of the interest rate response to a sustained deficit reduction will depend on how the demand for and supply of capital themselves respond to the interest rate. In the short run, the interest rate response will depend particularly on the extent to which output and income are affected and on the response of money demand to the interest rate, income, and wealth. It will also depend on the way that the deficit is reduced and the response of the monetary authority. Some economists also stress that the results will depend on whether the deficit reduction was anticipated by the public. Others argue that the interest rate response will be significantly reduced by international financial transactions--essentially because the

change in credit demand implied by the deficit reduction is smaller in relation to the world economy than it is relative to the domestic economy.

Some economists argue that these effects may be substantially, or evenly entirely, offset by individual saving behavior. They argue that a deficit must necessarily be backed by higher taxes in the future, and that people adjust their saving to be able to pay any taxes that they expect to be increased during their lifetimes. Reducing the deficit, according to this argument, correspondingly reduces the need to save and lessens the easing of interest rates. A group known as neo-Ricardians represent a polar case of this view by arguing that a deficit reduction will be exactly matched by decreased private saving. This follows, according to their argument, because individuals provide for any increased future tax liabilities that might occur not only in their lifetimes, but in the lifetimes of their descendants as well. If lower private saving exactly offset reduced deficits, the balance of supply and demand in the credit markets, and therefore the interest rate, would remain unaffected.

Empirical Tests

The Congressional Budget Office (CBO) surveyed studies that conducted direct statistical tests of interest rate equations (single-equation methods). The studies were more likely to find a significant and positive relationship for long-term than for short-term interest rates, especially when using annual data and/or structural fiscal measures. In addition, several studies have reported a relationship between expected deficits and long-term interest rates; and some have found a relationship with the debt but not the deficit. This may suggest the existence of a fundamental relation from deficits to interest rates that is obscured by short-term volatility in the data. Nevertheless, the results overall are too dispersed to be decisive.

Most of the single-equation studies that test for statistical relations found a positive, if small, relationship between deficits or debt and interest rates. On average, the 25 studies analyzed by the Congressional Budget Office suggest that, other things remaining equal, a $50 billion deficit reduction would lead to a fall in the short-term interest rate of 0.1 percentage point after one year. But the results range from an apparently perverse increase of 0.6 percentage point to a reduction of 0.8 percentage point. The average estimated fall in the long-term interest rate is 0.2 percentage point, but it ranges from essentially no change to a fall of 0.6 percentage point.

Policy Implications

Because the public debt has grown rapidly in the 1980s, relative to GNP, changes in interest rates have important implications for federal interest outlays and therefore for the deficit. For instance, the above calculations suggest that a $50 billion cut in the deficit could lower interest rates by as much as 0.5 percentage points. If interest rates of all maturities were affected by that much, the deficit would be reduced by approximately $15 billion more than the initial cut by the sixth

year.[1] If only intermediate and long-term interest rates were affected--that is, maturities of two years and longer--the deficit impact would be considerably smaller initially, but could grow to approximately $10 billion by the sixth year.

Finally, it should be noted that the level of the interest rate, in itself, is not the most fundamental implication of deficit policy. This stems from the fact that high interest rates are not in themselves considered to be the real burden of the deficit. Instead most, though not all, economists believe that, in the long run, the real burden of high deficits is the reduction of future income that they imply if they are not used to finance productive capital. In this view, financing public consumption with deficits makes the current generation better off at the expense of succeeding generations. The interest rate is a poor guide to the extent of this transfer between generations, and in an extreme open-economy case the transfer could occur even with no change in the interest rate. Transfers between generations--as well as other issues that arise in connection with federal debt policy--are of substantial importance, but are beyond the scope of this paper. Resolution of the deficit-interest rate connection will illuminate such issues, but they must be decided on their own grounds.

THEORETICAL ISSUES

Recently substantial theoretical controversy has arisen over the economic consequences of deficit reduction, including the effects on interest rates. This section provides a brief, stylized description of the disputed issues. It is intended as a cursory introduction, not as a complete review. For clarity, arguments are often stated in their most naive forms in order to emphasize their essence, if not preserve their subtleties.

Some terminological conventions have been adopted throughout to facilitate the discussion. In principle, the deficit is defined as the change in the net liabilities of the government. Discussion of changing the deficit refers to changing the level of the deficit when other things remain equal--the "static" or "structural" change in the deficit that can be directly determined by policy. The observed deficit that is determined by both policy and cyclical events will usually be referred to as the "actual" or "realized" deficit, unless the distinction is clear from the context. In addition, unless otherwise specified, it is assumed that changes in the deficit are not monetized--that is, the monetary authority is assumed not to change its holding of government debt, so the change in the deficit is fully reflected in privately held bonded debt of the government. The term "interest rate" by itself refers to the market, or nominal, interest rate, whereas the terms "output" and "capital" refer to the respective real (constant price) values. Finally, the terms "interest rates" and "the interest rate" are used interchangeably unless a specific case is being discussed in which interest returns to various assets would not all rise or fall together.

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1. Estimate based on "rules of thumb" developed by the Congressional Budget Office, relating the effect of a one-percentage-point increase in interest rates to the federal budget. See Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1989-1993* (February 1988), pp. 62-65.

The discussion focuses on pure deficit effects and abstracts from the price incentives that tax and expenditure policies may imply in themselves. For example, the Council of Economic Advisers argued in the *Economic Report of the President* (1985) that interest rates were then high, in part, because the net effect of business tax legislation of 1981 and 1982 increased business demand for capital, putting upward pressure on the real interest rate. Similarly, if private saving responds positively to the real after-tax interest rate, lowering personal tax rates should, other things equal, act to lower the interest rate. This section does not usually consider such incentive effects of fiscal policies, only the direct effects of deficits in themselves.

The Long-Run Effect of Deficit Reduction

Long-run analysis considers abstract economies in which all adjustment processes have been completed and all markets are in equilibrium. Because long-run analysis abstracts from short-run complications, studying the effects of deficit reduction in the long run is relatively straightforward. The long run will therefore be considered before turning to the short run.

Three principal views are considered: the traditional view in a closed economy, which holds that reducing the deficit would reduce interest rates; the open-economy variant, which holds that international financial flows would reduce--or in the extreme case eliminate--the effect of any single country's deficit on the interest rate; and a neoclassical approach whose extreme is represented by the neo-Ricardian view, which holds that interest rates are entirely unaffected by deficits in either a closed or an open economy.

The Traditional View in a Closed Economy. The traditional view holds that, in a closed economy (one with no international sector), permanently lower deficits would reduce total credit demand. This would lead to a lower real interest rate and a correspondingly higher capital stock and output in the long run.[2] Given the same long-run money growth, and therefore the same long-run inflation rate, the nominal interest rate will fall as well. The changes in private-sector capital and output and in the real interest rate will all be smaller the more interest-sensitive is the supply of capital. On the other hand, the increase in private-sector capital and output will be larger, and the fall in the real interest rate smaller, the more interest-sensitive is the private demand for capital. Therefore the amount by which the real interest rate falls is not itself an indication of the extent of resource reallocation or redistribution between generations that the deficit implies.

The Effects of an Open Economy. The traditional view is modified by assuming an open economy in which goods and capital (or asset claims on capital earnings) can flow across national boundaries. If asset claims are perfectly substitutable internationally, real interest rates on comparable securities will be equalized throughout

2. The discussion assumes that the deficit is not being used to finance government capital projects. There is general agreement that it can be appropriate to finance government capital projects by issuing debt because the asset acquired matches the increase in bond liability. It is also assumed that the deficit is not being used to finance projects that directly substitute for private activities.

the world.[3] Although lowering the deficit will reduce total domestic credit demand, any tendency for the domestic real interest rate to fall will be reduced as investors seek higher returns from foreign securities. The increased demand for foreign currency with which to buy such securities will cause the exchange value of the domestic currency to fall instead. In the extreme case of a country so small relative to the world economy that its actions have no appreciable effect on international capital markets, reducing the deficit will leave the real interest rate and domestic capital stock unaffected in the long run. Even in a country like the United States large enough to affect international capital markets, the real interest rate response in an open economy will still be smaller than that predicted by the traditional view in a closed economy.[4]

Deficits matter, however, even in the extreme open-economy case when the real interest rate and domestic capital and output are unaffected by deficit policy. The deficit reduction effectively causes a net flow of domestic funds, which would otherwise finance the deficit, to be invested abroad, thereby increasing the domestic net asset position against the rest of the world. Profit and interest earnings of these assets will be returned as income to citizens in the home country. Therefore the deficit reduction leads to an increase in the wealth, though not the capital stock, of the nation as a whole.[5] Again, the behavior of the real interest rate is, in itself, an unreliable guide to the allocative and distributional effects of the deficit.

