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In This Issue . . .

In the first article in this *Review*, John A. Tatom examines whether the 1981 federal tax rate reductions have reduced the federal tax burden. Comparing federal tax burdens in 1980 and 1984, Tatom concludes that federal tax burdens were greater in 1984 for most American families. Both the federal income tax "bracket creep" and Social Security tax increases from 1980 to 1984 have more than offset the 23 percent cut in average and marginal federal income tax rates since 1980.

The author uses this analysis to clarify two major sources of confusion about tax changes: First, he shows that the perception that the 1981 rate reductions benefited relatively higher-income groups at the expense of low-income families results from bracket creep and Social Security tax hikes, both of which have raised the taxes of low-income families disproportionately. The actual rate reductions, he shows, fell evenly across income levels. The net result was relatively large increases in federal tax paid per dollar of income for low-income families, and only slight reductions for relatively high-income families.

Since taxpayers generally paid higher average tax rates on larger real incomes in 1984 than in 1980, the extent to which the 1981 tax rate reductions have contributed to the federal deficit is obviously open to question. Proponents of the view that the 1981 tax changes raised the deficit apparently focus attention on the rate reductions alone, according to Tatom, and ignore the other factors that more than offset the rate reductions.

In the second article, "Real Interest Rates: What Accounts for Their Recent Rise?", A. Steven Holland estimates both short- and long-term real interest rates and shows that they have been higher during the 1980s than in the previous two decades. Most of this upward movement in real rates occurred during late 1980 and early 1981.

The author then examines several possible factors that affect real interest rates to see if they have played a major role in the shift to higher rates. He finds that an increase in the variability of money growth, which increased economic uncertainty and the risk premium on interest rates, was most closely coincident with the rise in real rates. Other potential factors, such as the major changes in current and projected government deficits and in tax policies, which many analysts blame for the real interest rate rise, took effect after most of the upward shift in real interest rates already had occurred.

In the third article in this *Review*, Daniel L. Thornton reviews the meaning of the phrase "monetizing the debt." The author points out that today, as in the past, monetizing the debt means money growth — induced by rapid growth of the federal debt — in excess of that needed to achieve some monetary policy objective. Consequently, debt monetization cannot be analyzed independently of the objectives of Federal Reserve policy.

Thornton points out the inherent limitations of using such measures as growth of the Federal Reserve's portfolio of government debt or growth in some reserve measure as evidence of debt monetization. He shows how simple correlations

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between such measures and debt growth can give erroneous "evidence" about debt monetization.

Finally, Thornton examines whether the Federal Reserve has monetized the debt in recent years by conducting tests of the temporal ordering of money growth and debt growth over the 1960–84 period. He finds no indication that the Federal Reserve has monetized the debt during the past decade, when the pressure to do so would seem to have been greater than it was in the 1960s and early 1970s.

The 1981 Personal Income Tax Cuts: A Retrospective Look at Their Effects on the Federal Tax Burden

John A. Tatom

THE tax structure in 1984 is an excellent watershed from which to assess the effects of the 1981 personal income tax changes on the federal tax burden. This is the first year in which the phased reduction of marginal tax rates became fully effective; it is the last year in which the personal tax structure was not indexed. Under the 1981 tax act, the brackets used to compute personal income tax liability will be indexed to inflation beginning in 1985.

Since 1981, analysts have examined the effects of these tax changes using various assumptions about economic performance. Some analysts focused only on the 23 percent rate reductions, suggesting that taxes were being reduced. Casual observers questioned the relevance of such a view, since it was difficult, especially at the individual or family level, to observe any actual reduction in tax burden. Other analysts compared the rate reductions to indexing, suggesting that inflation would raise nominal incomes and add to the tax burden, roughly offsetting the effect of rate reductions.[1] More recently, some analysts have attempted to use post-1981 data from income tax returns to analyze the impact of the tax rate changes on actual reported tax burdens.[2] Ironically, while early analyses required assumptions about 1981–84 economic developments, recent analyses often have neglected the effect of changing economic conditions on their conclusions.

This article examines the effects of the personal income tax rate reductions on the burden of federal taxes.[3] The impact of assumptions about the 1981–84 economic conditions, particularly inflation, is minimal since these conditions are now largely known. Alternative assumptions are employed, however, to highlight the importance of changes in real income. The effects of the tax law are standardized by examining the change in the tax burden facing three representative households: families with the 1980 median family income, and families that earned one-half or twice the median level.

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[1]See Meyer and Rossana (1981), Meyer (1983), McKenzie (1982) and Tatom (1981, 1984) for discussions of the absence of tax reductions due to bracket creep.

[2]Gwartney and Stroup (1984), *Wall Street Journal* (April 1984) and the Congressional Budget Office (1984) provide examples of the use of actual data without adjustment for changing economic conditions. The shortcomings of ignoring changing economic conditions in the former two cases are noted in *Business Week* (1984) and in McCulloch, et al. (1984).

[3]Only personal income and social security taxes are analyzed here; federal excise and corporate income taxes and state and local government receipts are not. These other taxes have risen substantially since 1980. From 1980 to the first half of 1984, federal excise tax liabilities rose 41 percent to $55 billion, and corporate income taxes rose 5.7 percent to $74.3 billion. State and local government tax receipts rose from $297.4 to $515.1 billion, a 73.2 percent increase over the same period.

Table 1

The 1980 Federal Tax Burden at Three Levels of Income

	One-half median income	Median income	Twice median income: One wage earner	Twice median income: Two wage earners
1980 Income	$10,500	$21,000	$42,000	$42,000
Personal Income Tax	$454	$2,505	$9,366	$9,366
Average Tax Rate	4.3%	11.9%	22.3%	22.3%
Marginal Tax Rate	16.0%	24.0%	43.0%	43.0%
Employee-Paid Social Security Tax	$644	$1,287	$1,588	$2,575
Personal Tax Plus Employee-Paid Social Security Tax				
Average Tax Rate	10.5%	18.1%	26.1%	28.4%
Marginal Tax Rate	22.1%	30.1%	43.0%	49.1%
Total Tax Burden[1]				
Average Tax Rate	16.6%	24.2%	29.9%	34.6%
Marginal Tax Rate	28.3%	36.3%	43.0%	55.3%

[1]Includes personal income tax and employee- and employer-paid social security tax.

The federal personal income tax has become increasingly complex. Differences in the economic circumstances and choices made by households led to different taxes in 1980 or 1984 and to different tax changes even for households with the same income levels. Interested readers may wish to pull out their own 1980 federal income tax return and preliminary data for 1984 to determine the outcome for their household. Are you better off, taxwise, in 1984 than in 1980? Do the changes in your tax burden since 1980 suggest that your tax changes are a source of recent and prospective deficits?

THE 1980 TAX BURDEN

The median family income in 1980 was about $21,000.[4] Table 1 shows the 1980 federal personal income tax and Social Security tax liabilities for this level of income and for one-half and twice this median income. In computing personal taxes, it is assumed that there are four people (exemptions) in each household, that a joint return is filed, that all income is adjusted gross income and that there are no other deductions, credits or income adjustments.

In 1980, the employee-paid Social Security tax equaled 6.13 percent of wages up to a maximum of $25,900, with an equal amount being collected from the employer. Since the cost of employment includes both payments, the tax burden borne by the recipients of the respective income levels are given both ways: including and excluding the employer-paid Social Security tax. It is the former that represents the total federal tax burden.[5] The analysis here concerns wage

[4]In 1980, the median family money income was $21,023. The median measure indicates the level at which one-half of all families receive more income and one-half receive less. The average size family in 1980 contained 3.27 members and the average number of wage earners per family was 1.63. The range of income in 1980 considered here encompasses most families. In 1980, 18.9 percent of families had incomes below $10,000 and 13.5 percent of families had incomes in excess of $40,000. See *Statistical Abstract of the United States* (1982–83), pp. 432–34.

[5]Social security taxes are measured as a percent of "income." The employer-paid portion, however, is deducted before the income is measured. As a percent of wage earnings up to the maximum tax base, the employer-paid tax is t/1 + t on average and at the margin, where t is the statutory rate on wage "income." Whether an increase in the employer-paid social security tax is borne from nominal take-home wage reductions or by product price increases is not important here. In either case, the real wage, the purchasing power of wages, is reduced. For discussions of this "incidence" issue, as well as thorough discussions of the tax system and its effects, see Pechman (1983) and Musgrave and Musgrave (1976).

income; the overall tax burden, at the personal level, on such capital income as dividends, or interest is limited to the personal income tax rates. The additional taxation of income from capital at the corporate level, however, is generally greater than the additional burden of Social Security taxes shown here.[6]

The tax burden is measured in two ways: by the average tax rate and the marginal tax rate. The average tax rate is simply the amount of taxes paid per dollar of total income. The marginal tax rate is the increase in federal tax liability per dollar of additional income; it is the relevant measure of the impact of the federal taxes on incentives to work, save and invest. Both measures are shown in table 1.

The tax calculations apply to a one- or two-wage-earner family at the $10,500 and $21,000 levels. At $42,000, however, the taxes are calculated for both one-wage-earner and two-wage-earner families. For the latter, it is assumed that each wage earner earns less than the Social Security maximum tax base of $25,900 in that year.

If one worker's earnings exceed this base in 1980, then the relevant marginal tax rate applicable for the high wage-earner is that indicated in the one-worker calculation, while the rate applicable for the low wage-earner is that indicated for the two-worker calculation. The average tax rates for such a family are in the range bounded by the average tax rates for the one- or two-wage-earner families. For example, if one worker earns $26,000 and the other earns $16,000, the former faces an overall marginal tax rate of 43 percent, while the latter faces a marginal tax rate of 55.3 percent. Such a household had an average tax rate of 34.5 percent, based on the $9,366 paid in personal income taxes, the maximum Social Security payment of $3,175 by the high wage-earner, and $1,962 paid in Social Security for the low wage-earner for a total of $14,503 on $42,000 of income.

Some General Properties of the Federal Tax Structure

The data in table 1 provide not only a benchmark from which to assess 1981–84 tax rate changes, but also an illustration of some important properties of the tax system. Moving from left to right in the table, one observes how marginal and average tax rates rise as income rises, because the marginal tax rate exceeds the average tax rate. In addition, one can observe the relative importance of social security taxation on both average and marginal tax rates.

At the low income, the employee-paid Social Security tax (one-half the total) exceeds the personal income tax liability. Even at the 1980 median income, the total Social Security tax liability [(.1226)($21,000) = $2,575] exceeds the personal income tax liability ($2,505). Moreover, the Social Security tax is regressive since, at wage-income levels above $25,900 in 1980, the marginal Social Security tax rate is zero. Thus, the gap between the average or marginal personal income tax rates and the average or marginal tax rate measures of the total burden narrows as income moves above $25,900. For example, at $42,000 (one worker), the difference between the overall tax burden and personal income tax average rates is only 7.6 percentage points (29.9 – 22.3); for the marginal tax rates, the difference is zero. At the lower two income levels, this difference is 12.3 percentage points.

THE CASE FOR THE PERSONAL INCOME TAX RATE REDUCTIONS

Although one argument favoring the marginal tax rate cuts under the 1981 tax act is essentially a normative case, it can be illustrated using the data in table 1. The marginal tax rates shown appear to be "high," even at relatively low levels of income. In the case of a two-worker couple earning $42,000, with each earning less than $25,900, each worker faced a marginal tax rate of over 50 percent (55.3 percent).

A stronger case for the 1981 rate-reduction legislation can be made based on what would have happened to tax burdens if the tax changes had not been made. Had no income tax rate changes been approved, inflation would have pushed all families into higher tax brackets. Coupled with existing provisions for Social Security taxation in 1980, these increases would have raised the average and marginal tax burden substantially, even if the purchasing power of family income (real income) had been unchanged. These effects are shown in table 2.[7]

Income in table 2 equals the 1980 levels adjusted for the 26 percent increase in the general level of prices (consumer price index for all urban consumers) from

[6] See Joines (1981), for example, for a discussion of the differential taxation of capital and labor income.

[7] In 1981, the strongest case for a tax cut was based on the mounting tax burden since 1965. A comparison of the 1980 families tax burden using 1965 and 1980 rates is given in the appendix.

Table 2

What the 1984 Federal Tax Burden Would Have Been under the 1980 Personal Income Tax Law: No Change in Real Income

	One-half 1980 median income	1980 median income	Twice 1980 median income	
			One wage earner	Two wage earners
1984 Income	$13,230	$26,460	$52,920	$52,920
Personal Income Tax	$923	$3,906	$14,249	$14,249
Average Tax Rate	7.0%	14.8%	26.9%	26.9%
Marginal Tax Rate	18.0%	28.0%	49.0%	49.0%
Employee-Paid Social Security Tax	$886	$1,773	$2,533	$3,546
Personal Tax Plus Employee-Paid Social Security Tax				
Average Tax Rate	13.7%	21.5%	31.7%	33.6%
Marginal Tax Rate	24.7%	34.7%	49.0%	55.7%
Total Tax Burden[1]				
Average Tax Rate	20.7%	28.5%	36.7%	40.6%
Marginal Tax Rate	31.7%	41.7%	49.0%	62.7%

[1]Includes personal income tax and employee- and employer-paid social security tax.

1980 to 1984; since income rises at the same rate as prices, no real income gain occurs. The 1980 tax tables are used to compute the personal tax liabilities. The Social Security tax calculations include both the rate increase to 13.7 percent (6.7 percent for employee-paid and 7.0 percent for employer-paid components) and the 46 percent rise in the tax base to $37,800, provided under the 1977 and 1983 Social Security Act amendments.[8]

Despite unchanged real incomes, the families in table 2 would have been subject to substantial jumps in their tax burdens from 1980 to 1984 under the 1980 tax law. Compared with 1980, the total tax burden, measured by taxes per dollar of income, shown at the bottom of tables 1 and 2, would have risen by 17.8 percent for the median-income family (28.5 percent divided by 24.2 percent = 1.178), 17.3 percent for a two-worker, high-income family and over 22 percent for the low-income and one-worker, high-income families.[9]

Bracket creep, the taxation of purely inflation-induced changes in wages, would have raised the average tax rate for the personal income tax by over 20 percent in most cases (see insert on pages 10 and 11).

[8]Social security taxes have an unusual feature in 1984 only, which does not affect the total burden of taxation, but does affect the calculations of the mix of the tax liability. Under the 1983 amendments, the Social Security tax rate in 1984 is 14 percent, instead of the 13.4 percent established in 1977 for 1984 or the 13.7 percent used here. The employee-paid portion of 7 percent is actually levied at a 6.7 percent rate, with the remainder (0.3 percent) paid from personal income taxes through a "tax credit" to Social Security funds. For purposes here, the Social Security tax in 1984 is 6.7 percent paid by employees and the employer-paid component is 7.0 percent.

[9]These percentage increases in the tax burden measure the rise in taxes as a percent of income, cents paid in taxes per dollar of income, on average. Similar calculations can be made for the marginal tax rate. Besides providing a meaningful measure of changes in the tax burden, percentage changes in the average tax rate provide a convenient approximation to percentage changes in nominal taxes. The latter is roughly the sum of the percentage change in nominal income and the percentage change in the average tax rate. Some analysts emphasize percentage-point changes in taxes; for example, a rise in the average or marginal tax rate from 5 to 10 percent is viewed as a 5 percentage-point rise instead of a 100 percent increase in taxes per dollar of income. The data for such calculations are provided in the tables, but the percentage-point calculations are not important here.

The rise for the lowest income level, from a 4.3 to a 7.0 percent average tax rate, would have been a staggering 63 percent increase. Even marginal tax rates would have risen sharply despite the unchanged real income. The change from table 1 to table 2 indicates that total marginal tax rates would have risen by 12 to 15 percent under 1980 tax laws. These relatively large percentage increases are associated with much smaller changes in the marginal tax rate for the personal income tax of 2 to 6 percentage points and a 1.44 percentage-point increase in the marginal tax rate for Social Security (12.26 percent to 13.7 percent).

Higher Real Income Raises the Federal Tax Burden

Of course, average and marginal tax rates actually would have increased more than the comparison of tables 1 and 2 indicates, because of typical real income increases and the progressive personal income tax system. From 1980 to 1984, real GNP per capita rose about 8 percent, or slightly less than 2 percent per year.

If each of the families in table 2 had experienced similar growth in their real incomes, their incomes would have been 8 percent higher than those shown in table 2 and their tax burdens would have been higher as well, given the progressive personal income tax. The overall average tax rates in table 2 would have risen by 2.5 percent to 4.2 percent above those shown in table 2.

For the 1980 median-income family shown in table 2, the personal income tax average rate, the component of the tax system most sensitive to real growth, would have risen from 14.8 percent to 15.7 percent, a 6.1 percent rise due to 8 percent real growth.[10] At relatively low incomes, the average tax rate is most sensitive to income changes because marginal tax rates exceed average tax rates by the greatest amount; 8 percent real income growth for the low-income families in table 2 would raise their personal income taxes much more, so that the average tax rate would rise from 4.3 cents per dollar of income to 7 cents per dollar, an 11.4 percent rise in the average tax rate. Such real income growth would have raised the average tax rate for the high-income family in table 2 by about the same percent as that for the median-income family. None of the families shown in table 2 would have moved into higher marginal tax brackets due to typical real income growth from 1980 to 1984 under the old tax law.[11]

THE 1981 PERSONAL INCOME TAX RATE REDUCTIONS

To offset the escalating tax burden due to inflation and the rise in marginal tax rates, which reduced incentives to earn additional income through work, saving or investment, Congress approved a 23 percent cut in all personal income marginal tax rates to be phased in fully by 1984. For our purposes here, the major components of the 1981 tax act were a 23 percent cut in all marginal tax rates, phased in as a 5 percent cut in October 1981, 10 percent in 1983 and 10 percent in 1984, and the "indexing" of bracket incomes and personal exemptions beginning in 1985.[12]

Other Provisions of the Economic Recovery Tax Act of 1981

There were other important changes in the 1981 tax act, especially the adoption of the accelerated cost recovery system, extended investment tax credits and reductions in tax rates on business income. These changes have been highly successful in stimulating business investment and productivity growth, as intended, and are not examined here.[13] Two other non-rate provisions had important effects on personal income taxes: the extension of tax-deferred income treatment through IRAs and the all-savers certificates (July 1981 to November 1982), and an earned income credit for two-wage-earner families.[14] These are not

[10]The rise in average tax rates with unchanged marginal tax rates arises from the fact that additional income is taxed at the marginal tax rate, which exceeds the average tax rate. It is also this discrepancy that gives rise to bracket creep for purely inflation-induced increases in nominal income.

[11]A $21,023 income increased 26 percent for inflation and 8 percent for real growth in 1980 to yield a 1984 income of $28,608, slightly above the income necessary to move into a new bracket. The conclusion in the text holds for this family due to rounding. This family would have jumped one bracket due to inflation (from a 24 percent marginal income tax rate to a 28 percent rate) and another bracket due to typical real income growth (from a 28 percent rate to 32 percent).

[12]The 23 percent cut arises because the tax rate was cut to 95 percent of its initial level, then 90 percent of this level, then 90 percent of that rate; the final tax rate is (.9)(.9)(.95) or 77 percent of its original level, a 23 percent cut. Differences due to rounding largely account for the departure from 23 percent for the marginal and average personal income tax rate reductions examined in table 3.

[13]See Ott (1984), Meyer (1983) and Tatom (1981). Also, see the *Economic Recovery Tax Act of 1981* for details of other non-rate provisions affecting the personal income tax.

How Typical Is Bracket Creep?

The table at right shows the brackets for taxable income for married persons filing joint returns under 1980 and 1984 income tax schedules. The income brackets were unchanged from 1980 to 1984, except that the top two were phased out because of reductions in the income level at which the maximum 50 percent marginal tax rate is achieved. For a family of four, the size of the brackets spans increases in income ranging from 15.6 to 46.7 percent. Focusing on those brackets up to $109,400 of taxable income, the average bracket size is 25.7 percent of the income at the bottom of the bracket. This is the maximum extent of income gain necessary to move from one bracket to the next.

