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THE FEDERAL RESERVE BANK of ST. LOUIS

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In This Issue . . .

The current debate over the magnitude of the federal deficit involves numerous myths concerning how it came to be so large, the outlook for future deficits, and the likely economic effects of persisting "large" deficits. In the first article in this *Review*, "A Perspective on the Federal Deficit Problem," John A. Tatom argues that triple-digit deficits in 1982 and 1983 arose largely from the strong cyclical downturn in the economy, not from policy actions such as increased defense spending, recent "cuts" in personal income taxes, or burgeoning transfer programs.

Tatom points out that the rise in defense spending over the past four years has been greatly outstripped by the rise in spending for federal transfer programs and has contributed little to the 1982–83 deficit picture. Moreover, tax cuts have been largely offset by bracket creep, social security tax increases and other tax hikes.

Tatom explains that the economic effects of deficit increases depend upon whether they are caused by changes in fiscal policy or by cyclical changes in the nation's income, output and employment. Most recent discussion of the possible adverse effects of deficits concerns those caused by fiscal policy actions, not the business cycle; this concern is basically irrelevant to the consideration of recent cyclical deficits. Furthermore, Tatom points out that there is no evidence supporting most of the purported adverse effects of higher policy-related deficits, such as higher inflation or interest rates.

However, Tatom indicates that current projections of future deficits point to an uptrend in the structural deficit — that part which is related to fiscal policy — as the cyclical component is eliminated. Whether the projected growth of the structural deficit will have adverse effects on the economy is problematic. The lack of evidence that higher structural deficits raise interest rates may be due simply to our lack of past experience with "large" and persistent deficits.

In the second article in this *Review*, "Money, Debt and Economic Activity," R. W. Hafer notes that there have been increasing suggestions that monetary policymakers should use the information from a variety of economic measures rather than focusing solely on the behavior of a monetary measure, such as M1. Although this approach to policy is by no means new or novel, suspicion that M1 has deteriorated as a useful policy measure in the wake of financial innovations has re-kindled the debate. Partially in response to these arguments, the Federal Open Market Committee (FOMC) at its February 1983 meeting established a "monitoring range" for the growth of total domestic nonfinancial debt. Hafer investigates the usefulness of this debt measure for monetary policy purposes by examining the relative abilities of M1 and debt growth in explaining the behavior of GNP growth. For the 1960–81 period, the explanatory power of M1 is about 10 percent greater than that of the debt measure in its relationship to GNP growth. Moreover, Hafer finds that, once the effects of M1 growth on GNP growth are estimated directly, the debt growth measure is redundant: it adds no additional useful information.

Hafer then compares the performance of M1 and debt in forecasting GNP growth during the 1982–83 period. Recent velocity behavior suggests that "the debt measure does *not* seem to be a relatively more stable guide to GNP behavior than M1 during the past few years." Thus, forecasting GNP growth for 1982–83 using the debt measure does not provide any significant gain over the results based on M1. In fact, the author notes that if M1 is adjusted for the effects of recent financial innovations which increased M1 growth during 1982–83, the forecast performance of this adjusted M1 measure is significantly better than that of debt. Consequently, Hafer concludes that there is little evidence to support the use of a broad debt measure as yet another intermediate target for monetary policy.

In the third article, "How Robust Are the Policy Conclusions of the St. Louis Equation?: Some Further Evidence," Dallas S. Batten and Daniel L. Thornton point out that, since it was first used in 1968 to investigate the relative importance of monetary and fiscal actions in influencing economic activity the St. Louis equation has been subject to much criticism. One criticism is that the policy conclusions may be dependent on the equation's econometric specification and, in particular, on the use of Almon's polynomial distributed lag estimation technique. To investigate the seriousness of such criticism, Batten and Thornton conduct a general investigation of the sensitivity of the St. Louis equation's policy conclusions to the choice of lag structure and polynomial degree. Using a variety of model selection criteria, they find that the policy conclusions are virtually insensitive to alternative lag structures or polynomial specifications. In every case examined, they could not reject the hypothesis that a one percentage-point increase in money growth leads ultimately to a one percentage-point increase in the rate of growth of nominal GNP. Moreover, the hypothesis that high-employment government expenditures had no long-run impact on nominal GNP growth was rejected only when contemporaneous government spending growth *alone* was included in the model; however, this specification was rejected when tested against longer-lag alternatives for government spending.

A Perspective on the Federal Deficit Problem

John A. Tatom

"None of us really understands what's going on with all these numbers."
—David Stockman,
Atlantic Monthly,
December 1981

FEDERAL budget deficits of $200 billion or more have created considerable controversy and confusion among analysts, policymakers and voters. The important problem, of course, concerns the consequences of current and projected spending, receipts and deficits. Public concern about these problems began, however, with the ballooning of deficits in 1982 and 1983.

Many analysts conjecture that recent and projected large deficits have deleterious effects on the economy — raising interest rates, exchange rates, the inflation rate, crowding out private sector investment and economic growth and threatening the economic recovery. Others are more sanguine, arguing instead that recent deficits have not significantly affected interest rates, exchange rates or price behavior.[1]

The purpose of this article is to assess these contrasting views on the causes and consequences of recent and prospective deficits. Most of the controversy arises from differences in theoretical and empirical judgments about the effects of deficits on the demand for goods and services. After examining these relevant conceptual issues, recent trends in the federal budget are taken up. Then these conceptual distinctions are used to clarify the source and potential economic effects of recent and projected deficits.

In the view of many analysts, both current deficits and future projections indicate a major break with the U.S. postwar experience. It is suggested below that this view is unwarranted when applied to recent deficits. While recent deficits have been large compared with earlier ones, they have arisen largely from the unusual cyclical experience in the U.S. economy, not from unprecedented fiscal policy actions that raised spending and/or reduced tax receipts. Future deficits, however, may represent a major break from the current and past experience. If so, past relationships between deficits and economic performance may prove to be of little use in judging their likely effects.

THE THEORY OF ACTIVE AND PASSIVE DEFICITS

The federal budget deficit is the excess of federal government expenditures over receipts. In analyzing the sources of the deficit and its effect on the economy, it is necessary to distinguish between "active" and "passive" components of the deficit. Spending, taxes and, therefore, the actual deficit are affected by both direct policy actions and changes in the level of economic activity, prices and interest rates. The latter changes occur passively, that is, without fiscal policy actions. Active deficits, in contrast, are those that arise from legislated changes in spending or taxes, *given* the other economic conditions that influence the deficit.

One attempt to deal with this difference is the measurement of the so-called high-employment budget. It involves measuring expenditures and tax

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John A. Tatom is a research officer at the Federal Reserve Bank of St. Louis. *Thomas H. Gregory provided research assistance.*

[1]An example of the latter argument is the study by the U.S. Department of the Treasury (1984). There does appear to be general agreement about the possibility that deficits can be "monetized," that is, financed by money creation. To the extent this occurs, inflation would accelerate.

receipts at a high-employment level of real GNP, given actual prices and interest rates. This measure is useful because it removes that part of the actual deficit that arises from passive adjustment to cyclical fluctuations in real GNP.

For example, as real income expands, tax receipts rise and spending (primarily transfer payments) declines, so that the actual deficit shrinks. This decrease (or increase when real incomes fall) reflects *automatic* movements that are built-in to existing tax and spending legislation. This automatic response of the deficit to economic conditions is referred to as a change in the passive deficit. In contrast, legislated increases in spending or tax reductions raise the actual deficit at any level of GNP and produce a change in the active deficit. At each point in time, the observed deficit reflects both an active component — the size of the deficit at, for example, a high-employment level of real output — and a passive component — the part due to the business cycle.

Conventional economic analysis, which forms the basis for much of the current popular discussion, focuses on the effects of a higher active deficit that arises from either a discretionary increase in federal expenditures or a cut in taxes. The conventional wisdom indicates that an increase in the active deficit causes spending on goods and services to rise. A federal purchase of goods or services directly raises total aggregate spending; increased transfer payments or tax reductions allow greater spending in the private sector. Thus, a change in the active deficit is important because it affects the level of real GNP.

At its simplest level, the conventional analysis indicates that, if the money stock is unaltered, interest rates will rise along with real GNP. At higher levels of spending and income, the demand for money will be higher. Thus, in this view, interest rates must go up to ration the available money stock. Of course, a rise in rates tends to choke off some of the expansion in spending and income that results from an increase in the active deficit. This latter effect is called "crowding-out" because the rise in interest rates discourages (crowds out) private investment and consumer purchases.

If income and spending rise as a result of an increase in the active deficit, prices are likely to rise as well. At unchanged prices, the higher level of demand for real output is unlikely to be produced. To induce suppliers to produce more output, the general level of prices will have to be bid up. A higher level of prices induces more crowding out, since it causes a reduction in the supply of purchasing power available from a given nominal money stock relative to the demand for it. Thus, interest rates rise further and more private spending is crowded out.

In summary, a simple version of conventional theory states that a rise in the active deficit raises not only the level of output and employment, but prices and interest rates as well. Crowding-out of private investment occurs, slowing the growth rate of economic capacity.

A rise in the passive deficit, in contrast, reflects a cyclical decline in real GNP and employment. Passive deficit increases do not exert an independent effect on economic activity.[2] Moreover, such deficit increases, in the simple conventional analysis, are typically associated with a decline in interest rates and/or prices, since cyclical declines in real GNP reflect declining demand for goods and services and credit.

There are many linkages in the results above that are open to question. Mainstream macroeconomic conclusions depend heavily on alternative hypotheses about the sensitivity of investment, consumer spending, money demand and aggregate supply to interest rate and price level fluctuations. Depending on these assumptions, considerably different conclusions about the effects of an increase in the active deficit can emerge.[3]

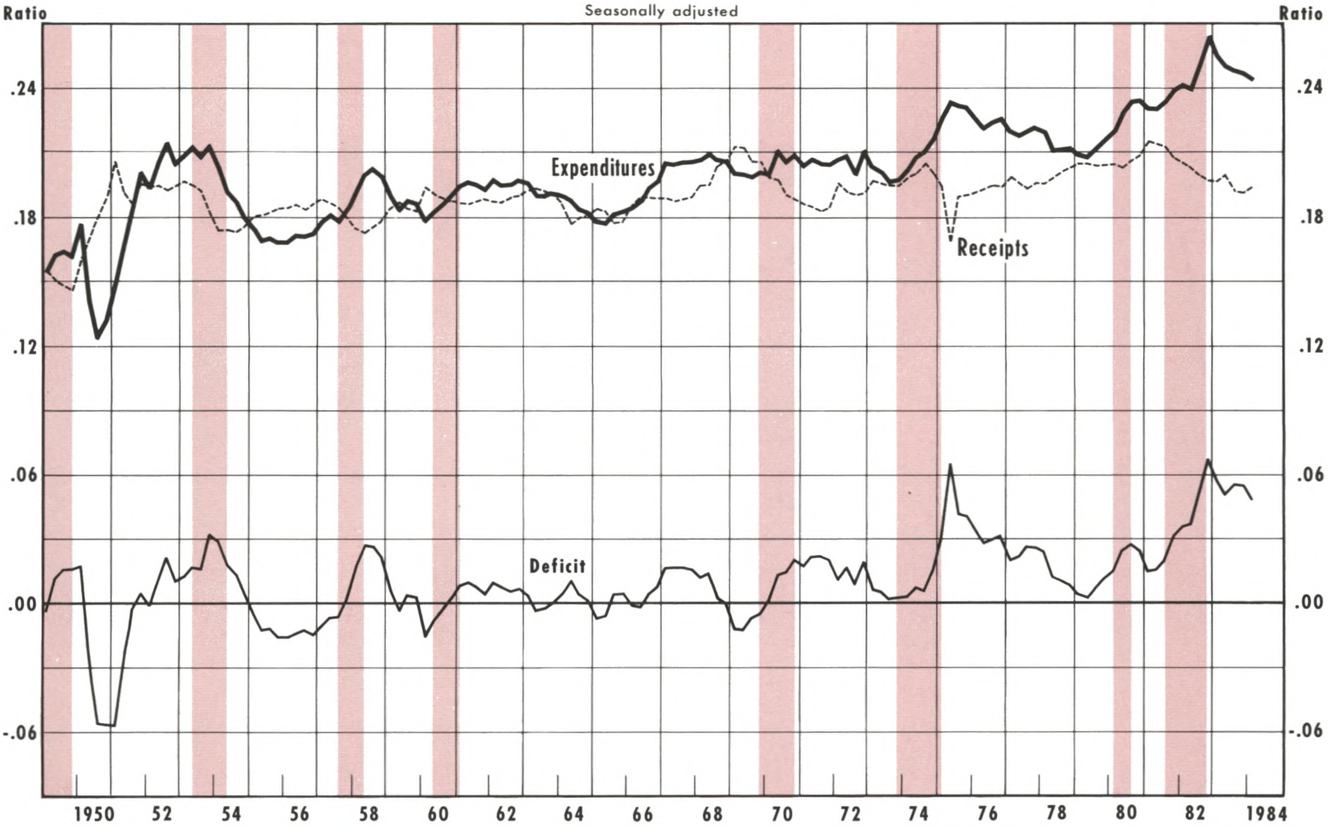
Central to the conventional analysis is the conclusion that an increase in the active deficit raises the demand for goods and services at unchanged prices and interest rates. Even this result is, in principle, problematic. Some analysts emphasize that the demand for goods and services is *not* raised by an increase in the active deficit. Federal spending, they point out, must be financed — if not in the present, then in the future. Thus, households will tend to discount the increased *future* tax liability that arises from an increase in the active deficit. In effect, households match the increased deficit by an equivalent increase

[2]Movements in the passive deficit are endogenous with respect to movements in real GNP, while active deficits are not. A rise in the passive deficit, when real GNP falls, may reduce the extent of the real GNP decline itself and the interest rate decline as well. Those adjustments, however, are endogenous because they are built-in to the structure of the economy.