Offsetting Changes in Private Saving. Finally, the effect of deficits on interest rates can be substantially reduced if individuals expect deficits to lead to higher taxes in the future. An extreme view in this context is held by the neo-Ricardian school led by Barro (1974) which maintains that deficits will have no effect on either real or nominal interest rates even in a closed economy. This conclusion stems from the contention that government bonds are not part of aggregate private net worth. While government bonds are assets to the individuals who hold them, they represent an equal amount of liabilities to citizen-taxpayers as a whole.

According to the argument, individuals see that taxes must be raised in the future to pay part of the interest on the bonds issued to finance the deficit, and they save to provide for this future tax liability.[6] Even if they do not expect to be alive

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3. This assumes an equilibrium in which exchange rates are not expected to change. Otherwise, the interest rate prevailing in a country would rise above (fall below) the world interest rate to reflect the expected rate of depreciation (appreciation) of its currency.

4. This assumes technical conditions in international and domestic financial markets that would lead a deficit reduction to induce currency depreciation (the most likely case). If financial conditions led to currency appreciation when the deficit was reduced, the change in interest rates would be greater in an open, rather than closed, economy. This is more likely to happen when market participants strongly prefer assets denominated in their home currencies to otherwise comparable assets denominated in foreign currencies

5. There will be an offsetting influence, however, if the capital outflow is associated with a depreciation of the home currency. This will act to reduce real domestic incomes by increasing the cost of imported goods.

6. Monetary debt bears no interest burden, however, so it does not imply a future tax liability and does constitute part of aggregate private net worth.

when taxes are raised, they do not want to reduce the consumption possibilities of their descendants by passing on this liability. (This behavior is known as intergenerational altruism). The present value of the future tax liability is equal to the current value of the bonds, so if the deficit is reduced now, the need to save is reduced by the same amount. This leaves total saving, and both real and nominal interest rates, unaffected.[7, 8]

The notion that the current deficit must be backed by future taxes (or by future money creation) is not unique to neo-Ricardians. It relies on the argument that the principal and interest due on current bond issues cannot indefinitely be repaid simply by issuing more bonds in the future. Trying to do so would be destabilizing because the debt relative to GNP would grow without bound.[9]

Most economists who argue that current deficits must be backed by future taxes, however, argue that a current deficit will lead individuals to save only against a rise in taxes that they expect to take effect during their lifetimes.[10] In this view, a deficit reduction would be only partially matched by a reduction in private saving if some taxpayers did not expect to be alive when taxes were lowered. Only neo-Ricardians make the additional assumption of intergenerational altruism to conclude that future taxes implied by deficits are entirely discounted by the public.

The Short-Run Effect of Deficit Reduction

Among those who, unlike neo-Ricardians, consider government debt to be part of aggregate private net worth, there tends to be more controversy over the relationship between deficits and interest rates in the short run than in the long run. The issue is complicated by the fact that movements in many variables--deficits, output, and interest rates in particular--tend to be associated over the business cycle. Identifying the separate effects of a given variable requires disentangling short-term co-movements among variables. So, even if economists agreed on the long-run effect of deficit reduction, they might disagree on the transitional effects.

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7. Neo-Ricardians believe that government expenditure, especially when temporary as during wartime, can raise both real output and interest rates. This would occur, however, whether the expenditures were financed by bonds or taxes. See Barro (1981).

8. While neo-Ricardians do not believe deficits affect interest rates or capital formation, debt policy is not irrelevant to their world view. They stress that it is inefficient to vary tax rates continually to maintain budget balance, and that this inefficiency leads to a welfare loss. For example if tax rates went up with temporary expenditures, as in wartime, this would provide incentives to postpone earning income until tax rates were lower again. Instead, neo-Ricardians believe that relatively stable tax rates should be set that over time would take account of the projected rate of expenditures. Thus transitory fluctuations in expenditure should be financed with debt.

9. In an economy with no uncertainty, this result depends on the effective interest rate on government debt being greater than the rate of growth of the economy. (Darby (1984) argues that the after-tax interest rate on government debt is the relevant rate). This condition has not generally been satisfied in the United States during the postwar period, but whether the instability result follows anyway in an uncertain world is an unresolved issue. See Abel, et. al. (1986).

10. See, for example, Auerbach and Kotlikoff (1987) or Frenkel and Razin (1986).

In fact it is possible for some effects to be perverse in the short run--moving opposite to their eventual direction.

The Keynesian View. Keynesians believe that a deficit reduction will initially reduce aggregate demand and induce a fall in output (or its growth).[11, 12] The ratio of the change in output to the change in the given expenditure (tax) is known as the expenditure (tax) multiplier. According to the Keynesian system, allowing realized deficits to rise and fall over the cycle acts automatically to help stabilize output.

As deficit movements affect short-term movements in output, these movements in output and in associated variables help to influence movements in the interest rate. The interest rate will fall both as the government reduces its credit demands and as private credit demands fall with activity. The fall in interest rates will act to stimulate demand and help eventually to reverse the initial fall in output. Because purchases affect output directly, the fall in output (and, hence, usually the interest rate) can be expected to be greater for a reduction in purchases than for a tax increase. Other things equal, output and interest rates will fall by a greater amount the more sensitive aggregate demand is to income and the less sensitive it is to interest rates. The inflation rate will also tend to fall as activity is dampened, so the course of the realized real interest rate is ambiguous.[13] It could initially rise, even though it must fall in the long run.

The extent to which interest rates fall will also depend on the initial state of the economy at the time the deficit is reduced, as well as on the response of the Federal Reserve. If the interest rate is already high, a given deficit reduction may induce a larger decline in the interest rate (and a smaller decline in output) than it would if the initial interest rate were lower.[14] Because long-term interest rates incorporate expectations of future short-term interest rates, the behavior of the long-term rate will depend on market anticipations at the time of the deficit reduction. If the market had already anticipated the deficit reduction, this would have been incorporated in the long-term rate, so it would not need to respond further when the deficit reduction actually occurred.[15] Finally, in the Keynesian scheme, if the Federal Reserve acts to counter the contractionary effects of deficit reduction, output will fall less and the interest rate will fall more than they would otherwise.

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11. The short-run response to a deficit cut will be smaller, however, if it is expected to be temporary, rather than permanent. Individuals will see that their future incomes are less affected in the temporary case and will borrow if necessary to try to maintain their current level of expenditure.

12. Blinder and Solow (1973) and Phelps (1982) discuss circumstances under which a deficit reduction would raise output in a Keynesian system (although in the case considered by Blinder and Solow, such circumstances would imply that the model was unstable). Both agree that the interest rate would fall even in these cases.

13. Raising excise or payroll taxes, however, could cause inflation to rise initially as attempts to pass the tax forward act to increase the price level.

14. This point is explained in the section discussing simulation results.

15. In fact, if market participants had expected a larger deficit reduction than is actually enacted, the long-term interest rate could rise.

The Monetarist View. Unlike the Keynesian case, deficit reduction will not lead to any co-movement between output and interest rates in a monetarist world. Monetarists believe that policy-induced deficit reduction will have no effect on total output. Instead, they think that interest rates will fall enough that interest-sensitive spending will compensate for the effect that cutting the deficit would otherwise have on output. This may occur for a number of reasons. Either of two polar conditions would guarantee such a result:

- Perfectly flexible wages would allow labor markets to clear continuously at full employment; with employment, and hence output, fixed, the lower deficit will imply that the interest rate will fall enough to clear financial markets and ensure that private consumption and investment are consistent with the given level of output;

- Perfectly interest-inelastic money demand (and supply) would mean that the public would be willing to hold the available stock of money only if interest rates fell enough for an increase in interest-sensitive spending to match the reduction in aggregate demand implied by the deficit cut.

Either of two other conditions might, but need not necessarily, lead to no short-term change in output when the deficit is reduced:

- Highly wealth-elastic money demand would imply that as holdings of government bonds were decreased, demand for money would also decrease, putting further downward pressure on interest rates;

- Much greater portfolio substitution between bonds and equity than between bonds and money would intensify the downward pressure on the rate of return to equity.

With no change in output or the money stock, prices will be unaffected by the deficit reduction, so the stylized monetarist model predicts unambiguously that the realized real interest rate will fall in the short run.

The New Classical View. Another group of economists, the new classical school, believes that policy-induced movements in the deficit have short-run effects on output only if they are unanticipated.[16] In this view the co-movement between output and interest rates arises from unanticipated events. Two assumptions principally account for this result: that agents collectively use all available information to form "rational" expectations of the future course of economic variables; and (the classical assumption) that prices are always flexible enough to clear all markets.

