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# Fiscal Deficits and Interest Rates in the United States: An Empirical Analysis, 1960-84

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# Fiscal Deficits and Interest Rates in the United States: An Empirical Analysis, 1960-84

by Vito Tanzi

Few relationships in economics have attracted as much attention as that between the U.S. fiscal deficit and U.S. interest rates. A large and growing number of theoretical and empirical papers have recently analyzed such a relationship and financial analysts as well as politicians often refer to it. Some economists have attributed the historically high real rates since 1981 to the fiscal policy pursued by the United States in recent years. Others have denied the role of such a policy. This paper adds to that literature by analyzing on a mostly empirical basis the relationship between interest rates and several variables presumed to influence them, including fiscal variables.

The paper is structured as follows. Section I discusses briefly the major theoretical arguments that have been advanced in support of the conclusion that fiscal deficits do not affect interest rates. As the conclusion that fiscal deficits do affect interest rates is fairly orthodox, no space is allocated to the arguments behind it. As the aim of this paper is to analyze empirically the relationship between interest rates and fiscal variables, this theoretical section is short and somewhat impressionistic. It is neither a survey of the vast literature, nor a rigorous treatment of the issues discussed. The busy reader can skip it. Section II describes the series used in the statistical analysis so that, in Section III, the empirical results can be presented without at the same time having to discuss the data. It also outlines the structural equations to be tested. Section III is the core of the paper. Section IV summarizes the main results and draws some conclusions. The period covered in the analysis is 1960 to 1984. For reasons explained later the 1960-80 and the 1960-84 periods are analyzed separately.

## I. Theoretical Considerations

The fiscal deficit can increase either (a) because government expenditure rises while revenue remains unchanged, or (b) because tax revenue falls while government expenditure stays unchanged, or (c) because tax revenue falls while government expenditure rises. Regardless of which of these three cases is behind the increase in the fiscal deficit, government bond sales will have to increase. Ceteris paribus, in order to induce people to buy a larger quantity of bonds than previously, the government must discount them somewhat. Putting it differently, interest rates must rise from the level that they would have reached in the absence of the deficit.

The above conclusion follows from the most fundamental law in economics, namely, the law of demand. That law tells us that if one wants to sell more of something, one has to reduce its price. This result should not be, thus, controversial. Still this is not the case as lots of controversy exists as to whether or not fiscal deficits bring about increases in interest rates. What is the source of this controversy? Stripped to the bare essentials, the lines of criticism against the orthodox conclusion stated above are basically two. First, there is the assumption of spontaneous compensating behavior on the part of the private sector. 1/ Second, there is the assumption that the elasticity of the supply of funds schedule facing the sale of government bonds is high or even perfectly elastic. Let us discuss briefly these two lines of criticism.

### 1. Compensating behavior

Compensating behavior may be related either to the behavior of the corporate sector or to the behavior of the household sector. Suppose, for example, that as the government increases its expenditure, private investment falls. If there is a dollar per dollar trade-off between the rise in deficits and the fall in private investment, it is conceivable then that the rate of interest could remain unchanged. To a large extent this happened during World Wars I and II when the large increase in government expenditure was partly met by tax increases, partly by an increase in household saving, and, to a large part, by a sharp fall in private investment. 2/ Of course, the fall in private investment must

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1/ In other words, of a compensating behavior not induced by the increase in interest rates.

2/ As a proportion of GNP, gross private domestic investment fell from an average of 15.7 percent in 1912-16 to 12.3 percent in 1917, and 9.1 in 1918. It fell from 12.7 percent in 1940-41 to 6.3 percent in 1942, 2.8 percent in 1943, and 3.3 percent in 1944. See U.S. Department of Commerce, Long Trend Economic Growth, 1860-1965 (Washington, October 1966), pp. 166-71. During these periods interest rates were also directly or indirectly controlled. For more detail see Vito Tanzi, "Do Large Deficits Produce High Interest Rates? A Comment" (mimeographed, April 1985).

not itself be caused by the increase in the rate of interest but it could be caused by changes in expectations or by direct prohibition (on the part of the government) of some activities.

The accommodating behavior on the part of the household factor could come in different ways. If, for example, the deficit is caused by a decrease in taxes and this decrease in taxes is seen as temporary by the taxpayers, it is conceivable that the additional disposable income received by the taxpayers could be largely saved and utilized to purchase the bonds that the government is selling. The requirement for this behavior is the permanent income hypothesis of consumption behavior. Alternatively, as argued by Barro, 1/ if the household sector has perfect foresight it would realize that the public debt being created now must be repaid at some future date so that in time taxes would have to go up. Or, putting it differently, the household sector would realize that government bonds are not net wealth so that holding more of them will not make taxpayers richer and thus induce them to consume more. In such case they would presumably save the income associated with the tax cut. This so-called Ricardian Equivalence Hypothesis, thus implicitly assumes that there are no permanent tax cuts regardless of the declaration of the government. It must also assume that no tax cuts are ever self-financing as argued by Arthur Laffer and some supply-siders.

If deficits are associated with tax cuts, households can go on maintaining the same level of consumption as before and still increase their saving rate as their disposable income has increased. The increase in their disposable income makes it easier for them to increase their saving rate. If the increase in the deficit is not associated with a tax cut but with an increase in government expenditure, then the behavior à la Barro seems far less likely. 2/ In such case the households would, actually, have to cut their present level of consumption to behave à la Barro. Presumably ratchet effects would make this difficult at least in

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1/ Robert J. Barro, "Are Government Bonds Net Wealth?" Journal of Political Economy (Chicago), Vol. 82 (November/December 1974), pp. 1095-1117.