[3]For illuminating discussions of these issues, see Carlson and Spencer (1975), Cohen and Clark (1984) and Knoester (1983). The latter shows that balanced budget increases in active fiscal policy lead to larger structural unemployment, higher wages and prices, larger future deficits and lower economic growth.

Chart 1

Federal Government Budget as a Share of GNP



Source: National Income and Product Accounts

Shaded areas represent periods of business recessions.
Latest data plotted: 1st quarter

in personal saving (or cut in consumption). Thus, total spending, given interest rates and prices, does not rise.[4]

If such discounting of future taxes occurs, the conventional conclusions about the effects of active deficits fail to hold, except for those concerning crowding-out, capital formation and economic growth. Others have noted the theoretical ambiguity of mainstream theory in this regard.[5] Thus, while the channels of influence of a change in the deficit are clear, especially the importance of the active-passive distinction, the assessment of the effects of a rise in the active deficit remains essentially an empirical question.

RECENT BUDGET TRENDS

The federal budget deficit soared to $147 billion (National Income Account, NIA, basis) in calendar year 1982, then rose to about $183 billion in 1983. Projections for the next several years range from a slight decline to a near doubling by the end of the decade. It is useful to compare the budget developments of the past two years with past trends to gain some understanding of how the deficit became so large.

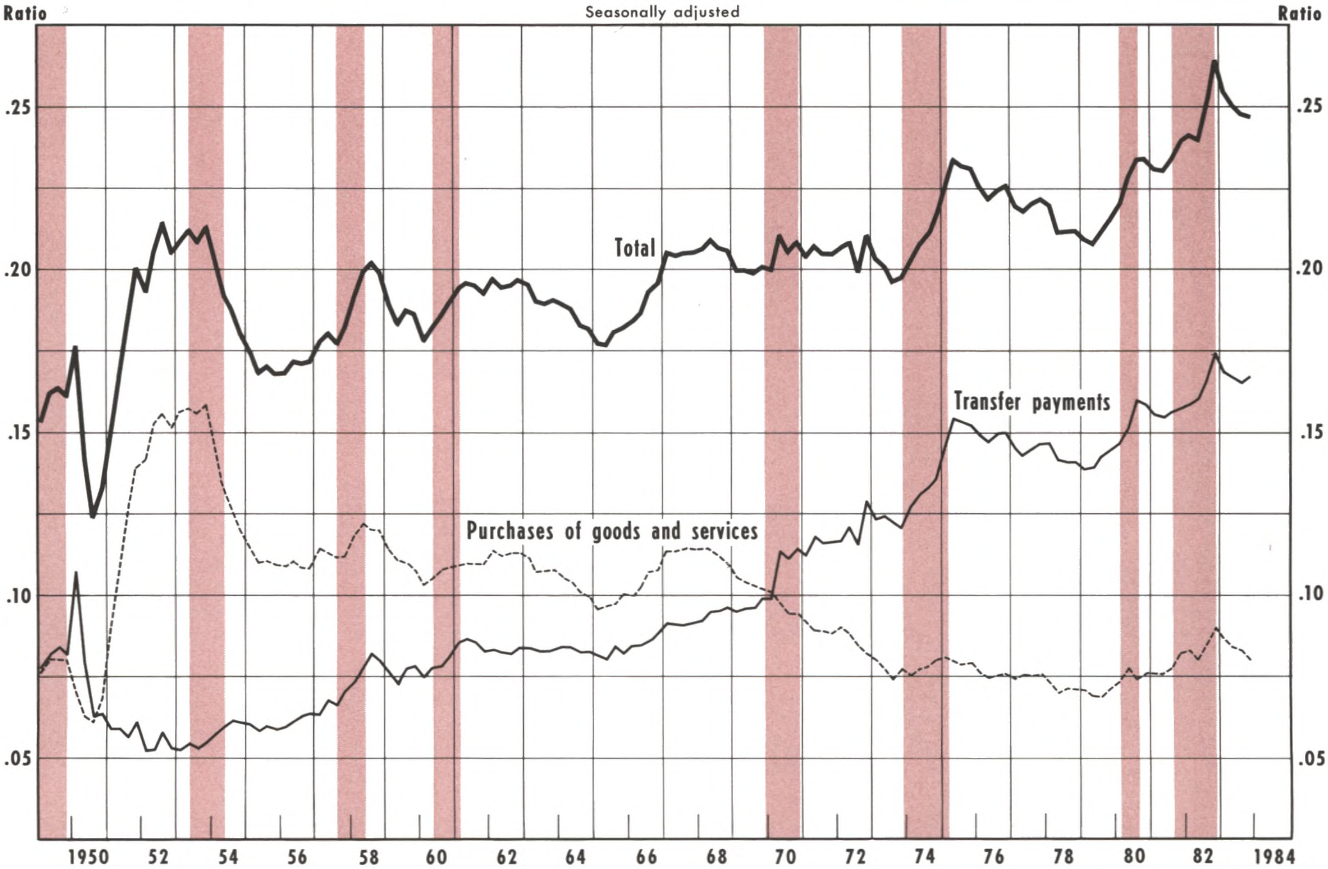
Chart 1 shows the growth of federal spending and receipts as shares of GNP from 1948 to 1983. The deficit, the difference between expenditures and receipts, also is shown as a share of GNP. In the fourth quarter of 1982, the deficit reached a peacetime record 6.7 percent of GNP. While this proportion subsequently declined, it remained above 5 percent through 1983.

The surge in the deficit is associated with an acceleration in federal expenditure growth and a decline in

[4]This result is referred to as the Ricardian Equivalence Theorem. See Barro (1974, 1978), as well as Buchanan and Wagner (1977).

[5]See, especially, the recent analysis by the U.S. Department of the Treasury.

Chart 2
Federal Government Expenditures as a Share of GNP



Source: National Income and Product Accounts
Shaded areas represent periods of business recessions.
Latest data plotted: 1st quarter

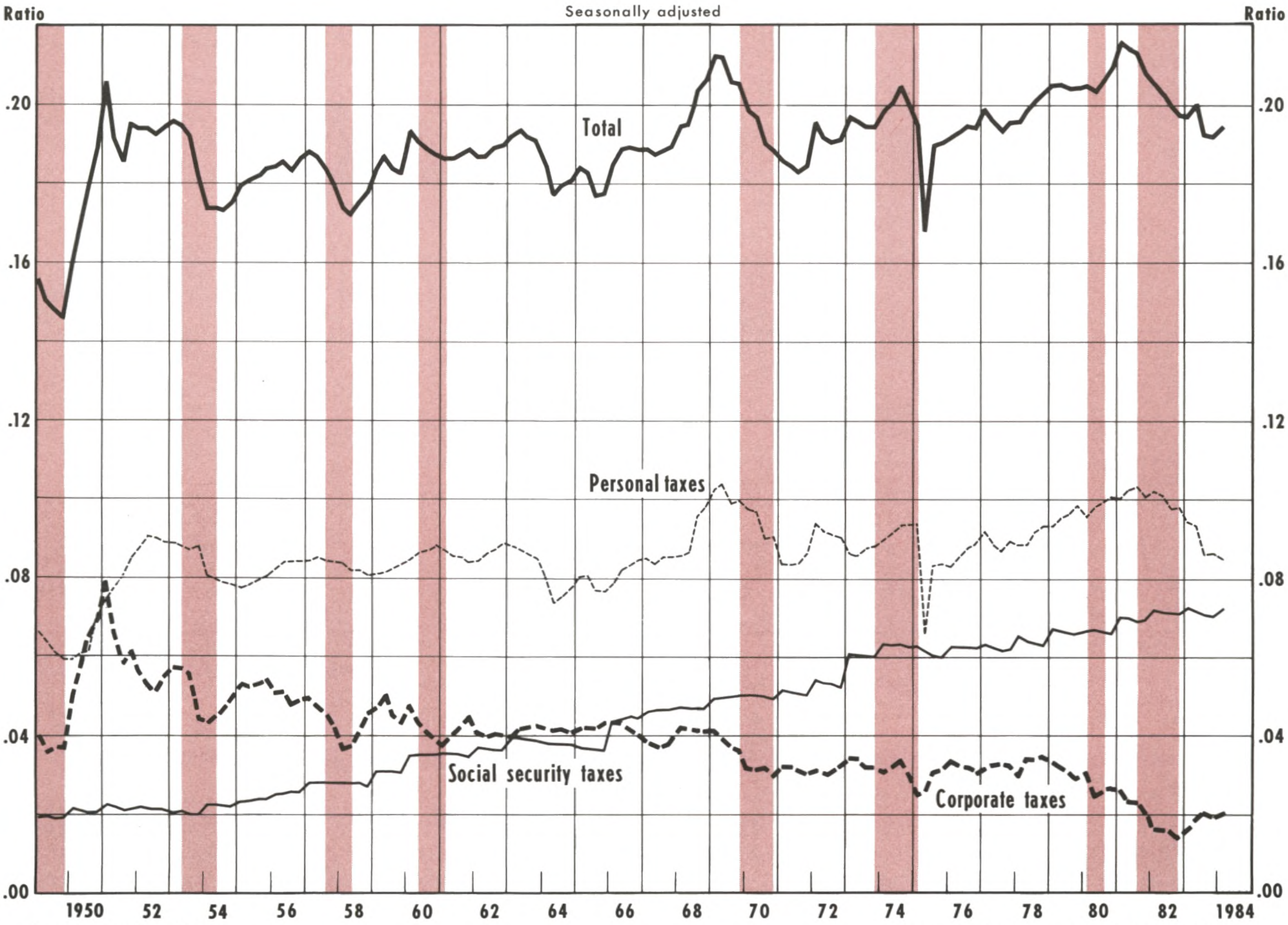
receipts growth, when both are measured relative to GNP. For example, from 1980 to 1983, when GNP grew at a 7.9 percent annual rate, expenditures grew at an 11.1 percent rate and federal receipts rose at only a 6.0 percent rate. As a result, expenditures rose from 22.9 percent of GNP in 1980 to 25.0 percent in 1983, and the share of receipts fell from 20.6 percent to 19.5 percent. Thus, over this time interval, the deficit widened from 2.3 percent to 5.5 percent of GNP.

The Growth of Federal Expenditures

The sharp surge upward in federal expenditures as a share of GNP is shown again in chart 2, where expenditures are broken into two major categories: the purchase of goods and services and transfer payments (including transfers to persons, state and local governments, net interest on the federal debt and subsidies to government enterprises). From 1967 to 1979, the share of expenditures in GNP rose little (except for a temporary spurt in 1975), with the surge in transfer payments almost offset by the decline in purchases of goods and services. Since 1979, however, both components of federal expenditures have risen relative to GNP. Purchases of goods and services rose from 7.0 percent to 8.3 percent of GNP from 1979 to 1983, while transfer payments continued their previous trend of rising faster than GNP, increasing from 14.1 percent to 16.6 percent of GNP.

The pattern of federal purchases of goods and services closely mirrors that of national defense expenditures (not shown), since the remainder, non-defense purchases, has remained about 2 percent to 3 percent of GNP since the early 1960s. National defense purchases, after declining from 1968 to 1979, rose from 4.6 percent of GNP in 1979 to 6.0 percent in 1983. This rise accounts for all of the rise in the share of purchases in GNP, but only 36 percent of the increase in the share of expenditures in GNP and an even smaller percentage of the increase in the deficit measured relative to GNP.

Chart 3
Federal Government Receipts as a Share of GNP



Latest data plotted: 1st quarter

Source: National Income and Product Accounts

Federal Receipts as a Share of GNP

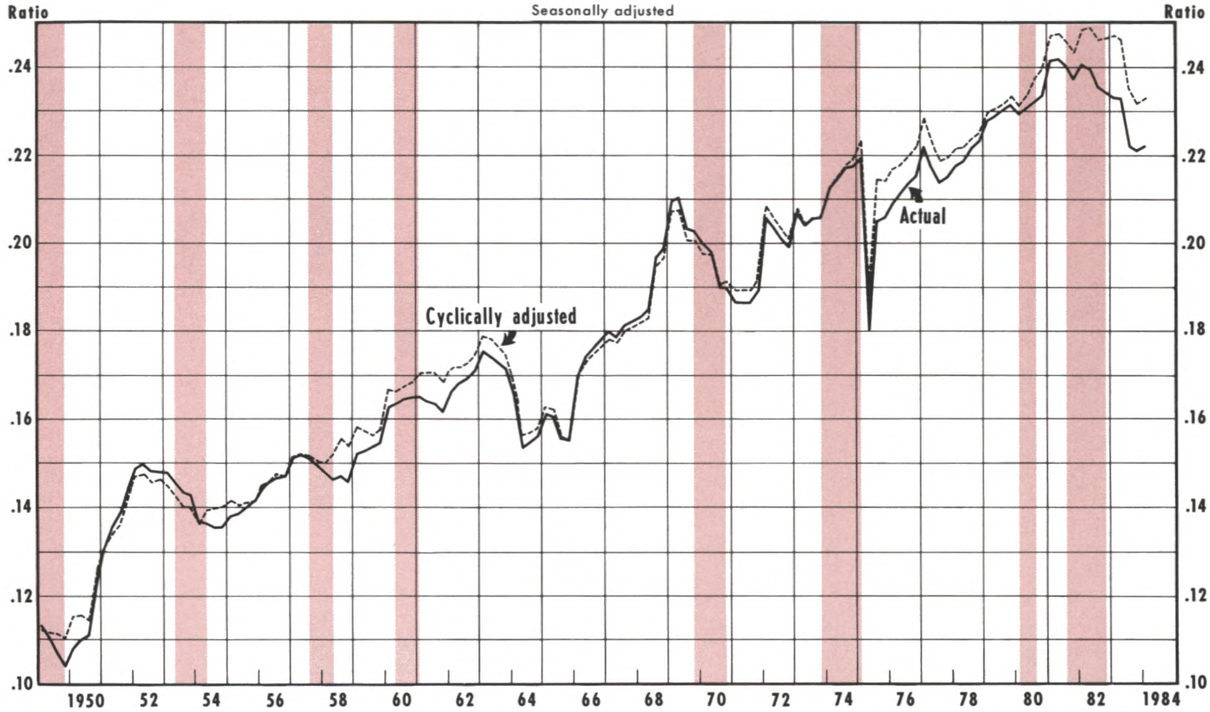
The share of federal receipts in GNP is shown in chart 3 along with its major components: personal tax and non-tax receipts, social security contributions and corporate income taxes. From 1979 to 1983, the share of social security taxes in GNP continued its upward climb, rising from 6.6 percent to 7.1 percent. This increase largely offset the decline in the share of personal taxes from 9.5 percent to 8.9 percent over the same period. Corporate taxes declined from 3.1 percent to 1.8 percent of GNP from 1979 to 1983, a decline that reflected an actual decline in such receipts from $74.2 billion to $59.3 billion. In large part, this was due to a similar percentage decline in corporate profits from $252.7 billion in 1979 to about $207.6 billion in 1983.