The assumption of rational expectations implies that, while expectations of the future are never exactly correct, over time they are correct on average and are never

16. Formally, given that policymakers and the public have the same information, policy feedback rules will leave the stochastic process governing output unaffected.

predictably wrong. In particular, according to this hypothesis, expectations reflect all information available in the system. This, in turn, implies that prices will reflect all available information.[17]

New classicals argue that, in a stable policy regime, the fiscal authority makes tax and expenditure decisions based on events that have occurred in the economy. The public understands the rules--formal or informal--that determine these decisions, and conditions its behavior on anticipations of fiscal actions.[18] Thus when movements in policy variables occur according to these policy rules, such movements are already reflected in the prices that will establish an equilibrium output. Therefore, fiscal actions can affect output in the short run only if they are unexpected.[19, 20]

In most instances new classical theory indicates that deficit reductions, whether anticipated or unanticipated, will lower both nominal and real interest rates in the short run. But historical responses to deficit changes have depended on the public's perception of policy rules, as well as on its responses to underlying economic variables. Therefore, establishing the precise nature of the relationship will depend on identifying truly autonomous policy changes and on separating anticipated from unanticipated fiscal changes.

The Effects of an Open Economy. As in the long run, the effects of deficit reduction are likely to be reduced by international financial transactions, but some complicating factors arise. Consider the most likely case in which deficit reduction leads to depreciation of the home currency, which should lead to a rise in net exports. Without instantaneous adjustments, the fall in the domestic exchange rate may initially cause nominal net exports in terms of the domestic currency to fall until real net exports rise enough to offset this effect.[21] Likewise, if the exchange rate adjusts rapidly to its appropriate new level while product prices respond sluggishly (as in the Keynesian system) a temporary rise in inflation will result. If this higher inflation is anticipated, and with an unchanged real interest rate, the nominal interest rate will temporarily rise.

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17. While expectations are also important in Keynesian and monetarist models, rational expectations imply theoretical restrictions traditionally unaccounted for.

18. The theory does not require that everyone has such information, but implies that arbitrage by knowledgeable market participants will lead all relevant information to be reflected in prices. Thus most market participants can rely on readily available information.

19. This does not necessarily rule out the efficacy of automatic stabilizers, because they take effect at the same time as any unanticipated events that trigger them. Their effects are thus unanticipated themselves.

20. Even with rational expectations, policy changes can affect output if frictions keep prices from instantaneously clearing markets. See Fisher (1977) and Phelps and Taylor (1977).

21. For example, suppose real exports and imports are initially unchanged after the domestic currency falls. The domestic price of exports will remain unchanged, but the domestic price of imports would rise with the depreciation of the home currency. Therefore, the nominal value of net exports will initially fall.

In addition, the nature of new classical models can lead to an ambiguous response of interest rates to an anticipated deficit reduction when the home country is large enough to affect world interest rates. Frenkel and Razin (1986) consider a model in which an anticipated future deficit reduction will lead to a decrease in the current real short-term interest rate only if the home country's marginal propensity to save is greater than the foreign marginal propensity to save. Otherwise the current real short-term rate will rise. Their conclusion depends on the assumption that current deficits must necessarily be backed by future taxes. Even in this model, however, the long-term interest rate unambiguously will fall in anticipation of the future deficit reduction, and the current real short-term rate will fall in response to a current deficit reduction.

EMPIRICAL EVIDENCE ON DEFICITS AND INTEREST RATES

This section reports on a review of 25 empirical studies on the question of whether deficits materially affect interest rates. The major conclusions can be summarized as follows:

- o No consensus exists on whether there is an important linkage between deficits and interest rates;

- o Certain patterns have emerged: long-term interest rates were more affected by deficits than short-term interest rates; smoothing the fiscal deficit or debt measure by cyclical adjustment or taking moving averages appeared to increase the chances of finding a relationship; government debt seems more critical than deficits per se; and

- o Results were not robust--they seemed sensitive to plausible changes in specification, sample periods, and/or choice of fiscal measure.

Most of the empirical research designed to test whether there is a statistically significant relationship between deficits and interest rates has involved the use of single-equation econometric models. Authors using single-equation models typically regress a representative interest rate against a set of explanatory variables including some measure of fiscal policy (e.g., the federal deficit or federal debt) and other variables. This paper focuses primarily on such single-equation methods.

Another approach to measuring the relation between deficits and interest rates is to simulate a macroeconomic model. Such models approximate salient features of the economy by representing key variables in a system of equations that are then statistically estimated. The model's implied response of the interest rate to a change in the deficit can be found by solving the model period-by-period (simulating) under alternative deficit assumptions. Such an approach seems attractive because the simulation allows all variables to respond to a change in the deficit, and takes account of the estimated interactions among variables. The construction of such models, however, typically assumes that lowering the deficit will lower the interest rate, although by how much is still a matter for estimation. In contrast, the lone interest rate equations surveyed here test for a relationship between deficits and interest rates after attempting to statistically isolate the influence of all other variables.

While, as a whole, the single-equation studies discussed in this paper do not strongly support the existence of such a relationship, neither do they strongly reject it. Many of the studies suffer from difficult statistical problems--especially the fact that deficits are not truly exogenous, which can lead to biased and inconsistent estimates of the coefficients. Other studies suffer from autocorrelation or multicollinearity problems which produce biased estimates of test statistics. The simulation approach remains of interest, therefore, particularly because it can address questions unanswered by the approach considered here. The simulation approach is considered in a companion paper.[22]

Specification of the Single-Equation Model

Most analysts in their statistical tests have used the following basic regression equation:

$$i = a + b_1 M + b_2 P + b_3 F + e,$$

where

i	=	the interest rate (typically, the nominal rate);
M	=	money growth or growth in the monetary base;
P	=	inflationary expectations;
F	=	the fiscal measure of the deficit; and
e	=	an error term.

The coefficient b_1 is expected to be negative, because an increase in the supply of money is expected to lower the cost of borrowing. The coefficient on inflation, b_2, is expected to be positive. The coefficient b_3 on the fiscal variable is then tested to see whether it is positive and statistically significant.

Some researchers embellish this basic model. Often researchers include a cyclical variable such as the percent change in real GNP or the unemployment rate; this cyclical variable usually turns out to be important for short-term rates although not for long-term rates. A few have added a variable to capture the effect of international capital flows. Also, a few analysts have, in effect, shifted the inflationary expectations variable to the left-hand side, thus, focusing on the determinants of the "real" interest rate (adjusted for inflationary expectations).

Some analysts have stressed a Keynesian short-run model of income determination, while others have stressed a longer-run, portfolio analysis (see earlier discussion of short-run versus long-run effects of deficit reduction). The portfolio models focus on the decisions of wealth holders about the allocation of their wealth among different assets, such as bonds and money. As such, the portfolio models deal primarily with stock variables, although income--a flow variable--is frequently included among the explanatory variables. By contrast, a Keynesian model focuses

22. See Congressional Budget Office, "Deficits and Interest Rates: Theoretical Issues and Simulation Results," Staff Working Paper, January 1989.

on the determination of national income with emphasis on the role of aggregate demand. Most of the Keynesian models and the portfolio models used in this context have been in the conventional tradition with a closed economy and with adaptive expectations, modeled using lagged variables. However, some of the more recent studies, such as Plosser (1982, 1987) and Evans (1987a, 1987b) have employed tests that depend on rational expectations.

Statistical Issues Underlying Single-Equation Estimates

Empirical testing using single-equation methods has proved to be difficult for a number of reasons. One is that, until the 1980s, the range of U.S. deficit experience was quite narrow except during wartime--and even for those periods, wartime controls and other special factors make it difficult to conclude anything about the deficit-interest rate relationship. Most of the variation in deficits has been associated with the business cycle.

Another reason for the difficulty with single-equation estimates is that the most commonly used type of estimation--ordinary least squares--assumes that the relation runs in one direction, from the independent variables (e.g., deficits) to the dependent variable (interest rate). Yet, in the case of deficits and interest rates, this assumption has no theoretical basis. For example, an increase in interest rates raises the cost of servicing the debt and therefore raises the deficit (unless offset by other changes).[23] In addition, the business cycle simultaneously affects both interest rates--particularly short-term interest rates--and the deficit. During recessions, fiscal deficits tend to rise and nominal interest rates tend to fall. Cyclical factors are distinct from the mechanisms by which a lower, policy-induced deficit lowers interest rates, and these cyclical effects must be taken into account in order to properly evaluate whether lower structural deficits lead to lower interest rates. Other difficult issues arise, such as whether to focus on real or nominal interest rates, how to scale the variables for growth in the economy, and how to adjust for inflation--to name a few.