2/ This, presumably, is the assumption behind the belief on the part of some economists that interest rates are not influenced by fiscal deficits but by the level of public expenditure. To be fair to Barro, his specific analysis in the 1974 article relates only to shifts between tax and debt finance for a given volume of public expenditures. However, his analysis has been applied to real life situations where it was expenditures that went up. See for example the various studies that cover the post-World War II period.

the short run. 1/ Furthermore, there is no valid reason why households, even if they had perfect foresight, should not see the increased level of spending as temporary and, thus, not requiring a drastic change in their consumption behavior. In this case, the rate of interest would have to go up and some investment expenditure, including the purchase of durables on the part of the households, would have to be crowded out by higher interest rates to accommodate the higher deficit. Even when the deficit is caused by tax reductions--the case more favorable for a behavior à la Barro--the requirements behind a reaction consistent with a Ricardian Equivalence Hypothesis are so stringent that many have difficulties in accepting them. A full discussion of this aspect would require far more space than can be allocated here. 2/

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1/ During both World Wars I and II households did not have to reduce the absolute level of their consumption because when the war started, there was a lot of unused capacity in the economy. The additional government spending could be accommodated largely through an expansion of output. Real consumption actually rose during both World Wars I and II, even though its share of GNP fell considerably. See Tanzi, "Do Large Deficits Produce High Interest Rates? A Comment," for more details on this aspect.

2/ There is now an enormous amount of literature on the Ricardian Equivalence Hypothesis. Although this hypothesis has become fashionable since the publication of Barro's paper, it received a lot of attention in the Italian public finance literature earlier in this century. Pareto, among others, dismissed it as an unrealistic possibility. See on this, James M. Buchanan, "Barro on the Ricardian Equivalence Theorem," Journal of Political Economy (Chicago), Vol. 84 (April 1976), pp. 337-42. Two recent papers that have rejected it are: F. Modigliani, T. Jappelli, and M. Pagano, "The Impact of Fiscal Policy and Inflation on National Saving: The Italian Case" (mimeographed: revised April 1985); and Michael J. Boskin and Laurence J. Kotlikoff, "Public Debt and U.S. Saving: A New Test of the Neutrality Hypothesis" (mimeographed: Carnegie-Rochester Conference, November 1984). For earlier criticism see James Tobin and William H. Buiter, "Fiscal and Monetary Policies, Capital Formation and Economic Activity," in The Government and Capital Formation, ed. by G. M. von Furstenberg (Cambridge, Massachusetts: Ballinger, 1980). There are also several studies that claim to have found support for that hypothesis. See, in particular, articles by R. C. Kormendi, "Government Debt, Government Spending, and Private Sector Behavior," The American Economic Review (Nashville), Vol. 73 (December 1983), pp. 994-1010; and by David Alan Aschauer, "Fiscal Policy and Aggregate Demand," The American Economic Review (Nashville), Vol. 75 (March 1985), pp. 117-27.

2. Supply of funds elasticity

The issue here is not whether the rate of interest must increase when the government attempts to increase its sale of bonds, but how much. If the government faced a perfectly elastic supply of funds schedule, the rate of interest would not rise. We shall distinguish two alternative versions of this issue, a domestic one and an international one.

a. Domestic supply of funds schedule

Several economists have called attention to the fact that the fiscal deficit, at 4-5 percent of gross national product, is still a very small fraction (say, one or two percent) of the total wealth of the United States. Therefore, a small reallocation in the portfolios of households, they argue, can absorb the additional public bonds which finance the deficit. 1/ As the American capital market is very efficient, this reallocation can be brought about by a very small increase in the interest rate. This is a clever argument that would have a lot of validity in a frictionless world. Unfortunately, the real world is not like that.

The main shortcoming of this argument is its lack of recognition of the fact that when an individual converts one type of asset (say, stocks, buildings, land, durables, etc.) into another (say, government bonds) he often faces substantial transaction costs. Some of these may be commissions to be paid to brokers, real estate agents, and the like. Others may be taxes that arise out of those shifts (income taxes on realized capital gains, transfer taxes, etc.). As a consequence of these costs, the supply of funds schedule that the government faces at any moment is upward sloping and the slope increases the more the government tries to borrow. These costs are obviously very small when bonds are purchased out of current net saving. This may be an important reason why the deficit is likely to have less of an effect on interest rates in countries, such as Japan, where the rate of saving is high.

b. International supply of funds schedule

A country does not face just its domestic supply of funds but also an international one. In a recent paper the author has emphasized the international character of the capital market and has pointed out that in today's world the interest rate is likely to be determined by the

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1/ See Edmund S. Phelps, "The Real Interest Rate Quiz," Atlantic Economic Journal (Worden, Illinois), Vol. 13 (March 1985), pp. 1-4; John Rutledge, "What Lower Yield on Tangibles Means," Wall Street Journal (New York), January 20, 1982 (Vol. CXCIX, No. 15), p. 23.

intersection of international supply and demand schedules. 1/ Let me quote from that paper:

> The U.S. demand for credit, whether originating in the public or in the business sector, can be met by the U.S. supply of credit as well as by the rest of the world's supply of credit. But, obviously, the U.S. demand for credit must compete against the rest of the world's demand for credit. If the U.S. demand rises because of a higher fiscal deficit at a time when the rest of the world's demand falls, interest rates need not rise. Mutatis mutandis, given the U.S. demand for credit, an increase in net investment or in fiscal deficits in Europe or Japan is likely to cause U.S. as well as foreign interest rates to rise. 2/

Thus, if an increase in the fiscal deficit in the United States leads to a rise in the rate of interest, this rise will attract capital from abroad. This capital inflow will moderate the rise in the rate of interest. This, many argue, is what has happened in recent years. Without the large capital inflows interest rates in the United States would probably have increased more than they did. In this context the size of the country is important. The U.S. economy is so large that it takes a substantial proportion of foreign savings to finance its deficit. 3/ In this case too the (foreign) supply of funds schedule is likely to be upward sloping. As the share of dollar-denominated bonds in the foreign portfolios increase, foreigners are likely to demand higher rates of return to keep investing in U.S. bonds. 4/

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1/ See Vito Tanzi, "The Deficit Experience in Industrial Countries," in The Economy in Deficit, Essays in Contemporary Economic Problems, ed. by Phillip Cagan (Washington: American Enterprise Institute, 1985), pp. 81-119.

2/ Ibid., p. 104.

3/ It has been estimated that in 1983 the deficit of the federal government of the United States was equivalent to 35.5 percent of the net personal savings of the G-7 countries. See Tanzi, ibid., p. 109.

