Federal Government Budget Deficits and Real Long-Term Interest Rates in the United States: An Alternative Perspective

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INTRODUCTION

Several recent empirical studies [including BARTH, IDEN, and RUSSEK (1984), BARTH, IDEN, RUSSEK, and WOHAR (1989), BELTON (1993), CEBULA (1988; 1991), FELDSTEIN and ECKSTEIN (1970), HOELSCHER (1986), OSTROSKY (1990; 1984), and TANZI (1985)] have found a positive and statistically significant correlation between the government budget deficit and real long-term interest rates. The usual assumption in these studies has been that the government budget deficit causes real long-term interest rates, i.e., an increase in the government budget deficit raises the demand for loanable funds, thereby causing the equilibrium real long-term interest rate to increase. However, the direction of causality between real long-term interest rates and the budget deficit might well be the reverse, i.e., real long-term interest rates might well cause the budget deficit. This reverse causality is possible for at least two reasons. First, much of the federal government's debt is rolled over each year. With the average maturity of the federal government debt ranging from a low of 2.58 years to a high of 6.08 years during the period from 1972 to 1991, approximately 20 percent (on average) of the total debt is refinanced during each year. Thus, a rise in the real interest rate means an increase in the real interest payments (debt service) that must be made during the any given year to service the national debt. In fact, net interest now represents approximately 14 percent of the current total budget of the federal government. Second, according to conventional macroeconomic theory, a rise in the real interest rate should lead to a fall in real economic growth, as aggregate investment and aggregate durable consumption demand fall. This decline may lead to higher unemployment and thus an increase in the government's cyclical deficit through reduced tax collections and increased transfer payments, such as unemployment benefits.

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The basic purpose of this study is to analyze empirically the direction of causality between the government's budget deficit and real long-term interest rates. First, we will study the direction of causality between the total government budget deficit and the real long-term interest rate. Then, we will dichotomize the total deficit into its structural deficit and cyclical deficit components and, using a multivariate causality test, determine the direction of causality between the real long-term rate of interest on the one hand and the structural and cyclical deficits on the other hand.

I. THE EMPIRICAL ANALYSIS

The first step in our empirical analysis is to define the variables under investigation. Our measure of the budget deficit is $TDY_t$, defined here as the ratio of the total government budget deficit to GNP in quarter $t$. The real long-term interest rate in quarter $t$, $R20_t$, is defined as the nominal average interest rate on the Treasury's 20-year bond during the quarter minus the actual annual inflation rate of the consumer price index in the quarter.

The next step in our analysis is to determine the appropriate form of the causality test. To avoid spurious regression results, we first test for stationarity of the variables. The data are quarterly; the time period for our study is 1972.1-1991.4. We begin with 1972.1 since this quarter immediately follows the quarter when the system of fixed exchange rates (Bretton Woods) began to collapse. The study ends with 1991.4 because the United States begins reporting of quarterly GDP data rather than quarterly GNP data thereafter.

The Augmented Dickey-Fuller (ADF) test reveals that both $TDY_t$ and $R20_t$ are non-stationary in levels. Thus, $DTDY_t$ and $DR20_t$, the first difference of $TDY_t$ and $DR20_t$, are used in the empirical analysis. The ADF statistics are -9.70 and -7.39 for $DTDY_t$ and $DR20_t$, respectively, which implies that both of the variables (the deficit and real interest rate) are stationary in first differences. The next step is to test for cointegration between $TDY_t$ and $R20_t$. We used the cointegration method developed by Johansen and Juselius (1990) and find that the variables are in fact cointegrated. The vector that minimizes the Augment-Dickey-Fuller (ADF) test statistic is indicated below by $z_t$:

$$z_t = R20_t - 3.02TDY_t$$

The ADF test statistic is -4.73, which is significant at the one percent level. The cointegrating vector, $z_t$, indicates that there is a long-term, positive relationship between the real long-term interest rate and the government's budget deficit.

With the variables being integrated as $I(1)$ but cointegrated as $CI(0)$, the error-correction model is used to test for the direction of causality. Thus, we test for causality by estimating the parameters of equations (2) and (3) below.
The budget deficit is said to cause the real long-term interest rate if the sum of the $a_2$'s are significant or if $a_3$ is statistically significant and the sum of the $b_1$'s are not significant. Similarly, the real long-term interest rate «causes» the budget deficit if the sum of the $b_1$'s are significant or if $b_3$ is significant and the $a_2$'s are not statistically significant. There is bidirectional causality if both the $a_2$'s or $a_3$ and the $b_1$'s or $b_3$ are statistically significant.

The causality test was performed using OLS. As discussed earlier, the lag-length was determined using the Aikaike Information Criterion and the residuals were tested against the hypothesis of serial correlation using both the Langrange-multiplier test and the Box-Pierce Q-statistic. These test statistics are not reported but are available upon request.

