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Federal Budget Deficits, Interest Rates, and Inflation: Their Implication for Growth

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INTRODUCTION

The persistence of large federal government deficits has revived interest in analyzing the impact of deficits on the U.S. economy. In particular, the impact these deficits have on interest rates is critical when assessing the overall effects of deficits on the U.S. economy. Empirical research enhances the understanding of the relationship between deficits and interest rates. In this respect, tests of the causal flow in the deficit-interest rate relationship provide important information on the effects of deficits on interest rates.

Numerous studies investigate the relationship between fiscal deficits and interest rates. Much of the discussion concerning the impact of deficits on interest rates centers on the crowding-out effects of deficits (Blinder and Solow 1973, Carlson and Spencer 1975, Buiter 1977, Friedman 1978). The crowd-out effects of deficits are investigated by several authors. Barth, Iden, and Russek (1984–85) undertake an extensive review of the studies analyzing the effects of deficits on interest rates and on other economic variables. Although these authors find some evidence supporting the conventional view of a positive impact of deficits on interest rates, their empirical results are inconclusive in the sense that many factors, such as the time period under investigation and the choice of the variables, can influence the results. In a later study Barth, Iden, and Russek (1986) investigate the debt-neutrality theorem. Again, the conclusions regarding this hypothesis are found to be empirically sensitive to the choice of the sample period. With regard to these studies, the authors suggest that more empirical research is necessary to investigate the effects of deficits on interest rates.

Two studies of the effects of fiscal deficits on interest rates were undertaken by Hoelscher who investigated the effects of deficits on short-term interest rates (1983) and, subsequently, the effects of deficits on both the short-term and the long-term interest rates. Hoelscher (1983) finds no impact of deficits on short-term interest rates finding them to be primarily determined by expected inflation, monetary factors, and general economic activity. In his 1986 paper he finds empirical support for the crowd-out hypothesis for long-term interest rates. No such evidence, however, is reported regarding the short-term interest rates.

The connection among deficits, money growth, and inflation has also been investigated by many authors (Niskanen 1978, Levy 1981, Hamburger and Zwich 1981, Dewald 1982, McMillin and Beard 1982, Allen and Smith 1983, Miller 1983, and many others). Their evidence is mixed; some find no evidence that deficits are directly related to increases in the money supply and thereby to inflation, while Ahking and Miller (1985), using the FPE method within a trivariate autoregressive framework to analyze the connection among deficits, monetary growth, and inflation, report direct effects of government deficits on inflation, regardless of whether these deficits are monetized or not.

Overall, the empirical testing of the deficit-interest rate connection and the deficit-inflation is inconclusive. The purpose of this study is to undertake such an examination within a causality testing framework. The study relies on the minimum final prediction (FPE) causality testing method outlined by Hsiao (1979 and 1981).[1] The study investigates two related theoretical issues. First, it analyzes the issue of causality in the deficit-nominal interest rate relationship. Second, it investigates the effects of deficits on

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the two components of nominal interest rates, namely the inflation rate and the real rate of interest. Both the short-term and the long-term interest rates are investigated.

The paper is divided into three sections. The first evaluates the bivariate causality test results involving deficits and nominal interest rates. Thereafter, the results of a trivariate analysis are reported. The focus of the trivariate analysis is to ascertain the impact of deficits on the two components of the nominal rate of interest: the real rate of interest and the rate of inflation. Conclusions are reported in the final part of the paper.

BIVARIATE TEST RESULTS

Hsiao's (1979 and 1981) minimum FPE causality testing procedure required several statistical steps. It combined the FPE criterion developed by Akaike (1969a and b) with Granger's (1969) definition of causality.[2] Essentially, given two variables X and Y, there exists a possibility of unidirectional causality or bi-directional causality between these variables. In addition, the two variables may be statistically independent.[3]

In this paper's calculations, X represents federal government deficits (DEF) and Y measures nominal interest rates. Causality tests are undertaken for both short-term nominal interest rates and long-term nominal interest rates to identify the effects of deficits on both of these rates. Nominal short-term interest rates (NSTIR) are approximated by an arithmetic average of three short-term interest rates, namely the federal funds rate, the prime commercial paper rate, and the prime lending rate. Nominal long-term interest rates (NLTIR) are an arithmetic average of the three-year U.S. Treasury notes, ten-year U.S. Treasury securities, and thirty-year FHA mortgages. In further calculations (trivariate analysis), inflation is approximated by the consumer price index (CPI).[4] Monthly seasonally unadjusted data ranging from October 1974 to December 1984 are used for all relevant variables.[5] All equations are estimated in the first differences of logarithms form.[6] The time period under consideration is most appropriate for the purposes of this paper because during this time federal government deficits were both large and variable. Additionally, the floating exchange rate has impacted the relationships under investigation. All of these factors make this period interesting for empirical analysis. After 1984 the variability of both interest rates and deficits declined substantially. Therefore, the 1985–88 period is not included in the present investigation.