4/ See on this Stephen N. Marris, "The Decline and Fall of the Dollar: Some Policy Items," Brookings Papers on Economic Activity: 1 (1985), The Brookings Institution (Washington), pp. 237-44.

## II. Description of Data and Tests to be Performed

### 1. Description of data

In all the equations presented in Section III the dependent variable is the rate of interest on U.S. Treasury bills. The tables reporting the estimated regression equations will all refer to Treasury bills of one-year maturity. However, a brief reference will also be made to results related to bills of different maturity although the equations will not be shown for these other maturities.

The independent variables will be the following. First, a measure of inflationary expectations covering the same period as the Treasury bills will be utilized. The one used is the Livingston index, which is based on observed inflationary expectations derived from surveys conducted every six months. 1/ It is based on data collected over many years by Joseph A. Livingston, a financial reporter, and published, for the 1948-71 period, in the Philadelphia Sunday Bulletin and, after 1971, in the Philadelphia Inquirer. More recently these data have been collected by the Federal Reserve Bank of Philadelphia. The Livingston index is the most commonly used in empirical work related to inflationary expectations. The responses of a sample of economists and other knowledgeable financial observers as to the rate of inflation that they expect over future periods of six months, one year, and 18 months are collected and averaged. As the paper deals with Treasury bills of one-year maturity, one year expectations will be utilized.

The second nonfiscal variable used aims at measuring the level of economic activity at a given time. This variable will be called the gap and is defined as follows:

$$\text{Gap} = \frac{\text{Actual GNP}_t - \text{Potential GNP}_t}{\text{Potential GNP}_t} \cdot 100$$

This index, measured in percentage terms, is negative during recessions, when actual GNP falls below potential GNP, and positive during booms, when the reverse occurs. When the economy is on its long-term trend, the gap becomes zero. Actual GNP has been obtained from official published sources. Data for potential GNP were prepared in past years by the Council of Economic Advisors. The series has been recently updated by the Congressional Budget Office as the Council discontinued its preparation.

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1/ For a detailed description of this index see J. A. Carlson, "A Study of Price Forecasts," Annals of Economic and Social Measurement (New York), Vol. 1 (June 1977), pp. 27-52.

In addition to the two independent variables reported above, the empirical analysis also utilizes three fiscal measures--two related to the deficit and one related to the public debt. In all cases these measures are expressed as percentages of gross national product. Both measures of the deficit are related to the federal budget and thus ignore the balances of state and local governments. The first measure of the fiscal deficit is the federal unified budget measure. It is on a cash basis rather than on an accrual basis, unlike the concept that one would find in the national accounts. A cash concept is considered more pertinent for an analysis of interest rates. The other measure of the deficit is a federal cyclically adjusted one. The series used was prepared by Frank de Leeuw and Thomas M. Holloway of the U.S. Department of Commerce and is based on a mid-cycle expansion trend. The measurement of this cyclically adjusted deficit requires several steps. 1/ First, a trend for GNP must be chosen. Second, the sensitivity of receipts and expenditures to short-run movements in GNP must be estimated. Third, on the basis of these sensitivities the effects of economic activity gaps on receipts and expenditures must be determined. Fourth, the actual budget must be adjusted for the effects estimated in the third step. As de Leeuw and Holloway point out, the first step is the most controversial. Finally, we shall also use the ratio of public debt held by the public to GNP. The series used was taken from the Budget of the United States Government - Special Analyses (1985). For this measure de Leeuw and Holloway have provided a cyclically adjusted measure which will also be used.

For quick reference Table 1 lists the symbols utilized to identify the variables throughout the paper.

## 2. Description of Tests

In an earlier paper the author outlined and tested some basic relationships between interest rates and two important independent variables, 2/ namely, inflationary expectations and economic activity. 3/

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1/ The measure is described and reported in Frank de Leeuw and Thomas M. Holloway, "Cyclical Adjustment of the Federal Budget and Federal Debt," Survey of Current Business (Washington: U.S. Department of Commerce), Vol. 63 (No. 12, December 1983), pp. 25-40. See also by the same authors "The Measurement and Significance of the Cyclically Adjusted Federal Budget and Debt," Journal of Money, Credit and Banking, Volume XVII (No. 2, May 1985), pp. 232-42.

2/ See Vito Tanzi, "Inflationary Expectations, Economic Activity, Taxes, and Interest Rates," The American Economic Review (Nashville), Vol. 70 (No. 1, March 1980), pp. 12-21.

3/ The role of taxes in interest rates determination was also discussed.

Table 1

Key to Symbols Used

R = interest rates on Treasury bills.

G = a measure of economic activity called the gap.

$\pi$ = the Livingston index of inflationary expectations.

DU = unified budget fiscal deficit as a share of GNP.

DL = cyclically adjusted fiscal deficit as a share of trend GNP.

Debt = ratio of public debt held by the public to GNP.

V = a dummy equal to zero for the 1960-80 period and equal to one for the 1981-84 period.

The Fisherian theory that predicts that, in an inflationary environment, interest rates will tend to change pari passu with changes in inflationary expectations, was amended to take account of the possibility that real interest rates may change over the cycle in response to fluctuations in the level of economic activity. The equation that was estimated was thus:

$$(1) \quad R_t = a + b\pi_t + cG_t$$

where $R_t$ is the nominal rate of interest for an instrument of a given maturity, $\pi_t$ represents the inflationary expectation over that same maturity period, and $G_t$ is the gap reflecting economic activity over some relevant period. The equation states that when the gap is zero, and thus the economy is moving on its long-run growth path, the nominal rate of interest tends to change in line with Fisher's hypothesis. However, during the period of expansion, $\Delta G_t > 0$ the nominal rate of interest increases by more than the change in the value of $\pi_t$. This means that, in such case, the expected real rate of interest (measured as $R_t - \pi_t$) tends to rise. The reverse occurs during periods of recession, when $\Delta G_t < 0$. The theory behind equation (1) recognized that the demand for funds and the real rate of return that lenders expect to receive on their loans tends to vary over the business cycle.