The OLS estimates of equations (2) and (3) are:

\[
DR20_t = a_0 + \sum_{i=1}^{r} a_{1i} DR20_{t-i} + \sum_{j=1}^{r} a_{2j} DTY_{t-j} + a_3 z_{t-1} + u_t \tag{2}
\]

\[
DTDY_t = b_0 + \sum_{i=1}^{s} b_{1i} DR20_{t-i} + \sum_{j=1}^{s} b_{2j} DTY_{t-j} + b_3 z_{t-1} + v_t \tag{3}
\]

where $DR20_t$, $DTDY_t$, and $z_t$ are as described above and $u_t$ and $v_t$ are stochastic error terms. The lag-lengths $r$ and $s$ are determined using Aikaike Information Criterion.

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The OLS estimates of equations (2) and (3) are:

\[
DR20_t = -0.54 + 0.38 DR20_{t-1} - 0.27 DR20_{t-2} + 0.33 DR20_{t-3} - 0.20 DTY_{t-1}
\]

\[
+0.19 DTY_{t-2} - 0.14 DTY_{t-3} - 0.10 z_{t-1}
\]

\[
D.W. = 1.89 \quad s.e.e = 1.45 \quad adj. R^2 = 0.165 \tag{4}
\]

\[
DTDY_t = +0.62 + 0.080 DR20_{t-1} + 0.074 DR20_{t-2} - 0.015 DTY_{t-1} + 0.26 DTY_{t-2}
\]

\[
-0.33 z_{t-1}
\]

\[
D.W. = 1.87 \quad s.e.e. = 0.61 \quad adj. R^2 = 0.314 \tag{5}
\]
written so that the coefficient of the dependent variable is one. Thus, in equation (4), $z_t$ is written as $z_t = R20_t - 3.02TDY_t$, and in equation (5) it is written as $z_t = TDY_t - 0.33R20_t$.

In equation [4], the coefficient on $z_{t-1}$ is not statistically significant at even the ten percent level, implying that budget deficits do not have any long-run causal effect on the real long-term interest rate. Further, the Granger F-statistic for the sum of the coefficients on $DTDY_t$ is 0.72, implying that there is no short-run causal effect of budget deficits on real long-term interest rates either. These findings are, in principle, consistent with some of the findings in the well-known study by Evans (1985), and in effect are also consistent with another well-known study by Evans (1987).

The coefficient on $z_{t-1}$ in equation (5) is negative and statistically significant at the one percent level, implying that the real long-term interest rate does, in the long-run, cause the budget deficit. The negative sign indicates a positive causal effect such that a rise in the real long-term interest rate causes a rise in the government's budget deficit (expressed as a percent of GNP). Thus, it appears that the positive correlation between the real long-term interest rate and the budget deficit found in many previous studies may be a result of the effect of the real long-term interest rate on budget deficits, not vice versa. This result may arise for the reasons summarized in the Introduction. To gain further insight from this analysis, we disaggregate the total budget deficit measure into its structural and cyclical components. Thus, we can write:

$$DTDY_t = DSDY_t + DCDY_t$$

(6)

where $DSDY_t$ is the first difference of $SDY_t$, the ratio of the structural deficit to GNP in quarter $t$; and $DCDY_t$ is the first difference of $CDY_t$, the ratio of the cyclical deficit to GDP in quarter $t$. Furthermore, we observe that $DCDY_t$ has been found to very largely be a function of $DU_t$, the first difference of $U_t$, the seasonally adjusted unemployment rate in quarter $t$ [Belton (1993), Cebula (1988, 1991) and Ostrosky (1990; 1984)]. It can be argued that the cyclical deficit grows essentially simultaneously with the unemployment rate because of rising unemployment benefits; however, it may be that tax receipts lag behind the unemployment rate (any discretionary fiscal policy aimed at elevating higher unemployment would be linked to the structural deficit). Thus, it is arguable that a greater lag could be called for. A greater lag length on the unemployment variable is allowed for in the Granger causality test performed later on in this study. Based on the Schwartz-Bayesian criterion, however, it is dismissed; hence, the use of the unlagged variable $DU_t$ as a proxy for $DCDY_t$ is appropriate. Therefore, we can write:

$$DTDY_t = DSDY_t + cDU_t$$

(7)