The Sources of Recent Deficits

It appears that the recent ballooning of federal deficits has been associated with a combination of adverse budgetary developments rather than a single cause. Expenditures have surged upward relative to the nation's GNP, primarily because of the continued rapid growth of transfer programs such as social security payments, Medicare, unemployment benefits and interest on the national debt. At the same time, receipts have grown more slowly than GNP, largely because of a decline in corporate income and corporate income tax receipts.

Simple explanations that attribute recent deficits to the defense buildup that began in 1979 or to tax cuts

Chart 4
Personal Taxes as a Share of Earned Personal Income [1]



Source: National Income and Product Accounts

[1] Personal taxes include social security taxes. Earned personal income is personal income less transfer payments
Shaded areas represent periods of business recessions.
Latest data plotted: 1st quarter

are inadequate for understanding recent deficits.[6] From 1979 to 1983, growth in the share of defense spending in GNP accounts for only 1.4 percentage points of a 4.8 percentage-point rise in the deficit as a percent of GNP (from 0.7 percent to 5.5 percent). Other expenditures, in particular transfer payments, account for a considerably larger part of the rise.

The tax cut argument is simply wrong. Personal tax rates generally have risen since the passage of the 1981 tax cut, a "cut" that evidently was a poor substitute for indexing (which begins in 1985). Confusion arises because, while tax rates and taxes obviously were cut from levels that they would otherwise have attained, actual tax rates tended to rise from 1980 to 1984. The cut in personal marginal tax rates was largely offset by inflation-induced "bracket creep" and social security tax hikes.[7]

Business tax cuts, provided primarily through accelerated depreciation (the Accelerated Cost Recovery System) substantially reduced effective tax rates on income from new investments, but had only a minor impact on average tax rates or on the real tax burden on business income from 1980 to 1983.[8] The lion's share of the observed decline in corporate income taxes as a share of GNP has been related to the business cycle. Lower tax rates on corporate income and accelerated depreciation have been largely offset by new indirect business taxes. Moreover, the taxation of capital, which arises from the use of historical costs in calculating depreciation in the face of inflation-induced boosts in replacement costs, has continued to increase.

Charts 1–3 show clearly that recent budget developments are largely related to the business cycle. During the shaded recession periods, expenditures (especially transfer programs) typically rise and receipts generally fall relative to GNP. Indeed, with the exception of the 1953–54 recession, when expenditures fell relative to GNP as a result of a sharp decline in national defense

[6] See "How to Cut the Deficit" (1984), p. 50, for example.

[7] See Tatom (1981), McKenzie (1982) and Meyer (1983), for example.

[8] See Hulten and Robertson (1982) and Meyer.

expenditures, this pattern has been observed in each postwar recession. The greater extent of the recent recession has amplified the cyclical swing in the deficit.

A further example of the effect of the cycle on the federal budget is given in chart 4, where a measure of the average tax rate on "earned" personal income is given. Transfer payments are excluded from personal income in the chart, because they are not subject to federal taxes; social security contributions are added to federal personal income taxes, because they are considered to be as direct and personal as income taxes. A cyclically adjusted average tax rate measure also is shown.[9]

The rates in chart 4 provide little indication of the so-called tax cut. The actual rate rose from 22.9 percent in 1979 to 23.1 percent in 1980, then fell slightly to 22.7 percent in 1983. There is some indication of a decline after mid-1982, but the average level for 1983 was virtually unchanged from its 1979 and 1980 levels.

On a cyclically adjusted basis, the evidence that taxes were cut is even weaker. On this basis, the average tax rate rose from 23.1 percent in 1979 to 23.5 percent in 1980 and reached 24.0 percent in 1983. While the tax rate declined somewhat in 1983 from its 1982 level, it was still above its 1980 level, the year before the "tax cut" began.

The 1.3 percentage-point difference between the actual and the cyclically adjusted average tax rates represents a $30.4 billion shortfall in federal receipts based on the level of income in 1983. Moreover, such income would have been substantially higher if the unemployment rate had averaged 5 percent in 1983, instead of the actual 9.6 percent rate. Each percentage point of unemployment is associated with about a 2 to 2½ percentage-point loss in real and nominal GNP and a 2¼ to 2¾ percentage-point decline in personal income less transfer payments.[10] Thus, the loss in personal tax receipts alone in 1983 was about $72 billion, a substantial share of the observed budget deficit.

Chart 5 shows the deficit as a percent of GNP and the high-employment deficit as a percent of high-employment GNP.[11] Typically, the high-employment deficit as a share of high-employment GNP has ranged between plus or minus 2 percent.[12] While actual deficits have risen substantially as a share of GNP since mid-1981, deficits measured on a high-employment basis have remained within that range.[13] For example, using fiscal year periods (ending in the third quarter of each year), the 1.6 percent high-employment deficit registered in 1983 was equaled or exceeded in 1967 and 1968 (1.8 percent and 1.6 percent, respectively).[14]

[9]The cyclical impact on the tax rate is found from the coefficient on unemployment in a regression model of the tax rate. The equation regresses the quarterly change in the actual tax rate on: changes in the unemployment rate lagged one quarter, the inflation rate (GNP deflator), a time trend, dummy variables for the 1964 tax cut (1 in the first and second quarters of 1964) and the 1975 tax rebate (1 in the second quarter of 1975 and minus 1 in the third quarter of 1975) and a constant, for the period I/1950 to IV/1983. When the equation is estimated to III/1981 and then simulated to IV/1983, it is stable and reveals no significant errors. The cyclically adjusted measure "adds back" the decline in the tax rate due to the excess of unemployment over a full-employment unemployment rate of about 5 percent in recent years. The cyclical effect associates a 1 percentage-point increase in the unemployment rate with a 0.25 percentage-point reduction in the average tax rate.

[10]See Tatom (1978) for a discussion of Okun's Law, the relationship of unemployment to the GNP gap. The relationship of personal income (less total transfer payments) to the business cycle was found by regressing quarterly changes in the logarithm of the ratio of such income to GNP on a constant and changes in the unemployment rate adjusted for a high-employment benchmark. The optimal lag is current and two lagged changes; no additional statistically significant information is provided by introducing longer lags. In level form, the sum coefficients indicate that each 1 percent of unemployment reduces the ratio of personal income less transfer payments to GNP by 0.28 percent.

[11]The high-employment budget data are prepared by the Bureau of Economic Analysis, U.S. Department of Commerce, following methods described in deLeeuw and others (1980). Their analysis uses a more disaggregated form of the cyclical adjustment procedure described in footnote 9. The high-employment budget data indicate the point above concerning "tax cuts." In fiscal 1980, the share of high-employment budget receipts in potential GNP was 20.7 percent. This ratio fell only slightly to 20.4 percent in fiscal 1983.

[12]The standard deviation of the high-employment deficit ratio is 1.17 percentage points for the period I/1955 to III/1983.

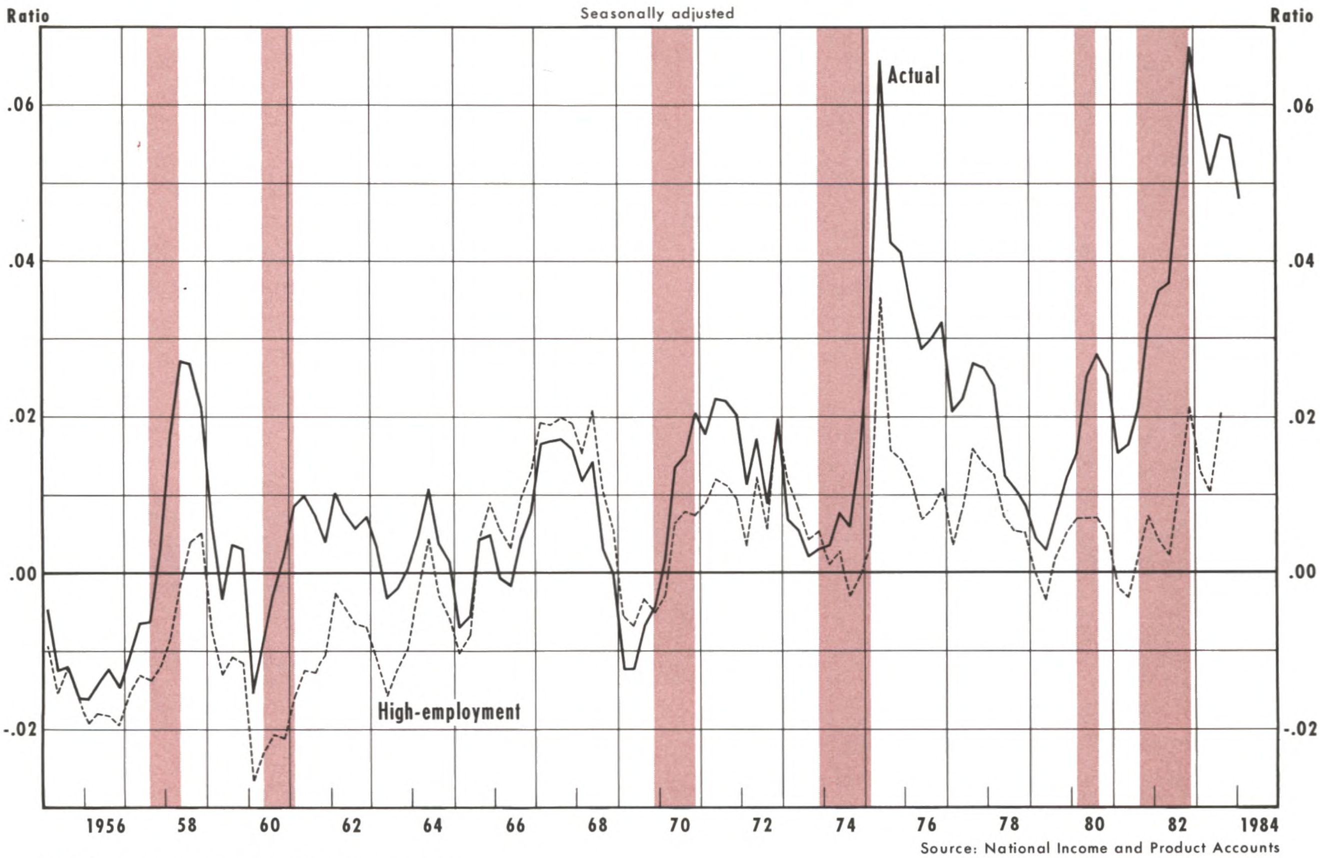
[13]The high-employment and actual deficit ratio are highly correlated (chart 5). This raises the suspicion that either the passive deficit has not been fully removed from the high-employment deficit or that there are cyclical changes in the active deficit; that is, policymakers respond quickly to changes in real GNP with active policies.

These cyclical movements in the high-employment deficit ratio were verified by regressing its changes on changes in the unemployment rate, using quarterly data from II/1955 to III/1983; $(d_t - d_{t-1}) = -0.012 + 0.417\ (UN_t - UN_{t-1})$, where d is the high-employment deficit ratio (deficits measured positively), and UN is the unemployment rate. The t-statistics are −0.2 and 3.07 for the constant and slope, respectively. Lags on the change in unemployment are not significant. A first-order autocorrelation correction is used. The unemployment rate (roughly the excess of the unemployment rate above 5 percent in fiscal 1983) coefficient indicates that an extra 5.1 percent unemployment rate raises the measured high-employment deficit ratio by 2.1 percent, somewhat more than the 1.6 percent ratio observed in fiscal 1983. Thus, it appears that the "true" deficit ratio for 1983 would be near zero but slightly in surplus.

[14]These earlier peaks in the high-employment (and actual) deficit ratio were of great concern to analysts at the time; in particular, they led to the proposal of a temporary income tax surcharge in January 1967 and its passage in mid-1968.

Chart 5

Deficits as a Share of GNP



Shaded areas represent periods of business recessions.
Latest data plotted: High-employment–4th quarter; Actual–1st quarter

THE DEFICIT OUTLOOK: FROM PASSIVE TO ACTIVE DEFICITS?

While recent budget deficits appear to have been largely the result of the 1980 and 1981–82 recessions, projections of future expenditures, receipts and deficits show a different picture. Such projections are shown in table 1, with earlier actual data for comparison purposes.

The first column in table 1 shows the estimated deficit for fiscal years 1983 to 1989, based on the assumptions used in the preparation of the fiscal 1985 budget for the economy on a "current services" basis.[15] The current services budget measures assume that all federal programs and activities in the future remain the same as those adopted for the 1984 fiscal year (ending in September 1984) and that there are no policy changes in such programs.[16] They also incorporate assumptions about future spending, real GNP growth, inflation, interest rates and unemployment.

The projected total deficits remain substantial through 1989, providing support for recent concerns about "large" deficits. Note, however, that relative to the size of the economy or GNP, the actual deficit declines after 1983.