The autoregressive estimates of the bivariate specifications yielding the smallest FPEs (along with their appropriate lags) are reported in Table 1. The format of reporting is adopted from Hsiao (1981). The actual procedure involves selecting the lag structure determined in the univariate one-dimensional autoregressive process and computing the FPEs of the bivariate model by testing the order of lags of the second explanatory variable from 1 to 10.[7]

Causality inferences are made by comparing the minimum FPEs of the univariate and bivariate specifications (Table 2). The results indicate that deficits (DEF) and nominal short-term interest rates (NSTIR) are statistically independent. However, when nominal long-term interest rates (NLTIR) are used as test variables, then a unidirectional causal flow is established from deficits (DEF) to nominal long-term interest rates (NLTIR). These results are consistent with Hoelscher's (1983 and 1986) studies and have important theoretical implications. Deficits and nominal interest rates are determined independently of each other in the short-run; other factors determine both of these variables. The absence of a relationship between short-term interest rates and fiscal deficits might be attributable to the influence of the international sector on domestic interest rates. Hoelscher (1986) offers an additional plausible explanation for the theoretical independence of deficits and short-term interest rates. This explanation involves the short-term nature of the public debt, interest elasticity of the short-term supply of credit, and the integration of U.S. and world capital markets.[8]

TABLE 1
The Optimum Lags of the Dependent Variables and the FPE of the Explanatory Variables*

Dependent Variables	Explanatory Variables	The Optimum Lag of Explanatory Variables	FPE × 10^{-2}
DEF (9)	NSTIR	1	0.9144
NSTIR (2)	DEF	1	0.6780
DEF (9)	NLITR	1	0.9100
NLTIR (9)	DEF	1	0.1063

*Numbers in parentheses are lags for minimum FPEs. Format of reporting is modified from Hsiao (1981).

TABLE 2
Causality Implications of the FPE Procedure for Deficits (DEF), Nominal Short Term Interest Rates (NSTIR), and Nominal Long Term Interest Rates (NLTIR)

NSTIR		NLTIR	
Process	Implications	Process	Implications
DEF Process:		*DEF Process:*	
FPE (Step 1) 0.9004	0.9004 < 0.9144	FPE (Step 1) 0.9004	0.9004 < 0.9100
FPE (Step 2) 0.9144	NSTIR ≠> DEF	FPE (Step 2) 0.9100	NLTIR ≠> DEF
NSTIR Process:		*NLTIR Process:*	
FPE (Step 1) 0.6616	0.6616 < 0.6780	FPE (Step 1) 0.1081	0.1081 > 0.1063
FPE (Step 2) 0.6780	DEF ≠> NSTIR	FPE (Step 2) 0.1063	DEF => NLTIR

The empirical evidence presented in Tables 1 and 2 suggests that the change in deficits leads to subsequent changes in nominal long-term interest rates and consequently to changes in the level of private investment, thereby, affecting economic growth. This finding supports the crowd-out theory of deficit financing, but does not rule out the possibility of other variables causally affecting nominal long-term interest rates.[9] However, the nature of bivariate causality tests does not allow the inclusion of all possible causal variables in the test equations.[10]

TRIVARIATE RESULTS

The bivariate results provide useful information about deficits as a causal force in determining nominal interest rates. For long-term nominal interest rates, empirical evidence indicates a unidirectional causal flow from deficits to nominal long-term interest rates. However, causality test procedures do not indicate to what extent the changes in deficits affect the two parts of nominal long-term interest rates: the inflation rate and the real rate of interest. The resolution of this issue is crucial for, if deficits affect only the inflation rate and leave the real interest rate unchanged, then their effect, if any, on the real capital formation in an economy would be minimal. Consequently, capital formation and economic growth would not be influenced for no other real variables—such as real investment and savings—change. If, on the other hand, the primary effect of deficits on nominal long-term interest rates operates through the real interest rate component of nominal long-term interest rates, then this result could have a far-reaching impact on capital formation and on economic growth. The resolution of this issue is critical for the development of economic theory and for economic policy decision making.