The single-equation approach does not capture possible interactions between fiscal and monetary policies. For example, the Federal Reserve may attempt to offset the effects of deficits on interest rates in some situations. In addition, debt monetization could exacerbate inflation expectations, which would in turn cause nominal interest rates to rise--particularly long-term rates. But the single-equation formulation would not capture these indirect effects. Economists have instead tested whether the Federal Reserve has monetized deficits in the past, but that literature is not reviewed here.[24]

Researchers have attempted to deal with the above econometric and measurement problems in a variety of ways. Some have used cyclically adjusted measures of the deficit or debt. Others have tried to isolate the influence of cyclical

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23. One approach that seems not to have been tried would be to use the primary deficit (the deficit less interest payments on the debt) as the fiscal explanatory variable.

24. For a recent review of the debt monetization issue, see Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1986-1990* (February 1985), pp. 100-102.

fluctuations by including real GNP among the explanatory variables; but this specification abstracts from one of the ways that an increase in the deficit may influence interest rates--to the extent that higher deficits provide a short-term stimulus to aggregate demand and thus to interest rates, as argued by the Keynesian school. Still other studies have used an instrumental variables approach by substituting for the deficit factors that affect the deficit and are exogenous to other variables in the equation. The attempts to deal with these difficult questions have produced a bewildering diversity among the studies, even though most studies tend to focus on the same basic variables. Typically, the studies use different economic models, statistical techniques, and sample periods--as well as different fiscal measures. This diversity has compounded the problem of attempting to draw general conclusions.

Measurement Issues

Central issues in the debate over whether deficits affect interest rates hinge on the choice of the fiscal measure (or measures) to use in this basic formulation, and how to handle the basic problem of simultaneity, particularly between short-term interest rates, the deficit, and business fluctuations. But the question of the fiscal measure encompasses other questions such as the theory underlying how the author believes fiscal facts might affect interest rates. In addition, it involves how or whether to adjust the fiscal variable for inflation and for the effect of the business cycle.

One basic distinction is whether to use a financially oriented measure of the deficit or an income-oriented measure. The important official measures include the financially oriented unified deficit and the income-oriented National Income and Product Accounts (NIPA) deficit. In general, the unified deficit measures the difference between the cash receipts and outlays of the federal budget, including net lending operations of federal agencies. The NIPA deficit measures receipts and expenditures as they accrue, excluding purely financial transactions. In general, the unified deficit would be the more appropriate variable for measuring the impact of the budget on credit markets, while the NIPA deficit would be more appropriate for measuring the impact of the federal budget on aggregate demand.

Some analysts choose to focus on the wealth-oriented government debt measure, rather than on the deficit. In the literature on deficits and interest rates, the most commonly used measure of the federal debt is the debt held by the public, which nets out the debt held by the government itself, such as securities held in the Social Security trust fund. In addition, some analysts net out the part of the federal debt held by the Federal Reserve.[25]

Auerbach and Kotlikoff (1987) argue that conventional measures of the deficit are apt to be misleading. In their view, the crucial factor is how taxes and government spending affect the welfare of current versus future generations. Deficit policy should therefore be defined in terms of the present values of net payments to government by current and future generations. From that perspective, the

25. For a detailed discussion of different measures of federal deficits and debt, see the following studies by the Congressional Budget Office: *Federal Debt and Interest Costs*, Special Study (September 1984) pp. 1-13; and "Measuring the Federal Debt and Deficit: Adjustment and Rationales," Staff Working Paper, processed, April 1985.

composition of taxes, transfers, and purchases can be more important than the deficit.[26]

Inflation and Market Adjustments. Some economists argue that the fiscal measure needs to be adjusted to reflect inflation and--in the case of debt--changes in market value due to changes in interest rates. But others go much further and argue for a measure of the net wealth position of the government.[27] Moreover, some would argue that the debt is only a part of the liabilities of the federal government, and that other equally relevant parts include the unfunded liabilities of the federal pension system and the Social Security System. Essentially, this issue hinges on whether people see through the "government veil" and adjust their behavior according to changes in the overall net wealth position of the government. Alternatively, people may focus only on private assets--in which case more narrow adjustments would be appropriate.[28]

Some analysts studying whether deficits affect interest rates use the current market value of the federal debt, rather than the par value. The rationale is that wealth holders would be more affected by the market value than by the par value of the debt that they hold. This may be indisputable as applied to the study of deficits and interest rates, but use of the market value compounds the simultaneity problem since an increase in rates reduces the market value of bonds. Thus, most researchers simply use the par value of the federal debt.

Cyclical Adjustments. Many analysts use a cyclically adjusted measure of the federal deficit, or the "standardized-employment" deficit. This measure is useful for isolating changes in the deficit due to changes in fiscal policy, as well as for coping with the simultaneity problem in analyzing the effects of deficits on interest rates. For this measure, both receipts and outlays are adjusted to reflect a constant rate of unemployment. During recessions, income grows more slowly, which reduces revenues; and unemployment rises, which causes outlays to rise for unemployment insurance. The standardized-employment measure removes such influences. CBO uses an estimate of NAIRU, or the non-accelerating inflation rate of unemployment, in calculating its standardized employment deficit; but in principle some other

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26. For a more detailed discussion, see Auerbach and Kotlikoff (1987), Chapter 7.

27. See Robert Eisner, *How Real Is the Federal Deficit?* (New York: The Free Press, 1986).

28. Because inflation reduces the real value of the federal debt, some analysts believe that both the debt and deficit measures should be adjusted to reflect the effects of inflation. In fact, most analysts who use debt in the study of interest rates take inflation into account at least partially. For instance, many analysts convert the debt series into a constant dollar measure, or take the ratio of fiscal debt to nominal GNP, which adjusts for changes in scale and, in a rough way, for inflation though not for changes in the market value of debt.

    The bigger controversy is over whether or not to adjust the fiscal deficit, rather than the debt, for inflation. Some analysts, such as Seater (1985), believe that an appropriate measure of fiscal deficit needs to take into account the effects of inflation on the real value of the debt. Others, such as Tanzi (1985b), disagree--arguing instead that economic agents do not fully and automatically adjust for inflation.

standard, such as de Leeuw and Holloway's (1985) trend unemployment rates, would serve the same basic purpose.

A few researchers have also used cyclically adjusted measures of federal debt. De Leeuw and Holloway (1985) recently developed a structural debt measure based on the growth trend for real GNP. An essential feature of the structural debt measure is that deviations above and below are approximately offsetting.

Review of Some Representative Studies: A Detailed Description

Conventional Models: The Feldstein/Eckstein Approach. Feldstein and Eckstein (1970) published one of the first studies to test empirically for a relationship between deficits and interest rates. Their model was in the Keynesian tradition, emphasizing income determination. In their model, the ten-year government bond rate was made a function of the log of real per capita government debt, the log of real per capita nongovernment GNP, expected inflation, the monetary base, and the lagged change in the dependent variable. The authors reported that the government debt variable had a statistically significant, though small, effect.

The Feldstein/Eckstein study served as a prototype for several subsequent studies that were made after government deficits had become much larger. For instance, Carlson (1983) used a similar model and, like Feldstein/Eckstein, reported a statistically significant, though small, coefficient on the government debt variable. Barth, Iden, and Russek (1984) tried to replicate Carlson's results but they did not obtain a statistically significant coefficient for the exact period analyzed by Carlson. However, when they tried a slightly different sample period they obtained a statistically significant debt coefficient, with a higher "t" statistic than reported by Carlson.

In a similar approach that was presented as part of testimony before the Senate Budget Committee, Kudlow (1981) used the ten-year government bond rate as the dependent variable. The explanatory variables included the per capita real money supply, inflationary expectations, per capita real GNP, and the real per capita federal debt. Kudlow reported a statistically significant positive coefficient on the federal debt variable.

Researchers at the Treasury Department (1984) attempted to replicate the Feldstein/Eckstein study, but did not find a statistically significant effect for the government debt variable. (Revisions in the data may be one reason for the discrepancy.) The Treasury's researchers developed their own preferred model of interest rate determination, which modified the Eckstein/Feldstein approach in several ways, including the method used to measure expected inflation. After developing their preferred model, which did not include a government debt variable, they then tested and rejected various measures of the government deficit and debt.

De Leeuw and Holloway (1985) developed a more elaborate portfolio model, stressing the role of the structural federal debt in the determination of interest rates. The authors developed their own measures of structural deficits and the structural debt, based on estimates of the trend in real GNP. In the de Leeuw/Holloway model, the interest rate on three-year government notes was made a function of the

monetary base, expected inflation, and the federal structural debt. Their specification represented a departure from Feldstein/Eckstein in that they distinguished between the structural and the cyclical debt, and more clearly emphasized a portfolio balance model. Their results indicated that the structural debt--but not the structural deficit--was statistically associated with interest rates in the expected way. Moreover, their results showed a much larger effect than the results of Feldstein/Eckstein. A one-percentage-point increase in the ratio of the structural debt to trend GNP would raise the interest rate on three-year government securities by almost half a percentage point, according to their results.