In the 1980 paper, equation (1) was tested with data extending to 1975. The dependent variable was alternatively six- and twelve-month Treasury bills.[2] The statistical results obtained were quite good. The $\bar{R}s$ exceeded 0.60, the Durbin-Watson statistics were close to two, and the coefficients of $\pi$ were not significantly different from one, as expected from Fisher's. The most important result, however, related to the variable reflecting economic activity. The paper provided some theoretical reasons as well as, for the first time, strong statistical support for the hypothesis that real interest rates are indeed affected by economic activity. Furthermore, this effect was large and not just significant. The expected real rate was shown to rise by about one percentage point for every four percentage point increase in the size of the gap. Thus over the cycle interest rates could easily vary by perhaps as much as two percentage points in a ceteris paribus situation.

When fiscal variables do not play a role in determining the demand for funds, say when the budget is balanced, equation (1) would tell us much about the factors that influence the level of interest rates. However, as we saw in Section I, there are some good reasons why the size of the deficit and possibly the level of the public debt could also play a role. As far as the deficit is concerned this role is rather obvious: if the government is trying to increase its demand for funds by selling bonds, this additional demand should put pressure on interest rates unless there is some countervailing effect elsewhere or unless

the rest of the world can accommodate that demand without any rise in the rates. Such a countervailing effect could, for example, be that associated with a behavior consistent with the Ricardian Equivalence Hypothesis. Or it could be associated with a decline in private investment not caused by the increase in interest rates.

As far as public debt is concerned the case for its inclusion among the independent variables is less obvious. One could assume, for example, that as the portfolios of individuals come to be laden with government bonds, and as debt is progressively diverted away from financing capital accumulation in the private sector, the rate of return in the latter would have to increase. 1/ This increase would in turn affect interest rates. Thus, perhaps both of these variables (fiscal deficit and public debt) should be considered in the determination of interest rates. However, this alternative introduces some statistical problems as the fiscal deficit and public debt are likely to be correlated. Equation (1) will be re-estimated adding the fiscal variables mentioned above. In addition to equation (1), the equations that will be estimated are the following:

$$R_t = a + b\pi_t + c\, G_t + d\, DU_t$$

$$R_t = a + b\pi_t + c\, G_t + d\, DL_t$$

$$R_t = a + b\pi_t + c\, G_t + d\, Debt_t$$

$$R_t = a + b\pi_t + c\, G_t + d\, DU_t + e\, Debt_t$$

$$R_t = a + b\pi_t + c\, G_t + d\, DL_t + e\, Debt_t$$

These equations should be considered as reduced forms of a structural model that has not been fully outlined in the paper.

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1/ As Benjamin M. Friedman has shown, the ratio of total debt (public and private) to gross national product has been relatively stable for a long time in the United States. See his paper, "Debt and Economic Activity in the United States," in The Changing Roles of Debt and Equity in Financing U.S. Capital Formation, ed. by Benjamin M. Friedman (Chicago: University of Chicago Press, 1982).

## III. Statistical Results

### 1. The 1960-80 period

As a first step in our analysis we shall re-estimate equation (1), extending the period beyond 1975. For reasons that will become clear later, we deal first with the period up to 1980 and then with the period up to 1984. Equation (1) has been re-estimated for the 1960-80 period. The results are shown as equation (2) in Table 2. 1/ Statistically, equation (2) is very good with an $\bar{R}^2 = 0.84$ and a D.W. of 2.02. The coefficients of the independent variables $\pi$ and G also have the right signs and are significant at the 1 percent level. Furthermore, as required by the Fisher hypothesis, 2/ the coefficient of $\pi$ is not significantly different from one. The coefficient of the economic activity variable, G, is even larger than in the 1980 study confirming that this variable should not be omitted in empirical studies that analyze the determinants of interest rates.

Equations (3) through (7) in Table 2 show the results for the 1960-80 period when the various fiscal variables are added. Equation (3) adds the unified budget deficit. The result is a bit disappointing. First, both the $\bar{R}^2$ and the Durbin-Watson statistic fall as compared to equation (2). Second, even though the deficit is significant (at the 5 percent level) and has the right sign, its inclusion renders insignificant the economic activity variable. Nothing is gained in terms of explanatory power by the addition of the deficit. This result, however, can be explained by the realization that there is a strong cyclical element in the unified budget deficit used in equation (3). When the economy is expanding, especially when there is some inflation and the tax system is not indexed so that its elasticity exceeds one, revenue rises faster than GNP, and public expenditure tends to lag behind revenue. Thus the deficit falls. The reverse happens during a slowdown. This means that the deficit tends to move with the cycle and thus tends to be correlated with the gap which also moves with the cycle. A correlation matrix between the independent variables shown in Table 2 indicated a significant correlation between the unified budget deficit and the gap. For the 1960-80 period the correlation coefficient was 0.52, significant at the 5 percent level. There was no significant correlation between the gap and the other fiscal variables used in Table 2.

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1/ The dependent variable in all the equations in Table 2 and the following tables is one-year Treasury bills.

2/ This is the traditional hypothesis that ignores the potential effect of taxes.

Table 2

Regressions for the 1960-80 Period

| | |
|---|---|
| (2) $2.797 + 0.897\pi_t + 0.287G_t$<br>$(6.119)^{**} \quad (8.553)^{**} \quad (3.230)^{**}$ | $\bar{R}^2 = 0.840$<br>D.W. = 2.020 |
| (3) $3.219 + 0.944\pi_t + 0.095G_t + 0.655DU_t$<br>$(9.502)^{**} \quad (9.403)^{**} \quad (1.261) \quad (2.849)^{*}$ | $\bar{R}^2 = 0.835$<br>D.W. = 1.756 |
| (4) $3.747 + 0.994\pi_t + 0.297G_t + 0.839DL_t$<br>$(10.841)^{**} \quad (10.317)^{**} \quad (4.333)^{**} \quad (3.571)^{**}$ | $\bar{R}^2 = 0.861$<br>D.W. = 1.959 |
| (5) $-1.605 + 1.127\pi_t + 0.349G_t + 0.109Debt_t$<br>$(0.796) \quad (8.034)^{**} \quad (4.214)^{**} \quad (2.244)^{*}$ | $\bar{R}^2 = 0.870$<br>D.W. = 1.969 |
| (6) $-2.083 + 1.260\pi_t + 0.250G_t + 0.475DU_t + 0.122Debt_t$<br>$(1.181) \quad (9.463)^{**} \quad (3.024)^{**} \quad (2.488)^{*} \quad (2.862)^{**}$ | $\bar{R}^2 = 0.901$<br>D.W. = 1.839 |
| (7) $-0.983 + 1.258\pi_t + 0.375G_t + 0.747DL_t + 0.112Debt_t$<br>$(0.614) \quad (10.613)^{**} \quad (6.029)^{**} \quad (3.811)^{**} \quad (3.000)^{**}$ | $\bar{R}^2 = 0.905$<br>D.W. = 1.959 |

Notes: (1) In this table as well as in the following tables two stars indicate significance at 1 percent level and one star indicates significance at 5 percent level.