Using the above relationship, we can derive equations (8), (9), and (10), the error-correction causality test model:
\[ DR20_t = a_0 + \sum_{i=1}^{r} a_{1i} DR20_{t-i} + \sum_{j=1}^{r} a_{2j} DSDY_{t-j} + \sum_{k=1}^{r} a_{3k} DU_{t-k} + a_4 z_{t-1} + u_t \]  
(8)

\[ DSDY_t = b_0 + \sum_{i=1}^{r} b_{1i} DR20_{t-i} + \sum_{j=1}^{r} b_{2j} DSDY_{t-j} + \sum_{k=1}^{r} b_{3k} DU_{t-k} + b_4 z_{t-1} + v_t \]  
(9)

\[ DU_t = c_0 + \sum_{i=1}^{r} c_{1i} DR20_{t-i} + \sum_{j=1}^{r} c_{2j} DSDY_{t-j} + \sum_{k=1}^{r} c_{3k} DU_{t-k} + c_4 z_{t-1} + w_t \]  
(10)

where \(u_t, v_t, \text{ and } w_t\) are the stochastic error terms in this model. Further, using \(DU_t\) instead of \(DCDY_t\) offers a major theoretical advantage. There is no theoretical reason to believe that the cyclical deficit should have any different effect on the real long-term interest rate than the structural or total deficit. Bond buyers cannot distinguish between bonds sold by the Treasury to finance the structural deficit from those bonds sold to finance the cyclical deficit. If \(DCDY_t\) is used as a variable in the model, its coefficient should be the same as that on \(DSDY_t\) plus the effect of \(DU_t\) on the dependent variable. Since we expect \(DU_t\) to have an impact on \(DR20_t\), or vice versa, it is important to include \(DU_t\) in the model. It is quite possible that, if there is no relationship between the budget deficit and the real long-term interest rate, that \(DTDY_t\) merely stands as a proxy for \(DU_t\) since changes in \(DU_t\) cause changes in \(DTDY_t\) and may be correlated with \(DR20_t\).

Like \(TDY_t\) and \(R20_t\), \(SDY_t\) and \(U_t\) have unit roots (are stationary in first differences). Thus, we must use \(DSDY_t\) and \(DU_t\) in our model rather than the structural deficit and unemployment rate in levels; the respective ADF statistics for \(DSDY_t\) and \(DU_t\) are -11.70 and -4.12, both of which are significant at the one percent level. Testing for cointegration reveals that \(U_t, SDY_t, \text{ and } R20_t\) are cointegrated as CI(0). The cointegration vector, \(z_t = R20_t - 2.87 U_t - 2.83 SDY_t\), has an ADF test statistic of -3.99. Thus, we can reject the null hypothesis of no cointegration at the five percent level. Again, we express the error-correction term, the cointegration vector, such that the dependent variable has the coefficient of one. Thus, \(z_t\) is expressed as:

\[ z_t = R20_t - 2.87 U_t - 2.83 SDY_t \text{ in equation (11)}; \]
\[ z_t = SDY_t - 0.35 R20_t + 1.02 U_t \text{ in equation (12)}; \text{ and } \]
\[ z_t = U_t - 0.35 R20_t + 0.98 SDY_t \text{ in equation (13)}. \]

Before performing the causality tests, the cointegration vector suggests one possible direction of causality. The vector indicates that \(R20_t\) and \(U_t\) are positively related. This is not consistent with the theory that \(U_t\) causes \(R20_t\), because we would expect that an increase in \(U_t\) would decrease the demand for loanable and, thus, lower real long-term
interest rates. However, if the direction of causality is from the real long-term interest rate to unemployment, this cointegration vector is consistent with theory: that is, we would expect a rise in the real long-term interest rate to cause a rise in the unemployment rate.

We now proceed by estimating the parameters of our model using OLS. The results are:

\[
DR20_t = -1.99 + 0.39DR20_{t-1} - 0.35DR20_{t-2} + 0.41DR20_{t-3} - 0.29DR20_{t-4}
\]
\[
-0.56DSDY_{t-1} - 0.22DSDY_{t-2} - 0.23DSDY_{t-3} - 0.26DSDY_{t-4} + 0.22DU_{t-1}
\]
\[
-0.24DU_{t-2} + 1.23DU_{t-3} - 0.62DU_{t-4} - 0.084z_{t-1}
\]
\[
D.W. = 1.95 \quad s.e.e. = 1.47 \quad adj. R^2 = 0.144
\]

\[
DSDY_t = -0.73 + 0.11DR20_{t-1} + 0.011DR20_{t-2} - 0.00DR20_{t-3} - 0.43DSDY_{t-1}
\]
\[
-0.23DSDY_{t-2} - 0.26DSDY_{t-3} + 0.64DU_{t-1} - 0.080DU_{t-2} - 0.13DU_{t-3}
\]
\[
+0.091z_{t-1}
\]
\[
D.W. = 2.01 \quad s.e.e. = 0.50 \quad adj. R^2 = 0.240
\]

\[
DU_t = 0.94 + 0.074DR20_{t-1} + 0.018DSDY_{t-1} + 0.60DU_{t-1} - 0.11z_{t1}
\]
\[
D.W. = 2.10 \quad s.e.e. = 0.25 \quad adj. R^2 = 0.640
\]

For equation (11), the Granger F-statistic for the hypothesis that \(DSDY_t\) causes \(DR20_t\) is 0.42, which, coupled with the non-significance of the coefficient on \(z_{t-1}\), allows us to reject the hypothesis that the budget deficit causes the real long-term interest rate. This conclusion is consistent with our previous results. Also, the F-statistic for the hypothesis that \(DU_t\) causes \(DR20_t\) is 0.78, which allows us to reject the hypothesis that unemploy-
ment causes the real long-term interest rate. This is consistent with the coefficient on $U_t$ in the cointegration vector as discussed earlier.