One reason that de Leeuw/Holloway found a debt effect and the Treasury did not may be that the Treasury formulation included a real output variable, while that of de Leeuw/Holloway did not. If a change in fiscal policy affected the level of real output and the change in real output was the source of a change in interest rates, then the inclusion of real output in the equation could make the coefficient on the fiscal variable understate the overall effect of deficits on interest rates.

Barth/Iden/Russek (1984) were able to replicate quite closely both the results of the de Leeuw/Holloway study and of one of the studies done at the Treasury, Girola (1985). Barth/Iden/Russek found that when they used a measure of the domestically held debt in the basic Feldstein/Eckstein equation instead of the conventional debt variable, the coefficient was positive and statistically significant.

Barth/Iden/Russek found that the de Leeuw/Holloway results were generally robust, but not entirely. The de Leeuw/Holloway results concerning the structural debt held up when government spending was added to the equation. Further analysis suggested that the de Leeuw/Holloway specification held both for the twenty-year government bond rate and the three-month Treasury bill rate. Moreover, the statistical significance of the debt measure was not dependent on the use of the structural debt measure. The coefficient on the actual privately held federal debt was statistically significant, although the coefficient and its "t" statistic were smaller than when the structural debt variable was used. However, the de Leeuw/Holloway results appeared to be sensitive to the particular period of estimation, since dropping recent data points caused the coefficient on the structural debt to become smaller and statistically less significant--although still significant at the 95 percent confidence level. Also, when quarterly data were used rather than annual data, the coefficient on the structural debt variable become smaller and no longer statistically significant.

The de Leeuw/Holloway development and use of a structural debt measure for explaining the interest rate is clearly an important new development in the literature. However, this measure is not without its detractors. For instance, Seater (1985) criticized the structural measure on grounds that it involves a number of arbitrary steps but, more important, that the statistical method used to decompose GNP into cyclical and structural components is too simplistic--because for instance, it implies that all shocks to GNP have purely transitory effects. Bosworth also

criticized the estimate of trend GNP because it implied that the associated unemployment rate had risen to 8 percent in 1983, which seemed too high.[29]

Tanzi (1985a, 1987) tested the statistical significance of several alternative fiscal measures in a model of interest rates on one-year Treasury bills. In Tanzi's formulation, the interest rate was made a function of inflationary expectations using the Livingston Index,[30] the gap between real GNP and potential real GNP, government debt, and measures of the fiscal deficit, including the de Leeuw/Holloway measure of the structural deficit. Tanzi did not include a specific variable to capture the effects of monetary policy, although his inflationary expectations variable may indirectly capture some aspects of monetary policy. Tanzi's results were mixed. The sign on the structural deficit was negative, suggesting that higher deficits lowered interest rates--a result that is difficult to reconcile with any theory. On the other hand, the actual debt variable did have the hypothesized positive and statistically significant effect.[31]

Tanzi was not alone in failing to find a positive and significant effect of the structural deficit on interest rates. Tatom (1984) used a simple univariate regression equation for the changes in the three-month Treasury bill rate as a function of either the change in the actual deficit (relative to GNP) or the change in the high-employment deficit. The coefficients for the deficit variable were not statistically significant. Similar results of nonsignificance for the fiscal variable were also reported for long-term interest rates. However, Tatom's analysis can be faulted for not including other important determinants such as the monetary base and inflationary expectations.

Evans (1985) uses a conventional Keynesian model to explain why deficits might be expected to affect interest rates.[32] In his formulation, the nominal interest rate is a function of real government spending, the real deficit, the real money stock, and expected inflation. While much of his analysis pertained to wartime, the period analyzed of most interest was from October 1979 to December 1983. He used monthly data, and two-stage least squares estimation to deal with the problem of the

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29. See de Leeuw and Holloway, "Measuring and Analyzing the Cyclically Adjusted Budget," and associated discussion comment by Bosworth, in *The Economics of Large Government Deficits*, sponsored by the Federal Reserve Bank of Boston, 1983, pp. 1-45.

30. The Livingston index of expected inflation is based on a sample survey initially conducted by Joseph A. Livingston and, more recently, by the Federal Reserve Bank of Philadelphia. For a detailed description and analysis of the survey, see Carlson (1977).

31. There was a mixup in the initial results reported by Tanzi, resulting from a confusion over the sign of the fiscal surplus variable that was actually used. A recent commentor on the Tanzi paper, Spiro (1987), argued that the positive coefficient on the fiscal surplus variable is evidence that deficits actually lower the short-term interest rate because foreign wealth holders anticipate that a rise in the structural deficit will cause an appreciation of the currency. Thus, the inflow of foreign capital drives down the short-term rate.

32. With this model, a policy-induced increase in the deficit stimulates a higher level of spending; with the money supply held constant, a higher level of the interest rate would be required for equilibrium in financial markets. Moreover, since a change in government purchases has a more direct effect on spending than a change in taxes, it is important to distinguish whether the change in the deficit is caused by a change in purchases or a change in taxes.

endogeneity of the deficit.[33] In any case, the coefficient on the deficit was usually negative and statistically significant. This result is difficult to explain with any theory, and Evans stopped short of arguing that deficits lower interest rates. He did, however, argue that no empirical support could be found for the notion that deficits raise rates. His explanation was that the Ricardian equivalence theorem must have held. But other interpretations are possible, such as that international capital mobility dominated interest rate movements for the recent period, or price controls and rationing accounted for the results for some of the wartime periods. As pointed out by Bernheim (1987), the way to test the Ricardian equivalence theorem is to focus on saving directly, rather than on interest rates.

Dewald (1983) tested for the effects of deficits on both short- and long-term interest rates, using two different estimating techniques. In one approach, annual data were used; in the second approach, data were averaged over the business cycle. In either case, deficits had a statistically significant effect on long- but not short-term rates. In his conclusion, Dewald emphasized that deficits did not have a large and consistent effect on interest rates. However, an equally important conclusion would seem to be that deficits have an effect on long-term interest rates, although not on short-term rates.[34]

Hoelscher (1983) constructed an empirical model of the short-term credit market, with the interest rate on three-month Treasury bills a function of the money base, inflation expectations, a cyclical variable--proxied by the unemployment rate--and net borrowing by the federal government. Hoelscher found that the coefficient on government borrowing was quite small and not statistically significant.[35] However, Barth, Iden and Russek (1984 and 1985) found that when they substituted the structural deficit for the net borrowing variable used by Hoelscher, the coefficient was positive and statistically significant. One implication is that Hoelscher's conclusions appear to be sensitive to the concept of the deficit that is used. His strategy of including a cyclical variable, such as the unemployment rate, may not be adequate for dealing with the simultaneity problem.

Foreign Capital Flows. Several recent studies have attempted to include foreign capital flows in the analysis--see de Leeuw (1986), Swamy and others (1988), and Cebula and Koch (1988). De Leeuw's analysis, which was an extension of his earlier paper with Holloway, suggested that an increase in net international assets (domestic holdings of foreign assets less foreign holdings of domestic assets) would be positively associated with the interest rate. In his empirical analysis, the coefficient on the change in international assets variable did have a positive sign, but it was not

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33. It is unclear whether the fiscal data were seasonally adjusted. Receipts in particular are highly seasonal, and failure to account for seasonality could bias the results.

34. Dewald's approach differed somewhat from most other researchers in that he attempted to explain real interest rates while most researchers have used nominal rates and included some measure of expected inflation as one of the explanatory variables. In addition, Dewald explored the effect of changes in the inflation-adjusted deficits, whereas most researchers have used nominal deficits, real debt or nominal debt as a percent of nominal GNP.

35. The coefficient on the lagged dependent variable suggested that the long-term effect of a change in the deficit could be almost three times the initial effect. But three times a tiny impact is still small.

statistically significant. Similarly, Swamy and others (1988) reported finding consistently negative coefficients for private foreign capital inflow, although they were not statistically significant. Cebula and Koch (1988), who used an instrumental variables technique to take account of the impact of cyclical factors on the federal budget, reported a statistically significant, negative coefficient on real net capital flows into the United States.

Expected Future Deficits. Expectations obviously play an important role in the determination of long-term interest rates, but it is difficult to find or develop measures of expected variables. Nevertheless, the distinction could be crucial since the deficit might go up but long-term rates might fall if the deficit went up less than expected.

Several recent studies have emphasized the role of expected future deficits (rather than contemporaneous deficits) in the determination of long-term interest rates. Feldstein (1986), Sinai and Rathjens (1983), Bovenberg (1987), Muller and Price (1984) and Evans (1987) have analyzed the effects of expected future deficits, and all except Evans reported statistically significant, positive coefficients on the expected deficit variables. With this approach, the method used to construct the expected deficit is obviously crucial and the studies have used various methods. In general, those that have reported a significant coefficient have used somewhat ad hoc measures of expected future deficits. One reason is that no consistent forecast series is available before approximately 1980.