Such percentage changes in money income are quite easily obtained over four-year periods, when inflation proceeds at 6 percent per year or so. When real income rises at 2 to 3 percent per year, bracket changes due to real growth alone occur for the average bracket size only within 8 to 12 years. At the smallest bracket differences taxable incomes of $16,000 and $35,200, bracket movements proceed much more rapidly and the marginal tax rate rises quite sharply. Under the 1980 tax law, the marginal rate at $16,000 of taxable income was 24 percent, and, at $35,200, it was 43 percent. Without index-

1980 and 1984 Personal Income Tax Brackets for Persons Married and Filing Joint Returns

Taxable income	Income[1]	Percent change in income in bracket
$ 3,400 to $ 5,500	$ 7,400 to $ 9,500	28.3%
$ 5,500 to $ 7,600	$ 9,500 to $ 11,600	22.1
$ 7,600 to $ 11,900	$ 11,600 to $ 15,900	37.1
$ 11,900 to $ 16,000	$ 15,900 to $ 20,000	25.8
$ 16,000 to $ 20,200	$ 20,000 to $ 24,200	21.0
$ 20,200 to $ 24,600	$ 24,200 to $ 28,600	18.2
$ 24,600 to $ 29,900	$ 28,600 to $ 33,900	18.5
$ 29,900 to $ 35,200	$ 33,900 to $ 39,200	15.6
$ 35,200 to $ 45,800	$ 39,200 to $ 49,800	27.0
$ 45,800 to $ 60,000	$ 49,800 to $ 64,000	28.5
$ 60,000 to $ 85,000	$ 64,000 to $ 89,000	39.1
$ 85,000 to $109,400	$ 89,000 to $113,400	27.4
$109,400 to $162,400	$113,400 to $166,400	46.7
$162,400 to $215,400[2]	$166,400 to $219,400	31.9
$215,400 and over[2]	$219,400 and over	—

[1]Includes a $4,000 exemption for four dependents.
[2]These brackets were phased out under the 1981 tax act.

formally analyzed here. Another important change was to end the differential tax treatment of capital income for relatively high-income families. In 1980, marginal personal income tax rates on income from capital rose from 54 percent to 70 percent as taxable income rose from $60,000 to $215,400. This distinction was dropped in 1982, so that all taxable income was subject to the same marginal tax rate.

The Effects of the 1981–84 Rate Reductions

With the rate reductions included in the 1981 tax act, the three families shown in table 2 faced the tax burden shown in table 3.[15] Compared with what they

[14]In 1984, personal income taxes can be reduced by contributions of up to $2,000 to IRA or deferred income plans that were not allowed for many taxpayers in 1980. As a percent of income, these benefits are, in the limit, equal to the marginal tax rate times $2,000 divided by income.

The new deduction for married couples when both work is limited to 10 percent of the lower income up to $30,000. The benefit subtracts the marginal tax rate times a maximum of one-half of income for a two-wage-earner family. The maximum reduction in the average personal income tax rates in table 3 are thus (0.05 × 14 percent) 0.7 percent at the lowest income, (0.05 × 22 percent) 1.1 percent at the median-income level, and (0.05 × 38 percent) 1.9 percent for the high-income family.

[15]The marginal personal income tax rate for the low-income family here masks the marginal tax burden at lower incomes. For incomes between $6,000 and $10,000, the earned income credit declines at a 12.5 percent rate on additional income. Thus, for a family of four, the marginal personal income tax rate is 12.5 percent for incomes from $6,000 to $7,400, 23.5 percent from $7,400 to $9,600, and 24.5 percent from $9,600 to $10,000. At $10,000 the marginal personal income tax on additional income drops to 12 percent and remains there until income reaches $11,600, where it rises to the 14 percent indicated in table 3. Thus, at the margin, the tax burden on families with incomes from $7,400 to $10,000 exceeded that of 1980 median-income families. The situation is even worse for a head of household with one dependent, where the marginal personal income tax rate of 23.5 percent begins at an income of $6,000 and rises to 26.5 percent as income approaches $10,000. Bracket creep falls most heavily on persons in these brackets because of both the large difference between marginal and average tax rates at low incomes and the complicated and non-indexed earned income credit.

ation, inflation created a manifest problem of bracket creep over relatively short periods of time.

Bracket creep, however, does not simply refer to periodic inflation-induced shifts into higher marginal income tax brackets.[1] It also includes the effects of inflation on average tax burdens within a bracket due to inflation-induced wage gains. For example, consider the low-income family in 1980 shown in table 1 in the text. In 1980, this family earned $10,500, had a taxable income of $6,500 after four personal exemptions and was in the bracket for taxable income that ranged from $5,500 to $7,600. The tax in this bracket was $294 plus 16 percent of the excess of taxable income over $5,500. At the low end of the bracket, the average tax rate was 3.1 percent, while at the high end of the bracket, the average tax rate was 5.4 percent. The low-income family at $10,500 paid 4.3 percent.

Inflation initially pushes up nominal income within the bracket — income rises from $10,500 to the top of the bracket, $11,600, a 10.5 percent income increase. Within the bracket, bracket creep pushes the average tax rate for the family with an unchanged real income from the 4.3 percent average tax rate, up to the 5.4 percent rate before a bracket rate change is triggered, further accelerating the climb in the average tax rate.

The rise in the average tax rate within the bracket arises because of the fixed nominal value of the exemptions, which decline in real value because of inflation and because the marginal tax rates applied to the inflation-induced income changes exceed the average tax rate. For example, for the 1980 low-income family, the marginal rate of 16 percent exceeded the 4.3 percent average tax rate shown in table 1 in the text. Thus, a $1,000 rise in income resulting solely from about a 10 percent increase in all prices would be taxed at the marginal rate of 16 percent, adding $160 to the $454 paid on the lower income instead of at the average rate of 4.3 percent, or $43. As a result, taxes of ($160 + $454) $614 on the higher income of $11,500 would yield an average tax rate, or tax per dollar of income, of 5.3 percent.

If the $1,000 gain in income had resulted from real income growth, not from inflation, the rise in the tax burden would be consistent with the "vertical equity" principle built into the progressive income tax; this principle is that higher real income families should pay higher average tax rates. When the $1,000 gain reflects inflation-induced bracket creep, however, families with the same real income will pay higher average tax rates after prices rise than they did before. The intertemporal change in the tax burden on a family with the same real income violates the horizontal equity principle that "equals should be taxed equally."

The sensitivity of the average tax rate to changes in income, whether due to price increases or real income gains, is indicated by the ratio of the marginal tax rate to the average tax rate at any level of income.[2] This ratio is largest at relatively low income levels. Thus, a given percentage rise in income raises the average tax rate the most at low income levels; similarly, a given reduction in real income reduces the average tax rate more at low income levels than at high ones.

[1]This point is commonly confused. Bracket creep occurs if marginal tax rates exceed average tax rates. Its existence does not depend on rising marginal tax rates.

[2]The elasticity of the average tax rate with respect to income is the ratio of the marginal to the average tax rate minus 1.

would have been (table 2), taxes were reduced substantially. For the personal income taxes considered alone, the cuts in average and marginal tax rates were close to the target. Average tax rates fell by 22.9 to 23.6 percent for the three family incomes. Similarly, marginal tax rates fell by 21.4 to 22.4 percent.

But the results shown in table 2 never actually occurred. A comparison of table 3 with the table 1 tax burdens, the actual taxes paid in 1980, indicates the effect of the 1981 rate changes on actual tax burdens, with no real income changes. Again, focusing only on the personal income tax liability, it appears that tax burdens were reduced. For the median-income family, the average personal income tax rate fell from 11.9 percent in 1980 to 11.3 percent in 1984, a 5 percent reduction; the marginal tax rate fell from 24.0 percent in 1980 to 22.0 percent in 1984, an 8.3 percent cut. These changes are shown in table 4. For all three groups, the marginal tax rates fell, but by far less than the 22 percent observed when comparing tables 2 and 3. For 1980 median-income taxpayers and higher-income families, average personal income taxes declined, but, again, by much less than 22 percent. At the relatively low income level, however, the average tax rate actually *rose* from 4.3 to 5.4 percent, a 25.6 percent increase.

It should be emphasized that the modest declines in the personal income tax rates from 1980 to 1984

Table 3

The 1984 Federal Tax Burden For Selected 1980 Real Incomes

	One-half 1980 median income	1980 median income	Twice 1980 median income	
			One wage earner	Two wage earners
1984 Income	$13,230	$26,460	$52,920	$52,920
Personal Income Tax	$711	$2,994	$10,958	$10,958
Average Tax Rate	5.4%	11.3%	20.7%	20.7%
Marginal Tax Rate	14.0%	22.0%	38.0%	38.0%
Employee-Paid Social Security Tax	$886	$1,773	$2,533	$3,546
Personal Tax Plus One-Half Social Security Tax				
Average Tax Rate	12.1%	18.0%	25.5%	27.4%
Marginal Tax Rate	20.7%	28.7%	38.0%	44.7%
Total Tax Burden[1]				
Average Tax Rate	19.1%	25.0%	30.5%	34.4%
Marginal Tax Rate	27.7%	35.7%	38.0%	51.7%

[1]Includes personal income tax and employee- and employer-paid social security tax.

Table 4

Changes in Tax Burdens From 1980 to 1984 for Selected Incomes: No Real Income Growth

	One-half 1980 median income[1]	1980 median income[1]	Twice 1980 median income	
			One wage earner[1]	Two wage earners[1]
Personal Income Tax Rates				
Average	25.6%	−5.0%	−7.2%	−7.2%
Marginal	−12.5	−8.3	−11.6	−11.6
Personal Income Tax Plus Employee-Paid Social Security Rate				
Average	15.2	−0.6	−2.3	−3.5
Marginal	−6.3	−4.7	−11.6	−9.0
Total Tax Rate				
Average	15.1	3.3	2.0	−0.6
Marginal	−2.1	−1.7	−11.6	−6.5

[1]Percent change; excludes "deduction for a married couple when both work."

Table 5

1980-to-1984 Changes in Tax Burdens for Selected Incomes: Real Income Gain of 8 Percent

	One-half median income			1980 median income			Twice 1980 median income: One wage earner			Twice 1980 median income: Two wage earners		
	1980	1984[1]	Percent change	1980	1984[1]	Percent change	1980	1984[1]	Percent change	1980	1984[1]	Percent change
Personal Income Tax Rates												
Average	4.3%	6.0%	39.5%	11.9%	12.1%	1.7%	22.3%	22.0%	−1.3%	22.3%	22.0%	−1.3%
Marginal	16.0	14.0	−12.5	24.0	22.0[2]	−8.3	43.0	38.0	−11.6	43.0	38.0	−11.6
Personal Income Tax Plus Employee-Paid Social Security Rate												
Average	10.5	12.7	21.0	18.1	18.8	3.9	26.1	26.4	1.1	28.4	28.7	1.1
Marginal	22.1	20.7	−6.3	30.1	28.7[2]	−4.7	43.0	38.0	−11.6	49.1	44.7	−9.0
Total Tax Rate												
Average	16.6	19.7	18.7	24.2	25.8	6.6	29.9	31.0	3.7	34.6	35.7	3.2
Marginal	28.3	27.7	−2.1	36.3	35.7[2]	−1.7	43.0	38.0	−11.6	55.3	51.7	−6.5

[1]Excludes "deduction for a married couple when both work."

[2]Income is $23 below next personal income tax bracket, where the marginal tax rate rises 3 percentage points.

shown in table 4 were fortuitous. They occurred primarily because inflation was not high enough to entirely erode away the gains from the personal income tax cuts for some families. The 6 percent average inflation rate over the four years was well below the 7.8 percent average rate projected by the administration in 1981. Even that forecast was viewed as a rosy scenario at the time; for example, the Congressional Budget Office projected a 9.8 percent average annual inflation rate for the four years.[16] Instead of the 26 percent rise in prices and income that occurred due to inflation since 1980, these forecasts envisioned 35 and 45.3 percent increases, respectively. Either outcome would have led to higher average and marginal personal income tax rates for most families in 1984 than they faced in 1980, despite the 1981 tax cuts and unchanged real incomes.

When the social security tax boosts since 1980 are taken into account, however, even the modest gains cited above generally disappear. At the bottom of table 4, the measures of the total tax burden indicate that average tax rates generally increased and that marginal tax rates fell only slightly for 1980 median- and low-income families. Only two-wage-earner, high-income families appear to have received a slight reduction in their average tax rate. One-wage-earner families at the same income level fared worse, on average, because the rise in the average tax burden due to social security tax hikes was larger for families that earned more than the maximum social security tax base in 1980.

Changes in the Actual Tax Burden

The assumption of no real income growth used to derive the tax rates in table 3 is appropriate for assessing the tax cut effects alone. Actual tax changes from 1980 to 1984, however, include not only the effects of inflation on income and the tax law changes, but also the effects of real income changes on income. Families typically earned higher real income in 1984 than in 1980 and paid higher tax burdens because of the progressive income tax.

Representative actual tax burden changes for the 1980 median-income families are shown in table 5. There, nominal income (from table 2) has been raised 8

[16]See Congressional Budget Office (1981), p. 4.

percent to reflect the rise in per capita real GNP over the 1980–84 period. The table provides a comparison of 1980 and 1984 tax burdens assuming this typical growth.

Table 5 shows that the average personal income tax rate *rose* from 1980 to 1984 for 1980 median- and low-income families. When the higher 1984 Social Security taxes are included, the overall average tax rate *rose for every group shown*. Marginal tax rates generally declined slightly over the period.[17]

It is clear that the rise in the tax burden from 1980 to 1984, despite the enacted tax rate reductions, fell disproportionately on low-income groups.[18] In table 5, the rise in the overall average tax rate is smaller at higher incomes, raising the possibility that some high-income families actually paid lower average tax rates in 1984 than in 1980. Indeed, there is a "break-even" 1980 income level of $55,537 at which the 1984 average tax rate under the assumptions above equals that paid in 1980. Only about 6 percent of tax returns had an income in excess of $50,000 in 1980. More important, these returns totaled about 15.9 percent of all taxable income. Moreover, the tax reductions from 1980 to 1984 for these taxpayers were generally quite small either as a percent of 1980 average tax rates or in absolute percentage-point reductions. The largest tax reductions were about 2 percentage points for 1980 incomes from about $80,000 to $100,000, where, under the assumptions above, the average tax was about 40 to 42 percent in 1980.

Two Myths About the 1981–84 Tax Rate Changes

Public discussion of the 1981 personal income tax cuts has been dominated by two pervasive myths. The first is that the tax rate reductions led to lower personal income taxes for high-income families but little reduction in taxes for low-income families. The second myth is that personal federal taxes fell from 1980 to 1984 (either absolutely or relative to income), thus contributing to higher federal deficits.

Table 4 clarifies the source of the conflicting claims that 1981 tax changes either resulted in greater benefits for those with higher incomes or reduced marginal and average tax rates equally.[19] Both the personal income and overall average tax rate changes in table 4 indicate that the tax increases shown there fell disproportionately on lower-income families. The differential impact of the tax cuts shown in table 4, however, does not arise from the tax rate changes since 1980; indeed, the comparison of tables 2 and 3 shows that average and marginal tax rates were lowered by about the same percentage across income levels by the tax cuts enacted. The discriminatory tax changes shown in table 4 arose from bracket creep and Social Security tax hikes, increases that fall disproportionately on lower-income families. Fortunately, the greatest culprit, bracket creep, was largely eliminated by the 1981 tax act, though not until 1985.[20]

The second myth is that the tax changes contributed to the surge in the deficit in late 1981 and 1982, and to the magnitude of recent and prospective deficits.[21] Table 5 clearly indicates that, for representative families, the average tax burden rose from 1980 to

[17]Without rounding the 1980 median income down by $23, the marginal personal income tax rate of this group would have risen from 24.0 to 25.0 percent, and the overall marginal rate of this group would have risen from 36.3 percent to 38.4 percent. The maximum marginal tax rate of 50 percent of earned income was achieved at $60,000 of taxable income in 1980 and at $162,400 in 1984. The latter is equivalent to $128,889 in 1980 prices. At earned taxable incomes above this level, the marginal tax rate has been unchanged from 1980 to 1984.

[18]*Business Week* (1984) notes that between 1980 and 1984 changes in the distribution of personal disposable real income were such that the top quintile (20 percent of income recipients) gained, while the bottom quintile lost, both by about 8 percent. Families in the second lowest quintile lost close to 2 percent, while those in the third quintile registered a slight gain of about 1 percent. In the fourth quintile, the gain was about 3.5 percent. This pattern reflects the effects of tax changes, spending cuts and the business cycle, with a large share arising from the different increases in the overall average tax rates shown in table 5.

[19]These distributional changes have been noted by Conyers (1984) and Heller (1984), for example.

[20]Proponents of the view that taxes were cut are often leading opponents of indexing. See Silk (1984) and Heller (1984), for example. An equally persistent and widespread fallacy concerning the 1981 tax act is that indexing reduces taxes. See Silk, for example. Indexing simply restores "horizontal equity," the principle that families with equal incomes should be taxed equally. Under indexing, changes in prices from one year to another do not lead to increased average tax rates for families or individuals with unchanged real incomes. Indexing can result in a lower tax burden only if nominal incomes do not keep pace with inflation, that is, if real income falls; a decline in the real tax burden when real income falls, given prices, has been a feature of the U.S. tax system since its inception and is consistent with notions of vertical equity, the tax principle that families with higher incomes should be taxed more than families with low incomes, other things equal. Silk does note, however, the Committee for Economic Development's recognition of the discriminatory impact of bracket creep on low-income families and its removal through indexing.

[21]See Walter W. Heller (1984). He attributes the rise in the deficit to the "huge tax cut" or the "biggest tax cut ever." The alternative cyclical view of recent deficits, which owes much to Heller for its popularization, is developed in Tatom (1984). Hershey (1984) and Harris Bank (1984) echo the frequent claim that personal tax cuts occurred from 1980 to 1984. The former also blames the deficit on such cuts.

1984. Thus, personal tax rate cuts alone are not a likely candidate as a source of the increased federal deficit. While personal taxes as a percent of income did decline slightly at very high incomes, these reductions did not fully offset the generally larger increases in tax liabilities of lower-income groups that earn the larger share of income.

Of course, federal revenues would have been larger and the deficit correspondingly smaller in 1984, had the 1981–84 personal income tax rate changes not occurred. A comparison of tables 1 and 2 shows that 1984 revenues would have been about 22 percent larger under the old tax schedule. For fiscal year 1984, actual personal income taxes amounted to about $300 billion; this would have been about $85 billion larger under the 1980 tax rates. This "loss," however, was more than offset by the effect of inflation alone on federal tax receipts.[22] The apparent decline in the size of taxes relative to GNP was largely due to the cyclical decline in the economy and to cuts in business taxes.

SUMMARY AND IMPLICATIONS

Personal income tax rate reductions were offset by bracket creep and increased Social Security taxes for most families between 1980 and 1984. Typical households, whose income merely kept pace with inflation and economy-wide real income gains during the past four years, faced higher average tax rates in 1984 than they did in 1980. Although this may seem implausible given the large declines (about 22 percent) in marginal and average tax rates provided by the 1981 tax act, it is easily explained. The failure of tax rates, on average, to decline is the result of both the massive extent of bracket creep produced by inflation over the 1980–84 period and the sharp rise in Social Security taxes since 1980.

The most important undercurrent of the analysis here is the role of indexation in eliminating bracket creep. Such indexation, as provided in the 1981 tax act, will begin next year. Contrary to most discussions, indexation will not lower average tax rates or taxes per dollar of income, unless real incomes decline. Instead, indexation allows inflation-induced income changes to be taxed at average tax rates, not at higher marginal tax rates that would push up taxes faster than incomes, even if real incomes are unchanged.

The analysis indicates that, at relatively low incomes, the effects of bracket creep are the strongest. Thus, not surprisingly, the 1980–84 rise in tax burdens has been largest at the lowest income levels. These increases were reinforced by Social Security tax hikes, which also add disproportionately to the tax burden of relatively low-income households and families.