(2) Equations (2), (5), and (6) have been corrected for serial correlation using a first-order Cochrane-Orcutt correction.

Equation (4) deals with the problem affecting equation (3) by replacing the (unadjusted) unified budget measure of the deficit by the cyclically adjusted measure. Equation (4) represents a noticeable improvement over both equations (2) and (3). The $\bar{R}^2$ rises to over 0.86, and the D.W. statistic, without any adjustment of the error term for serial correlation, is close to two. All the coefficients of the independent variables are significant at the 1 percent level. The coefficient of $\pi$ is now very close to one. Equation (4) is indeed a good equation; it provides some support for the hypothesis that the deficit has an impact on interest rates. On the basis of that equation one would conclude that, ceteris paribus, during the 1960-80 period a cyclically adjusted deficit of 5 percent of GNP would have raised the rate of interest by about four percentage points. 1/

Equation (5) follows a different route. Suppose that the impact of fiscal policy on interest rates comes through its effect on the public debt and not necessarily through its effect on the deficit. Then one would want to include a debt variable. Equation (5) uses the ratio of the debt held by the public to GNP. The $\bar{R}^2$ is now even higher than in equation (4) ($\bar{R}^2 = 0.87$) and the D.W. statistic is also very good. However, the equation has been corrected for serial correlation and the constant term has become insignificant. The debt variable is significant (at the 5 percent level) and the coefficient of $\pi$ now rises above one. 2/ One of the changes the debt variable brings to the equation is to turn the constant term from about 3 to a negative value which is statistically insignificant.

Equations (6) and (7) are combinations of equations (4) and (5) in the sense that both the deficit and the debt are entered as independent variables. In these equations the $\bar{R}^2$ are over 0.90 while the D.W. statistic is still very good. 3/ All the coefficients are significant and those in equation (7) are significant at the 1 percent level. The coefficients of $\pi$ are now well above one. This result might be seen as providing support for the tax-adjusted Fisher theory, which requires that when taxes are present interest rates tend to rise by more than the rate of inflation. However, as there is some correlation between the debt variable and the deficit variable, one must be careful in interpreting the coefficients. 4/

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1/ For the 1981-84 period the cyclically adjusted deficit as a percent of GNP was respectively 1.9 in 1981, 2.9 in 1982, 3.7 in 1983, and 4.7 in 1984. In the previous 20 years it never exceeded 3 percent.

2/ This might be rationalized on the basis of some tax effect. See Vito Tanzi, "Inflation, Indexation and Interest Income Taxation," Quarterly Review, Banca Nazionale del Lavoro (Rome), No. 29 (March 1976), pp. 54-76.

3/ Equation (6) is corrected for serial correlation.

4/ The correlation between Debt and DU is 0.47; that between Debt and DL is 0.62.

The equations in Table 2 would seem to provide support for the contention that the fiscal policy has an impact on interest rates. Ceteris paribus, the higher the ratio of the fiscal deficit to GNP, the higher the rate of interest. Similar results are obtained with the public debt. Table 2, however, refers to the 1960-80 period, a period when fiscal deficits never became very large and when the ratio of public debt to GNP generally fell. Much of the recent controversy about the impact of fiscal deficits on interest rates has concerned the post-1980 period when the deficit reached very high levels for nonwar years. It would thus be useful to extend the period to 1984 being aware, however, that there may have been a discontinuity in the structure of the underlying model used in the regressions.

2. The 1960-84 period

Table 3 gives the results obtained when the regressions shown in Table 2 are re-estimated for the 1960-84 period. No other change is made except for the addition of the four observations for the 1981-84 period. The results in Table 3 are generally not as good as those in Table 2. All the equations needed to be corrected for serial correlation. Furthermore, some of our hypotheses are no longer validated. For example, economic activity, G, is no longer significant and its coefficient is now much lower than in Table 2. Additionally, the fiscal variables become either insignificant or, in a few cases, they just pass the significance test at the 5 percent level.

The inflationary expectation variable, however, remains highly significant and continues to have coefficients consistent with the theory. On the basis of the results in Table 3 one would hesitate to argue strongly that the fiscal deficit and the public debt have much to do with the determination of interest rates. This is disappointing because as already mentioned, it is exactly for the 1981-84 period that the discussion of whether the U.S. fiscal deficits affect interest rates has been particularly intense. If one fails to find a relationship for a period including those years, one might as well abandon the view that fiscal deficits play a role in the determination of interest rates. Before taking this route, however, one must ask whether something might have happened, after 1980, that might have distorted the relationships shown in Table 3.

