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A NOTE ON INTEREST RATES AND STRUCTURAL FEDERAL BUDGET DEFICITS

John Kitchen

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Abstract

This paper provides evidence on the response of interest rates to Federal budget deficits. A simple model is presented that incorporates the role of monetary policy in the determination of short-run interest rates and that ascribes the effects of government budget imbalances on the term structure of interest rates to uncertainty about the expected evolution of inflation and real interest rates. Empirical results support the view that the term structure of interest rates is affected by Federal budget deficits, with a significant positive response of intermediate- and long-term interest rates relative to short-term rates in response to budget deficits.

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I. Introduction

The issue of the role of budget deficits and their effects on the economy is one of the most-debated topics in economics. Much of the debate has focused explicitly on the role of the U.S. Federal budget in the determination of domestic long-term interest rates. A broad literature exists. Some argue that the current and expected Federal budget position plays a significant role in the determination of interest rates. Others argue that no observable relationship exists. Ultimately, because of the competing theoretical views and possible channels, the question of how the government budget affects interest rates requires an empirical answer.

Some studies have found significant positive relationships between Federal deficits and interest rates, including Hoelscher (1986), Miller and Russek (1991, 1996), and Cebula and Koch (1994). Weak or mixed results were observed by others; for example Evans (1985, 1987a, 1987b), Plosser (1987), and Zimmerman (1997) found little or no significant effects of deficits on interest rates. Some authors have attempted to overcome some of the typical empirical problems by examining the response of interest rates and other financial variables to Federal budget announcements (Wachtel and Young (1987), Kitchen (1996)). Such evidence points to a significant relationship between Federal budget deficits and interest rates, but with only small effects. Elmendorf (1996) also presented evidence that the response of interest rates to news about deficits revealed a positive relationship between deficits and interest rates. In general, the evidence in the literature for a positive and significant relationship between budget deficits and interest rates is mixed at best, and certainly does not appear to be "robust" to changing specifications and time periods. [1]

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[1] An exhaustive review of the literature is beyond the scope of this paper. In addition to the articles cited in the text, the interested reader is also referred to Barro(1989), Bernheim (1987), Seater (1993).

Despite the uncertain relationship in the academic literature, the traditional view of a positive relationship between deficits and interest rates carries much weight in policy discussions. Fed Chairman Greenspan, for example, has publicly stated his view that higher Federal deficits are associated with higher interest rates. In a speech given January 11, 2002, Greenspan stated:

> "Some of this stimulus has likely been offset by increases in long-term market interest rates, including those on home mortgages. The recent rise in these rates largely reflects the perception of improved prospects for the U.S. economy. But over the past year, some of the firmness of long-term interest rates probably is the consequence of the fall of projected budget surpluses and the implied less-rapid paydowns of Treasury debt."

The Congressional Budget Office (CBO) also typically has perceived a positive relationship between the Federal budget deficit and interest rates. For example, in 1995 the CBO projected that the adoption of a balanced budget would yield a beneficial reduction in long-term interest rates. CBO projected a decline in long-term interest rates of 170 basis points in 2002 for eliminating a $350 billion deficit in 2002 (3.5 percent of GDP), or about 48 basis points per one percentage point change in the deficit as a share of GDP.[2],[3]

This paper provides additional evidence on the responses of the term structure of interest rates to Federal budget deficits. A simple model is presented that incorporates the role of monetary policy in the determination of short-run interest rates, ascribing the effects of

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[2] The Economic and Budget Outlook: An Update, August 1995: "Economic and Budgetary Implications of Balancing the Budget," pp. 36, 42-45.

[3] A recent paper by Canzoneri, Cumby and Diba (2002) found a similar size of response in the term structure of Treasury security yields, with long-term yields falling relative to short-term rates by about 55 basis points for every percentage point of projected budget surplus relative to GDP. As cited in their paper, the specification employed by Canzoneri, Cumby and Diba (2002) was based in part on the preliminary work that was the basis of this paper.

government budget imbalances to uncertainty about the expected evolution of inflation and real interest rates. Empirical results support the view that the term structure of interest rates is affected by Federal budget deficits, with a significant positive response of intermediate- and long-term interest rates relative to short-term rates in response to budget deficits.

II. A Simple Model

An observed regularity in the way that short- and long-term economic forecasts are made reveals that most forecasters anticipate that any short-run deviation from the economy's long-run growth path will be eliminated over a relatively short period of time, with the economy thereafter assumed to return to its long-run equilibrium growth path. The model presented here is a simple one that is consistent with that behavior yet that also will provide a specification that can be used in an empirical analysis that avoids many typical estimation problems.