Tax reform is high on the political agenda, but some of the implications of the analysis here have not been central to the discussion.[23] Supply-side analysts could conclude from the analysis here that little effective cutting of marginal tax rates has resulted from the 1981–84 changes. To the extent such changes are desirable, a new initiative would be in order. At least three recent reform proposals include sharp reductions in marginal tax rates.[24] Against a backdrop of an indexed tax system, another round of such cuts would be more likely to be effective.

REFERENCES

Bureau of the Census. *Statistical Abstract of the United States: 1982–83* (103d edition), Washington, D.C., 1982.

Bureau of Economic Analysis. *Survey of Current Business* (August 1984), p. 9.

Business Week. "The Reagan Tax Cuts: Were the Supply Siders Right?" (May 28, 1984), pp. 68–69.

Congressional Budget Office. "An Analysis of President Reagan's Budget Revisions for Fiscal Year 1982," Staff Working Paper, Congress of the United States (March 1981).

_____. "Effects of Major Changes in Individual Income and Excise Taxes Enacted in 1981 and 1982 For Households in Different Income Categories," Staff Memorandum (March 1984), processed.

Conyers, John, Jr. "What Recovery?" *Washington Post,* October 3, 1984.

Economic Diary. "Who Is Better Off Under Reagan — And Who Isn't," *Business Week* (October 22, 1984), p. 14.

Economic Recovery Tax Act of 1981: Law and Explanation (Commerce Clearing House, August 1981).

Gwartney, James, and Richard Stroup. "The Redistributionist Tax Reduction," *Wall Street Journal,* June 26, 1984.

Harris Bank. "A Taxing Development," *Barometer of Business* (September/October 1984).

Heller, Walter W. "The Unavoidable Issue," *Wall Street Journal,* October 26, 1984.

[22]For example, see table 2 in Bureau of Economic Analysis (1984) which indicates that cyclically adjusted receipts rose $121.9 billion due to inflation alone in 1981–83. Data for 1984 are not yet available.

[23]See Miller (1984) and Pechman (1984) for discussions of the recent proposals for tax reform.

[24]See *Wall Street Journal* (November 1984). It points out that three major current reform proposals involve reducing the top marginal tax rate for the personal income tax to 25 to 35 percent from the current 50 percent level. At least one of these proposals, however, the Bradley-Gephardt bill, omits indexing.

Hershey, Robert D., Jr. "The Reagan Economic Legacy," *New York Times,* October 28, 1984.

Joines, Douglas H. "Estimates of Effective Marginal Tax Rates on Factor Incomes," *Journal of Business* (No. 2, 1981), pp. 191–226.

McCulloch, J. Huston, James R. Knickman, Terrence E. Kelly, and Robert P. Springer. Letters to the editor of the *Wall Street Journal,* May 10, 1984.

McKenzie, Richard B. "Supply-Side Economics and the Vanishing Tax Cut," Federal Reserve Bank of Atlanta *Economic Review* (May 1982), pp. 20–24.

Meyer, Stephen A. "Tax Cuts: Reality or Illusion?" Federal Reserve Bank of Philadelphia *Business Review* (July/August 1983), pp. 3–16.

Meyer, Stephen A., and Robert J. Rossana. "Did the Tax Cut Really Cut Taxes?" Federal Reserve Bank of Philadelphia *Business Review* (November/December 1981), pp. 3–12.

Miller, Glen H., Jr. "Alternatives to the Current Income Tax," Federal Reserve Bank of Kansas City *Economic Review* (September/October 1984), pp. 3–16.

Musgrave, Richard A., and Peggy B. Musgrave. *Public Finance in Theory and Practice,* 2nd ed. (McGraw-Hill Book Company, 1976).

Ott, Mack. "Depreciation, Inflation, and Investment Incentives: The Effects of the Tax Acts of 1981 and 1982," this *Review* (November 1984), pp. 17–30.

Pechman, Joseph A. *Federal Tax Policy,* 4th ed. (The Brookings Institution, 1983).

_____. Options for Tax Reform (The Brookings Institution, 1984).

Silk, Leonard. "Federal Deficit and Indexation," *New York Times,* October 26, 1984.

Tatom, John A. "We Are All Supply-Siders Now!" this *Review* (May 1981), pp. 18–30.

_____. "A Perspective on the Federal Deficit Problem," this *Review* (June/July 1984), pp. 5–7.

Wall Street Journal. "All Supply-Siders Now," November 6, 1984.
_____. "Tricklenomics," April 11, 1984.

APPENDIX
The 1965 Tax Structure

Before 1981, marginal tax rates under the personal income tax had not been altered since 1965.[1] The increasingly onerous burden of the level of average and marginal tax rates in 1980 shown in table 1 in the text can be seen by comparison to the 1965 income tax structure.

Table A.1 shows the three representative 1980 families' tax positions, from table 1 in the text, based on 1965 taxes and prices for one-wage-earner families. In 1965, the social security tax was only 3.625 percent on wages up to $4,800 for both the employee- and the employer-paid amount. In 1965 prices, the 1980 income levels are considerably smaller, but purchasing power has been held constant. At the smaller 1965 nominal earnings, the 1980 median real income exceeded the maximum social security tax.

It should be noted that, at the income levels given for 1965, the 1980 families had considerably more real income than similarly placed families in 1965; the 1965 median-family income was only $6,957. The examples in table A.1 are for families that were comparatively better off than their 1965 counterparts; their real incomes were about 15.6 percent above the respective multiples of median income in 1965. Thus, their tax treatment represents higher tax rates for income than their 1965 counterparts.

The average personal income tax at each income rose substantially from 1965 to 1980. For the 1980 median income, the increase is 22.7 percent of the 1965 tax burden of 9.7 percent. Even at the low income, the average tax burden rose sharply (19.4 percent). At twice the 1980 median income, the average personal income tax rate rose from 15.1 percent in 1965 to 22.3 percent in 1980, a 48 percent increase in taxes per dollar of income, despite no change in real income. The marginal personal income tax rates rose sharply as well, increasing 6-2/3 percent at the low income, 26.3 percent at the 1980 median and 72 percent at the high income.

The overall tax burden on these unchanged real incomes ballooned much more. The overall marginal tax rate on the 1980 median income almost doubled, rising from 19 percent to 36.3 percent. The total marginal tax rate at the low income rose from 22.3 percent to 28.3 percent, a 27 percent increase, while that for the high-income family rose 72 percent. The overall average tax rates on these real incomes rose 53.7 percent for the low-income family, 72.9 percent for the median-income family and 72.8 percent for the high-

[1]From 1965 to 1981, many changes did occur in the personal income tax. These changes included alterations in standard deductions and personal exemptions, and changes in the incomes associated with brackets. The number of brackets and bracket rates, however, did not change.

Table A.1

The Federal Tax Burden on Selected 1980 Real Incomes in 1965[1]

	One-half 1980 median income	1980 median income	Twice 1980 median income
1980 Income	$10,500	$21,000	$42,000
1965 Equivalent	$4,021	$8,041	$16,082
1965 Personal Income Tax	$143	$779	$2,431
Average Tax Rate	3.6%	9.7%	15.1%
Marginal Tax Rate	15.0%	19.0%	25.0%
1965 Employee-Paid Social Security Tax	$146	$174	$174
Personal Tax Plus One-Half Social Security Tax			
Average Tax Rate	7.2%	11.9%	16.2%
Marginal Tax Rate	18.6%	19.0%	25.0%
Total Tax Burden			
Average Tax Rate	10.8%	14.0%	17.3%
Marginal Tax Rate	22.3%	19.0%	25.0%

[1]Assume one-wage-earner family for Social Security tax calculations.

income family. Except at the high income, the biggest share of the increase in the tax burden, on average or at the margin, was due to increases in both the Social Security tax rate and its tax base. At the relatively high-income level, almost two-thirds of the overall average and marginal tax burden increase occurred due to inflation-induced bracket creep. Even at the 1980 median real income, the jump in the tax burden due to bracket creep was substantial.

In summary, by 1980, marginal and average tax rates at all levels of income had risen dramatically from 1965 levels due to rising Social Security tax rates and its tax base, and to the effects of inflation pushing families into higher average and marginal personal income tax brackets. These forces continued from 1980 to 1984 and, in the absence of the 1981 tax cuts, would have further boosted the tax burden.

Real Interest Rates: What Accounts for Their Recent Rise?

A. Steven Holland

NOMINAL interest rates have risen to unprecedented levels in the last five years, and the common perception is that expected real rates of interest — rates minus expected inflation — have risen as well. These higher rates are blamed for a variety of economic ills including reduced capital investment and slowdowns in such interest-sensitive sectors as housing and automobiles.

This paper is concerned, first, with establishing that real interest rates have indeed been higher during the 1980s than in the previous two decades and, second, with examining possible causes of this major shift. Potential causes include changes in the expected rate of inflation, monetary policy, the state of the economy, taxes, federal budget deficits and the declining relative price of energy.

ESTIMATES OF BEFORE- AND AFTER-TAX REAL INTEREST RATES

The real interest rate is not known with certainty at the time a security is purchased, but the purchaser has an expectation of it. The nominal interest rate, i, is the sum of the expected real rate of interest, r, and the expected rate of inflation, $\dot{p}^e$:

$$(1)\quad i = r + \dot{p}^e.$$[1]

The expected real rate, thus, can be estimated according to the formula:

$$(2)\quad r = i - \dot{p}^e,$$

as long as an estimate of the expected inflation rate is available.

Proxies for the expected rate of inflation frequently are based on weighted averages of past inflation rates or the predicted values from regression equations in which the inflation rate depends on past inflation rates, past rates of money growth and a number of other variables.[2] Because empirical results can be sensitive to assumptions about the way expectations are formed, however, a potentially more fruitful approach is to use "observed" inflation forecasts to estimate expected inflation.[3] In this article, data from surveys of both short- and long-term inflation expectations are used to estimate short- and long-term expected real rates of interest.

This analysis oversimplifies the problem, since it applies only to the expected real *before-tax* yield. Since interest payments are taxable as earned income, the expected real after-tax yield (r^*) is:

$$(3)\quad r^* = i - ti - \dot{p}^e$$
$$= (1-t)i - \dot{p}^e,$$

where t is the marginal tax rate. An estimate of the average marginal tax rate on personal income is used below to estimate expected after-tax real interest rates.

The estimates presented in this article are intended to represent the pattern of recent real interest rate *movements*, not to provide completely accurate estimates of real interest rates at any point in time. Potential sources of error in the estimates include (but are not limited to): (a) measurement error in calculating the expected rate of inflation, (b) the effects of different

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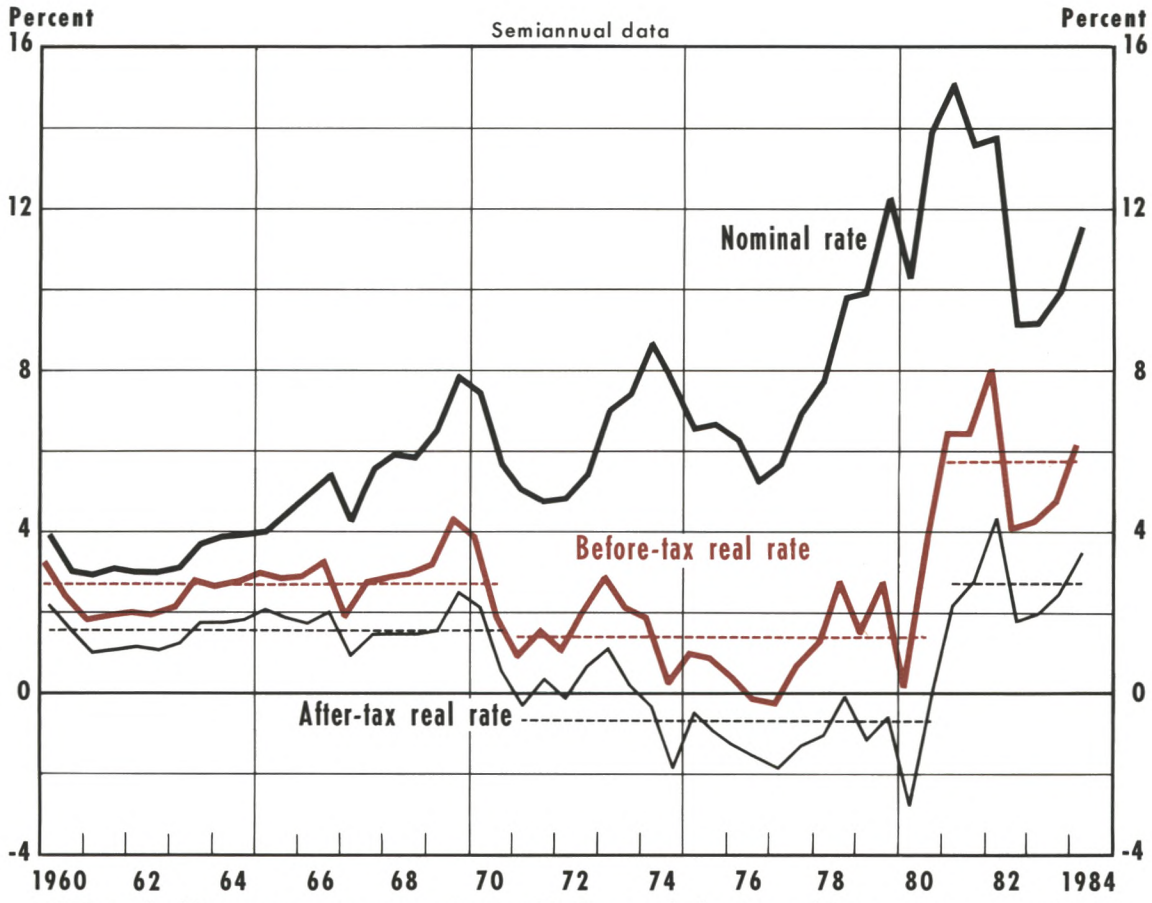
[1] This equation is a widely used approximation of the "Fisher equation." See Fisher (1965).

[2] As pointed out by Santoni and Stone (1982), however, the difficulty with this procedure is that any change in economic policy or any structural change or "shock" that affects inflation expectations will not be incorporated in the estimate of expected inflation.

[3] For an example of the sensitivity of empirical results to assumptions about expectations formation, see Holland (1984).

Chart 1

Nominal and Real 1-Year Interest Rates



NOTE: Dashed lines represent average levels of before- and after-tax real interest rates over selected time periods.

marginal tax rates across market participants and (c) the difference between the marginal tax rate expected to hold at the time interest payments are received and the current rate.[4] Whenever real interest rates are referred to in the following discussion, it will mean expected real interest rates.

Estimates of Short-Term Real Interest Rates

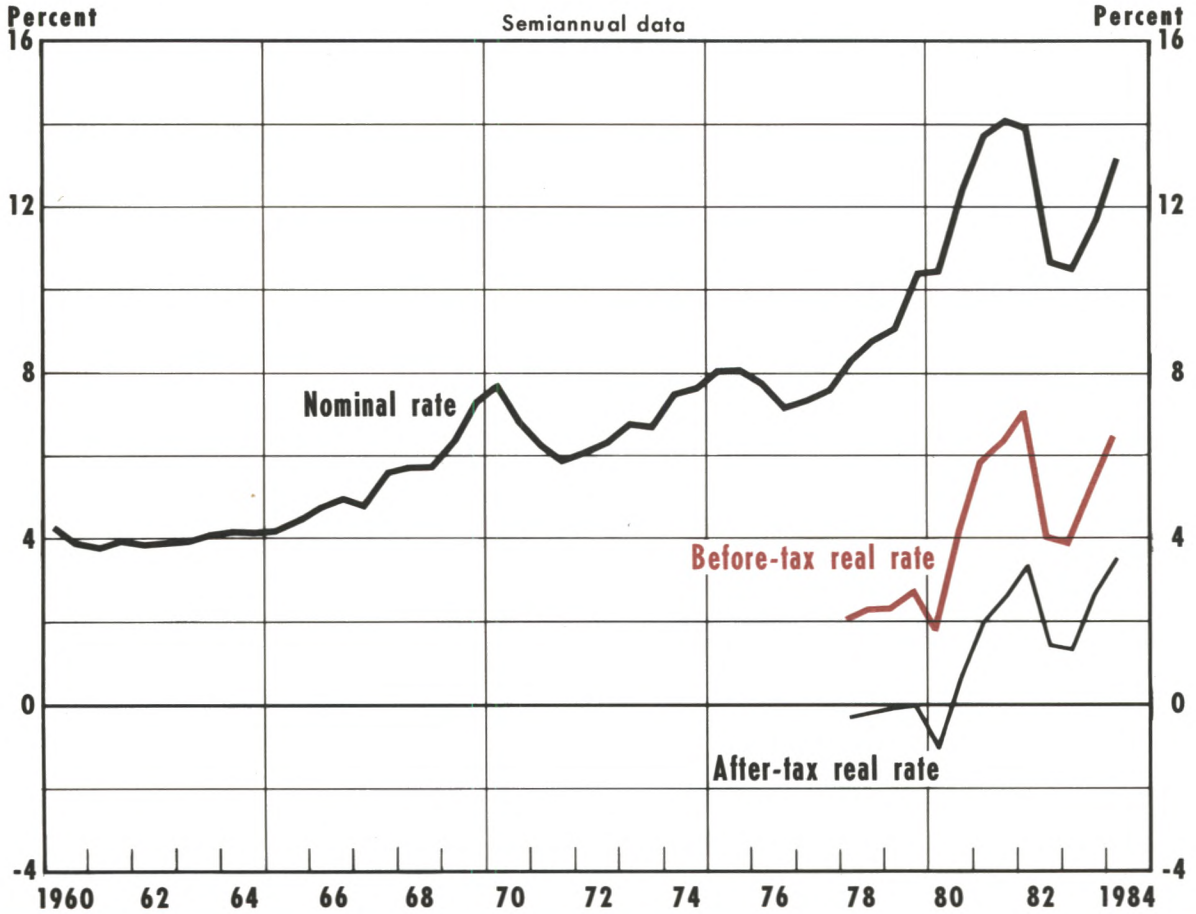
Chart 1 plots nominal returns and estimates of the before- and after-tax real returns on one-year Treasury securities, based on one-year inflation forecasts from the Livingston survey from 1960 to the first half of 1984.[5] Between 1960 and 1970, the nominal rate rose from around 3 percent to over 7 percent. Estimates of

[4]In addition, the return that is relevant for decision-making depends on risk and the tax burden on alternative uses of funds. More will be said about risk later in the article. See Ezrati (1982) and Mehra (1984) for discussions of the implications of taxes on alternative uses of funds.

[5]Joseph Livingston of *The Philadelphia Inquirer* conducts a survey of economists each spring and fall, requesting respondents to indicate their predictions of the consumer price index (CPI). Because the survey results published, for example, in June contain predictions for the following December and June, Livingston refers to them as six- and 12-month-ahead forecasts as this article does. Because the respondents to the June survey are thought to know only the April CPI, however, they are actually predicting eight- and 14-month rates of change. For a detailed discussion of the Livingston expectations data, see Carlson (1977). This article uses the data in Carlson's revised form updated to the present. The nominal interest rates used in the charts and table are the quarterly averages of the rates for the quarter in which the Livingston survey was taken. The same calculations were made for six-month Treasury bills based on six-month inflation forecasts. Since the pattern of movements was nearly identical, however, only the one-year rates are reported. The estimate of the average marginal tax rate comes from Chase Econometrics.

Chart 2

Nominal and Real 10-Year Interest Rates



the expected real rate indicate this was due primarily to higher expected inflation, since both the before- and after-tax real rates appear to have risen only slightly, if at all, over the period.

Between 1971 and 1980, short-term nominal interest rates, on average, were much higher than in the 1960s; real rates, for the most part, were lower. In fact, estimated before-tax real rates were below 1 percent from the second half of 1974 to the first half of 1978 and were even negative in late 1976 and early 1977. After-tax real rates were negative for nearly the entire period from 1974 to 1980. Nominal rates increased dramatically after 1977, with increases of about 200 basis points occurring in late 1978 and again in late 1979. These increases, however, served only to bring real rates closer to the levels that had prevailed before 1974.