The table also provides a breakdown of the deficit into "cyclical" and "structural" components. This distinction is similar to the high-employment vs. actual deficit categories used previously. In this instance, however, the cyclical deficit arises from the departure of real GNP from its 1969-to-1981 trend, rather than

[15]See Council of Economic Advisers (1984), p. 36.

[16]For a detailed discussion, see Office of Management and Budget (1984), pp. A-1 to A-38.

Table 1
The Cyclical and Structural Components of the Deficit: 1980–89 (dollar amounts in billions)

Fiscal year	Total deficit	Deficit as percent of GNP	Cyclical component	Structural component	Structural as percent of trend GNP	High-employment deficit	High-employment deficit as percent of potential GNP
Actual							
1980	$ 60	2.3%	$ 4	$ 55	2.1%	$16.7	0.6%
1981	58	2.0	19	39	1.3	1.0	0.0
1982	111	3.6	62	48	1.5	20.2	0.6
1983	195	6.1	95	101	2.9	56.8	1.6
Projected[1]							
1984	$187	5.3%	$49	$138	3.7%		
1985	208	5.3	44	163	4.2		
1986	216	5.1	45	171	4.1		
1987	220	4.8	34	187	3.9		
1988	203	4.1	16	187	3.8		
1989	193	3.6	−4	197	3.8		

[1]Deficit estimates for 1984–89 are from the current services budget, January 1984.

from a high-employment level. The structural deficit is the level that would exist if real GNP were at its trend level; the smaller high-employment deficit measures the deficit that would exist were real GNP at a high-employment level.

While the total deficit declines relative to GNP in the table, the structural deficit balloons up relative to GNP until 1985, then remains quite high as real GNP approaches trend. These estimates show an unprecedented rise in the structural deficit and record levels persisting through the decade.

There are a number of reasons for viewing such conclusions with extreme caution. First, estimates of the structural deficit tend to be raised by the use of trend GNP, since it is somewhat below the path of high-employment GNP. The table also includes high-employment measures of the deficit for 1980 to 1983, for comparison purposes.[17] The trend-based estimates of the structural deficit in 1980–83 average about 1.3 percentage points higher than structural deficits that are measured on a high-employment basis.[18] The size of projected structural deficits in the current budget estimates are likely to be similarly overstated; thus, the projections for 1984 to 1989 do not represent a major break from the record shown in chart 5.[19] Adjusted for

[17]High-employment budget measures exist only through the third quarter of 1983, following the methods described by deLeeuw and others. Beginning in December 1983, the Bureau of Economic Analysis switched to a new measure called a "cyclically adjusted" budget. It is not comparable with the earlier series since the benchmark level of GNP is an interpolation of "middle-expansion" phases of the business cycle, at which points unemployment rates have different structural/cyclical components. See deLeeuw and Holloway (1983). This measure also is not comparable to the trend-based GNP measure analyzed by the Council of Economic Advisers (1984) and used in table 1.

[18]The budget data in table 1 are for the unified budget, while the high-employment measures are on an NIA basis. For a discussion of the differences, see Pechman (1983), pp. 17–18. The principal difference is that the unified budget is measured on a cash basis, when outlays or receipts are actually made, while the NIA budget is measured on an accrual basis; that is, receipts are measured by an increase in tax liability, whether paid or not, and expenditures are measured by purchases, whether cash outlays have been made or not.

[19]Barro (1984) arrives at the same conclusion. He develops a model that explains deficits in terms of expected inflation rates, the business cycle and temporary changes in government spending. His estimates for the period since 1920 indicate that 1982–83 deficits and projections for 1984 are consistent with the previous structure and do *not* indicate that there has been a shift in fiscal policy toward higher deficits.

this difference, the projected 1988–89 deficits are slightly more than twice the standard deviation of the high-employment deficit ratio from 1955 to 1983, instead of over three times as large.

Also, the deficits in table 1 are current services estimates. Currently proposed Administration policies would reduce the structural deficit shown for 1989 to about 2.3 percent of actual or, roughly, trend GNP, instead of the 3.8 percent shown in the table.[20]

Third, if actual economic conditions differ from the economic assumptions used for the projections, future deficits could be higher or lower than indicated. Some analysts have been critical of a decline in interest rates assumed in making the projection. If interest rates are higher than projected from 1984 to 1989, the actual and structural deficits would be larger.[21] Others have criticized the projected rate of economic growth as too low; a higher growth rate would lower the actual and projected deficit.[22]

Economic assumptions are extremely important to deficit projections. Carlson (1983) demonstrates, for example, that changes in assumptions about economic conditions for fiscal 1986, between projections made in March 1981 and projections made in January 1983, accounted for most of a nearly tenfold rise in the projected deficit from $21.0 billion to $203.1 billion. Policy changes between the two projections *reduced* the projected deficit by about $39 billion, but downward revisions in the projected levels of prices and real GNP for 1986 raised it by $221 billion.

Even departures from near-term assumptions can have relatively large effects on projected deficits. For example, at the end of July 1983, the Office of Management and Budget (1983) estimated that the unified budget deficit for fiscal 1983, which ended two months later, would show a deficit of $209.8 billion. Two months later, the actual deficit ended up at $195.4 billion, primarily because outlays were about $13 billion lower than estimated two months earlier, when most of the fiscal year had been completed.

THE CONSEQUENCES OF LARGE DEFICITS

Conventional economic theory suggests that rising deficits may tend to raise prices, output and interest rates, while depressing capital formation. Obtaining empirical support for all but the last of these hypotheses has proved quite difficult, however.[23]

In 1981, concern over rising deficits associated with the Economic Recovery Tax Act of 1981 focused on the anticipation that increasing deficits would overheat the economy and raise inflation, just as inflation measures began to plummet and the economy entered the worst recession since the 1930s.[24] Since then, increased attention has been focused on the effect of deficits on interest rates and capital formation during a period in which, until recently, interest rates were declining and capital spending was unusually high relative to GNP.[25] In part, finding evidence on the consequences of deficit increases becomes difficult be-

[20]The Administration proposals would do this by reducing a projected 23.0 percent share of outlays in GNP by 0.9 percentage points and raising the 19.4 percent share of receipts by 0.4 percentage points, reducing the projected actual deficit to 2.3 percent. The proposed spending reductions include paring back 0.2 percentage points of the rise in the share of national defense outlays. The rest of the reduction is in net interest (0.2 percent), social security and Medicaid (0.1 percent) and other transfer payments and non-defense expenditures.

[21]This criticism is subject to a fundamental qualification, however. The assumed lower interest rates from 1984 to 1989 are largely premised upon a decline in inflation. If recent or higher interest rates are assumed because inflation is assumed to be the same or higher, then the impact of the higher interest rates on the interest component of outlays and the deficit would be more than offset by the positive effect of inflation on receipts relative to expenditures.

[22]Foremost among the critics has been the Congressional Budget Office (1984). Its principal departures from the assumptions used by the Administration are that: interest rates decline much less for 1984–89 and real GNP growth is slower in 1986–89. As a result, the deficit generally rises in the CBO projections, from $186 billion in 1984 to $248 billion in 1989.

The CBO does not discuss the structural deficit issue. Nonetheless, under its more pessimistic assumptions the deficit declines as a share of GNP from 6.1 percent in 1983 to 5.2 percent in 1984, to about 5 percent in 1985–87 and to 4.8 percent and 4.6 percent in 1988 and 1989, respectively (p. 2). Moreover, its discussion of the consequences of "large deficits" indicates that financing of such deficits will take a substantially *smaller* share of gross and net private domestic savings in 1984–85 than in 1983 (p. 19).

[23]Carlson (1982) presents evidence supporting the view that deficits crowd-out private sector capital formation.

[24]Hein (1981) explains the shortcomings of the hypothesized link between deficits and inflation. Essentially, as he notes, the fundamental linkage in such a hypothesis is the extent to which deficits are monetized; that is, the share of the deficit financed by the Federal Reserve through money creation, primarily open market purchases of government securities. There has been no such linkage since at least 1974. For a contrasting view, see Hamburger and Zwick (1981, 1982). McMillin and Beard (1982) have pointed to some shortcomings of the Hamburger-Zwick analysis.

[25]Curiously, analyses of proposals to deal with large future deficits by raising taxes or cutting federal spending growth emphasize the effects of such programs in avoiding rising interest rates that purportedly could choke off the current expansion. Higher interest rates resulting from future deficits, to the extent they would occur, are already part of the existing structure of interest rates. Such analyses typically ignore conventional thinking, which emphasizes that such fiscal programs directly retard spending and, hence, expansions, despite any effect of lower interest rates. Kopcke (1983), for example, has emphasized this point.

cause of a failure to account for the active/passive deficit distinction. This problem is most apparent when one looks at the investigation of the deficit-interest rate link.

The actual pattern of deficits and interest rates over the past four years runs counter to the higher-deficit, higher-interest rate hypothesis. Interest rates skyrocketed from III/1979 to III/1981; long-term Treasury security yields, for example, rose from about 9 percent to 14 percent. During the same period, the high-employment deficit for the most recent four quarters fell from about $2 billion to $1 billion, and the actual deficit rose from about $14 billion to $56 billion. Over the next two years (III/1981 to III/1983), long-term Treasury security yields fell from 14 percent to 11.6 percent. Yet, in the latter period, the actual deficit ballooned up to $186 billion and the high-employment deficit rose from near zero to about $57 billion.[26]

A principal difficulty in interpreting these movements in interest rates and deficits is the failure to account for the active/passive deficit distinction. In the past, deficits have been in large part passive, as chart 5 indicates. Thus, it is not surprising that, during and following periods of recession, deficits were rising or "high," and interest rates were falling or remained "low." The dominance of this negative cyclical relationship between passive deficits and interest rates interferes substantially with empirical investigations of the impact of deficits on interest rates. An example of this confusion is detailed in the insert on pages 16 and 17.

The second problem with testing the interest rate-deficit hypothesis is that the U.S. economy has had only limited peacetime experience with either large or variable active deficits, measured relative to GNP. As chart 5 indicates, deficits or surpluses rarely have exceeded 2 percent of GNP on a high-employment basis.

Thus, should future federal structural deficits be larger than they were in the earlier postwar experience, past empirical evidence would provide little guidance concerning the potential adverse effects on inflation and interest rate levels. Although past evidence suggests there are none, the economy has had no peacetime experience with large, persistent structural deficits, as some analysts have suggested will occur from 1983 to 1989. Thus, the past may offer little relevant evidence for assessing the future effects of deficits. Of course, financial market participants have been warned of the potential magnitude of future deficits and, to the extent such deficits could be expected to raise interest rates, such effects already should have been incorporated into the structure of rates. Interestingly enough, however, interest rates have generally fallen since late 1981, even though it has been only since then that the adverse deficit information began to be discerned and disseminated.

[26]Another such striking parallel occurred in fiscal 1975 (measured here as IV/1974 to III/1975) when the deficit ballooned to $58.4 billion from $6.9 billion in fiscal 1974. This set a postwar record, exceeding even the 1943 budget deficit of $54.9 billion. As a share of GNP, the 3.8 percent 1975 deficit also set a postwar record, not exceeded until fiscal 1982. Nonetheless, 3-month Treasury bill rates fell from about 9 percent in the fall of 1974 to about 5.5 percent at the end of 1975. See Carlson (1976) and Lang (1977) for a discussion of this episode.

SUMMARY

In 1982–83, federal deficits surged to triple-digit levels. Moreover, administration and CBO projections indicate they will remain so, at least through 1989. These deficits have arisen from the unsatisfactory cyclical performance of the U.S. economy. Typically, federal expenditures are raised when unemployment is higher and tax receipts are lower. Recessions in 1980 and 1981–82 have left the unemployment rate at unusually high levels since 1980. Suggestions that either a rise in defense spending or cuts in tax rates have played major roles in the creation of recent deficits are misleading.

Projections tend to show deficits declining as a share of GNP, but structural deficit projections show a worsening trend in 1984–85 and little improvement in 1986–89. Should the current cyclical deficit be transformed into a structural deficit, it is not clear what consequences such a development would have. There is little evidence supporting the adverse consequences of a sharp increase in the structural deficit. The lack of such evidence, however, may arise from the fact that the United States has had no experience with "large" peacetime structural deficits.

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Interest Rates and the Deficit: 1955–83

When the level of interest rates is related to the size of the deficit, measured relative to GNP, the relationship is generally negative instead of positive, as is often conjectured. Moreover, the negative relationship is often statistically significant. This result arises because of the simultaneous occurrence of cyclical deficit increases and recession-related decreases in interest rates, especially short-term interest rates.

This pattern clearly emerges in an examination of quarterly changes in both the 3-month Treasury bill rate and the Aaa bond yield for the period II/1955 to III/1983 and the subperiods II/1955 to IV/1969 and I/1970 to III/1983. These changes were regressed on current and past changes in the actual federal deficit-GNP ratio and on current and past changes in the high-employment deficit/potential GNP ratio. Although up to four past quarterly changes were examined, no lagged values were statistically significant in either case. The table shows the equations for each interest rate, for each period, for each deficit-GNP ratio.[1]

[1]The omission of other variables that influence interest rates does not bias the coefficient estimate of the effect of the deficit on interest rates unless the changes in the omitted variables are correlated with changes in the deficit ratio. For example, failure to control for an effect of the rate of money growth on interest rates does not bias the coefficient estimates here unless changes in money growth are correlated with changes in the deficit ratio. For the periods examined, they are not. The simple correlation coefficient for changes in M1 growth and in the actual deficit ratio is −0.12 in all three periods. The coefficient for changes in M1 growth and the high-employment deficit ratio is −0.15 for the 1955-to-1969 period, −0.10 for the 1970-to-1983 period, and −0.11 for the full period. None of these correlation coefficients are statistically significant at a 95 percent confidence level. Plosser and Schwert (1978) provide a useful discussion of the advantages and limitations of differencing in assessing economic relationships.