Equation (12) reveals an important difference. First, the non-significance of the coefficient on $z_{t-1}$ indicates that there is no long-run causality between $DSDY_t$ and $DR20_t$. In addition, the Granger F-statistic for the hypothesis that $DR20_t$ causes $DSDY_t$ is 2.11, which allows us to reject the hypothesis that the real long-term interest causes the structural deficit at even the ten percent level (since the $F$-statistic for three constraints and 65 degrees of freedom is 2.17 for the ten percent significance level and 3.14 for the five percent significance level). This result indicates that the previous conclusion that changes in the real long-term interest rate cause changes in the government's budget deficit is rejected when we account for changes in the unemployment rate. However, the Granger $F$-statistic for the hypothesis that $DU_t$ causes $DSY_t$ is 3.83, allowing us to accept this hypothesis at the two percent level: the unemployment rate Granger-causes the structural deficit.

Equation (13) reveals that there is both a long-run and short-run causality such that a higher real long-term interest rate causes a rise in the unemployment rate. This hypothesis is significant at the one percent level for both the long-run and the short-run.

**CONCLUSIONS**

The results reported in equations (4), (5), (11), (12) and (13) suggest that a rise in the real long-term interest rate Granger causes a rise in the government's total budget deficit, not vice versa as previously found in a number of published studies. However, this causality appears to arise from the effect of the real long-term interest rate on the unemployment rate rather than any direct effect of the real long-term interest rate on the structural deficit. This is suggested by the fact that when we added $DU_t$ to the model, the causal relationship between the real long-term interest rate and the budget deficit was no longer evident. In addition, we found a strong causal relationship between the real long-term interest rate and the unemployment rate, such that a rise in the long-term interest rate causes a rise in the unemployment rate. A rise in the unemployment rate increases the cyclical deficit which, in turn, increases the total budget deficit. Furthermore, we found an additional causal relationship between the unemployment rate and the structural deficit not related to the real long-term interest rate. Thus, apparently, when a rise in the long-term interest rate causes a rise in unemployment, this not only increases the cyclical deficit, but policy makers increase as well the structural deficit to stimulate the economy.

The policy implications of these results are considerable. First, these results do not support the notion of crowding out, since there is no empirical evidence that it is a rise in the budget deficit that causes a rise in the real long-term interest rate. Second, we have obtained empirical evidence that can be viewed as consistent with the notion of Ricardian Equivalence. Third, the result that a rise in the real long-term interest rate causes a rise
in the budget deficit has potentially major implications for the conduct of monetary policy. For example, if restrictive monetary policies act directly or indirectly to elevate real long-term interest rates, the government budget deficit may also rise.

REFERENCES


SUMMARY

The empirical results obtained in this study suggest that, in the United States, a rise in the real long-term rate of interest elicits a rise in the federal government budget deficit. This impact of the real long-term interest rate appears to arise because of the negative effect that higher real interest rates exercise on the unemployment rate. The findings obtained in this study imply that a monetary policy that directly or indirectly raises real long-term interest rates may raise the government budget deficit as well.

ZUSAMMENFASSUNG

Die sich aus dieser Studie ergebenden empirischen Ergebnisse lassen darauf schliessen, dass in den Vereinigten Staaten eine Erhöhung des langfristigen Realzinssatzes eine Steigerung des Haushaltsdefizits der Bundesregierung auslöst. Diese Auswirkung scheint sich aus dem negativen Effekt eines höheren Realzinssatzes auf die Arbeitslosen­zahl zu ergeben. Die sich aus dieser Studie ergebenden Feststellungen lassen darauf schliessen, dass eine monetäre Politik, die direkt oder indirekt die langfristigen Realzins­sätze anhebt, das Haushaltsdefizit der Bundesregierung ebenfalls erhöhen kann.

RESUME

Les résultats empiriques obtenus dans cette étude suggèrent que, aux Etats-Unis, une hausse des taux d'intérêt à long-terme cause une hausse du déficit du gouvernement fédéral. Cet impact des taux d'intérêt réels est causé par l'effet négatif qu'ils ont sur le taux de chômage. Les résultats de cette étude impliquent qu'une hausse des taux d'intérêt à long-terme augmente, en même temps, le déficit du gouvernement.