Suppose, for example, that some factors not taken into account by the equations shown in Table 3 (because they were not important before 1981) came to play a role in the 1981-84 period. It is then possible that the omission of these factors could affect the relationships and could thus render insignificant some of the variables. We know that several important policy changes were taking place during this period. First, there was the deregulation of the financial market that could have raised the level of interest rates. Second, there was the change in monetary policy which, by bringing about a rapid deceleration in the rate

Table 3

Regressions for the 1960-84 Period

(8) $2.561 + 0.970\pi_t + 0.108G_t$ — $\bar{R}^2 = 0.836$
(2.490)*(5.378)** (0.920) — D.W. = 1.875

(9) $2.944 + 0.980\pi_t - 0.035G_t + 0.379DU_t$ — $\bar{R}^2 = 0.841$
(2.287)*(5.102)** (0.208) (1.434) — D.W. = 1.906

(10) $3.247 + 0.950\pi_t + 0.097G_t + 0.256DL_t$ — $\bar{R}^2 = 0.830$
(2.230)*(4.806)** (0.735) (0.809) — D.W. = 1.958

(11) $-1.546 + 1.108\pi_t + 0.154G_t + 0.111Debt_t$ — $\bar{R}^2 = 0.843$
(-0.512) (5.562)** (1.295) (1.434) — D.W. = 1.831

(12) $-2.050 + 1.088\pi_t - 0.019G_t + 0.587DU_t + 0.178Debt_t$ — $\bar{R}^2 = 0.870$
(0.690) (5.757)** (0.128) (2.498)* (2.451)* — D.W. = 1.779

(13) $1.122 + 0.977\pi_t + 0.1905G_t + 0.589DL_t + 0.164Debt_t$ — $\bar{R}^2 = 0.856$
(0.290) (5.080)** (1.550) (2.110)* (2.250)* — D.W. = 2.095

Note: All the equations have been adjusted for serial correlation using a first-order Cochrane-Orcutt correction.

of inflation, could have induced individuals to increase their demand for money. In other words, we could have had the reverse of the well-known Mundell-Tobin effect. 1/ Third, and perhaps more importantly, were the changes in the tax laws brought about by the Reagan administration. Fourth, there was a lot of merger activity in this period that raised the demand for credit. Finally, some external factors, such as the debt crisis and the disappearing OPEC surplus, could also have played a role.

The changes in tax rules introduced in 1981 and 1982 implied a considerable reduction in the net cost of capital as compared to what it would have been under 1980 tax laws. They thus increased the rate of return to real investment. This increase has been estimated differently by different observers but it is likely to have raised at least for a while the rate of return on new investments by several percentage points. 2/ An increase in the rate of return to real investment cannot fail to affect real interest rates either because the demand for funds rises in response to the increase in investment, or because those who have funds available would prefer to invest them in equity rather than in financial assets if the rate of return on the latter does not change. 3/

The realization that after 1980 there may have been some structural changes in the relationships discussed earlier, a realization supported by the results shown in Table 3, implies that, somehow, we need to take account of these changes. The best option would of course be that of adding additional independent variables that reflect those changes. Unfortunately, statistical series that would make this course of action possible do not seem to be available. We must thus rely on second-best alternatives. The most straightforward alternative is to add, as an independent variable, a dummy that would take the value of zero for the 1960-80 period and of one for the 1981-84 period. The implicit assumption behind this approach is that the factors discussed above changed the

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1/ For a discussion of the role that the increased demand for money might have had on interest rates, see John H. Makin and Vito Tanzi, "Level and Volatility of U.S. Interest Rates: Role of Expected Inflation, Real Rates, and Taxes," in Taxation, Inflation, and Interest Rates, ed. by Vito Tanzi (Washington: International Monetary Fund, 1984) pp. 110-42.

2/ See U.S. Council of Economic Advisors, Economic Report of the President, 1982 (Washington: U.S. Government Printing Office), especially pp. 122-25; Stephen A. Meyer, "Tax Policy Effects on Investment: The 1981 and 1982 Tax Acts," Business Review (Federal Reserve Bank of Philadelphia, November/December 1984), pp. 3-14; and Leonard Sahling and M. A. Akhtar, "What is Behind the Capital Spending Boom?" Quarterly Review, Federal Reserve Bank of New York (Winter 1984-85), pp. 19-30.

3/ If these tax changes raise the rate of return to private investment and if, as B. Friedman (1984) argues, there is an absolute limit to total domestic debt, the government will be able to increase its proportion of that total only if it is willing to pay much higher interest rates on its borrowing.

level of the rate of interest without changing, once this level change is taken into account, the historical relationship between interest rates and the other variables already considered. In other words it assumes that the regression line shifted in 1981-84 but remained parallel to that for the 1960-80 period. 1/ When this is done the results obtained are shown in Table 4. Table 4 is the same as Table 3 except for the fact that a dummy represented by the symbol V has been added.

The results in Table 4 are indeed remarkable. In all respects they are substantially superior to those in Table 3. First of all, none of the regressions shown in Table 4 needed to be adjusted for serial correlation while all of those in Table 3 had to be adjusted; still the Durbin-Watson statistics are very good. Second, the $\bar{R}^2$ are much higher than in Table 3 and in fact are well above those in Table 2. In all equations containing fiscal variables they are higher than 0.90. Thus the addition of the fiscal variables significantly improves the explanatory power of the equations. Third, the gap variable is again highly significant except for equation (15). The problem here is the high correlation between $G_t$ and $DU_t$. Once a cyclically adjusted deficit replaces the cyclically sensitive deficit utilized in equation (15), the gap becomes significant. The fiscal deficit is again significant. The same is true for the variable representing public debt.

One interesting result worth calling attention to is the coefficient of the dummy variable. In all the equations, that coefficient ranges between 3.4 and 4.5 percent. This could be interpreted as meaning that the net effects of the factors peculiar to the 1981-84 period discussed above, but excluding the deficit, raised interest rates by around 4 percent in this more recent period. 2/

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1/ This is a restrictive assumption that implies that all the change is reflected in the constant term.

2/ An attempt was also made to test more directly the expected real rate of interest by removing $\pi$ from the independent variables and taking $(R - \pi)$ as the dependent variable. The results obtained for the three basic equations for the period 1960-84 are:

$$(R - \pi)_t = \underset{(7.08)^{**}}{2.405} + \underset{(3.500)^{**}}{0.283G_t} + \underset{(4.560)^{**}}{3.426V} \qquad \bar{R}^2 = 0.587, \ D.W. = 2.196$$

$$(R - \pi)_t = \underset{(9.210)^{**}}{3.352} + \underset{(3.910)^{**}}{0.260G} + \underset{(3.470)^{**}}{0.631DL} + \underset{(6.050)^{**}}{4.513V} \qquad \bar{R}^2 = 0.586, \ D.W. = 1.914$$

$$(R - \pi)_t = \underset{(1.120)}{-0.982} + \underset{(4.140)^{**}}{0.257G} + \underset{(4.110)^{**}}{0.102Debt_t} + \underset{(5.770)^{**}}{3.435V} \qquad \bar{R}^2 = 0.639, \ D.W. = 1.632$$

The first of these equations has been corrected for serial correlation. The coefficient of the dummy is again 4 percent.