In virtually every case, a rise in the actual or high-employment deficit is inversely related to the level of interest rates, though not, in most cases, statistically significant. In all three periods, increases in the *actual* deficit-GNP ratio are significantly associated with lower 3-month Treasury bill rates. Each 1 percentage-point increase in the actual deficit-GNP ratio is estimated to lower interest rates by 21 to 53 basis points. The negative effects of the actual deficit on the long-term rate, the Aaa bond yield, are not significantly different from zero.

Surprisingly, the results were little changed after controlling for the impact of the business cycle by using the high-employment deficit ratio. The effect on long- and short-term rates of a rise in the high-employment deficit ratio generally remained negative, but not significantly different from zero. As expected, the magnitude of the interest rate effect is less negative than for the actual deficit ratio. The negative relationship may arise because the techniques used to measure the high-employment deficit fail to fully remove cyclical influences.[2]

These results illustrate the difficulty of identifying the effects of deficits on the economic performance when the passive/active deficit distinction is ignored. Taking the distinction into account, however, still does not support the conventional proposition that there is a positive link between deficits and interest rates.

[2]When the high-employment deficit ratio is cyclically adjusted following the equation in footnote 13 in the text, the point estimate of the effect of changes in this adjusted deficit on interest rates becomes more positive. For the Aaa bond yield, the coefficient on such an adjusted deficit is 0.01 in all three periods, but this positive relationship is not statistically significant (the t-statistic is below 0.3 in all three cases). The effect on the Treasury bill rate is positive in the 1955-to-1969 period but insignificant: 0.13 (t = 1.29); in the later sample and for the full period, the Treasury bill effect remains negative and is statistically insignificant (t-statistics less than 0.70 in absolute value).

Interest Rates and the Federal Deficit

Dependent variable	Period	Deficit and GNP measure	Constant	Change in the deficit ratio	$\bar{R}^2$	SE	DW	ρ
Change in 3-month Treasury bill rate	II/1955–III/1983	actual	0.092 (1.10)	−0.419 (−3.81)*	0.11	0.885	1.92	—
	II/1955–IV/1969	actual	0.104 (1.89)	−0.213 (−2.41)*	0.08	0.422	1.63	—
	I/1970–III/1983	actual	0.090 (0.56)	−0.530 (−2.85)*	0.12	1.198	1.98	—
	II/1955–III/1983	high-employment	0.077 (0.88)	−0.277 (−1.98)*	0.03	0.924	1.78	—
	II/1955–IV/1969	high-employment	0.107 (1.30)	0.053 (0.50)	−0.01	0.418	1.73	0.35 (2.82)
	I/1970–III/1983	high-employment	0.051 (0.30)	−0.394 (−1.66)	0.03	1.255	1.84	—
Change in Aaa bond yield	II/1955–III/1983	actual	0.088 (1.89)	−0.069 (−1.50)	0.01	0.374	1.95	0.25 (2.67)
	II/1955–IV/1969	actual	0.079 (2.78)	−0.047 (−1.51)	0.02	0.146	1.77	0.34 (2.60)
	II/1970–III/1983	actual	0.103 (1.12)	−0.079 (−1.00)	0.00	0.523	1.95	0.23 (1.74)
	II/1955–III/1983	high-employment	0.085 (1.81)	−0.031 (−0.57)	−0.01	0.378	1.94	0.25 (2.68)
	II/1955–IV/1969	high-employment	0.079 (2.66)	−0.012 (−0.33)	−0.02	0.149	1.74	0.36 (2.79)
	IV/1969–III/1983	high-employment	0.096 (1.04)	−0.038 (−0.42)	−0.01	0.527	1.94	0.23 (1.73)

NOTE: t-statistics are given in parentheses; * indicates a deficit measure whose coefficient is significantly different from zero at a 95 percent confidence level.

Money, Debt and Economic Activity

R. W. Hafer

THE Federal Open Market Committee (FOMC) decided in October 1982 that, at least for the immediate future, less importance would be attached to movements in the narrowly defined monetary aggregate (M1) in establishing monetary policy. This departure from previous policy was motivated primarily by increasing expectations that the introduction of Super-NOW accounts would distort M1's usefulness as a reliable policy guide.

The notion that M1 may not be appropriate as the intermediate target measure is not confined to the period since 1982. Some economists long have argued that policy should not be based on a single variable, but on a variety of "informational" variables. If one target variable displays "abnormal" behavior, other target variables can be consulted for similar irregularities. Rather than basing policy on a target variable gone astray, policymakers can thus evaluate a diverse set of information and assign the proper weight to each intermediate target variable.[1]

Suspicion of recent distortions in M1 has prompted some economists to suggest that the Federal Reserve target a broad debt measure.[2] Their argument against too heavy a reliance on monetary measures is that such measures capture only the asset side of the nonfinancial sector's financial balance sheet; information from the liability side is being overlooked. Consequently, charting the path of a broad debt measure in addition to a monetary aggregate, they argue, will provide policymakers with information not revealed solely by money growth. Partially in response to these arguments, the FOMC at its February 1983 meeting established a monitoring range for the growth of total domestic nonfinancial debt.

This paper investigates the usefulness of adding this debt measure to the collection of targets already used to decide the direction of monetary policy.[3] Because any variable used as an intermediate target should be closely related to the goal of monetary policy, we will first compare how well the growth rates of M1 and debt explain the behavior of GNP growth in the past two decades.[4] We also will compare each measure's ability

R. W. Hafer is a senior economist at the Federal Reserve Bank of St. Louis. Larry J. DiMariano provided research assistance.

[1]Kareken, Muench and Wallace (1973), for example, conclude that the monetary policymakers should use all the information variables to which they have access. To some extent, knowledge of economic activity does play an important role in the FOMC's decision calculus. One need only read the "Record" of the FOMC meetings to see the extent to which economic conditions, such as real economic activity, price developments and recent changes in interest rates, influence monetary policy decisions. On the question of using several intermediate targets, Kane (1982), p. 204, draws the opposite conclusion: "I doubt very much that systems that employ a multiplicity of intermediate targets constitute efficient ways to organize decisions about monetary policy."

[2]This position has been argued by Benjamin Friedman in a series of papers (1981, 1982, 1983a). See also Kopcke (1983) and Morris (1982, 1983) for further arguments in favor of using the broad debt measure.

[3]The analysis in this paper draws on Hafer (1984a), where the issue is investigated in greater detail using a variety of statistical tests.

[4]During the past 20 years, numerous papers have investigated this link between different monetary measures and GNP: see, among others, Friedman and Meiselman (1963), Hamburger (1970), Carlson and Hein (1980), Hafer (1981), and Judd and Motley (1983).

Another feature of an intermediate target, one that is not dealt with in this paper, is that it should be controllable by the policymaker. In to forecast GNP growth during the 1982–83 period. Forecasts of GNP using an M1 measure that abstracts from recent financial innovations that may have distorted M1 growth (here called adjusted M1) also are reported. The evidence reveals that there is insufficient evidence to support the usefulness of the debt measure relative to two measures of narrowly defined money as a potential intermediate target for monetary policy.[5]

TOTAL DOMESTIC NONFINANCIAL DEBT

Total domestic nonfinancial debt, put simply, is a measure of the credit market debt owed by domestic nonfinancial sectors of the U.S. economy. As the definition suggests, the measure excludes debt owed by financial institutions, including U.S. government-sponsored credit agencies, federally related mortgage pools and private financial institutions. It also excludes trade debt, loans for the purpose of carrying securities and funds raised from equity sources. On the other hand, the debt measure includes debt securities, mortgages, bank loans, commercial paper, consumer credit and government loans owed by nonfinancial sectors.

Table 1 presents a summary of the composition of this debt measure by major sector as of IV/1983. In that quarter, total domestic nonfinancial debt stood at $5,218.96 billion. Of this amount, debt owed by the household sector and nonfinancial businesses accounted for 70 percent of the total. The government sector owes the remainder, with the U.S. government sector's share being about three times that of state and local governments.

Table 1
Total Domestic Nonfinancial Debt: IV/1983 (billions of dollars)

	Amount	Percent of total
U.S. Government	$1,177.95	23%
State/Local Government	395.54	8
Households	1,832.21	35
Nonfinancial Business	1,813.26	35
Total	$5,218.96	

NOTE: Total does not equal 100 percent due to rounding.

As shown in chart 1, the relative shares of the total debt measure owed by the various sectors have changed over time. For example, in 1960, the share of total debt accounted for by households and nonfinancial businesses was about 30 percent and 27 percent, respectively. By 1983, their shares each had risen to about 35 percent of the total. The proportion of debt owed by state and local governments has remained relatively unchanged during the past 20 years, declining from about 10 percent in 1960 to around 8 percent in 1983.

During the same period, however, the percentage of total debt accounted for by the U.S. government has varied considerably. From 33 percent in 1960, the U.S. government's share dropped to about 17 percent in 1974. Since then, it has increased to nearly 24 percent.

WHICH EXPLAINS ECONOMIC ACTIVITY BETTER: M1 OR DEBT?

Those who advocate the use of a debt measure as a target variable have presented evidence indicating that the level of debt relative to the level of GNP (debt velocity) has been relatively constant over the past few decades, in contrast to the M1-GNP relationship. They argue that the stable relationship between debt and GNP can be exploited for policy decisions.[6] If the goal of monetary policy is to achieve some desired growth of

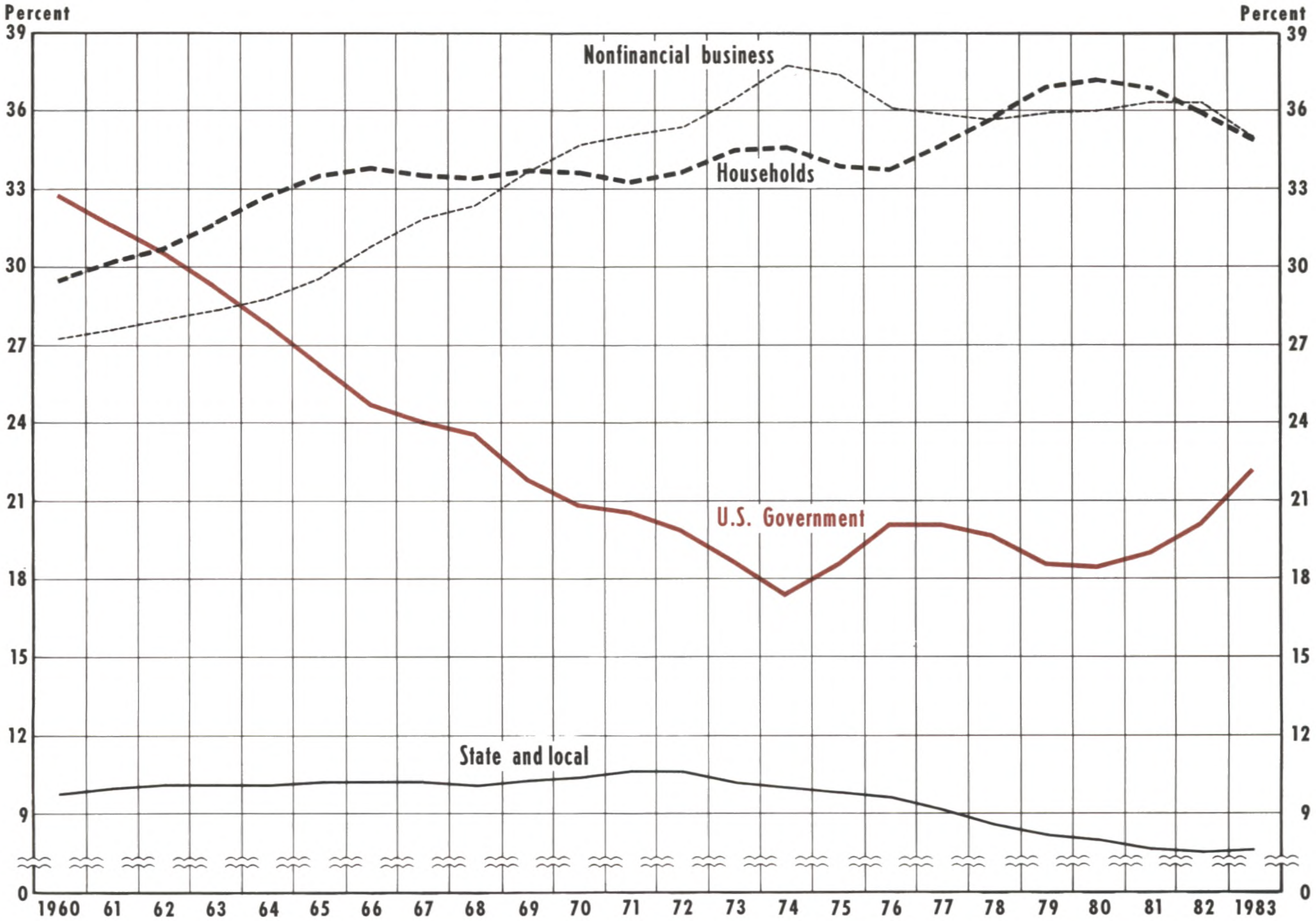
other words, changes in the "tools" of monetary policy, that is, changes in open market operations, reserve requirements and the like, should have reliable consequences on the intermediate target. Thus, although a measure may be closely related to the goal variable, this is of little solace if it is uncontrollable. Some evidence on the controllability of debt with respect to M1 is presented in Friedman (1983a) and Kopcke. Kopcke's evidence, based on one-, two- and three-month-ahead forecasts of an M1 and debt multiplier, suggests that the forecast errors of the debt multiplier are not offsetting as they are for the M1 multiplier. For example, the average error for the one-month-ahead forecasts for the period November 1979 through June 1982 are 0.06 percent for M1 and 0.23 percent for debt. When two- and three-month forecast horizons are used, the debt multiplier's average forecast error is at least twice that for M1. Although the mean absolute value of the two series' forecast errors are similar, the relative biasedness of the debt multiplier's forecasts could, if used for policy, produce incorrect signals. This is especially true because, as Kopcke notes, the debt data are available only with a lag, while the M1 data are calculated on a weekly basis. Moreover, there appear to be large revisions in the debt data unmatched by any of the relevant monetary measures.