Consider a simple two period model. The first period is a short-run "disequilibrium" period, and the second period represents the long-run when variables are expected to converge to their targeted and equilibrium levels. The assumption of convergence in the second period is implicitly a joint assumption of a stable economy and monetary policy "credibility" – that is, market participants expect the monetary authorities to ultimately succeed in attaining their targets. For example, the Federal Reserve often refers to its "long run goals of price stability and sustainable economic growth."[4] The behavior of public and private forecasters (e.g, the Blue Chip, the Office of Management and Budget (OMB), and the CBO) is also largely consistent with this approach, with short-run economic forecasts typically projecting the elimination of output and unemployment gaps, and longer-run projections showing growth at the economy's potential with steady inflation and interest rates.

In the first period, the monetary authority adjusts the one period, short-term interest rate in response to deviations of inflation and output from their targeted or equilibrium levels, as in a Taylor (1993) rule type equation:

$$(1) \quad i_{t,1} = \bar{r} + \bar{\pi} + \alpha(\pi_t - \bar{\pi}) + \beta(y_t - \bar{y}_t)$$

where $i_{t,1}$ is the one-period (short-term) nominal interest rate in period t; r is the one-period real rate of interest; π_t is the one-period inflation rate in period t; y_t is the natural log of real output in period t; a "bar" over a variable represents a targeted equilibrium level; and α and β are monetary policy parameters that represent the policy adjustments to the short-term interest rate associated with inflation deviations from target (α) and with the deviation of actual output from potential (commonly referred to as the "output gap") (β).

Because the second period is an expected equilibrium period in which inflation is expected to return to its targeted level and output is expected to return to potential:

$$(2) \quad E_t\pi_{t+1} = \bar{\pi}\ ; \qquad E_t y_{t+1} = \bar{y}_{t+1}$$

An equation for the spread between the long-term (two period) and short-term (one period) term interest rates from the term structure can be written as:

$$(3) \quad i_{t,2} - i_{t,1} \approx \frac{(i_{t,1} + E_t i_{t+1,1})}{2} + \sigma_{t,2} - i_{t,1}$$

[4] Federal Reserve Press Release, August 13, 2002.

where $\sigma_{t,2}$ is a term premium set in period t for the 2-period horizon. For the purposes of this paper, we define the term premium, $\sigma_{t,2}$, as:

$$(4) \quad \sigma_{t,2} \;=\; \lambda_{t,2} \;+\; \gamma_{t,2} \;+\; \varepsilon_{t,2}$$

where $\lambda_{t,2}$ is the usual liquidity premium over the term to maturity, $\gamma_{t,2}$ is a risk premium resulting from the financial uncertainty associated with government budget deficits, and $\varepsilon_{t,2}$ is a term that captures other unidentified (random) risk factors. Combining equations 1 – 4, and simplifying yields:

$$(5) \quad i_{t,2} \;-\; i_{t,1} \;\approx\; -\,0.5\,\alpha(\pi_t - \overline{\pi}) \;-\; 0.5\,\beta\,(y_t - \overline{y}_t) \;+\; \lambda_{t,2} \;+\; \gamma_{t,2} \;+\; \varepsilon_{t,2}$$

In this simple framework, with the assumption that market participants expect the economy to return to its long-run equilibrium growth path after a short-run deviation, equation (5) shows that the spread between long- and short-term government interest rates is largely determined by four factors: (1) current inflation; (2) the current output gap; (3) a liquidity premium; and (4) a risk premium related primarily to financial uncertainty associated with the government's financial position. A framework with a more general representation of the transition periods in the term to maturity would perhaps provide a more detailed view of the dynamic path. Nonetheless, the general interpretation and the variables of interest for the empirical specification would not be affected.

