Money Growth and the Size of the Federal Debt

Keith M. Carlson

Federal debt held by the public (including the Federal Reserve System) has risen relative to GNP over the past 10 years, with most of the increase occurring since 1981 (see chart 1). This recent increase in the federal debt-GNP ratio reverses a downward trend that had prevailed from the end of World War II. Furthermore, as of early this year, the Congressional Budget Office (CBO) projected that a continuation of current budget policies would lead to further rises in the debt-to-GNP ratio through 1989.

This change in trend is viewed with concern by most economic analysts. According to the CBO:

"Historical experience suggests that increases and decreases in federal debt relative to GNP have been accompanied by approximately offsetting changes in non-federal debt as a percentage of GNP. Similarly, growth trends in the federal debt-GNP ratio appear to have been mirrored by opposite trends in the capital-output ratio."

Should history repeat itself, the rising federal debt-GNP ratio will produce slower economic growth and a lower standard of living than would otherwise occur.

The accuracy of the CBO's projections depends, of course, on how accurately it is able to predict both deficits and future GNP. Two problems make it difficult to obtain accurate projections of these two variables. First, these variables are interrelated; consequently, their feedback effects must be taken into account. Second, assumptions about the future course of monetary policy are crucial to the analysis; different assumptions will produce widely varying projections of both future deficits and future GNP.

The purpose of this article is to examine the importance of monetary policy assumptions in the assessment of the federal debt-GNP ratio. To aid in this examination, simulations from a modified version of a St. Louis-type model are used in conjunction with a model of budget and debt determination. Because this model is sensitive to changes in money growth, it can be used to determine the effect of alternative monetary policies on the federal debt-GNP ratio.

A FRAMEWORK FOR ANALYSIS

The role for monetary policy in the determination of strategic budget variables can be described with the aid of a schematic diagram (see page 6). For a given tax structure and set of outlay programs, the economic variables — real GNP, unemployment, the price level and interest rates — impinge strongly to determine the budget outcome in a given period. These variables, in turn, are affected by the growth of the money stock. The size of the federal debt held by the public

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1CBO (February 1984), part I, p. 75.
2For a critique of the procedures used by the CBO and the Office of Management and Budget, see Klein (1984).
3In this diagram, the connection between economic variables and budget variables is predominantly in one direction, reflecting primarily the results of previous econometric studies.
relative to GNP is a convenient way of summarizing budget policy under a set of economic assumptions over a period of years.

With the aid of this schematic diagram, the key variables can be identified easily. The model must be capable of tracing a path through time for real GNP, the price level (GNP deflator) and interest rates. Given the responses of receipts and outlays, a time path for the federal debt can be derived. Then, to explore whether the federal debt grows explosively over time, the size of the debt can be compared with GNP.

**Summary of the Model**

The model used in this article is an augmented monetary model.\(^1\) For details, see appendix A. The key feature of the model is that nominal GNP is deter-

\(^{1}\) For further details on its properties, see Carlson and Hein (1983).
mired by current and lagged values of the money stock (M1); in other words, fiscal variables were not found to be significant in the determination of GNP. GNP is then divided between output and prices via a price equation. The GNP deflator is specified as a function of current and lagged values of the relative price of energy, demand pressure and anticipated price change. The 10-year Treasury bond rate is a function of past inflation. The 3-month Treasury bill rate is a function of current and lagged values of changes in output and prices.

The budget portion of the model consists of an outlays equation and a receipts equation. These equations depend on a given outlay program and a set of tax laws, respectively, as well as the growth of real GNP and inflation. Interest payments are specified as a function of the two interest rates in the model, the portion of the budget deficit financed by the public, the size of the federal debt and the amount of debt maturing within a year. Several other budget identities are specified to generate additional variables and to close the model so that it can be solved.

Properties of the Model

The properties of the model are monetarist. Changes in the growth rate of money change the growth of nominal GNP quickly, with the full effect achieved within five quarters. Initially, this change in nominal GNP is translated into a change in output (real GNP) because prices respond to changes in

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Footnotes:
5This specification contrasts with that used in Carlson and Hein in that federal expenditures are omitted. For empirical support, see Hafer (1982).
6For further detail, see appendix B. See Carlson (1983) for further discussion of these equations.
money growth with a much longer lag than nominal GNP does. The 3-month Treasury bill rate responds to a change in money via its effects on output and prices. The Treasury bond rate, on the other hand, responds more slowly to money because it depends only on past prices.