Feldstein (1986) used a five-year projection of the deficit as one of the determinants of the interest rate on Treasury securities with five years to maturity. For the deficit projection, Feldstein used the actual deficit and projections by Data Resources, Inc., for the years 1985 and beyond. The expected deficits were then adjusted to arrive at the high-employment expected deficit as a percent of high-employment GNP. A five year-average of this expected deficit was then entered in a portfolio model of interest rate determination. The coefficient on the deficit variable was positive and statistically significant, and suggested a quantitatively important effect.[36] The results were similar when the deficits were not adjusted for the business cycle. (To some extent, a five-year moving average of the deficit is already adjusted for the business cycle.)

In contrast, Evans (1987) also used a measure of expected government deficits, but came to the conclusion that they had no effect on interest rates. In brief, Evans concluded that neither past, present, nor expected deficits seemed to affect interest rates. Evans's measure of expected deficits was constructed differently than the others. For one thing, it did not involve smoothing of the data. For another, Evans used a rational expectations approach in the sense that he used variables designed to incorporate statistically all known information at the time the forecast of the deficits was being made--but not the specific forecasts of deficits by, say, the commercial forecasters, or the Office of Management and Budget. Evans's approach was less ad hoc than Feldstein's, but also less direct.

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36. According to Feldstein (1986), "Each percentage point increase in the projected ratio of budget deficits to GNP raises the long-term government bond rate by approximately 1.2 percentage points while the ratio of the current deficit to GNP (either actual or structural) has no significant effect."

Unanticipated Deficits. At least two papers have tested the view that it is not expected deficits that raise interest rates, but unanticipated or surprise deficits. Makin and Tanzi (1984) measured surprise deficits as residuals from a univariate time-series model. The surprise deficit variable was then used in a model of the three-month Treasury bill rate. The coefficient on the deficit variable was small but statistically significant.

Using a measure of unanticipated bond growth developed by Barro (1979), Barth and Bradley (forthcoming) did not find its coefficient to be statistically significant in their interest rate equation.[37] However, they did find that unexpected changes in government spending had a positive and statistically significant effect on interest rates.

Models of the Term Structure of Interest Rates. Hoelscher (1986) used a single-equation model of the long-term interest rate, with the short-term interest rate, inflation expectations, and several alternative measures of government deficits as independent variables. Ordinary least squares was used to estimate the model with annual data. His deficit measures, which were all expressed in real per capita terms, included the NIPA version of the federal deficit, a version that encompassed the state and local sector, and a third measure based on changes in real par value of publicly held federal debt. Hoelscher found the coefficient on government deficits to be positive and statistically significant, suggesting that increases in deficits tended to raise yield spreads. He did not find that the results were sensitive to the choice of deficit measure.

Hoelscher made some attempt to reconcile this finding with the findings of his earlier study that found no relationship between government borrowing and short-term interest rates. Among other factors, he argued that international capital markets might come closer to erasing differentials in short-term than in long-term rates.[38] Another observer, Spiro (1987), suggested that there is no contradiction because the later finding pertained solely to the differential between the long-term and the short-term rates. If the deficit actually lowered the short-term rate, as a few studies have indicated, then a widening differential need not imply that deficits raise the long-term rate. Still, no convincing rationale has been offered for a negative effect on interest rates--short or long.

Plosser (1982) also used a term-structure model to test whether fiscal variables affected interest rates. Vector autoregression techniques were used to test whether surprises in fiscal policy were associated with deviations from expected holding period returns on financial assets. He concluded that a substitution of deficit for tax financing had no effect on holding-period yields, but that changes in government purchases did--that is, an increase in government purchases was associated with higher yields. Plosser's findings were, thus, consistent with Barro's theory that deficits, per se, have no effect on interest rates.

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37. According to Barro (1979), the anticipated change in the public debt was a function of such factors as recession and war. The unanticipated change in the debt was then measured as a residual.

38. Another possibility is that the use of annual, rather than quarterly data may have contributed to the disparity in results. The first study by Hoelscher focused on short-term interest rates and used quarterly data, while the second study focused on long-term interest rates and used annual data.

Stochastic Coefficients Models. Swamy and others (1988) took stock of the diverse and tentative nature of much of the analysis to date on the deficit-interest rate issue. They tested a number of specifications that made use of conventional fixed coefficients, and found that the fiscal deficit variable frequently had a negative coefficient--even in some of the best-performing specifications and estimating procedures, evaluated on the basis of forecasting performance. They argued that one explanation for this result with conventional approaches could be that the coefficient on deficits should not be considered fixed. Instead, the magnitude and direction of the effects of deficits on interest rates may change from period to period. As the authors state: "It is particularly hard to account for this finding (negative coefficient on deficits) without attributing it to specification errors. One of these could have resulted from a possibly mistaken assumption that the slopes . . .are fixed over time" (p. 13). In their view, the coefficient on the deficit could change depending on how the conjunction of federal deficits, inflationary expectations, and changes in the money supply affects the supply and demand for funds.

Swamy and others (1988) then estimated a stochastic coefficients model--one in which coefficient estimates are allowed to change. They found that the coefficient on the fiscal variable sometimes changed signs over the historical period, and was generally negative. However, these results leave unanswered questions about the specific reasons behind changes in the magnitude of the deficit coefficient, nor do they explain the generally negative sign of the deficit coefficient.

Major Conclusions Derived from Empirical Studies

Overall, the single-equation results are ambiguous. The failure to find a consistent positive association between deficits and interest rates could mean a number of things:

- That deficits and/or interest rates are measured poorly;
- That the estimated models are poorly specified;
- That international capital flows adjust to allow deficits to be financed without any perceptible effect on interest rates;
- That the effects of deficits on interest rates may differ markedly over time; or
- That private saving deviations offset changes in the deficit.

None of these possibilities can be ruled out.

Despite a lack of consensus, several patterns can be detected that show which types of analytic approach are more likely to result in a positive estimated relationship between deficits or debt and interest rates. In general, studies that have found a deficit-interest rate relationship have adjusted the deficit to remove effects of the business cycle, used average deficits over an extended period of time, or used

measures of expected deficits, sometimes averaged over several years. Most studies that have used unadjusted deficits have not found a statistically significant, positive relationship. Researchers have more frequently found a relationship between deficits and long-term interest rates than between deficits and short-term interest rates. There are also stronger indications that changes in government spending affect interest rates, than that changes in deficits themselves do so. Finally, some studies have found a relationship using the government debt as a fiscal measure, while not finding a relationship with the deficit.

Several of these observations have a common thread: positive results seem to accompany smoothing of the deficit series. Averaging or smoothing of the measure of the deficit seems more critical to the conclusion than the model or school of thought of the researcher. For some studies, it is unclear whether the smoothing of the series or the use of forward-looking expectations of deficits is the key factor.

There are at least four reasons why the relationship appears stronger for long-term interest rates than for short-term rates. First, the business cycle has a larger effect on short-term than on long-term rates. Thus, the business cycle may confound any causal relationship between deficits and short-term rates. Second, international capital markets reduce interest rate differentials to a greater extent for short-term debt than for long-term debt, to the extent that short-term instruments in different currency denominations are closer substitutes than are long-term instruments. Third, monetary policy, which can have a more substantial effect on short-term interest rates than on long-term rates, may offset the effects of deficits on short-term rates. Finally, deficits may exacerbate inflationary expectations, particularly if investors believe that the Federal Reserve may monetize a substantial portion of the deficits. Changes in inflationary expectations would have a greater effect on long-term than on short-term interest rates.

Federal debt seems to have a stronger effect on interest rates than the federal deficit. Several explanations can be suggested. First, the portfolio model emphasizing investors' choices among assets may be more relevant than a model emphasizing determinants of the flow of spending. Second, measurement problems may be more severe for the deficit than for the debt. For instance, adjusting for inflation makes a much greater difference for the deficit than for the debt. Third, the debt series is smoother than the deficit series, and perhaps the lesser noise in the data makes the relationship more apparent.[39] In any case, the distinction between the deficit and the fiscal debt can have important implications. For instance, in recent years, the deficit has been falling relative to GNP but the privately held debt has continued to grow relative to GNP. In this circumstance, the net effect of the budget on interest rates is unclear from a theoretical perspective. However, from an empirical perspective, the debt seems to be more influential than the deficit.