Note that this framework does not explicitly account for the possible effects of government budget deficits on the key economic variables other than interest rates. Rather, this approach attributes the effect of the deficits to the uncertainty that market participants have regarding their possible effects. In the short run, the Taylor rule view of the determination of short-term interest rates does not assign a direct role to the effect of government budget variables. Rather, any effect of the government budget deficit only would occur indirectly through the deficit's possible effects on the output gap, a highly uncertain relationship in contemporaneous periods. Over longer periods of time, economic theory suggests several possible channels for the effects of budget deficits on future economic variables. For example, in a long-run Solow growth model without full offsets from international financial flows or Ricardian private savings behavior, a higher government budget deficit would produce a lower national saving rate, higher real interest rates, and lower investment and capital stock.[5] In our framework, market participants would still anticipate that the real output gap would be eliminated in the long run even if that equilibrium path were at a lower overall level of output. Alternatively, the monetary authority may accommodate the government deficits, leading to higher inflation over the relevant term for the determination of interest rates. This inflation effect could occur even if monetary authorities have a high degree of credibility because of the uncertain nature of economic information and the monetary authority's ability to interpret it.[6] For example, the monetary authority does not know precisely what the size of the output gap is at any given time; real GDP estimates are regularly revised by substantial amounts and great

[5] For an example of this approach see *Economic Report of the President* (1994), p. 85-87.
[6] Much debate exists in the recent literature about the role of fiscal policy in the determination of the price level, e.g., see Woodford (2001).

uncertainty exists about the potential growth path for real GDP as well.[7] As a result, market participants are not able to form precise expectations about the effects of the government budget position on future real interest rates and inflation. Rather, the uncertainty leads to a general response of long-term rates relative to short-term rates – that is, a change in a risk premium that captures the uncertainty about the expected real interest rate and inflation effects.[8]

III. Empirical Evidence

To empirically examine the relationships described above the following specification based on equation (5) was used:

$$(6) \quad i_{t,k} - i_{t,j} = c + a\ INFL + b(L)\ GDPGAP\ + g\ GOVSURP\ + e_t$$

where:

$i_{t,k}$ represents the yield on longer-term Treasury securities (k = 1, 3, 5, and 10 years);

$i_{t,j}$ is the interest rate on the short-term Treasury security, the 3-month Treasury bill rate;

INFL is the annual rate of consumer price inflation as measured by the chain price index for personal consumption expenditures excluding food and energy from the National Income and Product Accounts;

GDPGAP is the percentage deviation of real GDP from potential real GDP as estimated by the Congressional Budget Office (CBO);

[7] The uncertainty about the potential GDP and the output gap generally is analogous to the uncertainty about the full employment level of the unemployment rate (e.g., the NAIRU).

[8] Note that the approach and interpretation presented here also provides a consistent explanation for results in Kitchen (1996) that initially appeared contradictory. In that study, interest rates, the exchange value of the dollar, and precious metals commodity prices all were positively related to higher Federal deficits. The simultaneous positive relationships for the exchange value of the dollar and precious commodity prices seemed to be signaling simultaneous positive responses of real interest rates and inflation expectations, or perhaps inflation risk. The framework presented here explains the effect as a positive response of a risk premium related to uncertainty about the incidence of the positive response of future real interest rates and/or future inflation.

GOVSURP is the Federal government structural budget surplus as a percent of potential nominal GDP, based on CBO's standardized budget surplus estimates (e.g., CBO (2002)).

Because the evolution of the Federal budget is an annual phenomenon, the data were calculated on a Federal fiscal year basis. The estimation period covers the 1961-2001 fiscal years.

The choice of variables for the empirical specification warrants some further discussion. In the empirical work presented here the measure of the government budget position is the Federal structural budget surplus relative to potential GDP. A more-involved expectations-based approach might use a measure of expected structural Federal budget surpluses relative to potential GDP over future periods. But as Kitchen (1996) has shown, movements in longer-term budget positions that affect interest rates are closely correlated with movements in the contemporaneous year budget position, yielding the result that changes in contemporaneous year budget positions typically contain equivalent information to longer-term projected budgets shifts. The choice of using the structural budget surplus eliminates the contemporaneous cyclical economic effects on the budget variables, establishing a variable that is largely exogenous. The inflation variable enters separately in the estimation without accounting for the targeted inflation rate. This creates the implicit assumption that the inflation target is invariant through time, and its effect would be captured as a part of the estimated intercept. This is a necessary simplifying assumption as no reliable measure of the Fed's target for inflation exists. Although the omission of a variable inflation target (which likely would evolve very slowly over time) in the estimation may affect the proper estimation of the inflation parameter, it likely would not have much effect on the estimates of the key variable of interest in this study, the coefficient on the structural budget surplus. In the regressions, the current and first lagged values of the GDP output gap were included and the sum of those coefficient values is presented in the reported results.