This issue can be resolved by an empirical examination of the causal flow from deficits to the inflation rate and the long-term real rate of interest. The evidence can be obtained by extending Hsiao's (1979 and 1981) causality testing technique to a trivariate format. For this purpose, it is necessary to find appropriate measures of inflation and the real rate of interest. The consumer price index (CPI) can serve as a useful proxy of inflation. Therefore, the monthly data for seasonally unadjusted CPI are used throughout the trivariate analysis.[11] The real rate of interest is defined as the difference between the nominal rate of interest and inflation: $i_r = i_n - P^e$. i_r is the real rate of interest, i_n is the nominal rate of interest, and P^e is the rate of inflation.[12]

The trivariate analysis extends the FPE bivariate tests to a trivariate format. Ram (1984) outlines such an extension. The trivariate format includes an additional test variable. The dependent variables are the real long-term interest rate (RLTIR) and the rate of inflation (CPI). These variables are initially regressed on one another maintaining the optimal lag specification obtained from step one of the minimum FPE procedure. Then the first independent variable is added. The causality implications are obtained by including the second independent lagged variable (DEF) to both the inflation and the real interest rate equations (equations 5 and 6), and by comparing the minimum FPEs.[13]

The trivariate results are reported in Table 3. The last two rows of the table indicate that there is a causal flow from deficits to both the rate of inflation and the long-term real rate of interest. Including the lagged deficit variable to the real interest rate equation (5) reduces the FPE from 0.0849 to 0.0831, while adding the lagged deficit variable to the inflation equation (6) also reduces the FPE from 0.0792 to 0.0778. This implies that the impact of deficits on nominal long-term interest rates operates both through price-level changes and real interest rate changes. In the long-run, deficits not only cause inflation, but they also lead to changes in real interest rates. These results are consistent with Ahking and Miller's (1985) study, as deficits have a direct impact on inflation regardless of the monetization process.

The coefficients of the deficit variable in equation (5) indicate the direction and the size of the impact of deficits on long-term real rates of interest.[14] The coefficients of the lagged deficit variable are all positive, and they become quite large from the fifth period onward. The sum of the six lagged deficit coefficients is 0.427, suggesting that deficits have a substantial positive effect on real interest rates, especially in later periods. This result clearly supports the crowding-out theory of deficit financing.

Analyzing the coefficients of the deficit variable in equation (6) yields mixed results. The signs of these coefficients are negative in the first six periods and their sum is negative 0.261. This negative impact is reversed in later periods (period seven). Theoretically, this result indicates that initially deficits may reduce inflation, but ultimately they lead to increasing rates of inflation. This result may be explained by the fact that initially government borrowing associated with the existence of deficits depresses private consumption expenditures, leading to a slightly reduced pressure on prices. However, when in later periods deficits become monetized, the rate of inflation increases.

Comparing the sum of the lagged deficit variable coefficients from equations (5) and (6) indicates the relative strength of the causal flow from deficits to both the inflation rate and the real rate of interest. Since +0.427 is much greater in absolute value than negative 0.261, this result implies that the main impact of deficits is on the real rate of interest. Therefore, deficits have a substantial positive impact on real long-term interest rates.

The overall negative total impact of deficits on inflation in the present study may be due to a rather short-run selection of time horizon. The minimum FPE procedure dictates the selection of seven lags as the optimal lag structure of the DEF variable. Seven lags may not be sufficient time to capture the long-run effects of deficits on inflation. Given a longer lag structure, deficits may well have a positive overall effect on inflation. An examination of additional three lags lends support to this hypothesis. Coefficients of all of these lags were positive. This result indicates that, in the long-run, deficits lead to accelerated inflation, probably due to the long-run effects of the monetization of the federal government debt on inflation.

In order to test further the sensitivity of the causality implications to the choice of a longer term inflation variable, a two-year moving average of the rate of inflation was constructed. Equations (2), (4), and (6) were re-estimated using this new long term measure of inflation. In this case, too, the evidence of causal flow from deficits to inflation was found as the minimum FPE of equation (4) was 0.0158 while the minimum FPE of equation (6) was 0.0129. Consequently, the causality implications are not dependent on an arbitrarily selected measure of inflation.

TABLE 3

Trivariate Results. Causality Testing by Computing Final Prediction Errors.*

Equation	Dependent Variable	First Explanatory Variable	Second Explanatory Variable	FPE × 10^{-2}
(1)	RLTIR (9)			0.0833
(2)	CPI (8)			0.0787
(3)	RLTIR (9)	CPI (1)		0.0849
(4)	CPI (8)	RLTIR (1)		0.0792
(5)	RLTIR (9)	CPI (1)	DEF (6)	0.0831
(6)	CPI (8)	RLTIR (1)	DEF (7)	0.0778

*Numbers in parentheses are lags for minimum FPEs. Format of reporting is modified from Ram (1984).