Over the longer run, the effects of a change in monetary growth are reflected only in nominal variables, that is, nominal GNP, inflation and nominal interest rates. The achievement of full adjustment to a steady-state growth path takes about 30 years. For the five-year time horizon used by the government for budget analysis, output growth is still influenced by money growth; that is, the steady-state equilibrium has not yet been attained. To gain more insight into the future prospects for the budget, the model is simulated to its steady-state equilibrium, which occurs around 2015. This longer-run perspective yields conclusions that differ from those that result from focusing on the conventional five-year budget horizon.

THE BUDGET EFFECTS FOR ALTERNATIVE MONETARY POLICIES: 1984–89

Each year the CBO provides a set of estimates that it calls "baseline projections." These are projections of what federal receipts and outlays would be if current laws and programs were to continue for the next five years. In other words, despite the use of the term "projections," these are not forecasts of the budget; they are meant to be used as baseline estimates against which proposed changes in tax laws and spending programs can be measured and assessed.

In the process of preparing these estimates, the CBO develops a set of economic assumptions. This is a necessary part of the process because receipts and outlays depend crucially on economic conditions. Receipts depend, of course, on taxable income and sales which, in turn, depend on inflation and real growth. Similarly, outlays also are influenced by real growth, mainly via unemployment, and inflation, since a large number of programs are now indexed to the cost of living. Interest on the federal debt obviously depends on the level of interest rates as well as the size of the deficit and the amount and maturity structure of outstanding debt.

The CBO's 1984 report on the budget is particularly bleak. According to the CBO's baseline estimates, the federal deficit will continue to grow in dollar terms throughout the 1984–89 period. Even when scaled against a growing GNP, the CBO concludes that the "deficit projections are obviously alarming." As summarized in the ratio of federal debt to GNP, the baseline projections indicate that the sharp increase in the ratio in 1982–83 will continue through the 1984–89 period.

Economic Assumptions

To assess the validity of the CBO's conclusions, the monetary model was simulated using three different monetary scenarios — 4, 6 and 8 percent growth of M1. These three alternative money growth assumptions produced alternative paths for real growth, inflation and interest rates.

Table 1 summarizes the CBO's baseline projections and the simulations by the monetary model. Although the CBO's projections are derived under the assumption that money growth will be 6 percent, their results are not generally consistent with those obtained from the monetary model using 6 percent growth in money. In particular, the CBO's estimate of the dollar level of nominal GNP in 1989 falls about halfway between the results from simulations using 4 percent and 6 percent money growth.

The difference between the CBO's projections and the monetary model's simulations translates primarily into a difference in the projections for output. The CBO's projected level of real GNP for 1989 lies below that generated by the model using 4 percent money growth. Their relatively low projections of output tend...
to increase their estimates of the baseline deficit; their estimates of outlays are higher and their estimates of receipts are lower. The CBO’s projections of the price level, on the other hand, are quite close to the model’s simulation using 6 percent money growth.

The differences in interest rate projections are compared at the bottom of table 1. The CBO’s projections of the Treasury bill rate are consistent with the model’s simulations using 6 percent money growth. The CBO’s projections of the Treasury bond rate, on the other hand, are not; instead, they resemble more closely the model’s result using 8 percent money growth. Even using that comparison, however, the

### Table 1

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¹Percent change in parentheses. Simulations begin in III/1984, thus, 1984 reflects actual economic performance in the first half.
Table 2
Budget Variables: Model Simulations vs. CBO Baseline (billions of dollars)

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CBO's projections are generally higher throughout the period.11

Higher interest rate estimates will produce higher estimates of the deficit. Furthermore, there is a crucial cumulative effect — higher interest rates add to the current deficit, which carries over to future years in the form of larger debt that must be financed.

Simulating the Monetary Model with CBO's Baseline Estimates

Table 2 summarizes the model's simulation of receipts and outlays and compares them with the CBO's estimates. The CBO's estimated receipts are slightly more than the model's estimates using 4 percent money growth. By 1989, the CBO's estimate of receipts is $106 billion below that generated by the model using 6 percent money growth. The composition of GNP is instrumental in producing this result. Because the CBO has a relatively low estimate of real growth, their estimate of the growth of receipts is also lower.

The CBO's estimated outlays are well above the highest estimate derived from the model. This difference again reflects the relatively low level of output that the CBO projects. As a result, outlays for unemployment compensation and the amount of deficit to be financed are higher as is the CBO's estimate for the interest rate on Treasury bonds. Differences in forecasts for interest rates can accumulate quickly into higher deficits via their effect on outlays. The model simulates interest payments using an equation esti-
mated over a sample period of 1955–83 (see appendix B). The CBO does not estimate a single-interest payments equation; instead, its estimates are based on a detailed analysis of the components of the federal debt.12

When the model's estimates of receipts and outlays are combined, the resulting budget picture is less bleak than the CBO's projections indicate. The model's surplus/deficit projections show clearly that the size of the projected deficit is very sensitive to the rate of monetary growth assumed. With 4 percent money growth, the deficit increases in dollar amounts through 1989; however, the rise is smaller than what the CBO projects. When 6 percent money growth is assumed, the budget deficit slowly declines. With even more rapid money growth, the budget moves toward surplus after 1989, but, of course, inflation also is more rapid.