Table 1 shows the estimation results for equation (6). Generally, the results support the interpretation provided above, with most coefficient estimates being significant and of correct sign. The adjusted R-squared values range from 0.264 at the one-year horizon to a relatively high 0.642 at the 10-year horizon, and the Durbin-Watson statistics suggest little or no concern about serial correlation. Of particular interest, the coefficients for the structural Federal surplus are negative in sign and reliably significant at the usual levels of significance for maturities of three years or more. Likewise, the coefficients on the output gap terms are also of negative sign, as hypothesized, and significant at the usual levels. At the longer-term horizons, the coefficient estimates for the inflation variable are of correct sign and are significant. The notable exception to the hypothesized relationships is the inflation coefficient for the term spread for one-year Treasury securities.

Chart 1 shows the actual and fitted series for the 10-year Treasury security yield to 3-month Treasury bill rate spread. The close relationship in the chart provides a visual representation of the relatively high adjusted R-squared for the estimated regression.

Table 1 -- Regression Estimates for Long-Term to Short-Term Interest Rate Spread

$$i_{t,k} - i_{t,j} = c + a\ INFL + b(L)\ GDPGAP + g\ GOVSURP + e_t$$

k	c	a	b(L)	g	SE	Adjusted R-squared	DW
1-year	0.262*	0.050*	-0.073**	-0.071	0.264	0.406	2.10
	(0.109)	(0.021)	(0.022)	(0.040)			
3-year	0.769**	-0.050	-0.187**	-0.243**	0.438	0.618	1.88
	(0.181)	(0.035)	(0.036)	(0.066)			
5-year	0.980**	-0.093*	-0.155**	-0.321**	0.524	0.653	1.68
	(0.216)	(0.042)	(0.029)	(0.079)			
10-year	1.182**	-0.143**	-0.277**	-0.421**	0.642	0.654	1.52
	(0.265)	(0.052)	(0.053)	(0.097)			

* represents significant at 0.05 level.
** represents significant at the 0.01 level.
Estimation method: Two-stage least squares, lagged values of variables as explanatory first stage variables.

Chart 1 -- Actual and Fitted Term Spread
10-Year T-note yield - 3-month T-bill rate