CONCLUSIONS

This study investigates two closely related theoretical issues within the causality testing framework. First, the direction of the causal flow in the deficit-nominal interest rate relationship is analyzed. Second, the effects of deficits on the two components of nominal interest rates, i.e., the inflation rate and the real rate of interest, are investigated. The impact of deficits on both the short-term and the long-term interest rates is examined. The U.S. monthly seasonally unadjusted data ranging from October 1974 to December 1984 are used for all variables. The minimum FPE causality testing technique is used for all estimates.

Within the bivariate framework, deficits and nominal short-term interest rates are found to be statistically independent. This result is consistent with existing economic literature (Hoelscher 1983 and 1986). It indicates that both deficits and nominal short-term interest rates are determined by other economic variables. Therefore, this study finds no evidence to indicate that increasing deficits trigger increases in the nominal short-term interest rates. When investigating the long-run effects of deficits on nominal interest rates, a unidirectional causal flow is established from deficits to nominal long-term interest rates. This result indicates a significant fiscal crowd-out in the long-run, and the possibility of an important impact of deficits on economic growth. This evidence supports results reported by Hoelscher (1986). Economic growth would be affected if deficits lead to substantial changes in the real rates of interest rather than just changes in the rate of inflation.

The results reported in the trivariate section indicate that deficits affect both components of the long-term nominal interest rate: the real rate of interest and the inflation rate. The results that relate to the impact of deficits on inflation are consistent with Ahking and Miller's (1985) findings for the 1950s and the 1970s. The novelty of the present study lies in its emphasis on the impact of deficits on real rates of interest which is found to be substantial. The impact of deficits on the real interest rate is stronger than on the rate of inflation. Consequently, the results indicate not only that deficit financing has a fiscal crowd-out effect but, more important, that there are adverse effects on economic growth in consequence of reduced capital formation at higher real rates of interest. The implication is that deficits lead to long-run changes in real resource allocation in the U.S. economy.

NOTES

1. The FPE causality testing method is described in the following parts of this paper.
2. A more detailed description of the minimum FPE causality testing procedure is omitted due to space constraints. Interested readers are referred to Hsiao (1979 and 1981) for a complete description of this procedure and its causality implications.
3. For a further discussion of causality, see Hsiao (1981, pp. 90–91).
4. The federal government deficit data are the data for the unified budget. These data were obtained from various issues of the Monthly Statement of the Public Data of the United States. The interest rate data were obtained from various publications of the Board of Governors, Federal Reserve System, and from the Housing and Urban Development Department, U.S. Government.
5. Seasonally unadjusted data are selected to avoid the problem associated with different methods of seasonal adjustment.
6. All data were subjected to the Dickey-Fuller tests [Dickey and Fuller (1979), Fuller (1976)]. Each data series had a unit root and, therefore, the stationarity of the data could be assured by the first differences of logarithms specification.

7. The smallest FPEs from the univariate estimations for deficits (DEF), nominal short-term interest rates (NSTIR), and nominal long-term interest rates (NLTIR) are specified with 9, 2, and 9 lags respectively. Space constraints preclude detailed reporting of these univariate specifications. Tabulated results are available upon request.
8. For a detailed explanation of these issues, see Hoelscher (1986, pp. 15–16).
9. Undoubtedly, under the flexible exchange rate system other factors such as the capital flows can also affect domestic nominal long-term interest rates. Additionally, instability in the world finance dating back to the early 1980s can also have effects on the relationships under investigation. However, the discussion of these issues is beyond the scope of the present paper.
10. In general, the Granger causality test results may change if additional variables are included in equations. In such cases, the causality may be spurious due to the problems associated with omitted variables.
11. The rate of inflation can be calculated from the CPI data. In order to do so the following log transformation of this data was undertaken:

$$P^e = 100 \times [\log(CPI_t) - \log(CPI_{t-1})].$$

In this specification P^e is the rate of inflation, CPI is the monthly consumer price index, and t indicates the time period.
12. The long-term nominal rate of interest is approximated in this study by an arithmetic average of three long-term nominal rates, namely the three and the ten-year U.S. Treasury bond rates and the thirty-year FHA mortgage rate. The rate of inflation is approximated by the CPI data. Monthly data may be somewhat short-run in their nature. However, their choice is in line with the theoretical foundation of this study.
13. For a more detailed description of this method, see Ram (1984, pp. 475–6).
14. Due to space constraints, detailed reporting of equations (5) and (6) is not possible. The tabulated results of estimations of these equations will be made available to interested readers upon request.

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