From late 1979 to early 1982, short-term nominal interest rates were higher than at any time during the 1960s or 1970s. Short-term real interest rates, however, did not break with precedent until 1981 when before-tax real rates climbed above the 6 percent level; they continued to rise through early 1982. After-tax real rates behaved in a similar fashion and, on average, have been higher since 1981 than in the previous two decades. The difference is not as great, however, as it is for before-tax real rates. Both nominal and real rates have declined since early 1982, but they remain at very high levels relative to past history.

Estimates of Long-Term Real Interest Rates

We expect long-term real interest rates to behave in a manner broadly similar to short-term real rates; if short-term rates rise, long-term rates are forced up so that real yields over any holding period are compara-

Table 1

Spreads Between Yields on Ten- and One-Year Treasury Securities

Date	(1) Nominal rate spread	(2) Before-tax real rate spread	(3) After-tax real rate spread
I/1978	0.53	0.97	0.82
II/1978	−1.00	−0.38	−0.09
I/1979	−0.83	0.94	1.15
II/1979	−1.82	0.09	0.57
I/1980	0.20	1.81	1.76
II/1980	−1.42	0.50	0.89
I/1981	−1.38	−0.50	−0.11
II/1981	0.54	−0.02	−0.17
I/1982	0.13	−0.88	−0.91
II/1982	1.54	0.07	−0.30
I/1983	1.36	−0.25	−0.58
II/1983	1.74	0.62	0.23
I/1984	1.65	0.46	0.09

ble whether one holds short- or long-term bonds.[6] Because of data limitations, however, it is much more difficult to get an accurate representation of the market's expectation of inflation over the distant future than over the near future.[7] In fact, it is only since 1978 that a survey of expected inflation over periods substantially longer than a year has been undertaken. The survey, known as the Decision-Makers Poll, provides estimates of expected inflation over the next five and 10 years.[8]

[6]This assumes the absence of segmented markets. In other words, there is a high degree of substitutability between short- and long-term securities. This is not meant to imply that the term structure of interest rates does not change over time, only that short- and long-term interest rates behave in a broadly similar fashion.

[7]It is also more difficult to know the appropriate tax rate to use in calculating the after-tax yield, since interest payments are made much farther in the future.

[8]Richard Hoey of Drexel Burnham Lambert, Inc., conducts this survey of institutional portfolio managers. Each respondent predicts the rate of change of consumer prices over the next five years and over the five subsequent years. The average of the two provides the estimate of expected inflation over the next 10 years.

Since 1980, the survey has been conducted at least four times a year. To facilitate comparison with the shorter-term real interest rate estimates, we use data from surveys taken as close as possible to the dates of the Livingston surveys. There is never more than one month's difference in the dates of the surveys of the short- and long-term inflation expectations used in this paper. In 1978 and 1979, there was only one survey in each year (taken near the middle of the year). These two surveys provided data for the estimates of long-term inflation expectations for the first halves of 1978 and 1979. Estimates for the second halves of both years were calculated by interpolation.

Chart 2 plots the nominal yield on 10-year Treasury securities since 1960, as well as estimates of the 10-year, before- and after-tax real rates since 1978 based on the mean inflation forecasts from the survey. As expected, the pattern of movements in long-term nominal rates during the 1960s and 1970s is similar to that in short-term rates. In particular, when short-term nominal rates shot upward in the late 1970s, so did long-term nominal rates. Long-term real rates also reached heights comparable to those of short-term real rates in 1981 and 1982.[9] Thus, it appears that the increase in long-term real rates occurred at roughly the same time and was of roughly equal size as the increase in short-term real rates.

The Term Structure of Real Interest Rates

Nominal long-term rates have been substantially above nominal short-term rates since 1982, reversing the pattern from the late 1970s and early 1980s. This is illustrated in column 1 of table 1, which gives the difference between the yields on 10-year and one-year Treasury securities since 1978. Comparable differences for before- and after-tax real rates, respectively, are presented in columns 2 and 3 of the table.

The estimated real term structure tells an entirely different story than the nominal term structure. There

[9]Five-year rates exhibited a similar pattern.

Figure 1
Initial Equilibrium in the Market for Loanable Funds

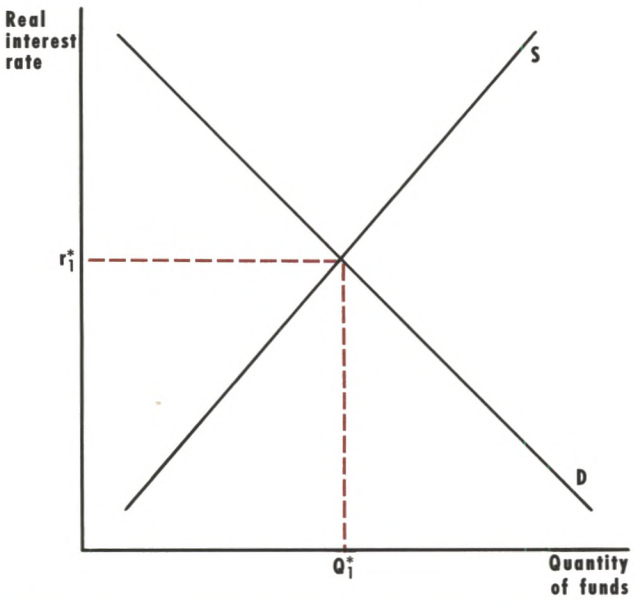
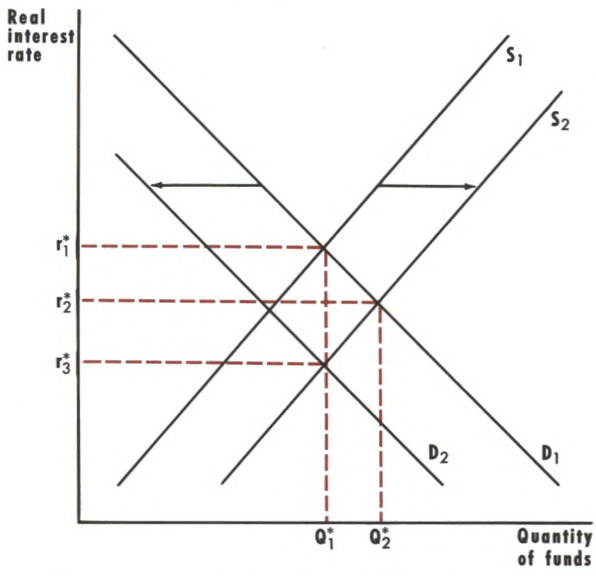


Figure 2
The Effects of an Increase in the Supply of and Reduction in the Demand for Loanable Funds



is, for the most part, very little difference between short- and long-term real rates. In other words, the real "yield curve" — the relationship between the term to maturity and the real rate of interest on securities — has been much flatter in recent years than the nominal yield curve. The average absolute difference between the one- and 10-year nominal rates from 1978 to 1984 is 109 basis points; for before-tax real rates, it is 58 basis points, while for after-tax real rates it is 59 basis points. These figures imply that long-term real rates have not differed substantially from short-term real rates in recent years.[10]

WHY DID REAL INTEREST RATES RISE?

The real interest rate is determined by the interaction of the supply of and demand for loanable funds. The quantity of funds available for lending (the quantity supplied) increases as the real rate of interest increases. The quantity that people wish to borrow (the quantity demanded) decreases as the real rate increases. The equilibrium real rate is that for which the quantity demanded and quantity supplied are equal.

In figure 1, this occurs at the real rate r_1^*, where S represents the supply curve and D represents the demand curve. Factors that affect the positions of the supply and demand curves determine the equilibrium rate. Potentially, these factors include the expected rate of inflation, monetary policy, the state of the economy, taxes, federal budget deficits and the declining relative price of energy. The potential impact of each of these factors on real interest rates is discussed below.

Expected Inflation

We know that expected inflation affects nominal interest rates. In fact, our real rate estimates are derived by subtracting the expected inflation rate from the nominal interest rate. Changes in expected inflation, however, also have the potential to alter real interest rates. One reason, associated with Mundell (1963), is that higher expected inflation causes people to transfer part of their assets from money to (higher) interest-earning assets, thereby increasing the supply of loanable funds and driving down the real interest rate. This occurs because money provides a very low or negative real return during times of inflation, whereas the return on interest-earning assets generally keeps better pace with expected inflation. A similar notion, associated with Tobin (1965), is that higher expected inflation causes people to shift part of their money balances into real capital. This induces net

[10]Notice that long-term inflation expectations were substantially lower than short-term inflation expectations from 1978 to early 1981, a period of predominantly rising inflation. This pattern has been reversed for late 1981 through early 1984, a period of generally declining inflation.

investment in capital that ultimately depresses the marginal return on capital, reducing the demand for loanable funds and the real interest rate.

An additional argument, based on the effect of expected inflation on the return to capital investment, is associated with Feldstein and Summers (1978): Higher inflation drives up the replacement cost of capital, while current tax law provides for depreciation allowances for businesses based on the historical cost of capital. Therefore, higher expected inflation results in a lower expected real return on capital investment, reducing the demand for loanable funds and, consequently, the real interest rate.

These effects are illustrated in figure 2. The Mundell effect shifts the supply curve from S_1 to S_2 (an increase in supply), resulting in a decline in the equilibrium real rate of interest from r_1^* to r_2^*. Similarly, the Tobin and the Feldstein-Summers effects shift the demand curve from D_1 to D_2 (a reduction in demand), resulting in a decline in r^* (to r_3^* if both shifts occur).

There is, however, a potential positive effect of expected inflation on the real interest rate that works through the personal income tax system.[11] Under the assumption that people try to maintain a constant after-tax real rate, higher expected inflation leads to higher before-tax real interest rates since taxes are assessed on the nominal return.[12] Thus, the higher the nominal return, the greater the spread between the before- and after-tax real rates, all other things equal. The widening of the spread between before- and after-tax real rates as the nominal interest rate increases can be seen in chart 1, where the averages of the before- and after-tax real rates for the periods 1960–70, 1971–80 and 1981–84 are given by the dashed lines.

Therefore, with the combination of the Mundell-Tobin and Feldstein-Summers effects and the income tax effect, it is not possible to say a priori whether an increase in expected inflation leads to higher or lower before-tax real interest rates, although we expect it to cause lower after-tax real rates.[13] From 1960 to 1980, the correlation between expected inflation and both before- and after-tax real rates on one-year Treasury securities was negative and statistically significant: −0.38 for the before-tax rate and −0.81 for the after-tax rate. This provides support for the Mundell-Tobin and Feldstein-Summers effects. From 1981 to 1984, however, the correlation has actually been positive for the before-tax rate and essentially zero for the after-tax rate. The same is true for the correlation between inflation expectations and long-term real rates over the 1981–84 period.[14] Furthermore, during the period of rapidly rising real rates from 1980 to 1982, long-term inflation expectations were also rising. Thus, though the evidence on the effect of expected inflation on real interest rates from simple correlations is mixed, it does not appear that changes in expected inflation were a major factor in the recent rise in real interest rates.

Monetary Policy

The effect of monetary policy on real rates of interest is a subject of considerable controversy. Textbooks typically describe the impact of an increase in money supply on the real rate as follows: An increase in the money supply relative to money demand creates an excess supply of money; in response, individuals increase their purchases of securities and goods until the interest rate declines by enough to induce them to hold the larger amount of money. Thus, the supply of loanable funds increases, driving down the real interest rate. Furthermore, an expansionary monetary policy leads to short-term increases in real income due to the increased demand for goods, which has two effects that influence real rates in opposite directions: (1) the level of savings increases, putting downward pressure on the real rate, and (2) the demand for money increases, causing the real rate to rise.[15]

One consequence of increasing the growth rate of the money supply, however, is a rise in future rates of inflation and also in *expected* future rates of inflation.

[11] See Darby (1975) and Feldstein (1976).

[12] To see this consider that

$$r^* = (1-t)i - \dot{p}^e$$

and that a constant after-tax real return, r^*, implies that

$$\Delta r^* = (1-t)\,\Delta i - \Delta\dot{p}^e = 0.$$

Therefore,

$$\Delta i = (1/1-t)\,\Delta\dot{p}^e.$$

With the tax rate, t, between 0 and 1, this implies that the change in the nominal interest rate, Δi, is greater than the change in the expected inflation rate, $\Delta\dot{p}^e$. If the tax structure is progressive, then higher expected inflation results in an even wider spread between before- and after-tax real rates.

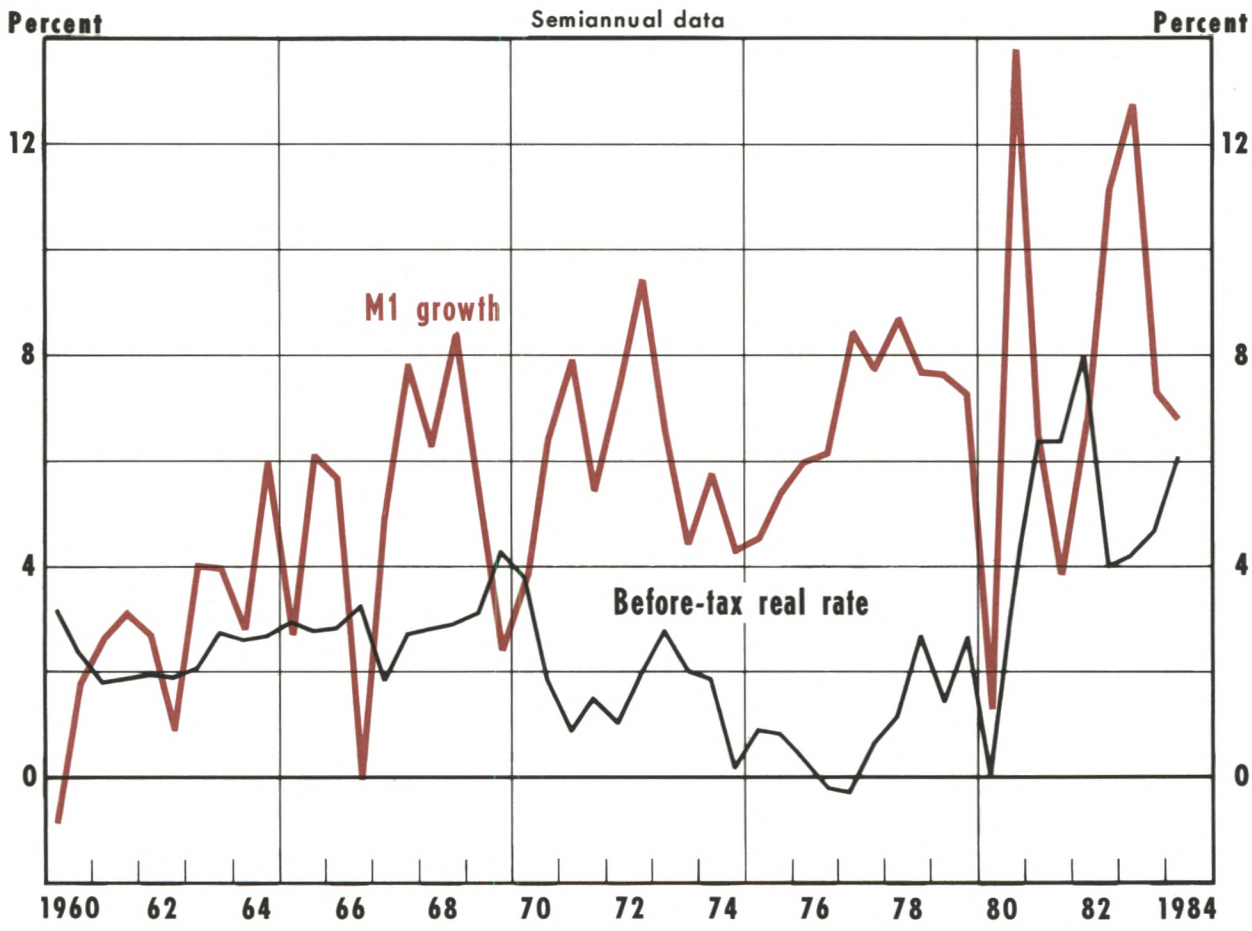
[13] See Makin and Tanzi (1983).

[14] The correlation coefficients for 1981–84 are: for the one-year before-tax real rate, 0.48; for the one-year after-tax real rate, −0.06; for the 10-year before tax real rate, 0.38; for the 10-year after-tax real rate, −0.04.

[15] For more detail, see Santoni and Stone, and Brown and Santoni (1983). The theory of rational expectations states that a fully anticipated change in the money supply will have no effect on real interest rates. When people forecast money growth and future inflation in an optimal manner — by using all of the information currently available at sufficiently low cost — then the monetary authority is powerless to affect real behavior of any kind unless it is able to fool the public. This implies that only an unanticipated change in money supply affects the real interest rate. See Fischer (1980).

Chart 3

2-Quarter M1 Growth and 1-Year Real Interest Rate



Therefore, the effect of increased growth of the money supply on nominal rates is likely to be positive in the long run even if its immediate effect on real rates is negative.

Empirical evidence suggests that there is little, if any, long-term effect of changes in the money supply on real interest rates. Hafer and Hein (1982) found that an initial negative effect of higher money growth on estimates of real interest rates was completely offset one quarter later. Similarly, Santoni and Stone (1982) found no evidence to link money growth and real rates over the long term.[16]

Chart 3 plots the two-quarter growth rate of M1 along with our estimate of the before-tax real interest rate on one-year Treasury securities. The first point to make is that the correlations between money growth and the real interest rate series are negligible for the sample period used in the chart.[17] It is true, however, that real rates of interest began to rise in 1980 just after a tremendous reduction in two-quarter M1 growth. This reduction was followed by an equally large increase in M1 growth, but real interest rates continued to climb nonetheless.

The data illustrated in the chart suggest another possible role for monetary policy in the determination

[16]Carlson (1982) actually finds a weak positive association between money growth and real interest rates.

[17]The correlation coefficient for two-quarter M1 growth and the before-tax real interest rate on one-year Treasury securities for 1960–84 is 0.076. The correlation between money growth and the before-tax real 10-year rate for 1978–84 is –0.071. Correlations with the after-tax yields on the same securities for the same time periods are –0.157 and –0.004, respectively.

of real interest rates: more variable money growth leads to higher real rates. The explanation for this is that the instability created by highly variable money growth makes for increased uncertainty about future returns on both short- and long-term interest-earning assets and capital and raises the demand for money relative to these assets. This is, in effect, a reduction in the supply of loanable funds, which causes an increase in real interest rates.[18]

Another way to state this is: lenders, if they are risk-averse, require that a greater "risk premium" be added to interest rates in order to offset the greater uncertainty associated with the future real return.[19] The effect of monetary variability on real interest rates is not completely unambiguous, however, since risk-averse borrowers reduce their demand for loanable funds as uncertainty increases. A recent empirical study by Mascaro and Meltzer (1983) suggests that the overall effect of monetary variability on nominal interest rates is positive. Since the variability of money growth should not affect expected inflation, it follows that the effect on real interest rates is positive as well.[20]

A casual glance at chart 3 suggests that money growth became substantially more variable in 1980, the same year that real rates of interest began to rise. The standard deviation of two-quarter M1 growth is substantially higher for 1980–84 than for 1960–79, 4.1 percent compared with 2.5 percent. The source of greater monetary variability is an unsettled issue, but many analysts attribute it to the change in Federal Reserve operating procedure that occurred in October 1979.[21] Other events also may have contributed to the rise in monetary variability including the innovation in financial markets (such as the introduction of NOW, Super NOW and money market deposit accounts) and the imposition and removal of credit controls in 1980.[22]

Thus, it appears that an increase in the variability of money growth in 1980 contributed to the increase in real rates of interest that occurred in 1980 and 1981. Furthermore, there is as yet no indication that the short-run instability of money growth was much affected one way or another by the Federal Reserve's shift to a more judgmental operating procedure in the fall of 1982, and real interest rates have yet to return to their pre-1981 levels.[23]

The State of the Economy

When the economy enters a recession, business firms experience excess capacity, and the need for additional capital is reduced. A reduction in both the demand for loanable funds and the real rate of interest follows. As the economy recovers, some firms begin to push toward their capacity constraints, requiring additional investment and increasing the demand for funds. Thus, higher real interest rates tend to accompany an expansion.