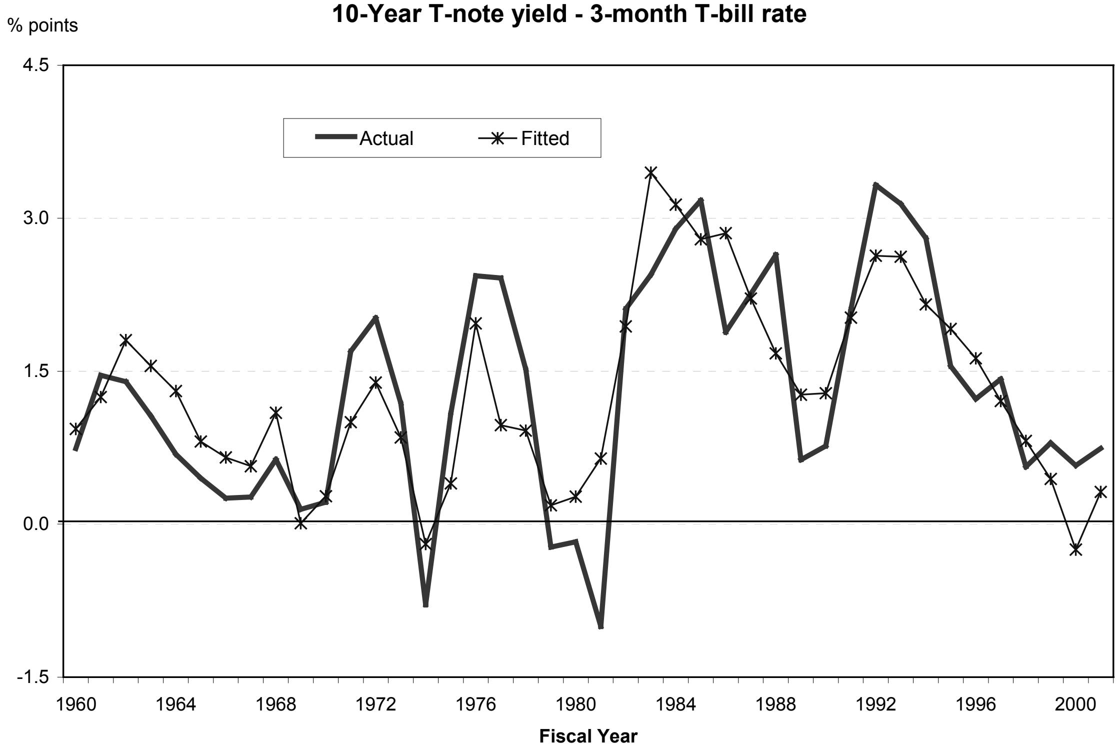


Table 2 presents the results for splitting the sample period into two subsamples: 1961-1978 and 1979-2001. As is well known, in its efforts to fight the high inflation of the late 1970s, the Federal Reserve changed its operating procedures in October 1979 to focus directly on targeting monetary aggregates. The specific policy of targeting the aggregates was relaxed in 1982, but the increased emphasis of monetary policy on reducing inflation persisted. In addition, the model presented above – and on which the empirical specification was based – uses a Taylor rule as a fundamental component, and the Taylor rule has had success in describing the behavior of short-term rates largely in the period following the early 1980s.

The results presented in Table 2 appear to be largely consistent with these interpretations. First, the results for the 1979-2001 period (in the bottom half of the table) are similar to the full sample results, especially for the estimated coefficients for the structural surplus variable. Some differences are worth discussing, though. First, the intercept coefficients are somewhat larger, indicating a larger fixed component of the term premium in the later decades. Second, the coefficient estimates for the inflation variables are more negative and more significant for the 1979-2001 period compared to the full sample. That result is consistent with the view that the Federal Reserve was more aggressive in adjusting short-term interest rates in reaction to inflation in the later period. Third, the coefficients on the inflation and output gap terms are of similar value and roughly of the magnitude that would be consistent with the original Taylor rule parameters. In contrast, the results for the earlier 1961-1978 period provide little support for the specification being applied to that earlier period. Generally, across the explanatory variables, the estimated coefficients are not significant, and in particular, are of incorrect sign in most cases for the inflation variable. In summation, the specification appears to work well for the later 1979-2001 period, but is of less value in application to the earlier 1961-78 period.[9]

[9] This result is similar to results observed in the literature on Taylor rules including Romer (2002).

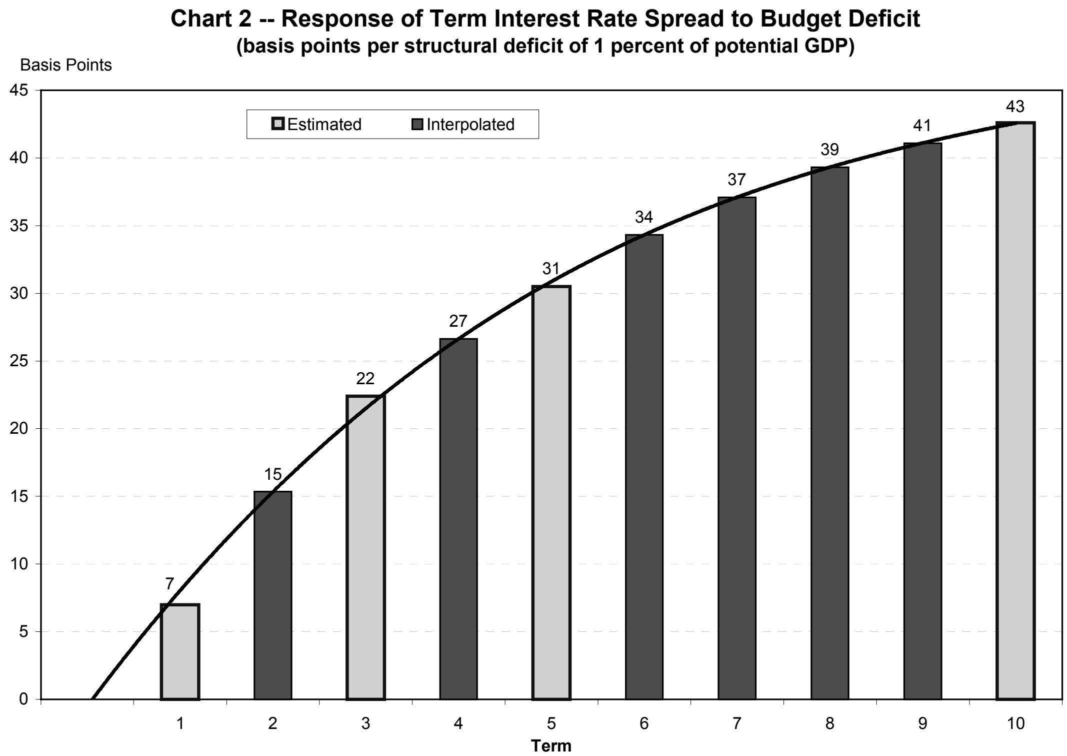
Table 2 -- Regression Estimates for Alternative Sample Periods