[5]A similar conclusion is reached by Porter and Offenbacher (1983), and Davidson and Hafer (1983).

[6]See, for example, the evidence presented in Friedman (1981, 1983a,b) and Kopcke.

Chart 1

Composition of Domestic Nonfinancial Debt



nominal GNP through the use of intermediate growth targets, however, the salient question is how well do the *growth* of M1 and debt explain variations in the *growth* of GNP? This issue is critically important in the selection of a viable intermediate target measure.

To investigate this issue, a variant of the St. Louis reduced-form GNP equation is used.[7] This equation relates the growth of nominal GNP to a measure of monetary actions, fiscal actions, changes in the relative price of energy and a measure to account for lost production due to labor strikes. By substituting the debt measure for M1 in the equation, we are able to compare the two measures' ability to explain movements in GNP growth.

Equations of the form described above were estimated using seasonally adjusted, quarterly data for the period I/1960–IV/1981. This sample period is used because it predates the 1982–83 period in which many believe M1's usefulness as an intermediate target declined considerably. Thus, our sample period enables us to compare each measure's relative capabilities in explaining GNP during an "untroubled" time. Also, these estimates can be used to forecast GNP growth to see whether the debt measure better predicts GNP during the perplexing 1982–83 period. Summary results of the estimations are presented in table 2.[8]

[7]The basic equation is described in Tatom (1981). The model is written as:

$$\dot{GNP} = \alpha_0 + \beta_1 \sum_{i=0}^{M} m_i \dot{M}_{t-i} + \beta_2 \sum_{j=0}^{N} g_i \dot{G}_{t-j} + \beta_3 \sum_{k=0}^{Q} pe_k \dot{P}^e_{t-k} + \beta_4 S_t + \varepsilon_t$$

where M represents money, G is high-employment federal expenditures, P^e is the relative price of energy and S is the strike variable. The dots above each measure denote rates of change, measured here as logarithmic differences.

Table 2
Regression Results for GNP Equations I/1960–IV/1981

Variable	Intermediate Target and Lags Used: M1	Lag	Debt	Lag
Constant	3.285 (3.03)		−1.961 (1.43)	
Strike	−0.580 (3.36)		−0.546 (3.03)	
$\Sigma\dot{X}_i$	1.266 (8.13)	3	1.148 (6.92)	0
$\Sigma\dot{G}_j$	−0.192 (1.39)	10	0.088 (1.97)	0
$\Sigma\dot{P}^e_k$	0.019 (0.45)	5	−0.530 (0.96)	11
$\bar{R}^2$	0.59		0.54	
SE	2.64		2.79	
DW	2.12		2.21	

NOTE: Absolute value of t-statistics appear in parentheses. $\bar{R}^2$ is the coefficient of determination adjusted for degrees of freedom; SE is the regression standard error; and DW is the Durbin-Watson test statistic.

Turning first to the results based on M1, we find that the equation accounts for about 60 percent of the variation in GNP growth. The regression results indicate that a 1 percentage point increase in M1 growth produces a 1.3 percentage point increase in the growth of GNP after three quarters. Although this estimated "long-run" effect is somewhat larger than the usual value of unity, a test of the hypothesis that this estimate does not differ statistically from one could not be rejected at a standard 5 percent level of significance.[9] The familiar result that fiscal actions exert no lasting effect on GNP growth is revealed in the estimated coefficient: the summed coefficient's value of −0.19 is not statistically different from zero at the 5 percent level.[10] Finally, the results indicate that the long-run effect of a change in the relative price of energy is zero, as theory predicts, and that days lost due to work stoppages have a significant, negative impact on the growth of GNP.

The second set of regression results reported in table 2 replaces M1 growth with the growth of total domestic nonfinancial debt. It is interesting to note that the lag-length selection procedures chose only contemporaneous values of debt growth. The estimated coefficient on this term is 1.15, indicating that a 1 percentage point increase in the growth of debt translates into a 1.15 percentage point increase in nominal GNP growth *in the same quarter*.[11] Although we again find that the cumulative effect of the change in the relative price of energy is not statistically different from zero ($t = 0.96$), the result for fiscal actions suggests a marginally significant contemporaneous effect ($t = 1.97$). This effect is, however, quite small in magnitude: a 1 percentage point increase in the growth of government expenditures yields only a 0.09 percentage point change in GNP growth. Moreover, because of the contemporaneous nature of this result, it is difficult to translate this finding into a meaningful long-run outcome.

A comparison of each equation's overall explanatory power indicates that M1 outperforms debt in explaining variations in GNP growth. The $\bar{R}^2$ of the estimated equation using M1 (0.59) is about 10 percent higher than that using debt (0.54). This difference, however, is not large and has led some to argue that this relative closeness does not preclude the usefulness of debt as an additional policy variable. As Benjamin Friedman has stated the case, "the evidence does not warrant including the money market but excluding the credit market on the grounds of the closeness, or lack thereof, of the observed empirical relationships."[12]

Of course, a comparison of relative explanatory power of GNP equations using M1 or debt may not provide an adequate test of their relative abilities to explain GNP. A more appropriate test would be to compare their marginal informational content. In other words, after we have accounted for the effects of M1 (debt) growth on GNP, is there any statistically significant, *additional* explanatory power gained by adding debt (M1) growth to the equation?

To test this notion, a contemporaneous debt growth term was added to the M1 equation shown in table 2. This expanded equation then was compared statistically to the previously estimated M1 equation. The result reveals that adding debt growth does not en-

[8]The equation is estimated using ordinary least squares. The lag lengths M, N and Q in footnote 7 were determined using several statistical tests: Mallows Cp, Akaike's Final Prediction Error criteria and the Pagano-Hartley procedure. Where lag lengths selected by the procedures differed, F-tests were used to pick the best lag for each variable. For further discussion of these lag length selection procedures as they apply to this type of specification, see Batten and Thornton (1984).

[9]The calculated t-statistic is 1.71.

[10]Evidence on the long-run insignificance of fiscal actions on GNP is investigated more fully in Hafer (1982).

[11]Testing the hypothesis that the estimated coefficient on debt equals unity yields a t-statistic of 0.89. Thus, we cannot reject the null hypothesis that the coefficient equals one.

[12]Friedman (1983b), p. 186.

hance M1 growth in explaining the growth of GNP: the calculated F-statistic was 1.72, far below the 5 percent critical value of 3.99. The reverse test, that of adding a contemporaneous and three lagged terms of M1 to the debt equation in table 2, also was performed. The calculated F-statistic was 3.33, large enough to exceed the 5 percent critical value of 2.50.

These results demonstrate that the apparent closeness in explanatory power between reduced-form GNP equations using M1 or debt derives from the close relationship between these two measures; that is, debt growth reflects the behavior of M1 growth when the latter is absent from the estimated equation.[13] Once the effects of M1 growth are estimated directly, the debt growth measure is redundant; it contains no additional statistically useful information.

M1 AND DEBT: THE 1982–83 EXPERIENCE

Some have argued that there has been a dramatic breakdown in the money-GNP link during the last two years and, therefore, the use of another, nonmonetary intermediate target is required. Presumably, the debt measure would not be subject to the same changes in its relationships with GNP; consequently, it would be a more reliable intermediate target. To test this presumption, we compare the behavior of M1 and debt velocity growth rates since the recession trough (IV/1982) with historical patterns to see how well the equations estimated earlier forecast movements in GNP during the 1982–83 period.

Velocity Behavior of M1 and Debt during the Recovery

The recent behavior of velocity growth has been cited as an illustration of the supposed deterioration in the money-GNP link.[14] To put velocity behavior in a historical perspective, the quarterly growth rates of M1 velocity in the trough quarter and the following four quarters for the most recent and four previous recessions are listed in the upper panel of table 3.

The most recent behavior of M1 velocity (IV/1982) clearly has been slower than the "average" recovery phase. The negative growth of velocity during the trough quarter and one quarter into the recovery are unmatched in the sample. The behavior of M1 velocity during the next three quarters also diverge from the average. Moreover, the average growth of M1 velocity during the four quarters after the trough was 5.36 percent during the previous four recoveries. In contrast, M1 velocity growth since IV/1982 has averaged only a 0.45 percent rate of growth.

The behavior of debt velocity during the current recovery, reported in the middle panel of table 3, also appears unlike its average post-trough period. Following the IV/1982 trough, debt velocity growth, like M1 velocity growth, was considerably below the average rate for several quarters. For example, the average rate of growth for debt velocity in the year following the trough was 2.06 percent. During the first year of the recent expansion, debt velocity growth averaged a negative 0.27 percent rate.

The most recent experience is not without historical comparison, however. The recovery following the 1970 recession, for example, reveals a substantial decline in debt velocity well into the expansion phase of the cycle. Thus, the debt measure does *not* seem to be a relatively more stable guide to GNP behavior than M1 during the past few years.

Velocity Using an Adjusted M1 Measure

Several recent studies have suggested that the problem with the M1 velocity behavior during the recent recovery is that "effective" money growth — growth that represents increases in transaction-oriented holdings — has been overstated because of financial innovations like the Super-NOW accounts introduced in January 1983.[15] One approach to investigate this concern is to use an adjusted M1 measure that excludes accounts with the dual characteristics of transaction and savings accounts.[16]

When this adjusted M1 measure is used to calculate velocity growth during the recent recovery, the results are considerably different. For example, as shown in the lower panel of table 3, adjusted M1 velocity growth

[13]This result gains further credence if one examines the causal relationship between M1 growth and debt growth. As reported in Hafer (1984a) using a slightly different sample period, the evidence overwhelmingly indicates that M1 growth Granger-causes debt growth. Also, evidence based on the lag length selection procedures indicates that, when M1 and debt growth are included in the GNP equation, no debt terms are significant.

[14]Analyses of the recent behavior of velocity include, among others, Hein and Veugelers (1983), Judd (1983) and Tatom (1983).

[15]See, for example, Judd and McElhattan (1983) and Hafer (1984b).

[16]The approach taken here follows Hafer (1984b); that is, the adjusted M1 measure omits interest-bearing checkable deposits. This approach admittedly overstates the savings nature of interest-bearing checkable deposits relative to the more sophisticated techniques of, say, Spindt (1984).

Table 3
Velocity Growth During Recovery

	Recession Trough	Quarters after trough 0	1	2	3	4
M1	II/1958	−1.02	7.85	6.52	3.11	7.93
	I/1961	0.53	5.49	4.47	7.00	5.91
	IV/1970	−4.96	8.81	−1.01	−0.27	3.22
	I/1975	−1.11	3.68	8.55	7.64	6.86
	Average	−1.64	6.46	4.63	4.37	5.98
	IV/1982	−12.64	−4.67	1.02	1.54	3.91
	Recession Trough					
DEBT	II/1958	−3.17	8.70	2.13	0.58	2.88
	I/1961	−1.38	3.52	−0.86	4.22	1.73
	IV/1970	−4.79	8.19	−2.43	−3.42	−2.39
	I/1975	−5.67	1.56	6.25	0.59	1.66
	Average	−3.75	5.49	1.27	0.49	0.97
	IV/1982	−6.56	−0.72	0.56	0.87	−1.80
	Recession Trough					
ADJUSTED M1	II/1958	−1.02	7.85	6.52	3.11	7.93
	I/1961	0.53	5.49	4.47	7.00	5.91
	IV/1970	−5.15	8.92	−0.96	−0.28	3.22
	I/1975	−0.93	3.81	8.63	7.82	7.21
	Average	−1.64	6.52	4.66	4.41	6.07
	IV/1982	−6.72	3.08	5.80	5.12	5.35

in the IV/1982 trough quarter is −6.7 percent, compared with −12.6 percent using M1. The average adjusted M1 velocity growth rate in previous troughs is −1.64 percent. During the four quarters after IV/1982, the growth of adjusted M1 velocity averages 4.84 percent per quarter, compared with the 5.42 percent average quarterly rate from previous recovery phases. In contrast, the growth rate of M1 velocity as currently defined averages only 0.45 percent during the four quarters after the IV/1982 trough. Thus, relative movements in debt velocity during the post-IV/1982 recovery suggest that the behavior of an M1 velocity measure that reduces the influence of financial innovations during the post-IV/1982 period is much closer to previous norms.

Forecasting GNP

A common technique used to assess the viability of alternative target variables is to examine the accuracy of out-of-sample forecasts of economic activity. Based on the coefficient estimates underlying the results reported in table 2, quarterly forecasts of GNP growth for the 1982–83 period were made using the actual growth rates of M1 and debt, as well as the other explanatory variables. The out-of-sample forecast errors derived from the M1 and debt equations along with actual GNP growth are reported in table 4.[17]

The forecast errors from the M1 equation indicate that M1 continually overpredicted GNP growth throughout 1982–83. The mean error is a negative 5.49 percent with the largest quarterly errors appearing in I/1982, III/1982, IV/1982 and I/1983.[18] It is interesting to note that these latter errors occur about the time when discussions about the effects of financial innovations on M1 suggest that M1 growth may be overstated. Moreover, the root-mean-squared error (RMSE) is 5.93,

[17]The errors reported are actual minus predicted GNP growth.

[18]These errors exceed two standard errors from the regression equation (SE = 2.64).

Table 4

GNP Forecasts: I/1982–IV/1983

Quarter	Actual GNP Growth	Forecast Errors Using: M1	Debt	Adjusted M1
I/1982	−1.43%	−7.18%	−6.07%	−1.95%
II	6.41	−3.93	−2.95	2.02
III	2.66	−7.58	−9.54	−3.42
IV	2.44	−8.29	−11.10	−4.68
I/1983	7.88	−6.96	0.54	1.28
II	12.48	−3.26	0.85	3.45
III	10.88	−1.50	5.11	5.68
IV	8.71	−5.19	−4.71	−1.12
Mean Error		−5.49	−3.48	0.16
Mean Absolute Error		5.49	5.11	2.95
Root-Mean-Squared Error		5.93	6.22	3.33

a value more than two times the estimated equation's standard error (2.64).