Chart 4 plots a measure of the amount of "slack" in the economy, the GNP gap, along with our estimate of the before-tax real rate on one-year Treasury securities. The evidence suggests that the state of the economy helps to explain movements in real interest rates both before and after the recent upward shift in real rates, but the shift itself appears to have little to do with overall economic conditions. The GNP gap has a correlation of −0.56 with the before-tax real rate for the period 1960–80, and −0.44 for 1981–84.[24]

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[18]See Friedman and Schwartz (1963).

[19]The analysis assumes that it is not possible to diversify one's holdings in a manner that completely offsets the greater risk associated with monetary variability.

[20]Mascaro and Meltzer estimate the variability of unanticipated money growth, which turns out to be highly correlated with the variability of actual money growth.

[21]The Federal Reserve announced on October 6, 1979, it would place less emphasis on confining variations in the federal funds rate and more emphasis on reserve aggregates as a sign of its commitment to longer-run restraint on money growth.

[22]See Hafer (1984) for a discussion of how financial innovations may have affected the accuracy of M1 as a measure of transaction balances.

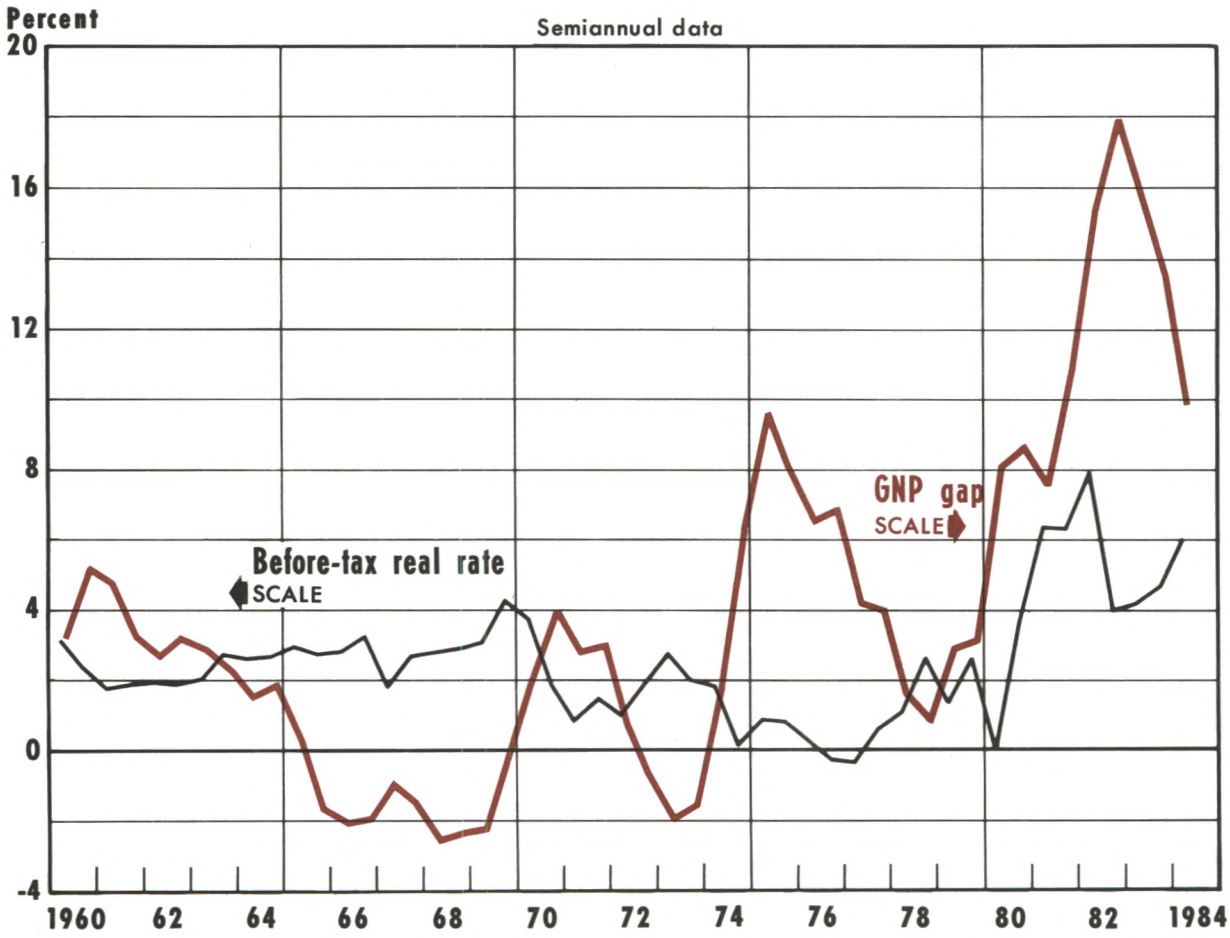
[23]As evidence that the money supply continues to be highly variable, consider the behavior of M1 during 1983 and 1984. M1 grew during the first two quarters of 1983 at a 12.8 percent rate and during the second two quarters of 1983 at a 7.3 percent rate. Similarly, in 1984 the growth rate of M1 was 6.8 percent in the first half of the year, compared with −0.4 percent from June to October.

It is generally recognized that the Federal Reserve altered its operating procedure again in late 1982. The post-1982 procedure is not the same as the pre-1979 procedure, however. See Wallich (1984). Another effect of the 1979 change in operating procedure was an increase in the day-to-day variability of nominal interest rates, which adds an additional element of risk in securities markets. This increased variability occurred in late 1979, however, while real interest rates did not begin to rise until late 1980. In addition, the federal override of state usury ceilings effective in March 1980 may have contributed somewhat to higher real interest rates, although there is no reason to think this action would push real rates to levels higher than those during previous periods (such as most of the 1960s and early 1970s) when these ceilings were not binding.

[24]The measure of the GNP gap is the difference between potential and actual GNP as calculated by the Council of Economic Advisers. To get data for 1984, potential GNP was assumed to grow at its average rate for 1960–83, 3.44 percent. For the 10-year before-tax real rate, the correlation for 1981–84 is –0.55. For after-tax real rates, the correlations are –0.62 for the 1960–80 period and –0.13 for the 1981–84 period for the one-year rate and –0.37 for the 1981–84 period for the 10-year rate.

Chart 4

GNP Gap and 1-Year Real Interest Rate



Business Taxes

As noted above, the higher the return on investment in physical capital, the greater the demand for loanable funds. A tax on business profits reduces the real return on investment and the demand for loanable funds, thereby lowering real interest rates. A tax on business profits is not the only business tax that affects investment and the real interest rate, however. Businesses often receive tax credits or deductions from taxable income for certain types of investment expenditures. Furthermore, tax deductions to offset the depreciation of capital equipment and structures can affect the investment decision and real rates, since these depreciation allowances may or may not reflect the true depreciation of the capital. If the allowances overstate the depreciation over a period of time, they tend to spur additional investment, driving up the demand for loanable funds and the real rate of interest. If allowances provide for smaller deductions than the actual loss from depreciation, they hinder investment and real rates are reduced.[25]

The Economic Recovery Tax Act of 1981 was designed to spur investment, primarily by altering the way in which depreciation is treated for tax purposes. The magnitude of the effect of the act on investment is a controversial issue, but there is fairly strong evidence

[25]See Ott (1984).

that it spurred investment spending. For instance, the growth rate of real nonresidential fixed investment as a percentage of real GNP was 8.7 percent over the expansionary period from the fourth quarter of 1982 to the second quarter of 1984, up from an average of only 1.5 percent over similar periods following the previous six recessions.[26]

One problem, however, with concluding that the new tax legislation is a primary cause of higher interest rates is that the legislation was not passed until August 1981 (although its provisions were retroactive to the beginning of 1981), while the shift in real rates began in 1980 and was mostly complete by August 1981. For this legislation to have been the primary factor in the recent rise in real interest rates, the passage of the legislation must have been predicted and the demand for loanable funds increased many months in advance as the predicted future return on capital investment rose. On the other hand, this legislation could have contributed both to the rise in real rates that occurred in late 1981 and early 1982 in the face of a severe recession and to the maintenance of relatively high real interest rates right up to the present.

Federal Budget Deficits

Government borrowing represents an increase in the total demand for loanable funds. This suggests that real interest rates rise as the size of the government budget deficit increases in real terms. One rarely sees a positive correlation between the size of deficits and the levels of interest rates, however. This is probably because they respond in opposite directions to changes in economic conditions; deficits tend to rise during business recessions and fall during expansions (because tax revenues and outlays for transfer payments are sensitive to the state of the economy), while interest rates typically fall during recessions and rise during expansions.[27]

As for the recent rise in real interest rates, it is clear from chart 5 that the recent dramatic increase in the cyclically adjusted budget deficit did not occur until late 1982, by which time real and nominal interest rates had begun to fall. A closer look at the chart indicates that two major increases in the size of the cyclically adjusted deficit have occurred in recent years: one in 1975 and the other in 1982. Neither was associated with rising real interest rates.

This does not necessarily imply that deficits have no effect on real interest rates. Since interest rates are based on expectations, expected future deficits could have an impact on today's real interest rates. If one assumes the budget projections of the Congressional Budget Office (CBO) are representative of the market's expectation of future deficits, however, then deficit projections do not appear to have been the major instigator of the recent rise in real interest rates. The CBO report published in July 1981 projected a 1982 deficit of less than $30 billion and *surpluses* in the next four years growing to over $200 billion by 1986.[28] Recall that at the time this report was written, our estimates of both short- and long-term before-tax real interest rates were already far in excess of historical norms and after-tax real rates had risen to near their previous peaks. By February 1982, the CBO had altered its projections and was predicting a deficit of nearly $200 billion in 1983, growing to nearly $300 billion by 1987.[29] Yet 1982 was a year of generally falling real and nominal interest rates.[30] Like the change in the tax laws, however, expectations of future deficits may be helping to keep real interest rates at levels that are quite high relative to past history.

Declining Relative Price of Energy

Finally, it has been suggested that drastic increases in the relative price of energy contributed to the low real interest rates of the 1970s, which would imply that the generally falling relative price of energy of the 1980s has contributed to higher real interest rates.[31] The argument is that the demand for capital fell during the 1970s because of a reduction in the supply of

[26]The six previous expansionary periods were IV/1949–II/1951, II/1954–IV/1955, II/1958–IV/1959, I/1961–III/1962, IV/1970–II/1972 and I/1975–III/1976. The difference between the growth of the investment-GNP ratio in the current recovery and the average growth in the six previous recoveries is statistically significant.

[27]See Tatom (1984).

[28]Congressional Budget Office (1981). Carlson (1983) discusses possible sources of bias in the CBO's budget projections.

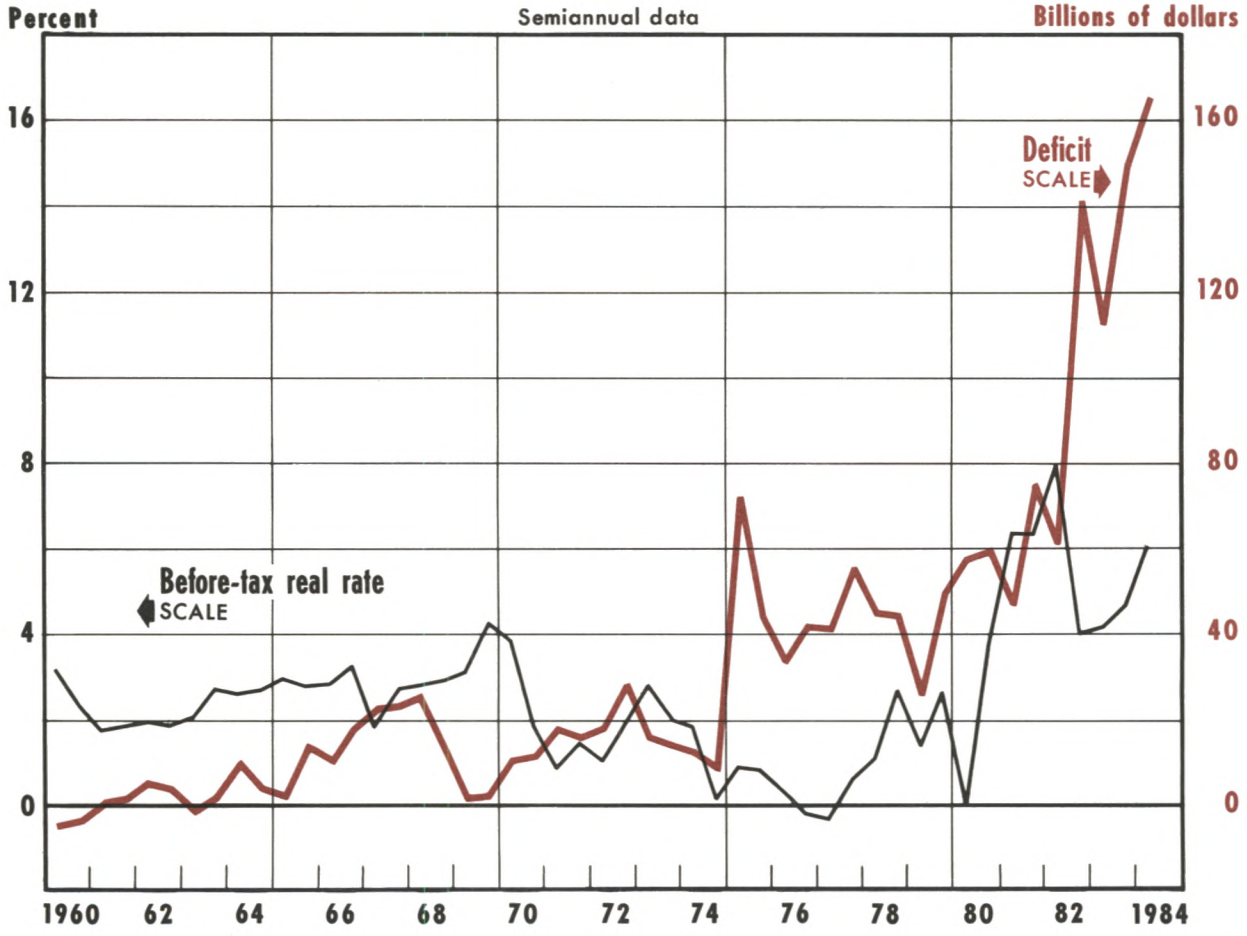
[29]Congressional Budget Office (1982). In discussing the reasons for the change in the outlook on the deficits between 1981 and 1983, the Congressional Budget Office (1983, p. 18) says that, "Over the entire five-year period, 60 percent of the change in outlook from budget surpluses to budget deficits can be attributed to the failure of the economy to perform as projected two years ago." In addition, it says (p. 20) that, "Legislative actions are the second largest reason for differences between the two baselines, accounting for about 30 percent of the change over the five-year period."

[30]It is possible that higher projected government budget deficits lead to greater expected inflation, in which case higher deficits would cause higher nominal, but not necessarily real, interest rates.

[31]See Wilcox (1983).

Chart 5

Cyclically Adjusted Budget Deficit and 1-Year Real Interest Rate



complementary energy inputs, which resulted in reduced demand for loanable funds and lower real interest rates.[32]

Once again, however, the timing of the recent rise in real interest rates fails to lend credence to the theory. During the period of most rapidly rising real interest rates in 1980 and the first half of 1981, the relative price of energy was still rising rapidly as a result of the second oil crisis; the growth rate of the relative price of energy between IV/1979 and II/1981 was 18.3 percent.[33] Reductions in the relative price of energy did not begin until late 1981, after most of the increase in real interest rates already had occurred.

CONCLUSIONS

The 1980s have seen unprecedented behavior in several key economic variables, the most notable being interest rates. According to estimates of real interest rates based on surveys of expected inflation, both short- and long-term real rates rose to record levels in 1981 and 1982 and, although they have declined somewhat since then, have not returned to the levels of the 1960s and 1970s.

A comparison of estimates of before- and after-tax real interest rates indicates that the overall pattern of

[32]See Tatom (1979) for a discussion of the impact of energy shocks on investment.

[33]The measure of the relative price of energy is the producer price index for "fuels and related products and power" divided by the business sector deflator.

their movements has been similar. The spread between the before- and after-tax real rates increased over much of the sample, however, as nominal interest rates (and expected inflation) increased. Therefore, after-tax real interest rates have not been nearly as high relative to previous experience as before-tax real rates. Nonetheless, they have been higher on average than they were in the 1960s and much higher than in the 1970s.

The phenomenon most closely coincident with the rise in real rates was an increase in the variability of money growth, which increased economic uncertainty and the risk premium on interest rates. Major changes in current and projected government budget deficits and in tax policies happened *after* much of the upward shift in real interest rates already had occurred, but may have contributed to some additional upward movement. Changes in economic conditions have been a major influence on the movement of real interest rates since 1981; periods of slow growth or recession have produced falling real rates, while expansions have pushed real rates upward.

REFERENCES

Brown, W. W., and G. J. Santoni. "Monetary Growth and the Timing of Interest Rate Movements," this *Review* (August/September 1983), pp. 16–25.

Carlson, John A. "A Study of Price Forecasts," *Annals of Economic and Social Measurement* (Winter 1977), pp. 27–56.

Carlson, Keith M. "The Mix of Monetary and Fiscal Policies: Conventional Wisdom Vs. Empirical Reality," this *Review* (October 1982), pp. 7–21.

_____. "The Critical Role of Economic Assumptions in the Evaluation of Federal Budget Programs," this *Review* (October 1983), pp. 5–14.

Congressional Budget Office. *Baseline Budget Projections: Fiscal Years 1982–1986* (U.S. Government Printing Office, July 1981).

_____. *Baseline Budget Projections for Fiscal Years 1983–1987* (GPO, February 1982).

_____. *Baseline Budget Projections for Fiscal Years 1984–1988* (GPO, February 1983).

Darby, Michael R. "The Financial and Tax Effects of Monetary Policy on Interest Rates," *Economic Inquiry* (June 1975), pp. 266–76.

Ezrati, Milton J. "Inflationary Expectations, Economic Activity, Taxes, and Interest Rates: Comment," *American Economic Review* (September 1982), pp. 854–57.

Feldstein, Martin. "Inflation, Income Taxes, and the Rate of Interest: A Theoretical Analysis," *American Economic Review* (December 1976), pp. 809–20.

Feldstein, Martin, and Lawrence Summers. "Inflation, Tax Rules, and the Long-Term Interest Rate," *Brookings Papers on Economic Activity* (1:1978), pp. 61–99.

Fischer, Stanley. "On Activist Monetary Policy with Rational Expectations," in Stanley Fischer, ed., *Rational Expectations and Economic Policy* (The University of Chicago Press, 1980), pp. 211–47.

Fisher, Irving. *Appreciation and Interest* (1896), Reprints of Economic Classics (Augustus M. Kelley, Bookseller, 1965).

Friedman, Milton, and Anna Jacobson Schwartz. *A Monetary History of the United States 1867–1960* (Princeton University Press, 1963).

Hafer, R. W. "The Money-GNP Link: Assessing Alternative Transaction Measures," this *Review* (March 1984), pp. 19–27.

Hafer, R. W., and Scott E. Hein. "Monetary Policy and Short-Term Real Rates of Interest," this *Review* (March 1982), pp. 13–19.

Holland, A. Steven. "Does Higher Inflation Lead to More Uncertain Inflation?" this *Review* (February 1984), pp. 15–26.

Makin, John, and Vito Tanzi. "The Level and Volatility of Interest Rates in the United States: The Role of Expected Inflation, Real Rates, and Taxes," Working Paper No. 1167 (National Bureau of Economic Research, July 1983).

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

Mehra, Yash. "The Tax Effect, and the Recent Behaviour of the After-Tax Real Rate: Is It Too High?" Federal Reserve Bank of Richmond *Economic Review* (July/August 1984), pp. 8–20.

Mundell, Robert. "Inflation and Real Interest," *Journal of Political Economy* (June 1963), pp. 280–83.

Ott, Mack. "Depreciation, Inflation and Investment Incentives: The Effects of the Tax Acts of 1981 and 1982," this *Review* (November 1984), pp. 17–30.

Santoni, G. J., and Courtenay C. Stone. "The Fed and the Real Rate of Interest," this *Review* (December 1982), pp. 8–18.