Perhaps the most dramatic difference between the CBO's projections and those obtained from the model appears when the time paths for federal debt held by the public are compared. The cumulative effect of deficits over six years generates a public debt of $2,406 billion with 4 percent money growth, $2,115 billion with 6 percent money growth, and $1,785 billion with 8 percent money growth. Because the CBO projects higher deficits for every year than does the model, federal debt held by the public rises to $2,652 billion in 1989 under the CBO projections.

Simulating the Monetary Model with the Administration's Budget

Given the model's simulations, either the budget situation or the outlook for inflation is bleak. Although the situation projected by the monetary model is not quite as bad as that seen by the CBO, the broad conclusions about continuing large budget deficits are generally the same. To determine what might be required to prevent continued large deficits, the administration's budget, as prepared in February 1984 and recalculated with the CBO's economic assumptions, is subjected to the same exercise used in the previous section.13

The administration's budget for 1985–89, summarized in table 3, can be compared with the CBO baseline estimates in table 2. Note that the administration proposed modest increases in revenues, amounting to only an additional $23 billion in 1989. According to the CBO's analysis of the administration's budget, the proposed revenue increases stem from the following:

1. taxation of health insurance premiums;
2. "structural reform" proposals, mainly in the form of limitations on tax-exempt leasing and on private-purpose tax-exempt bonds; and
3. restrictions on tax shelters and on accounting and corporate tax abuses.

The proposals are not major; the CBO estimates that by 1987–89 primary revenues would be increasing only at a slightly faster rate than the CBO baseline estimates, 8.8 percent vs. 8.5 percent.

With regard to outlays, the administration program is somewhat more ambitious; outlays are projected to be $62 billion less than the CBO's baseline estimate by 1989. The administration's program proposes considerable change in the composition of federal spending. For 1989, relative to the CBO's baseline projections, defense spending would be $11 billion higher, entitlement programs would be $15 billion lower, non-defense discretionary spending would be $17 billion lower, "offsetting receipts" would be higher by $6 billion and net interest would be lower by $10 billion. Although these differences do not appear large, the administration's estimate for primary outlays for the 1987–89 period would be increasing at a 7.1 percent rate, which compares with the CBO's baseline estimate of an 8.9 percent rate of increase.

The simulation results for the model using administration estimates are summarized in table 3. When compared with table 2, the contours of the deficit to GNP appear little different, especially in the early years. Closer inspection reveals that, for a given money growth, the administration program moves either toward surplus or toward a smaller deficit by 1989. This shows how relatively small changes in the growth rates of receipts and outlays can alter significantly the outlook for the deficit and the federal debt, even by 1989. It is to be noted, however, that the prospects for the debt improve in conjunction with an inflationary monetary policy.
The previous comparisons demonstrate that the monetary model yields smaller deficit estimates than those using the CBO baseline projections. The chief conclusion from the simulations derived from the model is that faster money growth will produce smaller deficits up to 1989.11

Because public discussion of the effects of future deficits suggests that they are concerned with periods of time longer than five years, and because the model does not reach its full equilibrium in five years time, it is informative to carry on with the simulation through time. To make a comparison possible between the CBO’s analysis and the model’s simulations for this longer period, both the CBO’s baseline estimates for primary receipts and outlays and the administration’s estimates were extended beyond 1989 at their average growth rates for the 1987–89 period. This provided sufficient input for the model to continue the simulations past 1989. The model was simulated through 2015, when it reaches steady-state equilibrium.

### Long-Term Simulations of CBO Baseline Estimates

Chart 2 summarizes the simulation results using the model and the CBO baseline projections for the full period. Because dollar amounts are generally dif-
difficult to interpret meaningfully when considered over long time periods, the results for the federal debt are presented relative to GNP.

Chart 2 yields a surprising result. Here, federal debt held by the public, expressed relative to GNP, rises without limit for 4 and 6 percent money growth. Only with 8 percent money growth does the debt appear to eventually decline relative to GNP.