When the debt equation in table 2 is used to forecast GNP growth, there is a slight improvement in the absolute forecast errors. Relative to the 5.49 percent mean absolute error using M1, using debt yields a mean absolute forecast error of 5.11 percent. Three of the quarters' errors (I/1982, III/1982 and IV/1982) also exceed two times the debt regression's standard error (2.79). The relatively minor improvement in the mean errors from using the debt measure disappears when RMSEs are compared. The RMSE derived from debt forecasts of GNP is 6.22, somewhat larger than that from M1. Like the RMSE for M1, this value is more than twice the equation's standard error, again indicating little gain in the use of the debt measure over M1.

GNP Forecasts Using Adjusted M1

Based on the foregoing velocity comparisons and previous empirical findings, it may prove useful to investigate the GNP forecasting record of M1 when the effects of the financial innovations are removed. To do this, M1 was replaced by adjusted M1 in the regression equation and used to forecast GNP growth.[19] The forecast results using the adjusted-M1 measure, also reported in table 4, corroborate the evidence based on comparing relative velocity movements. The GNP forecast errors from the adjusted-M1 equation are noticeably smaller than those for M1 or debt and, more important, are not continually one-sided. The consequence of this latter property is that the mean error using adjusted M1 to forecast GNP growth is only 0.16 percent. Moreover, the mean absolute error is 2.95 percent, well below that for the other two measures. Finally, the RMSE is calculated to be 3.33, almost one-half the value found using M1 or debt to forecast GNP.[20]

The evidence indicates that the debt measure provides little or no improvement over M1 in forecasting GNP growth during the 1982–83 period. Moreover, using a transactions definition of money that abstracts from the effects of recent financial innovations on M1 provides forecasts of GNP growth that are statistically superior to forecasts based on debt.

SUMMARY AND CONCLUSION

Some analysts have suggested that information from the liability side of the economy's balance sheet might be useful in the formation of monetary policy. In this paper, we have investigated this contention by comparing the relative abilities of M1 and total domestic nonfinancial debt to explain the growth of GNP. Based on evidence from the sample period 1960–81, M1 better explained movements in GNP than debt. Moreover, once the effects of M1 growth were accounted for, debt growth did not significantly increase the explanatory power of the GNP equation. In contrast, M1 provided significant information to explain GNP growth, even after the effects of debt were included in the explanatory equation.

Out-of-sample forecast results of GNP during the 1982–83 period also indicate that there is no advantage to using the debt measure. Recent debt velocity behavior appears as equally at odds with historical patterns during post-trough periods as does M1 velocity behavior. What little improvement there is in using debt instead of M1 to forecast GNP stems from recent financial innovations which bloated the measured growth of M1 in 1982–83. When an M1 measure that adjusts for such effects is used, GNP growth rate forecasts based on the behavior of debt fare poorly compared with the adjusted M1 measure.

Thus, there is little evidence to support the use of a broad debt measure as yet another intermediate target variable for monetary policy.

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[19]The estimated equation is identical to the M1 equation, except that a dummy variable term is added to capture the intercept shift in 1981 due to the introduction of NOW accounts on a nationwide basis. The cumulative effect of adjusted M1 (using the same lag structure as M1) is 1.21, compared with 1.27 for M1. The $\bar{R}^2$ for the equation using adjusted M1 is 0.56, compared with 0.59 for M1.

[20]Judd and McElhattan, based on a different measure of adjusted M1, also find an improved forecasting record relative to the published M1 growth rate during 1982–83.

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How Robust Are the Policy Conclusions of the St. Louis Equation?: Some Further Evidence

Dallas S. Batten and Daniel L. Thornton

IN a previous issue of this *Review*, we provided some evidence that the policy conclusions of the St. Louis equation are robust with respect to both the specification of its lag structure and the imposition of polynomial restrictions: monetary policy has a significant long-run effect on aggregate income, while fiscal policy does not.[1] This result is important because it provides evidence that these policy conclusions are not dependent on the equation's econometric specification, a subject of continued debate since the equation first appeared. This conclusion, however, was based on the use of only one technique — developed by Pagano and Hartley (1981) — for selecting the appropriate lag structure and polynomial degree. Consequently, the general sensitivity of the policy conclusions to the specification of lag lengths and polynomial degrees remains an issue.

The purpose of this article is to use various model selection criteria to investigate the impact of model specification on the policy conclusions drawn from the St. Louis equation.[2] The evidence presented here demonstrates that these conclusions are extremely robust with respect to changes in either the lag structure or the polynomial restrictions. Thus, arguments that the general policy conclusions of the St. Louis equation are dependent upon an ad hoc econometric specification are without merit.

THE PROBLEM OF MODEL SPECIFICATION

To investigate the appropriate lag lengths for the St. Louis equation, we employ the growth rate specification, presented as equation 1 in table 1. The dots over each variable represent quarter-to-quarter annual rates of change, and Y, M and G are nominal GNP, money (the M1 definition) and high-employment government expenditures, respectively.

The first problem in estimating the St. Louis equation, or for that matter, any finite distributed lag model, is to specify the order of the distributed lags (I, K). Model selection criteria typically trade off the bias associated with specifying too short a lag (or too low a polynomial degree) against the inefficiency associated with selecting too long a lag (or too high a polynomial degree). In general, if either the lag is too long or the polynomial degree too high, the estimates will be unbiased but inefficient. If either the lag is too short or the polynomial degree too low, the estimates will be biased but efficient. Furthermore, since the St. Louis equation

Dallas S. Batten and Daniel L. Thornton are senior economists at the Federal Reserve Bank of St. Louis. Sarah R. Driver provided research assistance.

[1]See Batten and Thornton (1983).

[2]Since there has been an increased interest in techniques for specifying lag lengths of finite distributed lag models, our results, although data and model specific, should provide an experiential starting point for those interested in using these procedures.

Table 1

Various Equations for the PDL Specification of the St. Louis Equation

$$(1)\quad \dot{Y}_t = \mu + \sum_{i=0}^{I} \beta_i \dot{M}_{t-i} + \sum_{j=0}^{K} \gamma_j \dot{G}_{t-j} + \varepsilon_t$$

$$(2)\quad \begin{aligned} \beta_i &= \alpha_0 + \alpha_1 i + \alpha_2 i^2 + \alpha_3 i^3 + \ldots + \alpha_P i^P; \quad i=0, 1, 2, \ldots, I; P \leq I \\ \gamma_j &= \lambda_0 + \lambda_1 j + \lambda_2 j^2 + \lambda_3 j^3 + \ldots + \lambda_Q j^Q; \quad j=0, 1, 2, \ldots, K; Q \leq K \end{aligned}$$

$$(3)\quad \dot{Y}_t = \mu + \sum_{r=0}^{P} \alpha_r Z_{rt} + \sum_{s=0}^{Q} \lambda_s W_{st} + \varepsilon_t$$

NOTE: $Z_{rt} = \sum_{i=0}^{I} i^r \dot{M}_{t-i}$ and $W_{st} = \sum_{j=0}^{K} j^s \dot{G}_{t-j}$,

where, for notational purposes, 0^0 is defined to be 1.

has two distributed lag variables, the resulting estimates *will* be biased and may be inefficient if one lag is too long and the other too short.[3]

Because different criteria give different weights to this bias/efficiency trade-off, they may select different lag structures (and polynomial degrees). In the context of the St. Louis equation, this means that different policy conclusions may be obtained simply because different weights are used for the bias/efficiency trade-off. In particular, the conclusion that fiscal policy is ineffective in the long run may result largely from the lack of efficiency of the estimator. In order to investigate this issue, we examine the general conclusions concerning monetary and fiscal policy effectiveness in models selected by six different model selection criteria. These criteria were chosen either because they are among the most commonly suggested or because they represent a definite ordering of the bias/efficiency trade-off.

LAG-LENGTH SELECTION

The criteria employed here are: Pagano and Hartley's t-test (PH), Mallows' (1973) Cp-statistic, Akaike's (1970) Final Prediction Error (FPE), Geweke and Meese's (1981) Bayesian Estimation Criterion (BEC), Schwarz' (1978) Bayesian Information Criterion (SBIC) and the standard F-test. (See the appendix for a brief description of these criteria.)

Each of the six alternative criteria for determining the appropriate lag lengths is used to select the lag lengths (I, K) for money and government expenditures growth.[4] To assess the sensitivity of the various techniques to the selection of the maximum lag length (L), three values of L (8, 12 and 16) are specified initially for each variable.

Empirical Results of Lag-Length Selection

The St. Louis equation is estimated over the period II/1962 to III/1982.[5] The results reported in table 2 show

[3]The actual conditions are somewhat more complicated than is indicated here. Let ℓ and ℓ^* denote the assumed and correct lag length and p and p* denote the assumed and correct degree of polynomial, respectively. Estimates of the parameter vector will be biased if (a) $\ell = \ell^*$ and $p < p^*$, (b) $\ell < \ell^*$ and $p = p^*$, or (c) $\ell > \ell^*$, $p = p^*$ and $\ell - \ell^* > p^*$. In the instance when $\ell - \ell^* \leq p^*$, the polynomial distributed lag estimates may be biased, but need not be. That is, there are restrictions that may or may not be satisfied by the data. Furthermore, PDL estimators will be inefficient if $\ell = \ell^*$ and $p > p^*$. See Trivedi and Pagan (1979).

[4]While it is unclear how the various criteria will select lags in the general case, it is possible to order the selection when only two alternative lag specifications, p and p + q, are considered. The criterion would pick p, using an F-test, in the following way: Cp if $F < 2$; FPE if $F < 2T/(T+p+1)$; SBIC if $F < 1 + [(T+p+1)(T^{q/T} - 1)/q]$; BEC if $F < 1 + [(T-p-1)\ln T/(T-p-q-1)]$, where T is the sample size.

[5]The sample period is chosen to conform to that employed in Batten and Thornton.

Table 2
Lag Lengths Selected by Various Model Selection Criteria

Criterion	Maximum Lag Length (L): 8		12		16	
	$\dot{M}$	$\dot{G}$	$\dot{M}$	$\dot{G}$	$\dot{M}$	$\dot{G}$
PH	5	0	10	9	10	9
Cp	5	2	5	2	5	2
FPE	5	2	10	9	10	9
BEC	1	0	1	0	1	0
SBIC	2	0	2	0	2	0
F-test	1	8	10	8	1	0

that the chosen lag lengths differ by criterion and, to a lesser extent, by the maximum lag length specified. For example, when the maximum lag length was eight, the PH criterion selected the lag on money growth (I) to be five and the lag on government expenditure growth (K) to be zero.[6] Both the FPE and Cp criteria choose the same lag on $\dot{M}$ but a slightly longer lag on $\dot{G}$. When the maximum lag is increased to 12 and 16, both the FPE and PH criteria select longer lags on $\dot{M}$ and $\dot{G}$ ($I = 10$ and $K = 9$). The Cp statistic, however, is unaffected by changing the maximum lag length. The Bayesian criteria also are unaffected by the choice of the maximum lag length; however, they select lags that are extremely short. Perhaps these criteria give too much weight to efficiency in the bias/efficiency trade-off.[7]

The F-test appears to be the most sensitive to the choice of the maximum lag length. It tends to indicate shorter lags whenever the last significant lag coefficient is followed by a number of insignificant ones. The insignificant coefficients tend to dilute the discriminating power of the F-test. Thus, it chooses a much shorter lag when L is increased from 12 to 16. This is to be expected, however, given the general nature of this test.

Table 3
Tests of Policy Effectiveness for Various Distributed Lag Models

Lag Length $\dot{M}$	Lag Length $\dot{G}$	Chosen by	$\Sigma\dot{M}$	$\Sigma\dot{G}$
10	9	PH, FPE	1.16	−0.04
			(0.62)	(0.26)
10	8	F-test	1.03	0.08
			(0.11)	(0.62)
5	2	Cp, FPE	1.00	0.07
			(0.00)	(0.92)
5	0	PH	0.98	0.11*
			(0.09)	(2.38)
2	0	SBIC	1.19	0.09*
			(0.97)	(1.99)
1	0	BEC, F-test	0.95	0.10*
			(0.29)	(2.05)
1	8	F-test	1.10	−0.01
			(0.57)	(0.11)

Absolute value of t-statistics in parentheses for testing $\Sigma\dot{M} = 1$ and $\Sigma\dot{G} = 0$.

*Statistically significant at the 5 percent level.

Policy Effectiveness and the Lag Structure

To test for the long-run effectiveness of monetary and fiscal policies, simple t-tests of the sums of the distributed lag weights are performed. The results of these tests, for the lag structures reported in table 2, are presented in table 3. The summed effects of money growth on nominal income growth range from 0.95 to 1.19, and the hypothesis that there is a one-to-one relationship between money growth and growth in nominal income in the long run cannot be rejected for any of the lag structures.

The summed effects of government expenditures on nominal income range from −0.04 to 0.11 and, in contrast to the estimated impacts of changes in money growth, are not significantly different from zero in every instance when there is a lagged effect of $\dot{G}$. This suggests that there is no long-run effect of $\dot{G}$ on nominal income growth. In the three models where only contemporaneous $\dot{G}$ is included, however, its coef-

[6]Actually, the PH t-ratio for the second lag of $\dot{G}$ is 1.91 when the lag on $\dot{M}$ is five. Thus, the PH technique nearly selects the same lag structure (five on $\dot{M}$ and two on $\dot{G}$) as does the FPE criterion.

[7]The Bayesian criteria are designed to be asymptotically efficient in that they select the correct lag length in large samples (see Geweke and Meese for details). It appears, however, that they give this property too much weight in small samples and select lags (and polynomial degrees) that are too short. In a Monte Carlo experiment, Geweke and Meese found that the probability of underfitting is about 50 percent even with a sample size of 50.