Tatom, John A. "Energy Prices and Capital Formation: 1972–1977," this *Review* (May 1979), pp. 2–11.

_____. "A Perspective on the Federal Deficit Problem," this *Review* (June/July 1984), pp. 5–17.

Tobin, James. "Money and Economic Growth," *Econometrica* (October 1965), pp. 671–84.

Wallich, Henry C. "Recent Techniques of Monetary Policy," Federal Reserve Bank of Kansas City *Economic Review* (May 1984), pp. 21–30.

Wilcox, James A. "Why Real Interest Rates Were So Low in the 1970's," *American Economic Review* (March 1983), pp. 44–53.

Monetizing the Debt

Daniel L. Thornton

"MONETIZING the debt" conjures up fearsome images of excessive money stock growth resulting from Federal Reserve purchases of Treasury debt. Many analysts fear that debt monetization may produce undesirable economic consequences, such as more rapid inflation and, thus, higher nominal interest rates. There appears to be some confusion, however, over what debt monetization means, whether or to what extent the Federal Reserve has pursued a policy of debt monetization in the past and what the best indicator of debt monetization is. These questions are of intense interest, with potentially large deficits looming on the horizon that could put increased pressure on the Federal Reserve to monetize the debt in the future.

The purpose of this article is to clarify the meaning of the phrase "monetizing the debt" and to determine whether the Federal Reserve has monetized the debt since 1960. As we will see, the policy objectives of the monetary authority play an important role in determining whether the Federal Reserve will monetize the debt. We also will show that care must be taken not to confuse debt monetization with growth in the Federal Reserve's portfolio of government debt.

MONETIZING THE DEBT: WHAT DOES IT MEAN?

In large measure, the phrase "monetizing the debt" grew out of the experience of the Federal Reserve immediately after World War II. At the time, the Federal Reserve had a tacit commitment to the U.S. Treasury to stabilize the Treasury's cost of financing the war debt. After the war, individuals began liquidating their holdings of Liberty Bonds. Because of its agreement with the Treasury, the Federal Reserve purchased substantial amounts of government debt.[1]

These purchases increased the reserves of the banking system and, consequently, the money stock; the Federal Reserve was said to have monetized the debt. In March 1951, the Federal Reserve and the Treasury reached an accord whereby the Federal Reserve established its independence.[2] Since then, the Federal Reserve has been free to pursue its policy objectives independent of the debt financing needs of the Treasury.[3]

With the net federal debt (NFD) — total debt minus holdings of government agencies and trusts — at nearly $1.3 trillion and with historically high deficits, in both nominal and real terms, there is concern that the rapidly rising debt will put upward pressure on interest rates, inducing the Federal Reserve to in-

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[1]The Federal Reserve's holdings of government debt more than tripled from 1943 to 1946. See *Historical Statistics of the United States* (1975), p. 1116.

[2]See Ahearn (1963), pp. 16–21.

[3]Actually, at a more abstract level, the question of the independence of monetary and fiscal policies is open to debate. Sargent and Wallace (1981) use the government budget constraint to argue that the monetary authority must ultimately monetize deficits. This argument has been challenged recently by Darby (1984), and some evidence has been supplied recently by Barth, Iden and Russek (1984). Furthermore, the budget constraint can be used to argue that the seignorage associated with Federal Reserve open market operations requires a compensatory change in government expenditures or taxes. This latter point is discussed in Horrigan (1983). The seignorage associated with open market operations is easily illustrated from the budget constraint suggested by Thornton (1984).

crease the money supply more rapidly than it otherwise would or, perhaps, should.[4]

Today, as in the immediate post-World War II period, the phrase "monetizing the debt" means money growth induced by attempts to moderate the effects of rapidly growing government debt on interest rates. By definition, open market operations (buying and selling government securities in the money and capital markets) represent debt monetization, that is, the replacement of government debt with money. Open market purchases and debt monetization, therefore, are often taken to be synonymous.[5] This view is enhanced by the fact that open market operations are usually considered the principal tool through which the Federal Reserve influences the money supply, so that changes in Federal Reserve policy are likely to be reflected initially in its portfolio of government debt. For these reasons, analysts sometimes look at the growth of the Federal Reserve's portfolio of government debt, the ratio of the Federal Reserve's holdings of debt (FHD) to NFD, or similar measures as indicators of debt monetization. These measures, however, give too little attention to the goals of policy and the nature of the money stock mechanism.[6]

It is clear from our definition that debt monetization cannot be analyzed separately from the objectives of Federal Reserve policy. Assume, for example, that the Federal Reserve is targeting money growth to achieve price level stability. Furthermore, assume that real income is growing at a faster rate than velocity so that money growth must be positive. If this money growth is achieved through open market purchases of government debt while the debt is simultaneously increasing, the correlation between the growth in the Federal Reserve's portfolio and government debt growth would give the false appearance of debt monetization.[7] In this example, debt monetization actually occurs only if the Federal Reserve modifies its primary objective of price stability because it fears that debt growth will boost interest rates.

Furthermore, in order to claim that the Federal Reserve has monetized the debt, one would have to argue both that there is a positive relationship between actual or anticipated interest rates and debt growth and that the Federal Reserve had modified its primary money stock growth objective in response to actual or perceived upward pressure on interest rates. In this instance, the association between the difference in the actual and targeted growth rates of money and the growth of NFD would provide evidence of debt monetization.[8] Thus, using the growth of FHD or the ratio of FHD to NFD alone as indicators of debt monetization could be misleading. If the Federal Reserve achieves its desired money growth objective, it is *not* monetizing the debt, even if money growth is achieved solely through open market purchases of government debt.

Alternatively, suppose the Federal Reserve's intermediate policy objective is to peg interest rates at some desired level.[9] Then the Federal Reserve monetizes the debt only when changes in the debt, ceteris paribus, produce changes in interest rates in the same direction. That is, if increases in the debt put upward pressure on interest rates, the Federal Reserve will monetize the debt under an interest rate target.

OBSTACLES TO IDENTIFYING DEBT MONETIZATION

In addition to the need to account for the explicit or implicit targets of monetary policy, there is another consideration that makes the growth of FHD, the ratio

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[4]See Tatom (1984) for a historical survey of the deficit.

[5]In principle, any debt can be purchased. In practice, however, the Federal Reserve primarily purchases marketable debt of the U.S. Treasury.

[6]These measures are singled out here because they are most frequently used in the popular press. Other measures, such as growth of total reserves or the monetary base, suffer from this same deficiency, as well as some of the deficiencies noted in the following discussion. See Blinder (1983), Dwyer (1984) and Barth, Sickles and Wiest (1982) for examples of the various measures that have been employed in empirical studies of this question.

[7]The astute reader will recognize that this implies that open market purchases of debt are not strictly required for debt monetization to occur. This can be argued in a number of ways. At a rudimentary level, assume that the Treasury has the power to print money, so that deficits can be financed either by issuing debt or, as a substitute, printing money. Printing money directly is as much debt monetization as if debt were first issued to finance the deficit, then repurchased (later) through note issue.

Of course, the Treasury cannot issue notes directly. Indeed, the Federal Reserve cannot even purchase government debt directly from the Treasury. Consequently, all deficits must initially be financed through debt issue. This initial debt issue increases the demand for credit. If this drives interest rates upward, the Federal Reserve can lessen the effect by increasing the supply of credit, using any of its policy tools. The long-run effects of Federal Reserve activities, however, depend on the tool used due to possible wealth effects and the seignorage associated with open market operations. See Thornton.

[8]This does not imply that the Federal Reserve has the ability to hit its money target exactly. It requires only that there be a systematic relationship between these errors and debt growth. The identification of this process could be complicated, however, if the unintentional errors are associated directly or indirectly with debt growth.

[9]It is difficult to conceive of a situation in which the Federal Reserve could control interest rates in anything but the short run; nevertheless, this is a common conception of the transmission mechanism of monetary policy.

of FHD to NFD and similar measures even less reliable as indicators of debt monetization: money growth does not necessarily require growth in the Federal Reserve's portfolio of government securities. Thus, the link between debt monetization and the growth of FHD may be much weaker than commonly imagined.

Consider the simple model of money growth,

$$\dot{M} = \dot{m} + \dot{B},$$

where the growth of money, $\dot{M}$, is the sum of the growth of the money multiplier, $\dot{m}$, and the growth of the adjusted monetary base, $\dot{B}$. If adjusted base growth were achieved entirely through open market operations and if the multiplier were constant (i.e., $\dot{m} = 0$), money growth would be equal to the growth in the Federal Reserve's portfolio of government debt. If the multiplier were rising, however, money growth would exceed portfolio growth; if the multiplier were falling, portfolio growth would exceed money growth. Therefore, the extent to which the Federal Reserve is monetizing the debt cannot be determined simply by observing the growth rate of the Federal Reserve's portfolio of government securities. Multiplier movements must be considered because such movements weaken the link between portfolio growth and debt monetization.

Base Growth and Debt Monetization

Other factors affect the link between adjusted base and portfolio growth and, thereby, make the connection between debt monetization and the growth of the Federal Reserve's portfolio even more tenuous. Even if the multiplier is constant, the growth rate of money need not correspond closely with growth in the Federal Reserve's holdings of government debt.

One of these factors is changes in reserve requirements, such as those mandated by the Monetary Control Act of 1980. These reserve requirement changes are reflected in the reserve adjustment magnitude (RAM).[10] Increases in RAM increase the base, while reductions reduce it. Consequently, changes in RAM may cause the Federal Reserve to buy more or less government debt than it otherwise would to achieve its monetary growth objective under a monetary targeting procedure.

Adjusted base growth also is affected by other factors, such as depository institution borrowing from the Federal Reserve and Federal Reserve float.[11] Secular movements in these factors can result in adjusted base growth that is faster or slower than the growth of the Federal Reserve's portfolio. Consequently, data on the growth rate of the Federal Reserve's portfolio is not necessarily a good indicator of the extent to which the Federal Reserve is monetizing the debt.

An Illustration of These Relationships

The importance of these factors is illustrated in charts 1–4. Chart 1 shows the ratio of FHD to NFD annually from 1960 to 1983. This ratio increased from 1960 to 1974 and declined thereafter. Thus, generally speaking, the Federal Reserve purchased government securities at a more rapid pace than the growth of NFD up to 1974, but at a much slower pace afterwards. If this ratio were used as the sole indicator of debt monetization, one would likely conclude that the Federal Reserve monetized the debt from 1960 to 1974, then reversed this policy.

The same conclusion would emerge if only the growth rate of the Federal Reserve's portfolio were considered.[12] Yet M1 growth was about 4.8 percent during the former period and about 7.2 percent during the latter period. Thus, the growth of money was slower in the first period than in the second, despite the fact that growth of FHD was faster in the first period than in the second, both in absolute terms and relative to the growth of NFD.

This inverse relation can be explained, in large part, by movements in the money multiplier, RAM, depository institutions' borrowings and float. These series are presented in charts 2–4.

The multiplier declined more or less steadily through 1974. Over the same period, RAM was fairly stable, first rising then dropping slightly. Borrowing was fairly stable through 1972, then increased dramatically in 1973–74. Float increased modestly through 1972, then declined by about $1 billion during 1973 and 1974. On net, a modest amount of monetary base was supplied to the banking system from 1960 to 1974 through borrowings and float, while RAM drained a modest amount of monetary base from the system over this period. With the exception of borrowings during 1973–74, however, none of these factors was

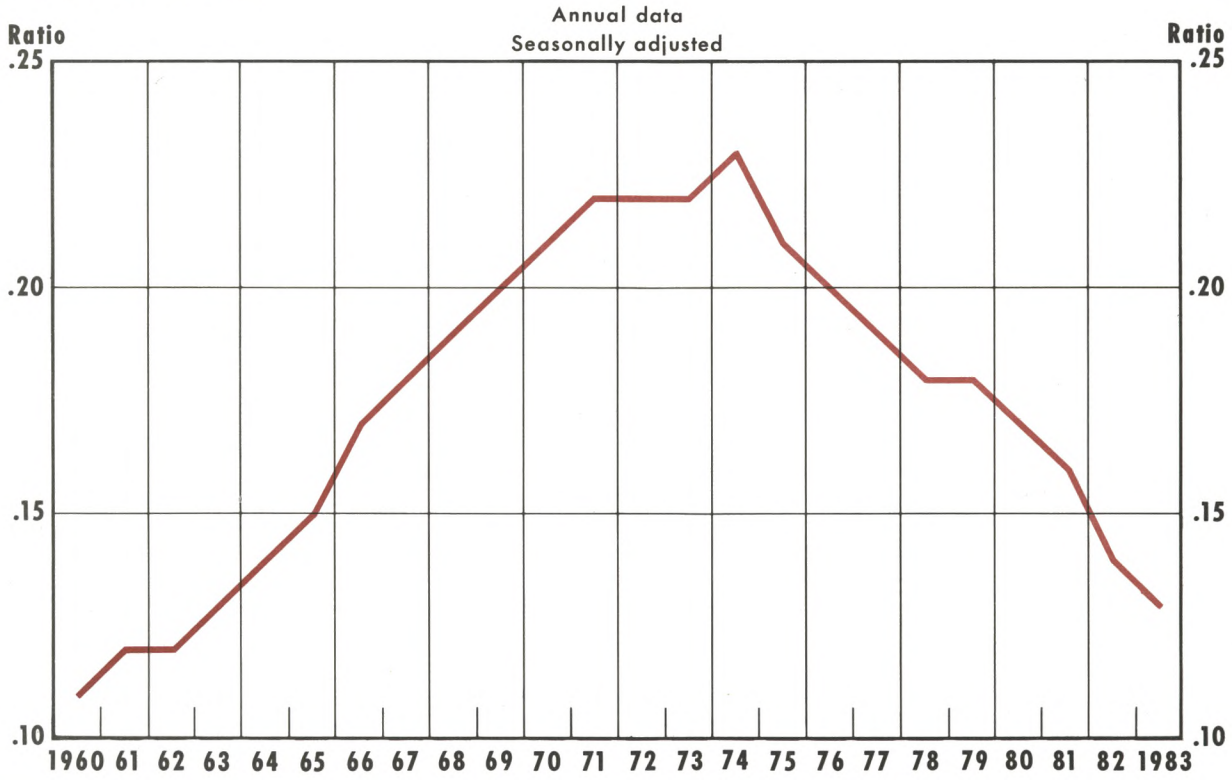
[10] See Tatom (1980) for a discussion of the adjusted monetary base and RAM.

[11] There are other factors that affect base growth; however, quantitatively they are typically less important than those noted.

[12] The compounded annual rate of growth of FHD was 6.89 percent from 1974–83, compared with 8.23 percent from 1960–74.

Chart 1

Ratio of Federal Reserve Holdings of Federal Debt to Total Debt



particularly large relative to the decline in the multiplier.[13]

Consequently, even if the policy objective had been zero money growth, the Federal Reserve still would have had to make substantial net open market purchases of government securities to offset the decline in the multiplier. Thus, the increase in the ratio of FHD to NFD might reflect nothing more than the Federal Reserve's need to make purchases of government debt (to offset multiplier movements) in excess of the growth of NFD over this period.

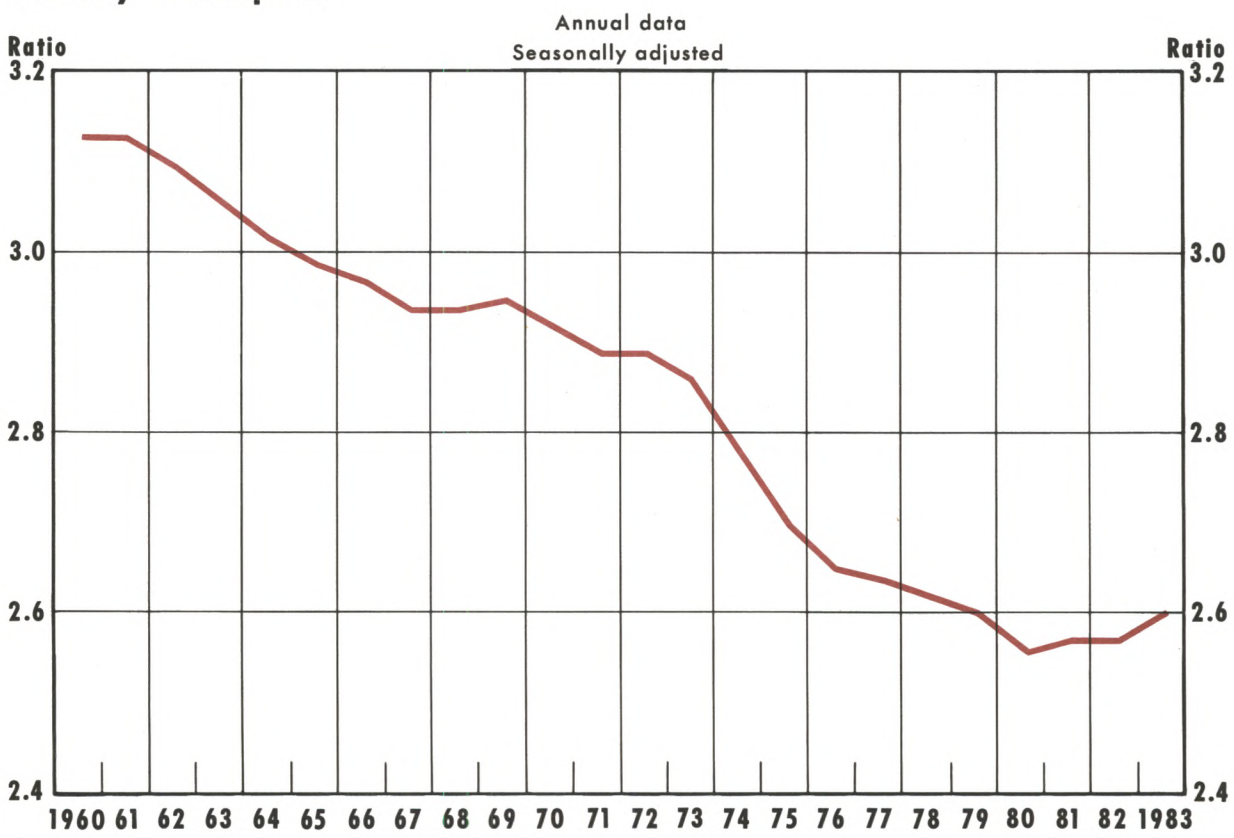
After 1974, a number of factors reduced the Federal Reserve's need to engage in open market purchases. There was a significant increase in RAM through 1974–78, followed by an even more dramatic rise after the Monetary Control Act of 1980. At the same time, both borrowings and float increased dramatically through 1975–79, then declined through 1983. While the multiplier continued to decline through 1980, the rate of decline was more moderate than before. Since 1980, the multiplier has remained relatively unchanged. It is easy to see how money growth could have accelerated since 1974 even though the ratio of FHD to NFD has fallen.[14] Thus, the growth of FHD could be used as an indicator of debt monetization only if these other factors affecting money remain unchanged.

[13]For example, the multiplier declined from 3.13 in 1960 to 2.78 in 1974. Given the average level of the adjusted monetary base of $64.82 billion over this period, the decline in the multiplier had an impact equivalent to a $7.64 billion drain on the adjusted monetary base on average over this period.

[14]No attempt is made here to explain why the various changes in the multiplier, RAM, the float or borrowings occurred. Nevertheless, some of these changes can be readily explained. For example, the increase in borrowings in 1974 was due, in part, to the Federal Reserve's efforts to shore up the banking system after the collapse of the Franklin National Bank (see the Board of Governors of the Federal Reserve System [1974], pp. 740–41). Likewise, the significant jump in RAM after 1980 can be attributed directly to the Monetary Control Act of 1980, while the significant decline in the float after 1979 is associated with Federal Reserve efforts to improve the check-clearing process.