Finally, there appears to be more evidence for a link between government purchases and interest rates than for a link between a change in the deficit brought

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39. This characteristic also suggests a need for caution, though, because it raises the possibility that the association could be spurious. See James R. Barth, Frank S. Russek, and George H. Wang, "A Time Series Analysis of the Relationship between the Capital Stock and Federal Debt: A Comment," *Journal of Money, Credit and Banking* (November 1986), pp. 527-538.

about by changes in other components of the federal budget and interest rates. This is consistent with both the Keynesian viewpoint and the Ricardian equivalence perspective. According to Keynesian theory, a change in government purchases has a larger fiscal multiplier--and, therefore, larger effects on interest rates--than a change in net taxes. Thus, Keynesian theory implies that the tax effect is smaller than the purchase effect--but that it is not zero. According to the Ricardian equivalence view as expounded by Robert Barro (1981), a temporary change in purchases may affect interest rates but a change in the fiscal deficit by itself would have no effect.

Quantitative Effects of Fiscal Deficits: Some Rough Calculations

Most single-equation studies have focused on whether or not there is a statistically significant relationship between deficits and interest rates--not on the magnitude of any such relationship. Nevertheless, because of the diversity of findings, it is desirable to compare the effects of a given change in the deficit suggested by different studies and to attach a range of uncertainty to each point estimate. The problems associated with this kind of exercise are legion, and the results are at best extremely rough. For one thing, the studies are based on different periods of estimation, and some of the studies, done a number of years ago, exclude much recent and highly relevant history. Moreover, the studies are made over periods that cover quite different policy regimes. For instance, the shift to flexible foreign exchange rates in 1973 may be of critical importance in any empirical analysis of deficits and interest rates.

Another problem is that the effect of a shock of a given absolute magnitude can be quite different depending on the period. A $50 billion change in the deficit is a much bigger change for the economy in 1970 than in 1987. In some cases, a $50 billion change would be outside the range of usual experience so that the estimates may have especially large errors. The problem of scale may be reduced somewhat if the variables are converted to logs or expressed as a percent of GNP before estimation, but not all studies made these transformations.

In addition, it is difficult to compare relative bands of uncertainty across studies. First, the studies use different statistical estimating procedures. Some studies correct for serial correlation in the residuals, while others do not. The uncorrected estimates may look better--they will have higher "t" values--but the appearance of precision is deceiving in the presence of autocorrelation of residuals. Second, the studies reported the standard errors of the coefficients evaluated at the mean values of the variables--rather than the standard error associated with a $50 billion change in the fiscal variable.

Despite the limitations, we have made some rough calculations of magnitudes and ranges of uncertainty of effects from a $50 billion reduction in the deficit, and the results are summarized in Figure 1. A standard $50 billion reduction in the deficit was introduced into representative equations from 25 studies. The calculations were based on 1986 dollars and on the overall scale of the economy in 1986. The $50 billion change in the deficit was translated into the fiscal variable used in the study, and then the deficit-related coefficient in the equation was used to calculate the effect.

To illustrate the uncertainty associated with the estimates, the calculation was also performed holding the relevant coefficient at two standard errors on either side of its estimated value. The bars in the figure represent the point estimate, plus and minus two standard errors for the coefficients--not two standard errors for the estimate of the entire equation. The results for each equation were tabulated in the figure. Each study represented is identified by a letter and is indexed in the directory of studies that follows the figure.

This exercise inevitably required translation and judgment--and a great many arbitrary decisions that can affect the results. For instance, some studies focused on the stock of debt, rather than on the deficit or flow variable. In such cases, the one-year effect on the debt was assumed, rather than the long-run or steady-state effect. If a longer period had been assumed, the effect in some cases would have been considerably larger. Similarly, some studies used a moving average for the deficit, partly to depict expectations, but averaging also mitigates the problems associated with the business cycle. The calculations assume that only one year of the moving average is affected by the policy shock, but a case could be made that a permanent change would be quickly incorporated in expectations.

Several tentative conclusions can be offered based on the results summarized in Figure 1. First, while the figure generally suggests that a reduction in the deficit of $50 billion would tend to reduce interest rates, it also suggests that the decline rates, it also suggests that the decline might be small, at least in the short run. Most of the estimates are clustered between plus and minus one-half percentage point, although it might be argued that half a percentage point is not "small." Second, the large standard errors suggest that the estimates are associated with a large band of uncertainty, though the standard errors are smaller for the studies that dealt with long rates than for those that used short rates.

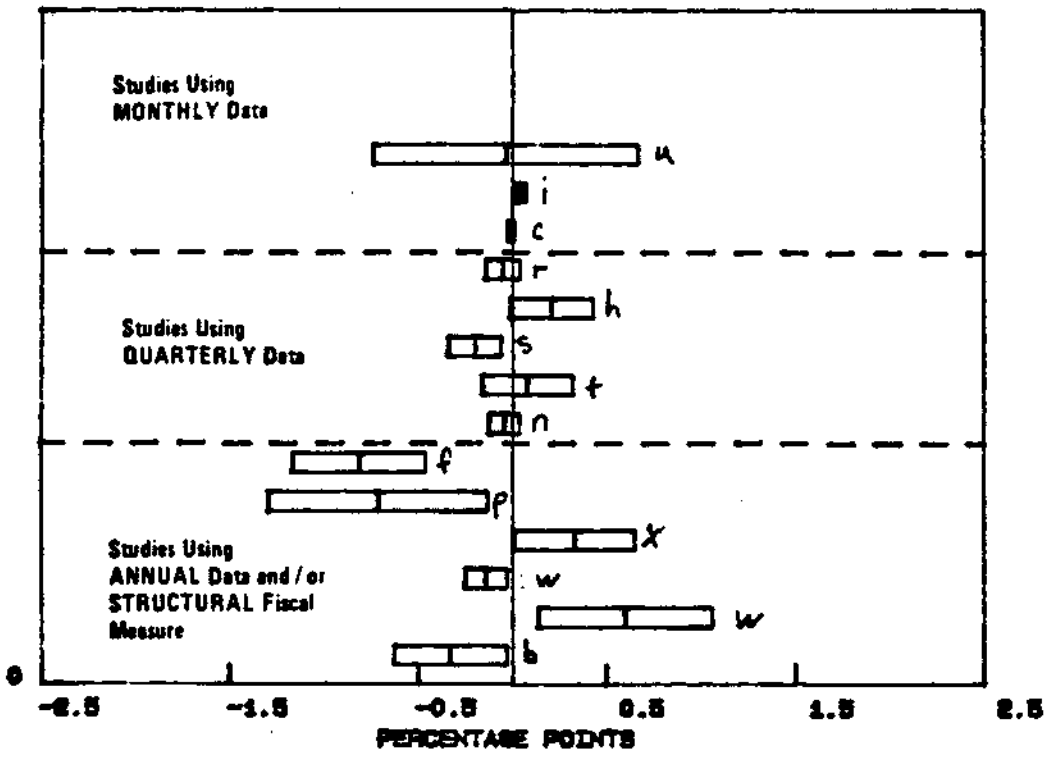
Some studies suggest that the effect of a $50 billion reduction in the deficit on interest rates would grow over time, and in some cases could become quite large. In particular, the studies that used the ratio of debt to GNP would show substantially larger effects after several years than after only one year because the debt reduction would cumulate. Similarly, the studies that used an annual moving average of expected deficits would show substantially larger effects if the moving average fully reflected a sustained lowering of the deficit.

In addition, several studies used a lagged dependent variable which also suggested that the effect would grow over time. (The impact calculations in Figure 1 took account of only the direct effect.) However, most studies that used the lagged dependent variable formulation reported very small direct effects so that even after several periods the effects would still be small.

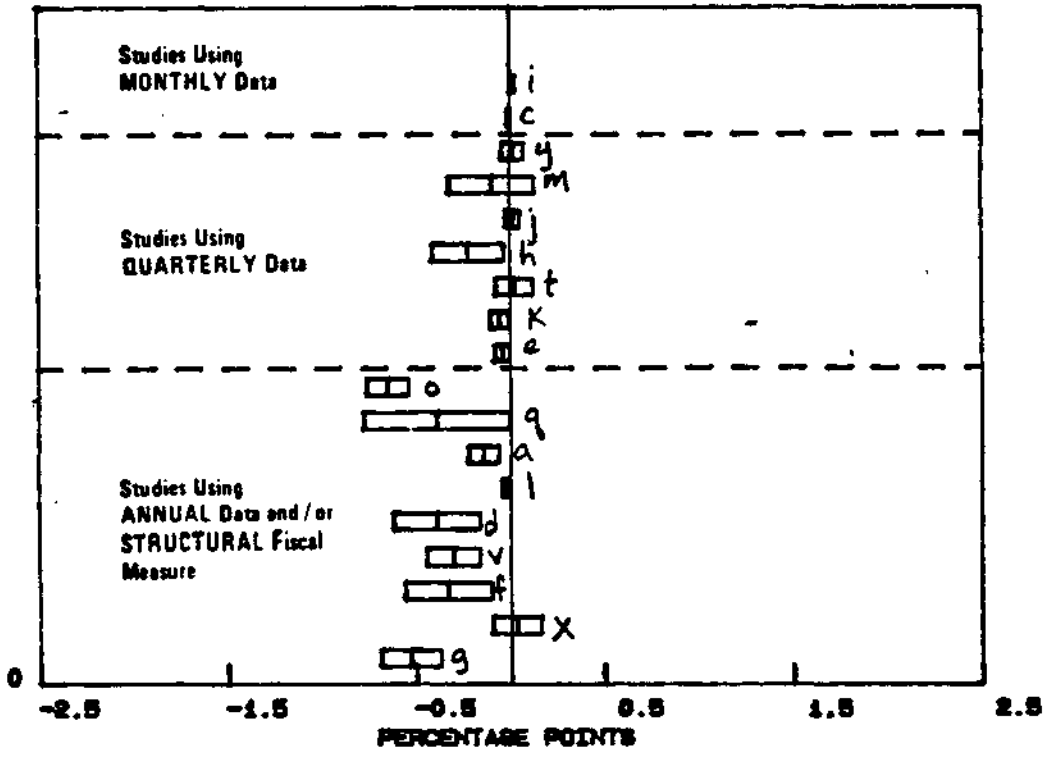
Figure 1 distinguishes among studies by the frequency of the data used and whether the fiscal data were adjusted to remove cyclical changes. This grouping suggests that the likelihood of finding consistent results across studies is to some