Why the difference in the short-run and long-run results? Isolating the reasons for this difference requires detailed examination of the time response of receipts and outlays to real growth, inflation and interest rates. The nature of the long-term results reflects primarily that outlays respond more slowly to inflation than receipts do. In addition, because it takes time for the debt to build up in response to deficits, the cumulative effect of deficits takes the form of increased outlays. These delays are further compounded because inflation responds more slowly to money growth than output does.

Long-Term Simulations of the Administration’s Budget

Chart 3 summarizes the long-term simulations of the administration’s budget. Here the differences from the 1984–89 horizon are also striking.

Using 4 percent money growth, the simulations show only a modest upward drift in the federal debt as a percent of GNP over the 30-year period. With 6 and 8 percent money growth, debt declines relative to GNP and is eventually eliminated, resulting in a net creditor position for the federal government.12

12Currently, because the federal government borrows more than it lends, it is a net debtor. Simulations showing the government as a net creditor are only meant to be illustrative. They should not be construed as forecasts.
SUMMARY

There is a developing consensus that budget deficits are growing at disquieting rates. To examine the likelihood of future deficits, a monetary model was expanded to include the determination of budget variables. Key budget variables were recalculated using the CBO’s baseline estimates and the administration’s February 1984 budget. These simulation results indicate that the prospects for a balanced budget depend on the time path of monetary growth. In particular, achieving a balanced budget is facilitated by faster money growth.

Another conclusion that derives from this study is that a five-year planning horizon seems too short to judge whether a particular set of policies is really reducing the sequence of future deficits. Because of the lag structure between policy variables and economic variables, a decade or more might be necessary before the full impact on deficits can be discerned.

The charts and tables in this article should not suggest that considerable precision is possible in the preparation of budget estimates — especially those for a far distant period. The simulations are meant to be illustrative; they are conditioned by a large number of assumptions, not the least of which is the model chosen to derive the simulations. Nevertheless, the major conclusion stands: the long-term process of reducing budget deficits is difficult, but possible. In particular, receipts and outlays depend on key economic variables like real growth, inflation and interest rates; these, in turn, depend crucially on the rate of monetary expansion. Thus, fiscal plans to reduce deficits over time must be coordinated with monetary policy actions if they are to be successful; any choice of deficit reduction via faster money growth must be assessed in conjunction with the possible inflationary costs involved.

REFERENCES

Appendix A
A Monetary Model

The model used for simulations of the economic variables is summarized below. A dot over a variable indicates compounded annual rate of change. Most equations are estimated with Almon constraints on the coefficients. Absolute values of t-statistics are in parentheses.

1. GNP equation
   \[ \dot{Y}_t = 2.67 + 1.14 \sum_{i=0}^{4} \dot{M}_{-i} \]
   Sample period: 1/1960–IV/1981
   \[ (2.60) \quad (16.30) \quad i = 0 \]
   \[ R^2 = .36 \quad SE = 3.65 \quad DW = 2.11 \]

2. Price equation
   \[ \dot{P}_t = .87 + .14 \sum_{i=1}^{5} \dot{P}_{e-i} + .09 \sum_{i=0}^{5} \dot{X}_{-i} - \dot{X}_{e} \]
   Sample period: 1/1960–IV/1983
   \[ (2.30) \quad (5.80) \quad i = 0 \]
   \[ R^2 = .72 \quad SE = 1.41 \quad DW = 2.01 \quad \hat{\rho} = .15 \]

3. Treasury bill rate equation
   \[ RS_t = .55 \sum_{i=0}^{10} \dot{X}_{e-i} + .99 \sum_{i=0}^{10} \dot{P}_{e-i} \]
   Sample period: 1/1960–IV/1983
   \[ (3.28) \quad (6.45) \quad i = 0 \]
   \[ R^2 = .15 \quad SE = .90 \quad DW = 1.90 \quad \hat{\rho} = .91 \]

4. Treasury bond rate equation
   \[ RL_t = 2.88 + .36 \sum_{i=0}^{20} \dot{P}_{e-i} \]
   Sample period: 1/1960–IV/1983
   \[ (1.96) \quad (3.75) \quad i = 0 \]
   \[ R^2 = .13 \quad SE = .51 \quad DW = 1.77 \quad \hat{\rho} = .95 \]

5. GNP identity
   \[ Y = (P/100) X \]

6. Demand pressure definition
   \[ \dot{X}_{F} = (XF/X) - 1 \cdot 100 \]

7. Price anticipations definition
   \[ \dot{P}_{A} = .96 \sum_{i=1}^{21} \dot{P}_{e-i} \]

\[ Y \quad = \text{nominal GNP} \]
\[ M \quad = \text{money stock (M1)} \]
\[ P \quad = \text{GNP deflator (1972 = 100)} \]
\[ PE \quad = \text{relative price of energy} \]
\[ X \quad = \text{output in 1972 dollars} \]
\[ XF \quad = \text{potential output (Rasche-Tatom)} \]
\[ RL \quad = \text{Treasury bond rate} \]
\[ RS \quad = \text{Treasury bill rate} \]
Appendix B
Budget Model