Table 4

Regressions for the 1960-84 Period
(with dummy)

| | | |
|---|---|---|
| (14) | $3.194 + 0.770\pi_t + 0.193G_t + 3.630V$ | $\bar{R}^2 = 0.884$ |
| | $(8.486)^{**}(9.509)^{**}\ (2.663)^{**}\ (5.219)^{**}$ | D.W. = 1.503 |
| (15) | $3.293 + 0.844\pi_t + 0.100G_t + 0.436DU_t + 4.112V$ | $\bar{R}^2 = 0.904$ |
| | $(9.570)^{**}(10.552)^{**}\ (1.309)\ \ (2.347)^{*}\ \ (6.196)^{**}$ | D.W. = 1.966 |
| (16) | $3.619 + 0.852\pi_t + 0.225G_t + 0.488DL_t + 4.518V$ | $\bar{R}^2 = 0.910$ |
| | $(9.748)^{**}(10.874)^{**}\ (3.450)^{**}\ (2.603)^{**}\ \ (6.416)^{**}$ | D.W. = 2.091 |
| (17) | $-1.592 + 1.047\pi_t + 0.268G_t + 0.115Debt_t + 3.375V$ | $\bar{R}^2 = 0.907$ |
| | $(0.814)\ (7.864)^{**}\ (3.747)^{**}\ (2.483)^{*}\ \ (5.343)^{**}$ | D.W. = 1.636 |
| (18) | $-0.643 + 1.055\pi_t + 0.181G_t + 0.347DU_t + 0.094Debt_t + 3.805V$ | $\bar{R}^2 = 0.918$ |
| | $(0.340)\ (8.473)^{**}\ (2.252)^{*}\ \ (1.965)\ \ \ (2.109)^{*}\ \ (6.039)^{**}$ | D.W. = 1.864 |
| (19) | $-0.235 + 1.054\pi_t + 0.279G_t + 0.394DL_t + 0.091Debt_t + 4.146V$ | $\bar{R}^2 = 0.922$ |
| | $(0.120)\ (8.640)^{**}\ (4.230)^{**}\ (2.190)^{*}\ \ \ (2.070)^{*}\ \ (6.12)^{**}$ | D.W. = 2.053 |

Note: Numbers in parenthesis are t statistics. Two stars indicate significance at 1 percent level; one star indicates significance at 5 percent level.

It may be worthwhile at this point to look back at Table 2, which covers the 1960-80 period, and compare its results with those in Table 4. We should pay particular attention to the coefficients of the variables to identify any changes. The coefficients of both $\pi$ and G are smaller in the 1960-84 period than in the 1960-80 period. However, it is the coefficients of the fiscal variables and particularly of the deficit variables that have fallen the most. For example, comparing the coefficient of DL in equation (4) and in equation (16) we observe a fall from 0.84 to 0.49. This would indicate that the impact of a deficit of a given size (measured as a percent of GNP) on interest rates was somewhat lower in the 1981-84 period than in the previous period. A possible explanation of this change was provided in the already cited paper by the author which pointed out that, 1/ as international financial markets have become much more integrated in recent years, the U.S. deficit can now be financed more easily than in the past by foreign savings through capital inflows. Capital inflows have been very high in the past 2-3 years.

In view of the restrictive assumption behind the use of the dummy as in Table 4 and of the apparent changes in the coefficients of the key variables, an attempt was made to formally test the hypothesis that some of the key parameters (i.e., slopes) other than the constant term might have shifted between 1960-80 and 1981-84. To do this, new dummy variables (slope dummies) were added to the equations in Table 3. These new dummy variables were: $G_t \cdot V_t$, $DU_t \cdot V_t$, $DL_t \cdot V_t$, and $Debt_t \cdot V_t$, where all the symbols have the same meaning as earlier. If the coefficients for the newly defined variables are significant, the hypothesis that some of the key parameters (beside the constant term) might have shifted would be accepted. In one alternative only a slope dummy was used to test whether the coefficient of a selected variable in each equation had shifted; in another alternative, both a constant dummy and a slope dummy were used to test whether both the constant and the slope dummy had shifted.

The regression equations so estimated are not shown, but the results can be summarized as follows:

a. In these alternative formulations of testing for shifts of the equations, the statistical significance of the key independent variables (inflationary expectations, economic activity, deficit, and debt variables) is not diminished.

b. In the regressions testing the shifts of both the constant and the slope, the estimates of the coefficients of the slope dummy variables

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1/ See Tanzi, "The Deficit Experience in Industrial Countries" (1985).

are either insignificant or only marginally significant probably because of multicollinearity between the constant dummy and the slope dummy variables. However, the positive estimates of the coefficient of the V variable are compatible with the results of Table 4. Also the negative estimates of the slopes, implying a smaller slope for 1981-84 than for 1960-80, appear to be broadly compatible with the similar results implied by the regressions reported in Tables 2 and 4. As already pointed out, the coefficients for G, $\pi$, and the DL are smaller for 1960-84 than for 1960-80.

c. The new regressions (not reported) suggest that the slopes may have shifted while the results in Table 4 suggest that the constant may have shifted. Possibly both the slopes and the constant shifted. Therefore, some caution is required in the interpretation of the results. The new regressions, however, support the results in Table 4 by suggesting strong structural shifts of the equations between 1960-80 and 1981-84.

d. The new equations also suffer from the problem observed in the reported tables; whenever the debt variable is included, the constant term becomes insignificant and carries a negative sign. It is not obvious why this is so.

3. Additional results

In addition to the results shown above, other statistical tests were conducted. The specific regression equations for these tests are not shown as the results were generally not interesting. They can be summarized briefly. First, other series for the debt variable were used in addition to the one reported above. More specifically, these other series were: (a) public debt at market value as a share of trend GNP; (b) public debt at par value as a share of trend GNP; and (c) cyclically adjusted public debt at market value as a share of trend GNP. These alternatives made little difference to the results.