Chart 2

Money Multiplier



Actually, it would be legitimate to use the growth of the FHD as an indicator of debt monetization if the Federal Reserve established it as an intermediate policy target. Since this has never been done, the possibility is not considered here.[15]

A Note on the Interest Rate and Liquidity Effects

The reader is cautioned that this analysis is an illustration of debt monetization under the usual textbook description of countercylical monetary policy. As such, it and the empirical analysis that follows are heavily dependent on the existence of two effects that find little support in empirical studies.[16] The first is the effect of changes in the government debt on interest rates. The story of debt monetization told above rests on the idea that increases in debt issue by the Treasury raise the demand for credit relative to the supply; consequently, interest rates rise. While it is beyond the scope of this article to delve into these arguments, some economists believe, and the bulk of empirical work suggests, that increases in debt have no effect on interest rates. If this is true, then increases in debt would not put pressure on the Federal Reserve to monetize under any policy regime — unless, of course, the Federal Reserve believes that debt increases cause interest rates to rise.

The second effect implicit in this analysis is the so-called liquidity effect, an initial decline in interest rates associated with an unexpected acceleration in the growth rate of money. While the liquidity effect has been isolated empirically, estimates suggest that it is weak and short-lived. The evidence further suggests that the longer-run effect of accelerated money growth is higher, not lower, nominal rates of interest. If the Federal Reserve believed this, it would be considerably less anxious to monetize debt increases, re-

[15]During the period from October 1979 to October 1982, the Federal Reserve used nonborrowed reserves as an operating target. Money growth, however, was its intermediate policy target.

[16]For evidence on the liquidity effect, see Brown and Santoni (1983), Melvin (1983) and the references cited in these articles. For evidence on the relationship between debt growth and interest rates, see Evans (1984), Blinder and the references cited in Blinder.

Chart 3

Reserve Adjustment Magnitude (RAM) and Float at Depository Institutions

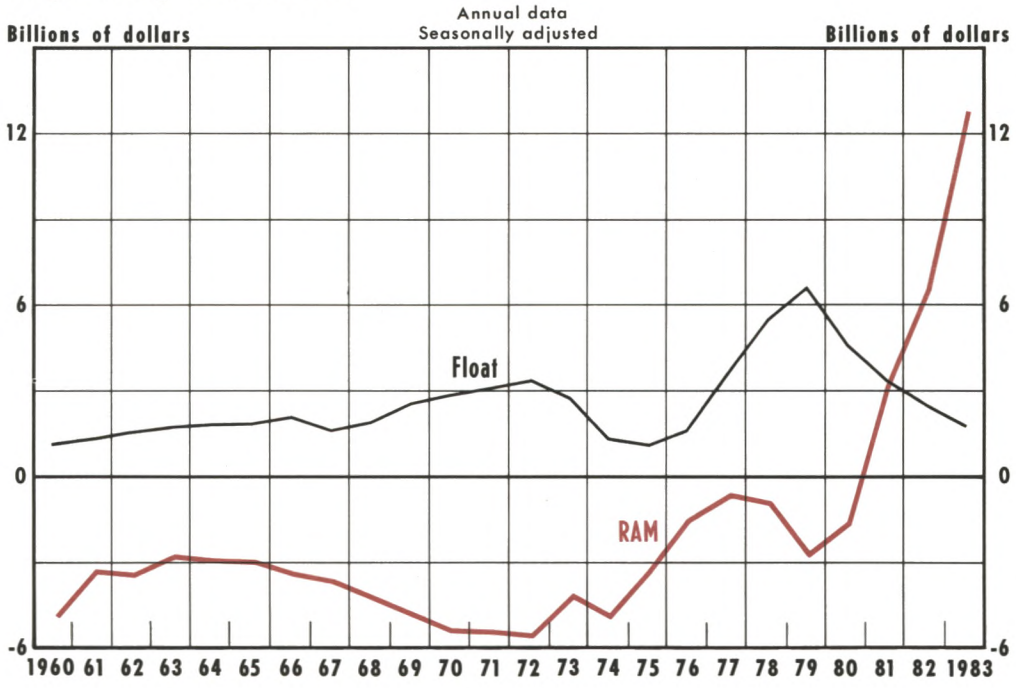
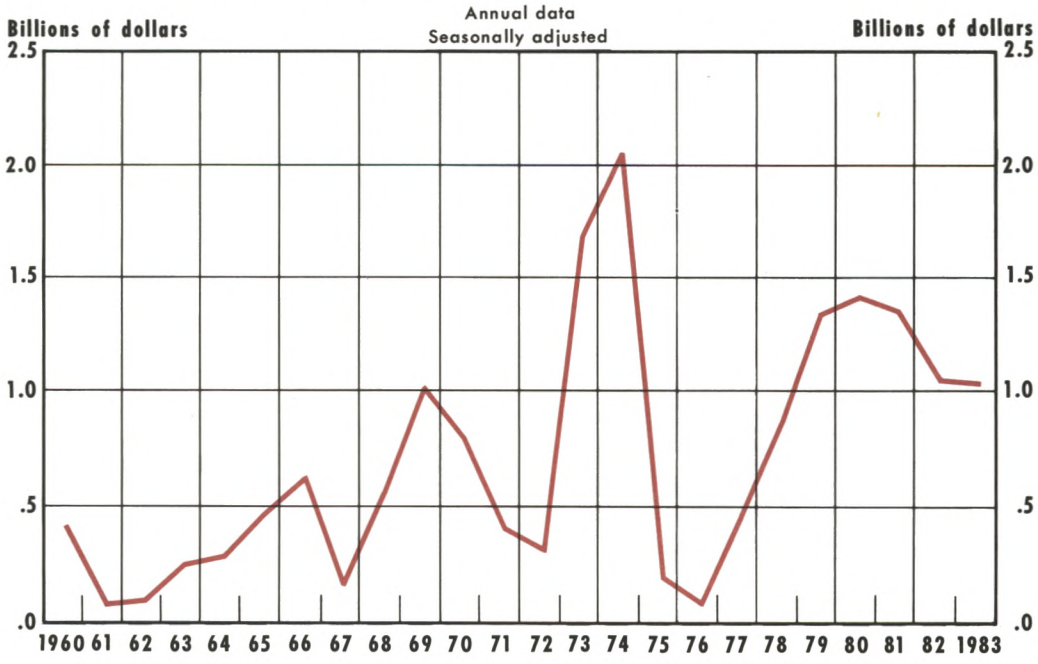


Chart 4

Total Borrowings at Federal Reserve Banks



alizing that the longer-run consequences of its actions would be higher inflation and higher nominal interest rates.

WHAT IS THE EVIDENCE ON DEBT MONETIZATION?

Ideally, to determine whether the Federal Reserve has monetized the debt, deviations between actual and desired monetary targets (say money growth) should be compared with debt growth. Practical considerations make such a comparison difficult. If the Federal Reserve established target rates for the growth of money that were changed infrequently, the growth rate of money might represent a useful proxy for the deviations between actual and desired money growth. Unfortunately, during most of the post-accord experience with countercyclical monetary policy, the evidence suggests that the Federal Reserve seldom focused exclusively on a monetary aggregate target.

Instead, the Federal Reserve has given considerable emphasis to interest rates as the primary intermediate policy target. Only during the past 15 years has the Federal Reserve given monetary aggregates much explicit attention. In January 1970, the Federal Open Market Committee (FOMC) expressed a desire to place increased emphasis on the growth of certain monetary aggregates, but explicit targets for the aggregates were not established until 1975. From October 1979 to October 1982, the FOMC emphasized the growth of the monetary aggregates even more; however, the weight given to the various aggregates changed over this period. Consequently, it is difficult to find an extended period over which monetary policy objectives are sufficiently stable to draw strong inferences about whether the Federal Reserve has monetized the debt. Despite these difficulties, we provide some evidence, which should be regarded as descriptive, of the relationship between money growth and debt growth during the past two and one-half decades.

The empirical investigation undertaken here differs from the usual procedure, which is to estimate a "Federal Reserve reaction function." The reaction function is an equation that presumably represents the Federal Reserve's response to variables affecting its policy decisions. Studies that have used this type of equation have produced inconclusive results and suffer from two problems.[17]

First, many of these studies have used reserve or base growth as the monetary policy variable. Since the evidence suggests that the Federal Reserve has never targeted explicitly on these variables, changes in the growth rates of these variables should not be relied on to provide evidence of debt monetization.

Second, these studies include only contemporaneous values of both the monetary policy variable and the measure of federal debt growth. Since these variables are considered only simultaneously, it cannot be determined whether monetary growth *causes* debt growth or vice versa. The causation running from money to debt is likely because money growth affects prices, output and nominal interest rates which, in turn, feed back to debt growth.[18] Of course, no statistical procedure can establish causality. There is an easily implemented procedure, however, which can be used to test for the temporal ordering of two or more variables. The procedure is called a test of Granger causality.[19]

The Test Procedure

This test procedure can be illustrated by using the growth rate of M and NFD. Let $\dot{M}_t$ and $\dot{NFD}_t$ denote the growth rates of money and the net federal debt, respectively, in the current period and let $\dot{M}_{t-2}$, $\dot{M}_{t-2}$, ..., $\dot{NFD}_{t-1}$, $\dot{NFD}_{t-2}$, ..., denote values of these variables in previous periods. The test for Granger causality running from $\dot{M}$ to $\dot{NFD}$ amounts to regressing the current value of $\dot{NFD}$ on past values of itself and $\dot{M}$, and testing the hypothesis that all of the coefficients on the past values of $\dot{M}$ are zero. To test that Granger causality runs from $\dot{NFD}$ to $\dot{M}$, the current value of $\dot{M}$ is regressed on previous values of itself and $\dot{NFD}$, and the hypothesis that the coefficients on the past values of $\dot{NFD}$ are zero is tested. If the latter hypothesis is rejected, while the former is not, then it is said that growth of the NFD Granger-causes (temporally precedes) money growth. If the former is rejected, while the latter is not, then money growth is said to Granger-cause (temporally precede) growth of the NFD. If both are rejected, no temporal ordering can be established (i.e., there is feedback between $\dot{M}$ and $\dot{NFD}$). If neither can be rejected, the series are not temporally related (i.e., they are said to be independent).

[17]For a more precise definition and a review of some of the empirical literature, see Dwyer. For other reviews of empirical studies, see Blinder and Barth, Sickles and Wiest.

[18]See Dewald (1984), Carlson (1984) and footnote 3.

[19]Friedman and Schwartz (1963) were among the first to try to establish the temporal ordering between macroeconomic variables. Despite its name, it is now recognized that this procedure is not literally a test of causality, nor is it a test of statistical exogeneity. See Zellner (1979) for a discussion of causality, and see Jacobs, Leamer and Ward (1979) and Wu (1983) for a discussion of the relationship between Granger causality and statistical exogeneity.

Tests of Granger causality were performed over the I/1960–IV/1983 period using two measures of debt growth that have been used in the reaction function literature. The first is the growth of NFD, discussed earlier. The second is the high-employment budget deficit (HEBD).[20] The deficit and changes in the NFD differ by the so-called off-budget items. These items are omitted from the official reports of the deficit, despite the fact they require debt issue.

In addition, the changes in the NFD and the HEBD differ in that the latter is adjusted for cyclical factors, while the former is not. Consequently, changes in NFD may misrepresent the pressure to monetize the debt because they are not cyclically adjusted. In other words, a given change in NFD is likely to be associated with a much smaller effect on interest rates if it occurs in the contraction rather than the expansion phase of the cycle.

Furthermore, since a relatively larger portion of deficits are cyclically induced, these cyclical influences may be dominant.[21] If these cyclically induced changes in debt are not associated with rising interest rates, there is no pressure to monetize the debt. Thus, because the cyclical effects have not been controlled for, there may be no temporal ordering running from NFD to money. Changes in money growth, moreover, have been shown to induce cyclical swings in economic activity, so we should not be surprised to find a strong effect running from money to income to NFD. To account for the effects of cyclical factors, lags of output growth and lags of the inflation rate are included in some of the tests of Granger causality.[22]

The advantage of using the HEBD is that it is adjusted directly for cyclical factors. It too may misrepresent the pressure to monetize the debt, however, because the off-budget items are omitted. Consequently, it may be significantly smaller than the amount of debt issue.[23] Furthermore, since the HEBD is cyclically adjusted, changes in past output should not affect tests of Granger causality running from money to HEBD; past changes in prices, however, may affect these tests.

Finally, because the question of debt monetization is tied closely to the policy objectives of the Federal Reserve, it is important to take account of these policy objectives. Thus, the tests of Granger causality were conducted over the entire period I/1960–III/1983 and over the subperiod III/1972–III/1983, during which at least some consideration was given to money stock objectives.[24] Because of the shortness of this period, it was necessary to restrict the search to six lags on each variable and to include only three lags of output growth and inflation.

Empirical Results

The Granger causality tests were performed on quarterly growth rates of M1 and NFD and on the quarterly growth rate of M1 and HEBD, following a procedure outlined in Thornton and Batten (1985).[25] The significance levels corresponding to the calculated F-statistics of the Granger tests are reported in tables 1–6.[26] The significance levels are presented because the significance of the F-statistics vary with the

[20]The data for HEBD ends in III/1983, so the tests of Granger causality involving this variable were performed over this shorter period. Although there are other ways to carry out these tests, work by Geweke, Meese and Dent (1983) and Guilkey and Salemi (1982) indicate that the procedure used here is preferred.

[21]See Tatom (1984).

[22]Lags of past inflation are included based on the finding reported by Blinder and on the work of Horrigan and Protopapadakis (1982) and others who find that much of the measured deficits are related directly to inflation. It could also be argued that the lag from money growth to inflation is long. Therefore, the lags of past inflation may simply be a proxy for even longer lags of money growth.

In addition to NFD, a relatively new measure, the cyclically adjusted federal debt calculated by deLeeuw and Holloway (1983), was used. The qualitative results with this variable were unchanged from those using NFD, so they are not reported here.

[23]For example, the change in NFD in fiscal 1983 of $202.8 billion was made up of a $188.8 billion on-budget deficit and a $14.0 billion off-budget deficit. See *Economic Report of the President* (1983). Also, see Allen and Smith (1983).

[24]The FOMC stated its desire to place increased emphasis on certain monetary aggregates at its January 1970 meeting; however, the estimation period begins in III/1972 to be conservative and to allow for the six lags of both variables.

[25]The fact that these tests ignore the question of whether changes in the debt affect market interest rates is particularly important in interpreting the results. If changes in debt have no effect on interest rates, we should not expect to find a temporal ordering running from debt growth to money growth. If changes in debt have an effect, we may or may not find such a temporal ordering. Thus, the lack of a temporal ordering running from debt to money growth could result either from a lack of an interest rate effect *or* from a refusal on the part of the Federal Reserve to monetize the debt.

Furthermore, in a rational expectations view, the Federal Reserve might anticipate the deficit and increase money growth in advance of the actual increase in the debt. In this case, money growth might precede debt growth, but we find no evidence of this temporal ordering.

[26]Tests of Granger causality should be conducted with time series that are covariance stationary. When the autocorrelation functions of $\dot{M}1$, $N\dot{F}D$ and HEBD were investigated, the series appeared stationary. When the Granger causality tests were undertaken including a time trend, however, the trend variable was always significant at the 5 percent level, suggesting that the series are not stationary. When the tests were performed on first differences of $\dot{M}1$, $N\dot{F}D$ and HEBD, the time trends were uniformly insignificant. With one exception noted below, however, these results were *not* qualitatively different from those using the growth rates of M1 and NFD and the level of HEBD. The latter results are reported because they are easier to interpret.

Table 1

Significance Levels for Granger Causality Tests of $\dot{M}1$ on $N\dot{F}D$ for the I/1960–IV/1983 Period

Lags of $\dot{M}1$	$\dot{M}1$ on $N\dot{F}D$ Lags of $N\dot{F}D$											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.074	.035*	.046*	.089	.124	.190	.269	.264	.229	.260	.310	.332
2	.080	.041*	.048*	.094	.132	.202	.283	.275	.235	.271	.325	.338
3	.082	.041*	.047*	.091	.121	.187	.263	.257	.228	.260	.308	.319
4	.221	.156	.168	.269	.342	.465	.566	.538	.479	.511	.566	.589
5	.061	.068	.110	.179	.235	.343	.396	.355	.306	.349	.407	.422
6	.038*	.059	.095	.165	.224	.329	.392	.369	.322	.366	.425	.440
7	.276	.204	.327	.478	.609	.726	.756	.745	.758	.743	.774	.779
8	.318	.214	.348	.503	.631	.747	.778	.768	.779	.766	.795	.797
9	.191	.277	.367	.493	.636	.757	.804	.814	.830	.823	.862	.873
10	.203	.268	.383	.523	.662	.779	.826	.836	.853	.843	.880	.891
11	.208	.255	.401	.562	.680	.785	.842	.840	.851	.851	.889	.900
12	.203	.247	.398	.564	.667	.765	.836	.828	.846	.843	.881	.893

Lags on $N\dot{F}D$	$N\dot{F}D$ on $\dot{M}1$ Lags of $\dot{M}1$											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.248	.514	.000*	.000*	.000*	.000*	.000*	.000*	.000*	.000*	.000*	.001*
2	.244	.510	.000*	.000*	.000*	.000*	.000*	.000*	.000*	.000*	.001*	.001*
3	.195	.420	.000*	.000*	.000*	.000*	.000*	.000*	.000*	.000*	.001*	.001*
4	.241	.502	.002*	.000*	.001*	.000*	.000*	.000*	.000*	.001*	.002*	.003*
5	.245	.509	.001*	.000*	.001*	.000*	.000*	.000*	.000*	.001*	.002*	.002*
6	.251	.517	.001*	.000*	.001*	.000*	.000*	.000*	.001*	.001*	.002*	.003*
7	.246	.509	.001*	.001*	.001*	.000*	.000*	.000*	.001*	.001*	.003*	.003*
8	.253	.519	.002*	.001*	.001*	.000*	.000*	.000*	.001*	.002*	.003*	.004*
9	.300	.578	.002*	.001*	.002*	.000*	.000*	.001*	.001*	.003*	.005*	.006*
10	.337	.616	.003*	.001*	.002*	.000*	.000*	.001*	.002*	.004*	.006*	.008*
11	.462	.757	.002*	.001*	.001*	.000*	.000*	.000*	.001*	.002*	.003*	.003*
12	.430	.734	.002*	.001*	.001*	.000*	.000*	.000*	.001*	.001*	.002*	.002*

*indicates significance at the 5 percent level

degrees of freedom. The outcomes that are significant at the 5 percent level are denoted by an asterisk. For example, in the regression of $\dot{M}1$ on $N\dot{F}D$ in table 1 the entry for three lags on each variable is .047. This indicates that the hypothesis that $N\dot{F}D$ does not Granger-cause $\dot{M}1$ can be rejected at the 5 percent significance level for this lag specification. When the lag length is increased to four, however, this hypothesis cannot be rejected because the entry, .269, is greater than .05.

The significance levels based on simple bidirectional tests of Granger causality between $\dot{M}1$ and $N\dot{F}D$ and $\dot{M}1$ and HEBD are presented in tables 1 and 2, respectively. The results in table 1 indicate a strong unidirectional effect running from $\dot{M}1$ to $N\dot{F}D$. Only seven of the 144 F-tests for the influence of $N\dot{F}D$ on $\dot{M}1$ reported were significant at the 5 percent level. None of these seven lag structures, however, was chosen by a commonly used lag-length specification criterion.[27] Because NFD is not cyclically adjusted and is likely to be affected by changes in real output and prices induced by changes in the money supply, it is not too surprising that the temporal ordering runs from $\dot{M}1$ to $N\dot{F}D$.[28]

[27]The lag-length selection criterion used here is the final prediction error. See Thornton and Batten, and Batten and Thornton (1984).

[28]It is somewhat surprising, however, that the same qualitative result is obtained for the cyclically adjusted debt measure. This suggests the possibility that this cyclically adjusted measure does not capture all the effects of past output and price level growth. This conjecture is supported by the fact that the significance levels are greatly increased when three lags of output growth and inflation were included in these specifications. In any event, there is no evidence of a temporal ordering running from cyclically adjusted debt to money.