$$i_{t,k} - i_{t,j} = c + a\ INFL + b(L)\ GDPGAP + g\ GOVSURP + e_t$$

k	c	a	b(L)	g	SE	Adjusted R-squared	DW
Sample: 1961-1978							
1-year	0.214	0.076*	-0.070	-0.051	0.224	0.388	1.97
	(0.139)	(0.034)	(0.036)	(0.147)			
3-year	0.447	0.048	-0.216**	-0.278	0.311	0.712	1.37
	(0.238)	(0.060)	(0.065)	(0.344)			
5-year	0.454	0.016	-0.305**	-0.542	0.343	0.761	1.58
	(0.270)	(0.067)	(0.073)	(0.393)			
10-year	0.335	-0.062	-0.453**	-1.064	0.679	0.368	2.13
	(0.544)	(0.134)	(0.147)	(0.792)			
Sample: 1979-2001							
1-year	0.327	0.027	-0.087	-0.070	0.324	0.270	2.15
	(0.188)	(0.038)	(0.048)	(0.058)			
3-year	1.133**	-0.156**	-0.217**	-0.224*	0.444	0.678	2.53
	(0.260)	(0.053)	(0.067)	(0.079)			
5-year	1.447**	-0.228**	-0.260**	-0.305**	0.499	0.750	2.50
	(0.292)	(0.059)	(0.075)	(0.090)			
10-year	1.700**	-0.286**	-0.257**	-0.426**	0.600	0.754	2.38
	(0.353)	(0.071)	(0.090)	(0.109)			

*   represents significant at 0.05 level.
** represents significant at the 0.01 level.
Estimation method: Two-stage least squares, lagged values of variables as explanatory first stage variables.

Chart 2 shows the term structure response to the structural Federal budget deficit. The estimated relationships are shown for the 1-, 3-, 5-, and 10-year term spreads. At other horizons of the term structure, the response is based on interpolations along a polynomial fitted relationship. For the one-year Treasury to three-month Treasury bill spread the estimated effect is about 7 basis points per 1 percentage point of structural Federal budget deficit relative to potential GDP. The effect rises to 22 basis points at the 3-year horizon, 31 basis points at the 5-year horizon, and 43 basis points at the 10-year horizon.[10]



IV. Summary and Conclusions

This paper provides evidence on the responses of the term structure of interest rates to Federal budget deficits. The simple model presented here incorporates the role of monetary policy in the determination of short-run interest rates while attributing the effects of government budget imbalances on long-term interest rates to uncertainty about the expected future paths of inflation and real interest rates. The empirical specification adopted avoids various problems often associated with empirical analysis of budget deficits and interest rates. The use of the

[10] Note that these results are of a somewhat smaller magnitude than those presented in Canzoneri, Cumby, and Diba (2002), where the response was estimated to be in the 40 to 60 basis point range for the 5- and 10-year Treasury yields relative to the 3-month Treasury bill rate.

long-term to short-term interest rate spread – made possible by the assumption of a Taylor rule type monetary reaction function for short-term interest rates -- avoids the problem of directly modeling the level of interest rates. The use of the structural Federal budget surplus relative to potential GDP as an explanatory variable eliminates much, if not all, of the cyclically endogenous nature of government budget deficits.

The regression results support the hypothesis that the term structure of interest rates is affected by Federal budget deficits, with a significant positive response of intermediate- and long-term interest rates relative to short-term rates in response to structural budget deficits. The estimated effects on interest rates across the term structure show, for example, that a structural Federal budget deficit of one percent of potential GDP would boost 5- and 10-year Treasury bond yields relative to the Treasury bill rate by about 30 to 40 basis points, respectively. One caveat is that the estimation results indicate that the relationship is more applicable for the post-1979 period than for the period prior to 1979. Additional coincidental results from the specification employed support the conventional wisdom that monetary policy was more oriented toward fighting inflation in the period following 1979 compared to the 1960s and 1970s. In general, the results presented in this paper support the view that interest rates in the term structure are positively related to structural government budget deficits, although the level of interest rates is dependent on the cyclical performance of the economy as well.

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