Figure 1. Estimates of the Effects of a $50 Billion Decrease in the Deficit on Interest Rates

Effect on Short-Term Interest Rates



Effect on Long-Term Interest Rates



NOTE: The bars represent point estimates, plus and minus approximately 95 percent confidence intervals.

SOURCE: Congressional Budget Office and studies listed below.

a. James R. Barth and Michael D. Bradley, "Rational Expectations and the Effects of Federal Debt: Some Empirical Results," George Washington University, Department of Economics, processed (1985).

b. James R. Barth, Frank S. Russek, and George Iden, "Government Debt, Government Spending, and Private Sector Behavior: Comment, *Southern Economic Journal* (October 1985).

c. Michael D. Bradley, "Federal Debt Surprises and Real Interest Rates: Whither Crowding Out?" George Washington University, Department of Economics, processed (October 1983).

d. Lans A. Bovenberg, "Long-Term and Short-Term Interest Rates in the United States: An Empirical Analysis," International Monetary Fund, Fiscal Affairs Department, mimeo (1987).

e. Jack Carlson, Statement before the Joint Economic Committee (October 21, 1983).

f. Richard J. Cebula, *The Deficit Problem in Perspective* (Lexington, Massachusetts: Lexington Press, 1987).

g. Frank de Leeuw and Thomas M. Holloway, "The Measurement and Significance of the Cyclically Adjusted Federal Budget and Debt," *Journal of Money, Credit and Banking*, vol. 17, no. 2 (May 1985), pp. 232-242.

h. William G. Dewald, "Federal Deficits and Real Interest Rates: Theory and Evidence," Federal Reserve Bank of Atlanta, *Economic Review* (January 1983), pp. 20-29.

i. Paul Evans, "Do Large Deficits Produce High Interest Rates?" *American Economic Review*, vol. 75, no. 1 (March 185), pp. 68-87.

j. Martin S. Feldstein and Gary Chamberlain, "Multimarket Expectations and the Rate of Interest," *Journal of Money, Credit, and Banking*, vol. 3, no. 4 (November 1973), pp. 973-902.

k. Martin S. Feldstein and Otto Eckstein, "The Fundamental Determinants of the Interest Rate," *Review of Economics and Statistics*, vol. 52, no. 4 (November 1970), pp. 363-375.

l. Jeffrey A. Frankel, "A Test of Portfolio Crowding-Out and Related Issues of Finance," National Bureau of Economic Research, Working Paper Series, No. 1205 (September 1983).

m. Demetrios S. Giannaro and Bharat R. Kolluri, "The Budget Deficit Debate: A Review of the Recent Empirical Studies," University of Hartford, processed (1985).

n. Gregory P. Hoelscher, "Federal Borrowing and Short-Term Interest Rates," *Southern Economic Journal*, vol. 50 (October 1983), pp. 319-333.

o. Gregory P. Hoelscher, "New Evidence on Deficits and Interest Rates," *Journal of Money, Credit, and Banking*, vol. 18, no. 1 (February 1986), pp. 1-17.

p. Michael Hutchinson and David H. Pyle, "The Real Interest Rate/Budget Deficit Link: International Evidence, 1973-1982," Federal Reserve Bank of San Francisco, *Economic Review* (Fall 1984), pp. 26-35.

q. Lawrence Kudlow, Statement before the Senate Budget Committee, statistical appendix (October 20, 1981).

r. John H. Makin, "Real Interest, Money Surprises, Anticipated Inflation and Fiscal Deficits," *Review of Economics and Statistics*, vol. 65, no. 3 (August 1983), pp. 374-384.

s. John H. Makin and Vito Tanzi, "Level and Volatility of U.S. Interest Rates: Roles of Expected Inflation, Real Rates and Taxes," in Vito Tanzi, ed., *Taxation, Inflation and Interest Rates* (Washington, D.C.: International Monetary Fund, 1984), pp. 110-142.

t. Angelo Mascaro and Allan H. Meltzer, "Long- and Short-Term Interest Rates in a Risky World," *Journal of Monetary Economics* (November 1983), pp. 485-518.

u. Brian Motley, "Real Interest Rates, Money and Government Deficits," *Economic Review*, Federal Reserve Bank of San Francisco (Summer 1983), pp. 31-45.

v. Patrice Muller and Robert Price, "Public Sector Indebtedness and Long-term Interest Rates," paper presented for the World Bank and Brookings Institution Seminar on the International Consequences of Budgetary Deficits and the Monetary-Fiscal Policy Mix in the OECD (September 1984).

w. Vito Tanzi, "Fiscal Deficits and Interest Rates in the United States," *IMF Staff Papers*, vol. 32 (December 1985), pp. 551-76.

x. John A. Tatom, "A Perspective on the Federal Deficit Problem," Federal Reserve Bank of St. Louis, *Review*, vol. 66 (June/July 1984), pp. 5-17.

y. U.S. Treasury Department, *The Effects of Deficits on Prices of Financial Assets: Theory and Evidence* (March 1984).

degree dependent upon the "smoothness" of the basic time series, since less frequently observed data or cyclically adjusted data are less volatile.[40]

The estimates associated with Figure 1 should be viewed with a great deal of caution. For one thing, the studies are quite heterogeneous with regard to sample periods, specifications, and definitions of the fiscal variable. For another, work done by Barth and others suggests that the results of these studies are not very robust. In a number of instances, serially correlated residuals plagued the basic regression estimates, and the application of standard first-order corrections produced large changes in the magnitudes of estimated coefficients and standard errors. The regression coefficients were in some cases found to be quite sensitive to the form of the fiscal policy variable and to the sample period. This latter conclusion is consistent with the findings of Swamy and others (1988), that the coefficient on the fiscal variable varied over time.

The Effects of Interest Rates on the Deficit

To the extent that a reduction in the deficit reduced interest rates, there would be a feedback effect of lower interest rates on the deficit. The rapid expansion of the federal debt since the early 1980s means that a given change in interest rates now has a much larger effect on the deficit than at the beginning of the decade.

According to recent estimates by the Congressional Budget Office, a one-percentage-point reduction in interest rates for all maturities, effective in January 1988, would reduce budget outlays by $3 billion in fiscal year 1988. By 1993, outlays would be approximately $30 billion lower--reflecting the roll-over of almost all the debt, as well as projected growth in the debt.[41]

The review of studies in the previous section suggests that a $50 billion reduction in the deficit might reduce interest rates by as much as 1/2 percentage point after one year. The CBO estimates cited above suggest that the original $50 billion reduction might, then, be augmented by an additional $15 billion fall in interest outlays by the sixth year. A one-half percentage point cut in intermediate and long-term rates (issues with maturities of two years and longer) could still have a substantial effect on the budget, although the effect would be minimal at first. The reason is that the turnover or refinancing of the longer-term debt occurs more slowly than for the total debt including the short-term debt. In the above time frame, a half-point reduction in intermediate and long-term interest rates in early January would lower outlays by $0.5 billion in fiscal year 1988, but by roughly $10 billion in 1993.

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40. For a given time series, monthly observations can generally be expected to be more volatile than the corresponding quarterly observations, and the quarterly series more volatile than the annual series. This is the sense in which "smoothness" is used in the text--moving to a lower-frequency version of a given time series yields a smoother series. Structural measures are generally smoother--at a given frequency--than the series on which they are based.

41. See Congressional Budget Office, *The Economic and Budget Outlook: Fiscal Years 1989-1993* (February 1988), pp. 62-65.

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