Table 2

Significance Levels for Granger Causality Tests of Ṁ1 on HEBD for the I/1960–III/1983 Period

Lags of Ṁ1	Ṁ1 on HEBD, Lags of HEBD											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.000*	.001*	.003*	.003*	.007*	.015*	.018*	.028*	.015*	.021*	.035*	.045*
2	.000*	.001*	.004*	.003*	.008*	.016*	.019*	.030*	.018*	.024*	.039*	.050
3	.000*	.001*	.004*	.004*	.008*	.017*	.019*	.030*	.018*	.023*	.037*	.051
4	.000*	.002*	.004*	.002*	.005*	.010*	.010*	.018*	.009*	.012*	.019*	.029*
5	.000*	.001*	.002*	.001*	.003*	.007*	.008*	.013*	.005*	.005*	.009*	.016*
6	.000*	.001*	.002*	.001*	.003*	.006*	.008*	.013*	.004*	.005*	.009*	.016*
7	.002*	.010*	.021*	.009*	.018*	.032*	.023*	.041*	.021*	.018*	.026*	.040*
8	.003*	.011*	.025*	.010*	.021*	.036*	.027*	.046*	.022*	.020*	.030*	.044*
9	.004*	.015*	.028*	.016*	.032*	.052	.035*	.058	.018*	.020*	.030*	.041*
10	.004*	.015*	.030*	.018*	.037*	.060	.040*	.066	.022*	.022*	.033*	.044*
11	.005*	.021*	.041*	.028*	.054	.085	.057	.092	.031*	.031*	.044*	.058
12	.006*	.022*	.041*	.028*	.053	.082	.049*	.080	.027*	.028*	.039*	.057

Lags of HEBD	HEBD on Ṁ1, Lags of Ṁ1											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.171	.379	.298	.270	.277	.150	.169	.225	.292	.181	.195	.197
2	.208	.446	.339	.297	.307	.166	.188	.250	.324	.204	.216	.222
3	.195	.362	.444	.365	.401	.183	.219	.292	.356	.286	.294	.320
4	.209	.380	.435	.390	.429	.195	.235	.311	.372	.282	.308	.335
5	.358	.604	.599	.692	.805	.408	.426	.504	.586	.528	.592	.666
6	.358	.614	.597	.696	.815	.432	.450	.528	.610	.552	.616	.689
7	.360	.615	.582	.689	.810	.451	.463	.541	.621	.562	.624	.699
8	.243	.482	.460	.533	.661	.306	.247	.340	.421	.418	.484	.558
9	.200	.440	.437	.503	.642	.324	.285	.382	.451	.451	.521	.595
10	.138	.328	.276	.349	.474	.267	.263	.355	.406	.450	.513	.591
11	.159	.342	.307	.415	.547	.284	.292	.380	.424	.483	.509	.581
12	.169	.366	.418	.514	.661	.364	.325	.409	.406	.465	.476	.483

*indicates significance at the 5 percent level

The results in table 2 for the HEBD, however, indicate unidirectional causality running from HEBD to Ṁ1. The hypothesis that HEBD has no impact on M1 was rejected for nearly every lag specification considered, while the hypothesis that Ṁ1 has no effect on HEBD was never rejected. Thus, this measure suggests that money growth responds to cyclically adjusted changes in the debt.

The Granger Tests Extended for Cyclical Influences

In the simple tests of bivariate Granger causality presented above, the observed feedback between money growth and N$\dot{F}$D or the causality running from HEBD to Ṁ1 could be the result of the close association between these variables and factors not accounted for by the equation. In order to guard against this possibility, the tests were repeated adding three and then six lags of the growth rates of prices and real output as additional variables.[29]

The results for the equations with six lags are presented in tables 3 and 4. The results in table 3 indicate

[29]The possibility that money growth responds to either past output growth or inflation can be argued two ways. First, such variables could represent a Federal Reserve reaction function response, e.g., high past rates of inflation or output growth induce the Fed to slow the rate of M1 growth. Second, the money supply could be endogenous (at least over short periods of time like a quarter), i.e., related to other variables in the system like interest rates. Since interest rates are positively related to both inflation and output growth, the money stock should move with these variables. If the second case were correct, there should be a positive relationship between past inflation and money growth; however, Blinder reports a negative relationship. We find the same result, although it is not reported here.

Table 3

Significance Levels for Granger Causality Tests of $\dot{M}1$ on $N\dot{F}D$ for the I/1960–IV/1983 Period, with six lags of $\dot{P}$ and $\dot{X}$

Lags of $\dot{M}1$	$\dot{M}1$ on $N\dot{F}D$ Lags of $N\dot{F}D$											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.463	.255	.248	.376	.478	.611	.708	.673	.680	.754	.734	.706
2	.505	.279	.255	.358	.473	.606	.697	.611	.637	.723	.687	.601
3	.486	.188	.202	.297	.369	.498	.584	.470	.546	.644	.564	.477
4	.665	.409	.464	.562	.634	.729	.811	.653	.734	.814	.712	.678
5	.464	.340	.474	.629	.707	.805	.875	.606	.677	.763	.710	.626
6	.401	.340	.484	.621	.729	.826	.892	.690	.758	.832	.780	.690
7	.577	.358	.509	.642	.757	.841	.904	.738	.810	.868	.821	.751
8	.529	.363	.509	.643	.760	.842	.905	.741	.814	.871	.817	.736
9	.355	.472	.561	.722	.825	.892	.942	.809	.875	.922	.903	.852
10	.356	.477	.561	.723	.827	.894	.944	.812	.877	.924	.906	.852
11	.410	.520	.612	.758	.843	.900	.948	.813	.877	.924	.913	.867
12	.407	.529	.616	.764	.850	.907	.952	.824	.886	.930	.920	.875

Lags of $N\dot{F}D$	$N\dot{F}D$ on $\dot{M}1$ Lags of $\dot{M}1$											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.477	.415	.060	.061	.091	.104	.046*	.077	.113	.125	.178	.130
2	.466	.419	.069	.065	.097	.113	.053	.087	.127	.141	.198	.144
3	.397	.368	.055	.043*	.072	.089	.040*	.065	.094	.088	.130	.085
4	.394	.388	.059	.046*	.076	.096	.044*	.071	.101	.092	.136	.085
5	.395	.401	.063	.049*	.082	.099	.047*	.076	.108	.098	.142	.085
6	.419	.401	.060	.063	.102	.123	.063	.098	.136	.124	.177	.109
7	.469	.413	.067	.065	.112	.134	.070	.109	.147	.135	.192	.127
8	.474	.410	.071	.069	.117	.138	.074	.115	.155	.144	.202	.135
9	.589	.370	.125	.137	.220	.204	.143	.198	.237	.233	.310	.224
10	.604	.400	.128	.136	.218	.202	.154	.210	.254	.254	.335	.245
11	.708	.487	.094	.093	.147	.138	.106	.160	.164	.166	.231	.145
12	.728	.519	.102	.102	.158	.147	.110	.164	.173	.171	.238	.155

*indicates significance at the 5 percent level

that $\dot{M}1$ and $N\dot{F}D$ are independent series. There are just seven instances where the F-tests of $N\dot{F}D$ on $\dot{M}1$ are significant, and none of these were selected by the lag-length specification criterion.[30] Thus, once output growth and inflation are accounted for, there is virtually no evidence of a separate effect of money growth on debt growth and no evidence of causality from $N\dot{F}D$ to $\dot{M}1$.

The results in table 4 are similar to those in table 2, in that $\dot{M}1$ has no effect on HEBD, while HEBD continues to Granger-cause $\dot{M}1$. A comparison of tables 2 and 4, however, shows that the significance levels for the tests of the effect running from HEBD to $\dot{M}1$ are substantially larger when growth rates of output and prices are accounted for. Nevertheless, the HEBD provides some evidence of debt monetization not evident when $N\dot{F}D$ is used.

Results for III/1972–IV/1983

The results for the III/1972–III/1983 period, in which more emphasis was placed on the monetary aggregates, are reported in tables 5 and 6. (Only the results with lags of inflation and output growth are reported.)[31] These results indicate that, over this period,

[30]When first differences of growth rates are used, there is no area of the lag space where the hypothesis can be rejected.

[31]When no lags of inflation and output growth are used, the results indicate unidirectional causality running from $\dot{M}1$ to $N\dot{F}D$ and independence between $\dot{M}1$ and HEBD.

Table 4

Significance Levels for Granger Causality Tests of $\dot{M}1$ on HEBD for the I/1960–III/1983 Period, with six lags of $\dot{P}$ and $\dot{X}$

Lags of $\dot{M}1$	$\dot{M}1$ on HEBD Lags of HEBD											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.014*	.046*	.105	.018*	.038*	.068	.035*	.055	.058	.090	.133	.090
2	.016*	.054	.117	.024*	.048*	.084	.046*	.072	.081	.123	.173	.117
3	.021*	.071	.140	.026*	.053	.090	.037*	.059	.070	.104	.147	.122
4	.012*	.042*	.087	.010*	.022*	.041*	.015*	.027*	.027*	.041*	.063	.052
5	.023*	.064	.104	.009*	.018*	.035*	.011*	.019*	.016*	.020*	.034*	.045*
6	.026*	.069	.120	.009*	.018*	.035*	.013*	.022*	.017*	.024*	.038*	.051
7	.033*	.086	.146	.011*	.022*	.042*	.012*	.022*	.017*	.021*	.034*	.049*
8	.033*	.088	.151	.012*	.024*	.045*	.013*	.023*	.018*	.022*	.035*	.051
9	.044*	.126	.184	.024*	.046*	.083	.025*	.041*	.028*	.034*	.053	.078
10	.045*	.129	.190	.024*	.044*	.079	.023*	.038*	.026*	.035*	.055	.079
11	.056	.159	.227	.035*	.062	.107	.032*	.053	.036*	.046*	.070	.100
12	.057	.165	.242	.038*	.068	.117	.035*	.057	.038*	.050	.075	.103

Lags of HEBD	HEBD on $\dot{M}1$ Lags of $\dot{M}1$											
	1	2	3	4	5	6	7	8	9	10	11	12
1	.059	.112	.076	.143	.223	.268	.361	.453	.538	.413	.466	.329
2	.079	.157	.099	.182	.271	.322	.425	.526	.617	.483	.526	.390
3	.096	.151	.135	.237	.321	.331	.440	.550	.617	.564	.605	.517
4	.097	.166	.155	.267	.353	.379	.489	.601	.687	.653	.671	.574
5	.253	.370	.281	.432	.446	.393	.484	.592	.682	.737	.791	.790
6	.257	.358	.279	.429	.450	.382	.480	.586	.678	.733	.794	.787
7	.258	.382	.346	.509	.521	.416	.487	.586	.676	.737	.798	.814
8	.119	.204	.196	.323	.375	.343	.372	.475	.567	.655	.707	.712
9	.108	.207	.194	.318	.365	.344	.375	.481	.565	.653	.709	.721
10	.068	.128	.083	.156	.216	.239	.309	.410	.485	.587	.641	.671
11	.075	.124	.087	.163	.221	.234	.311	.415	.496	.597	.629	.655
12	.086	.144	.118	.212	.259	.277	.348	.457	.520	.621	.652	.633

*indicates significance at the 5 percent level

$\dot{M}1$ is independent of both $N\dot{F}D$ and the HEBD. There was no portion of the lag space considered in which the hypotheses constituting the Granger tests could be rejected. Hence, there is no evidence of debt monetization over this period for either measure of debt growth. Thus, the HEBD result, which indicates that the Federal Reserve had monetized the debt over the 1960–83 period, appears to result from the Federal Reserve's interest rate target procedures over nearly the first half of the period — a period when debt monetization is more likely to be an inherent result of attempts to influence interest rates. An investigation of a period for which it is more relevant to consider the question of debt monetization yields no evidence that the Federal Reserve has monetized the debt.

CONCLUSIONS

The purpose of this article was to clear up confusion that often characterizes discussions of debt monetization and to provide some evidence on the question of whether the Federal Reserve has monetized the debt. Specifically, it was pointed out that the phrase "monetizing the debt" means money growth in excess of that required to achieve some policy objective that is induced by rapid growth in the federal debt.

It was noted that the ratio of Federal Reserve debt holdings to net federal debt, or other such measures, cannot be used alone as evidence of debt monetization. Changes in the money multiplier and factors that affect components of the monetary base will influence

Table 5

Significance Levels for Granger Causality Tests for $\dot{M}1$ and $\dot{NFD}$ for the III/1972–IV/1983 Period, with three lags of $\dot{P}$ and $\dot{X}$

$\dot{M}1$ on $\dot{NFD}$

	Lags of $\dot{NFD}$					
Lags of $\dot{M}1$	1	2	3	4	5	6
1	.310	.236	.415	.574	.719	.830
2	.377	.254	.435	.611	.749	.852
3	.395	.180	.325	.489	.628	.752
4	.524	.242	.366	.532	.661	.775
5	.315	.223	.360	.531	.667	.789
6	.229	.221	.361	.532	.676	.796

$\dot{NFD}$ on $\dot{M}1$

	Lags of $\dot{M}1$					
Lags of $\dot{NFD}$	1	2	3	4	5	6
1	.884	.296	.329	.296	.328	.212
2	.782	.276	.347	.301	.347	.244
3	.776	.342	.526	.562	.605	.441
4	.804	.498	.676	.673	.680	.542
5	.816	.512	.682	.675	.681	.516
6	.813	.530	.695	.688	.676	.526

Table 6

Significance Levels for Granger Causality Tests for $\dot{M}1$ and HEBD for the III/1972–III/1983 Period, with three lags of $\dot{P}$ and $\dot{X}$

$\dot{M}1$ on HEBD

	Lags of HEBD					
Lags of $\dot{M}1$	1	2	3	4	5	6
1	.433	.737	.741	.782	.826	.857
2	.473	.768	.799	.843	.875	.913
3	.495	.788	.842	.879	.914	.941
4	.317	.597	.732	.681	.808	.854
5	.367	.659	.833	.779	.885	.933
6	.336	.629	.813	.751	.865	.910

HEBD on $\dot{M}1$

	Lags of $\dot{M}1$					
Lags of HEBD	1	2	3	4	5	6
1	.183	.411	.088	.167	.272	.108
2	.234	.494	.109	.202	.320	.125
3	.299	.558	.156	.273	.400	.164
4	.316	.586	.168	.289	.421	.186
5	.764	.911	.307	.425	.530	.178
6	.765	.915	.323	.444	.548	.174

the growth of the Federal Reserve's portfolio of government securities for any given policy objective in ways that confound attempts to determine the extent of debt monetization taking place.

Two commonly used measures of debt growth, the growth of net federal debt and the high-employment budget deficit, were used to test whether money growth precedes debt growth, or vice versa. The results for the III/1972–IV/1983 period, during which the Federal Reserve placed more emphasis on the monetary aggregates than it had in previous years, shows no evidence of debt monetization by the Federal Reserve using either debt measure. For the entire 1960–83 period, there is evidence of debt monetization for the high-employment deficit measure, but not for growth of the net federal debt. Thus, the only evidence of debt monetization occurs during the period of interest rate targeting, when debt monetization is to be expected if increases in the federal debt put upward pressure on interest rates.

The reader is cautioned, however, in that actual money growth, rather than deviations of actual from desired money growth, was used in these tests. Since the debt monetization has to do with movements away from policy objectives induced by actual or perceived pressure of rapid debt growth on interest rates, the critical implicit assumption here, and in most previous studies of debt monetization, is that actual changes in money growth proxy such movements.

REFERENCES

Ahearn, Daniel S. *Federal Reserve Policy Reappraised: 1951–1959* (Columbia University Press, 1963).

Allen, Stuart D., and Michael D. Smith. "Government Borrowing and Monetary Accommodation," *Journal of Monetary Economics* (November 1983), pp. 605–16.

Barth, James R., George Iden and Frank S. Russek. "The Economic Consequences of Federal Deficits: An Examination of the Net Wealth and Instability Issues," processed (1984).

Barth, James R., Robin Sickles and Philip Wiest. "Assessing the Impact of Varying Economic Conditions on Federal Reserve Behavior," *Journal of Macroeconomics* (Winter 1982), pp. 47–70.

Batten, Dallas S., and Daniel L. Thornton. "How Robust Are the Policy Conclusions of the St. Louis Equation?: Some Further Evidence," this *Review* (June/July 1984), pp. 26–32.

Blinder, Alan S. "On the Monetization of Deficits," in Laurence H. Meyer, ed., *The Economic Consequences of Government Deficits* (Kluwer-Nijhoff, 1983), pp. 39–73.

Board of Governors of the Federal Reserve System. "Announcements," *Federal Reserve Bulletin* (October 1974), pp. 740–41.

Brown, W. W., and G. J. Santoni. "Monetary Growth and the Timing of Interest Rate Movements," this *Review* (August/September 1983), pp. 16–25.

Carlson, Keith M. "Money Growth and the Size of the Federal Debt," this *Review* (November 1984), pp. 5–16.

Darby, Michael R. "Some Pleasant Monetarist Arithmetic," Federal Reserve Bank of Minneapolis *Quarterly Review* (Spring 1984), pp. 15–20.

deLeeuw, Frank, and Thomas M. Holloway. "Cyclical Adjustment of the Federal Budget and Federal Debt," *Survey of Current Business* (December 1983), pp. 25–40.

Dewald, William G. "Deficits and Monetary Growth," Federal Reserve Bank of Atlanta *Economic Review* (January 1984), pp. 11–20.

Dwyer, Gerald P. "Money Creation and Federal Deficits," processed (1984).

Economic Report of the President, February 1983. (U.S. Government Printing Office, 1983).

Evans, Paul. "Do Large Deficits Produce High Interest Rates?" processed (1984).

Friedman, Milton, and Anna J. Schwartz. *A Monetary History of the United States 1867–1960* (Princeton University Press, 1963).

Froyen, Richard T. "A Test of the Endogeneity of Monetary Policy," *Journal of Econometrics* (July 1974), pp. 175–88.

Geweke, John, Richard Meese and Warren Dent. "Comparing Alternative Tests of Causality in Temporal Systems: Analytic Results and Experimental Evidence," *Journal of Econometrics* (February 1983), pp. 161–94.

Guilkey, David K., and Michael K. Salemi. "Small Sample Properties of Three Tests for Granger-Causal Ordering in a Bivariate Stochastic System," *The Review of Economics and Statistics* (November 1982), pp. 668–80.

Historical Statistics of the United States: Colonial Times to 1970, part 2. (GPO, 1975).

Horrigan, Brian R. "Pitfalls in Analyzing Deficits and Inflation," Federal Reserve Bank of Philadelphia Working Paper No. 83-4 (1983).

Horrigan, Brian R., and A. Protopapadakis. "Federal Deficits: A Faulty Gauge of Government's Impact on Financial Markets," Federal Reserve Bank of Philadelphia *Business Review* (March/April 1982), pp. 3–16.

Jacobs, Rodney L., Edward E. Leamer and Michael P. Ward. "Difficulties with Testing for Causation," *Economic Inquiry* (July 1979), pp. 401–13.

Melvin, Michael. "The Vanishing Liquidity Effect of Money on Interest: Analysis and Implications for Policy," *Economic Inquiry* (April 1983), pp. 188–202.

Sargent, Thomas J., and Neil Wallace. "Some Unpleasant Monetarist Arithmetic," Federal Reserve Bank of Minneapolis *Quarterly Review* (Fall 1981), pp. 1–17.

Tatom, John A. "A Perspective on the Federal Deficit Problem," this *Review* (June/July 1984), pp. 5–17.

_____. "Issues in Measuring An Adjusted Monetary Base," this *Review* (December 1980), pp. 11–29.

Thornton, Daniel L. "The Government Budget Constraint with Endogenous Money," *Journal of Macroeconomics* (Winter 1984), pp. 57–67.

Thornton, Daniel L., and Dallas S. Batten. "Lag-Length Selection and Granger Causality Between Money and Income," *Journal of Money, Credit and Banking* (forthcoming, May 1985).

Wu, De-Min. "Tests of Causality, Predeterminedness and Exogeneity," *International Economic Review* (October 1983), pp. 547–58.

Zellner, Arnold. "Causality and Econometrics," in Karl Brunner and Allan H. Meltzer, eds., *Carnegie-Rochester Conference Series on Public Policy,* Volume 10 (Amsterdam: North-Holland 1979), pp. 9–54.

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