To estimate the effect on budget projections of an alternative set of economic assumptions, the following budget variables were estimated:

1) primary receipts: total receipts minus earnings of the Federal Reserve System
2) primary outlays: total outlays minus net interest
3) net interest

The basic source for estimates of the relevant elasticities were estimates published by the CBO (February 1984), Part I. Net interest was estimated using fiscal year data for 1955-83.

**Primary receipts**

The implied coefficients for receipts as derived from estimates prepared by the CBO were:

\[ \Delta R_t^r = .75 \Delta \dot{X}_t + .81 \Delta \dot{X}_t, - .01 \Delta \dot{X}_{t,1} + .26 \Delta \dot{X}_{t,3} + .14 \dot{X}_{t,3} + .21 \dot{X}_{t,3} + .75 \Delta \dot{P}_t + .36 \Delta \dot{P}_{t,1} + .02 \Delta \dot{P}_{t,2} + .16 \Delta \dot{P}_{t,3} - .06 \Delta \dot{P}_{t,4} + .13 \Delta \dot{P}_{t,5} \]

where

- \( \Delta R_t^r \) = deviation of percent change in primary receipts from baseline estimate in fiscal year \( t \)
- \( \Delta \dot{X}_t \) = deviation of percent change in real GNP from baseline estimate in year \( t \)
- \( \Delta \dot{P}_t \) = deviation of percent change in GNP deflator from baseline estimate in year \( t \)

**Primary outlays**

The implied coefficients for outlays as derived from estimates prepared by the CBO were:

\[ \Delta O_t^r = .25 \Delta \dot{X}_t + .06 \Delta \dot{X}_t, + .03 \Delta \dot{X}_{t,3} - .03 \Delta \dot{X}_{t,4} + .01 \Delta \dot{X}_{t,5} - .02 \Delta \dot{X}_{t,3} + .00 \Delta \dot{P}_t + .39 \Delta \dot{P}_{t,1} + .21 \Delta \dot{P}_{t,2} + .14 \Delta \dot{P}_{t,3} + .00 \Delta \dot{P}_{t,4} + .15 \Delta \dot{P}_{t,5} \]

where

- \( \Delta O_t^r \) = deviation of percent change in primary outlays from baseline estimate in fiscal year \( t \)

**Net interest**

The estimation form of the net interest equation was derived from the following equation:

\[ I_t = i_t - S_t - \pi_t^r - S_t^r + I_{t-1} - \frac{M_{t-1}}{D_{t-1}} + \frac{M_{t-1}}{D_{t-1}} \]

where

- \( I_t \) = net interest in fiscal year \( t \)
- \( i_t \) = average yield on 3-month Treasury bills and 10-year Treasury bonds in year \( t \)
- \( S_t^r \) = budget surplus in fiscal year \( t \)
- \( \pi_t^r \) = primary surplus in fiscal year \( t \)
- \( S_t^r \) = primary surplus in fiscal year \( t \)
- \( S_t^r \) = primary surplus in fiscal year \( t \)
- \( \pi_t^r \) = earnings of the Federal Reserve System in fiscal year \( t \)
- \( S_t^f \) = financing from other than borrowing from the public in fiscal year \( t \)
- \( D_t \) = federal debt held by the public in fiscal year \( t \)
- \( M_t \) = average length to maturity of federal debt (in years) at end of fiscal year \( t \)

The first term on the right-hand side represents borrowing from the public in the current fiscal year. The second term is an approximation of the change in interest cost due to refinancing maturing debt. This equation was solved for \( I_t \), in the form shown below. Since it is an approximation, the equation was estimated using data from 1953-83:

\[
\begin{align*}
I_t & = 0.47 \left[ \frac{i_t - S_t^r - \pi_t^r - S_t^r}{1 - i_t} + 0.72 \left( \frac{D_{t-1}}{1 - i_t} \right) \right] + 0.31 \left( \frac{1}{1 - i_t} \right) \frac{D_{t-1}}{M_{t-1}} \\
& + 1.0 \left( \frac{1}{1 - i_t} \right) \\
\bar{R} & = 0.99 \quad SE = 2.05 \quad DW = 1.95 \\
\rho_r & = -0.34 \quad \rho_t = 0.17
\end{align*}
\]