Furthermore, for this analysis, the equation is constrained to contain both variables. That is, the possibility that one of the criteria can select a model in which either $\dot{M}$ or $\dot{G}$ is excluded completely is precluded. If this constraint is removed, however, both Bayesian criteria indicate that not even contemporaneous $\dot{G}$ should be included in the equation.

ficient is always significant, a result independent of the lag on $\dot{M}$.[8] This suggests that high-employment government expenditures may have an immediate and permanent impact on nominal output. When the models with "long" lags on both variables ($\dot{M}$ and $\dot{G}$) are tested against a model with a "long" lag on $\dot{M}$ and no lag on $\dot{G}$ via a likelihood ratio test, however, the latter model is rejected at the 5 percent significance level.[9] That is, the model with long lags on both variables is preferred. In the preferred specification, $\dot{G}$ has a significant short-run effect, but no long-run effect on nominal output.

The above results suggest that the long-run policy implications of the St. Louis equation are relatively insensitive to the lag specification and, hence, to the relative weighting of the bias/efficiency trade-off. Only in the models chosen by the Bayesian criteria does government spending have a permanent effect on income. The data suggest, however, that longer lag specifications are preferable over the short ones chosen by the Bayesian criteria. Consequently, it appears that these criteria give too much weight to efficiency in the bias/efficiency trade-off.

It should be noted that, even though the long-run (equilibrium) properties of the equation are quite robust with respect to the lag structure, the short-run dynamics differ considerably, especially for a change in money growth. In particular, the short-run impact of a change in money growth is considerably larger, and lasts longer, in the models with relatively long lags on money growth than in the shorter lag specifications.

POLYNOMIAL-DEGREE SELECTION

The problem of polynomial-degree selection is completely analogous to that of lag-length selection. To see this, we note that the polynomial distributed lag (PDL) estimation technique assumes that the regression coefficients on $\dot{M}$ and $\dot{G}$ (i.e., the βs and γs) fall on polynomials of degrees P and Q, respectively, where $P \leq I$ and $Q \leq K$. These assumptions are given by the equations (2) in table 1. Given the lag lengths, I and K, the equations in (2) can be combined with (1) to obtain the PDL equation (3). Thus, selecting the polynomial degree amounts to choosing orders (P, Q) of equation (3). As with the specification of lag lengths, we must specify the maximum polynomial degree that will be considered initially. In this instance, however, the choice is not arbitrary because the polynomial degree cannot be larger than the lag length of the model we are considering.

The application of the above procedure to all of the models in the previous section would be tedious since seven different lag structures were selected by the various criteria for different maximum lag lengths. Thus, to simplify choosing the polynomial degree, a "best" lag structure is chosen. To do this, each lag structure in table 2 is tested against the others and against arbitrarily chosen lags of four, six and twelve on both $\dot{M}$ and $\dot{G}$ using a likelihood ratio test. The resulting χ^2 statistics are reported in table 4. Because some of the lag structures reported in table 2 differ only slightly from each other, the results of all the tests are not reported.

These results indicate that the model with 10 lags on $\dot{M}$ and 9 lags on $\dot{G}$ does well relative to all the others. For example, when this model is tested against the arbitrary model with six lags on both variables, the null hypothesis that the additional four lags on $\dot{M}$ and the additional three lags on $\dot{G}$ are all zero is rejected at the 5 percent significance level. This is also true of the other "short" lag models. Furthermore, when this model is compared with one with twelve lags on both variables, the null hypothesis that the additional two lags on $\dot{M}$ and the additional three lags on $\dot{G}$ are all zero cannot be rejected. Indeed, only the longer lags chosen by the PH and FPE criteria cannot be rejected relative to all of the other specifications. Finally, it is interesting to note that the extremely short lags of the Bayesian criteria are generally rejected relative to the longer lag specifications. While no amount of testing can be conclusive, these results suggest that the longer lag structures selected by the PH and FPE criteria are the most appropriate. Consequently, the results of polynomial-degree selection, which are reported below, are based on a model with 10 lags on $\dot{M}$ and 9 on $\dot{G}$.

Empirical Results of Polynomial-Degree Selection

The same six criteria used to determine the lag length were applied to the selection of the polynomial degree.[10] The results are presented in table 5.[11] These

[8]Estimates of the equations that include only contemporaneous $\dot{G}$ and lags of $\dot{M}$ from 1 to 10 are not qualitatively different from those reported in table 3.

[9]When models with 10 lags on $\dot{M}$ and 9 or 8 lags of $\dot{G}$ are compared with a model with 10 lags on $\dot{M}$ and only contemporaneous $\dot{G}$, the implied restrictions are rejected at the 5 percent significance level. The calculated χ^2 statistics (5 percent critical values) are 24.39 ($\chi^2(9)$ = 16.9) and 17.28 ($\chi^2(8)$ = 15.5), respectively.

[10]Because of their spurious nature, the endpoint constraints are not imposed; see Thornton and Batten (1984).

[11]The polynomial degrees chosen by the PH criterion here differ from those reported in Batten and Thornton. In that article we attempted to account for the preliminary test problem.

Table 4
χ^2 Statistics for Lag Specification Tests

Lags on $\dot{M}$ and $\dot{G}$		Lags on $\dot{M}$ and $\dot{G}$: 10 9	6 6	5 2	4 4	2 0	0 0
12	12	3.33	N.A.	29.78*	N.A.	43.39*	N.A.
10	9	—	21.10*	26.45*	32.13*	40.06*	—
6	6	—	—	5.35	N.A.	18.96*	N.A.
5	2	—	—	—	—	13.61*	—
4	4	—	—	—	—	7.94	N.A.
2	0	—	—	—	—	—	18.14*

N.A. indicates that the likelihood ratio was not calculated between arbitrarily chosen lags.
*Statistically significant at the 5 percent level.

Table 5
Polynomial Degrees Selected by Various Model Selection Criteria

Criterion	Polynomial degree: $\dot{M}$	$\dot{G}$
PH	6	7
Cp	6	8
FPE	6	8
BEC	1	0
SBIC	1	0
F-test	6	3

NOTE: Based on a specification including 10 lags on $\dot{M}$ and 9 on $\dot{G}$.

Table 6
Policy Effectiveness for Various Polynomial Distributed Lag Models

Polynomial degree $\dot{M}$	$\dot{G}$	Chosen by	$\Sigma\dot{M}$	$\Sigma\dot{G}$
6	8	Cp, FPE	1.09 (0.34)	−0.01 (0.06)
6	7	PH	1.08 (0.31)	— (0.02)
6	3	F-test	1.08 (0.30)	−0.01 (0.07)
1	0	BEC, SBIC	1.00 (0.00)	0.02 (0.14)

NOTE: Based on a specification including 10 lags on $\dot{M}$ and 9 on $\dot{G}$. Absolute value of t-statistics in parentheses for testing $\Sigma\dot{M} = 1$ and $\Sigma\dot{G} = 0$.
— indicates less than .005 in absolute value.

results are similar to those obtained in the lag-length selection in that the FPE and PH criteria (and in this instance, Mallows' Cp) select relatively high polynomial degrees, while the Bayesian criteria select extremely low degree polynomials. The Bayesian results suggest that estimates of the 11 coefficients on $\dot{M}$ (contemporaneous plus the 10 distributed lags) and the 10 on $\dot{G}$ can be obtained by estimating only 2 polynomial coefficients on $\dot{M}$ and only 1 on $\dot{G}$. Indeed, when the polynomial restrictions implied by the model selected by these criteria are tested, they are rejected at the 5 percent significance level. On the other hand, when the implied polynomial restrictions of the FPE and PH determined specifications are tested, they cannot be rejected.[12]

Policy Effectiveness and the Polynomial Degree

Tests of the policy implications from these PDL models are presented in table 6. Again, the results confirm the robustness of the policy implications of the St. Louis equation. The summed effects of money growth on nominal income growth differ only slightly from those reported in table 3 and range from 1.00 to 1.09. Furthermore, a test of the hypothesis that there is a one-to-one relationship between the growth rate in money and nominal income growth cannot be rejected at the 5 percent significance level for the various sets of polynomial restrictions.

[12]The χ^2 statistic for testing the polynomial restrictions selected by the Bayesian criteria is 52.64, compared with a critical value of $\chi^2(18)$ = 28.9. For the FPE, PH and F-test selected PDL models, the χ^2 statistics (5 percent critical values) are 8.62 ($\chi^2(5)$ = 11.1), 11.19 ($\chi^2(6)$ = 12.6) and 23.21 ($\chi^2(10)$ = 18.3), respectively.

Also, the summed coefficients on $\dot{G}$ are nearly zero and the hypothesis that they are equal to zero cannot be rejected at the 5 percent significance level. Thus, the policy implications of the St. Louis equation also appear to be unaffected by the choice of polynomial degree.

CONCLUSIONS

This paper has investigated the robustness of the policy conclusions of the St. Louis equation with respect to its polynomial distributed lag specification. Six alternative model specification criteria have been used to identify lag lengths and polynomial degrees, and tests of policy effectiveness have been performed on each of these specifications.

In each case, the hypothesis that a 1 percentage point increase in money growth leads ultimately to a 1 percentage point increase in the rate of growth of nominal GNP cannot be rejected at conventional levels of statistical significance. Alternatively, high-employment government spending has a permanent impact on the rate of growth of nominal GNP only when contemporaneous government spending growth alone is included with the distributed lag of money growth in the model. This specification, however, is consistently rejected when tested against higher order specifications. Consequently, the general conclusion from this study is that, in the long run, monetary policy is effective and fiscal policy is ineffective in influencing the growth of GNP. This result is almost totally insensitive to alternative lag structures or polynomial specifications.

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Appendix: Model Selection Criteria

The criteria employed here can be outlined within the framework of the following distributed lag model:

$$(1) \quad \underline{Y} = X\underline{\beta} + \underline{\varepsilon},$$

where X is a T by $(\ell+1)$ matrix of distributed lag variables, $\underline{\beta}$ is a $(\ell+1)$ by 1 vector of parameters and $\underline{\varepsilon}$ is a T by 1 vector of disturbances. The initial step in implementing any of these techniques is to specify a maximum lag length, L.

Pagano-Hartley t-test

The Pagano-Hartley technique employs a Gram-Schmidt decomposition of the observation matrix. Specifically,

$$X = QN,$$

where Q is a matrix whose columns form an orthonormal basis for X, and N is an upper triangular matrix with positive diagonal elements. Equation (1) can now be rewritten as

$$(2) \quad \underline{Y} = QN\underline{\beta} + \underline{\varepsilon} = Q\underline{\lambda} + \underline{\varepsilon}, \text{ where } \underline{\lambda} = N\underline{\beta}.$$

To select the appropriate lag length, Pagano and Hartley suggest choosing the smallest j for which the hypothesis,

$$H_{L-j} : \lambda_{L-j} = 0,$$

can be rejected. The PH technique also enables efficient calculation of the other lag-length selection statistics discussed below.

Mallows' Cp-statistic

An alternative to the PH technique is to consider minimizing some function of the residual sum of squares. One such statistic is Mallows' Cp-statistic, which is based upon a mean square error prediction norm. The Cp-statistic is defined as

$$Cp_{L-j} = \frac{1}{s^2} RSS_{L-j} - T + 2(L+1-j), \quad j=0, 1, ..., L,$$

where RSS_{L-j} denotes the residual sum of squares with j restrictions imposed and $s^2 = RSS_L/(T-L-1)$. As j increases from zero to L, the Cp-statistic trades off some reduction in the variance of prediction for an increase in the bias. The value of j for which the Cp-statistic is a minimum is the one that minimizes the expected mean square error of prediction. It can be shown that the Cp-statistic will attain a local minimum whenever the t-statistic on the marginal distributed lag coefficient is greater than or equal to $\sqrt{2}$.

Akaike's FPE Criterion

Another criterion based on a mean square error prediction norm is Akaike's Final Prediction Error (FPE) criterion, defined as

$$FPE_{L-j} = \frac{T + (L+1-j)}{T - (L+1-j)} \cdot \frac{RSS_{L-j}}{T}, \quad j=0, 1, ..., L.$$

Like Mallows' Cp-statistic, the FPE criterion attempts to balance the "risk" due to bias when shorter lag lengths are selected against the "risk" due to the increase in variance when longer lag lengths are chosen. Hsiao (1981) has shown that minimizing the FPE is equivalent to applying an approximate sequential F-test with varying significance levels.

Bayesian Criteria

Two Bayesian criteria have been suggested that select the correct lag length asymptotically. The first of these is Schwarz' Bayesian Information Criterion (SBIC) and is given by

$$SBIC = \ln\left(\frac{RSS_{L-j}}{T-L-1+j}\right) + (L+1-j)\frac{\ln T}{T}, \quad j=0, 1, ..., L.$$

The second, suggested by Geweke and Meese, is the Bayesian Estimation Criterion (BEC) given by

$$BEC = \frac{RSS_{L-j}}{T-L-1+j} + (L+1-j)s^2\left(\frac{\ln T}{T-L-1}\right), \quad j=0, 1, ..., L.$$

Since choosing a lag length that is too long does not result in biased estimates of the distributed lag parameters, the only advantage of the Bayesian criteria is asymptotic efficiency.

The Standard F-test

A final procedure involves calculating a sequential F-statistic, defined as

$$F_{L-j} = (RSS_{L-j-1} - RSS_L)/(j+1)s^2, \quad j=0, 1, ..., L,$$

and selecting the lag length as the first $L-j$ for which the null hypothesis, $\beta_L = \beta_{L-1} = ... = \beta_{L-j} = 0$, is rejected.

These procedures also can be applied to the problem of polynomial degree selection. Once the lag length is selected, determining the polynomial degree amounts to nothing more than selecting the length of the vector of polynomial coefficients.