Second, as some economists have argued that government expenditure may be an important variable in the determination of interest rates, 1/ this variable was added to the other independent variables discussed above. More specifically, the following versions were tried: (a) total government expenditure as a share of actual GNP; (b) cyclically adjusted total expenditure as a share of trend GNP; (c) federal expenditure as a share of actual GNP. Government expenditure failed to be significant in any of these attempts.

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1/ See Charles I. Plosser, "Government Financing Decisions and Asset Returns," Journal of Monetary Economics (Amsterdam), Vol. 9 (May 1982), pp. 325-52.

Finally, the rate of interest on longer-term Treasury bills was tried as the dependent variable. The results were disappointing. This outcome should have been expected as the framework utilized in this paper does not lend itself to an analysis of longer term securities. First, and most importantly, the inflationary expectation variable available covers at most a period of 18 months so that other methods would have to be used to estimate inflationary expectations for longer periods. There is no reason why, for example, inflationary expectations for the next 12 months should be relevant for bonds of longer maturities. 1/ Second, long-term bonds are much less likely to be influenced by cyclical fluctuations than shorter term bonds. If they were as influenced by these fluctuations as the Treasury bills, corporations would find it to their advantage to borrow during recessions, even though they might actually not need the funds until later. This expected behavior by corporations would obviously reduce the movement in rates of return to long-term bonds during the cycle. Finally, the fiscal deficit of a particular year, unless it was seen to reflect a more permanent stance of fiscal policy, should not have a large influence on bonds that cover much longer periods. The debt variable, on the other hand, should have been significant but it was not. Interestingly enough even in these equations related to long-term bonds the coefficient of the dummy was still around 4 percentage points. 2/

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1/ For example, the one-year expectations used in this paper were, for the 1981-84 period, respectively, 10.3, 7.2, 5.1, and 5.6. On the other hand, ten-year inflationary expectations in those same years were 8.7, 7.9, 6.8, and 6.2. The latter are based on a survey by Drexel Burnham Lambert Inc.

2/ For an analysis that focuses on long-term interest rates see: Patrice Muller and Robert Price, "Public Sector Indebtedness and Long-Term Interest Rates" (mimeographed, Washington: World-Bank-Brookings Workshop, September 1984)--preliminary draft prepared for the Conference on the International Consequences of Budgetary Deficits in the OECD. See also de Leeuw and Holloway (1985) for results related to three-year Treasury bills. Both of these papers find that the deficit had a significant effect on interest rates.

## IV. Summary and Conclusions

This paper has dealt with the ongoing controversy on (a) whether fiscal deficits bring about higher interest rates, and (b) whether the historically high fiscal deficits that the United States has experienced in recent years have been the main factor explaining the extraordinarily high level of real interest rates. On the basis of a simple model of interest rate determination that included among the explanatory factors nonfiscal variables as well as fiscal variables, it has been shown that interest rates are, in fact, positively influenced by fiscal deficits and (possibly) by levels of public debt. The empirical results indicate that if the U.S. fiscal deficit had been lower, interest rates would have been somewhat lower, ceteris paribus. On the basis of the statistical tests, it can be estimated that a balanced budget would have reduced interest rates on one-year Treasury bills by more than 2 percentage points in 1984. A one percent of GNP reduction in the fiscal deficit would reduce interest rates by about 50 basis points (one half of one percentage point). Thus on the issue of whether fiscal deficits do or do not affect real interest rates, the paper sides with those who maintain that they do.

The paper has also concluded, however, that a large part of the increase in real interest rates in the 1981-84 period was not associated with the fiscal deficit but with other factors. Potential candidates among these are deregulation of the financial market, mergers, changes in monetary policy, and, perhaps more importantly, changes in tax legislation. Other factors, including nondomestic ones, may also have played a role. Changes in tax legislation introduced in 1981 and 1982 may have been responsible for part of the total rise. If one believes the statistical results shown in Table 4, these other factors may have contributed as much as 4 percentage points of the total rise in the expected real rate that occurred in 1981-84. Whether this rise is permanent or temporary remains to be seen. By inducing a large capital spending boom, the changes in tax rules are likely to have contributed to the rise in interest rates in the short run. However, as additional investment leads to a higher capital stock, the rate of return to investment must fall, thus reducing further capital spending and, as a consequence, reducing interest rates.

Attention should be called to the fact that the sensitivity of interest rates to fiscal deficits seems to have fallen in recent years. A deficit of a given magnitude (as a share of GNP) results in a lower increase in interest rates now than it did in the past. This is consistent with the hypothesis that international financial markets are now much better integrated than they were even a few years ago. The consequence of this development is that a rise in interest rates in one country (say, caused by a rising fiscal deficit) attracts capital from

abroad. As part of the deficit is financed by foreigners, there is less pressure on the domestic financial market. Therefore, interest rates rise by less than they would have risen in the past. Of course, this advantage does not come without costs as growing reliance on foreign financing is inevitably accompanied by growing uncertainty and potential instability.

The statistical tests provided strong support to the Fisher hypothesis. Inflationary expectations did prove to be highly significant. The coefficients of $\pi$ were mostly either close to one, as one would expect from the traditional Fisher hypothesis, or above one, as one would expect from the tax-adjusted version of it. The role of changes in the level of business activity in the determination of interest rates, was also highlighted. This particular result may help explain the sharp fall in interest rates in recent months when the rate of growth of the economy slowed down considerably. 1/

Perhaps a word of caution is necessary. Although the statistical results are relatively strong and, in the author's judgment, are consistent with economic theory, they cannot be taken as proving the case beyond doubt. This type of work can never give definitive answers and is never beyond criticism. Undoubtedly some will disagree with the statistical tests. Others may point out that the relationships tested are not based on a fully specified structural model. Still the results are unusually strong and, for those who believe in empirical tests, they seem to indicate that deficits matter quite a lot in the determination of interest rates.

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1/ The slowdown in investment spending must also have played a role. Obviously, these two factors are related.

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