BOARD OF GOVERNORS
OF THE
FEDERAL RESERVE SYSTEM

Office Correspondence

Date December 1, 1995

To Members of the Board

Subject Taylor's Monetary Policy Rule and Current Economic Conditions

From Donald Kohn

-- For Information Only --

The attached note by Andrew Levin and Volker Wieland analyses the major components of Taylor's monetary policy rule and its implications in light of current economic conditions. This note complements the recent briefing by David Small and other material distributed to the FOMC, and may provide some useful background for the discussion of this rule at the December 5 meeting with John Taylor and other outside consultants.

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December 1, 1995

Taylor's Monetary Policy Rule and Current Economic Conditions

Introduction

Although a large body of theoretical and empirical literature exists on monetary policy rules,[1] the specific rule proposed by John Taylor (1993) has received widespread attention from macroeconomists and media analysts. Neither Taylor nor most other analysts believe that the underlying structure of the U.S. economy is sufficiently well understood to obtain an optimal policy rule that could be used to fine-tune the economy in every conceivable situation. Instead, Taylor's formula was designed as a simple rule-of-thumb to determine the level of the federal funds rate consistent with stable inflation and sustainable real growth. A recent Board briefing by David Small examined the extent to which Taylor's rule can explain the path of the federal funds rate over the past decade, and its sensitivity to alternative measures of inflation and economic activity.[2]

In this note, we analyse each of the major components of Taylor's rule, and we consider its implications in light of current economic conditions. If inflation is viewed as being approximately on target, and Taylor's original estimate of the equilibrium real federal funds rate is considered appropriate, then the rule yields a federal funds rate target of 5.1 percent. However, Taylor's rule may provide a rationale for maintaining the federal funds rate at its current value if the long-run desired core CPI inflation rate is about 2 percent, or if recent financial market developments have substantially raised the equilibrium real federal funds rate.

The Components of Taylor's Rule

As shown in Figure 1, the federal funds rate target (i) implied by Taylor's rule can be expressed as the sum of four components: (1) current inflation (π) as a proxy for expected future inflation (π^e) ; (2) the equilibrium real federal funds rate (r^*); (3) a policy response to deviations of actual inflation from the target rate of inflation ($\pi - \pi^*$); and (4) a policy response to the resource gap ($q - qpot$), based on either deviations of real GDP from potential ($y - ypot$),

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[1]See, for example, Henderson and McKibbin (1993) and Bryant, Hooper, and Mann (1993).

[2]The briefing material was developed by David Small and David Wilcox in a 10/17/95 memorandum to Governor Yellen, "Summary of recent work on monetary policy rules and a proposed revised standard rules package."

or deviations of unemployment from its natural rate (*unat - u*) multiplied by a factor of 2 to reflect Okun's Law.

Figure 1
Taylor's Monetary Policy Rule

$$i = \pi^e + r^* + 0.5(\pi - \pi^*) + 0.5(q - qpot)$$

$$\text{where } (q - qpot) = \begin{cases} (y - ypot) \\ \text{or} \\ 2(unat - u) \end{cases}$$

(1) Expected inflation. Taylor's rule is designed to indicate an appropriate value for the real federal funds rate, i.e., the federal funds rate less expected short-term inflation. If expected inflation is subtracted from both sides of the formula shown above, the rule implies that the short-term real interest rate is set equal to the equilibrium real rate r^* when output is at potential and inflation is on target.

Since financial market expectations are not directly observed, a proxy for expected short-term inflation must be used to make this component of Taylor's rule operational. Because certain indicators of short-term inflation (such as the consumer price index) are somewhat volatile, it is likely that market expectations are based on more persistent and stable indicators of the underlying inflation rate (such as the core CPI or output price deflators). Taylor used the current inflation rate of the implicit GDP price deflator as a proxy for expected short-term inflation. However, since this measure of inflation is fairly sensitive to changes in computer prices, the chain-weighted GDP price index and the core CPI should constitute better proxies for expected inflation.[3]

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[3]Since the current inflation rate is used as a proxy for expected inflation, Taylor's rule can be expressed as follows:

$$i = (r+\pi^*) + 1.5(\pi - \pi^*) + 0.5(q-qpot)$$

where $(r+\pi^*)$ is the steady state nominal federal funds rate, at which inflation remains on target and economic activity remains at potential. The reaction coefficient on inflation deviations is greater than unity in this expression, highlighting a key property of interest rate rules: the federal funds rate must respond more than proportionately to

(2) The equilibrium real federal funds rate. The equilibrium real rate (the second component of Taylor's rule) can be defined as the interest rate at which economic activity remains at potential. Based on empirical analysis of post-war data, Taylor and others have estimated that the equilibrium real federal funds rate is approximately 2 percent. However, some economic theories and empirical evidence suggest that the equilibrium real interest rate can be affected by fiscal policy and other structural influences.

For example, Taylor has estimated that the achievement of a balanced federal budget could ultimately reduce the equilibrium real federal funds rate by nearly a full percentage point, so that the new equilibrium rate would be one percentage point above inflation. Thus, if the government budget becomes balanced over a period of seven to ten years, the equilibrium federal funds rate would decline by about 15 basis points per year.

However, the near-term implications for the equilibrium real rate depend on the nature and timing of the deficit reduction as well as the formation of expectations by private agents. For example, expectations of deficit reduction may have contributed to the recent run-up in stock and bond prices. The resulting drop in long-term real interest rates and rise in consumer wealth would tend to stimulate aggregate demand, in advance of the contractionary effects of implementing the deficit reduction measures. In this case, the real federal funds rate required to maintain current economic activity at potential may be somewhat higher than Taylor's estimate of 2 percent.

(3) Inflation deviation from target. If current inflation exceeds the target rate, the third component of Taylor's rule indicates that the federal funds rate should be raised, thereby dampening economic activity and placing downward pressure on the inflation rate. To balance these considerations, Taylor's rule indicates that the federal funds rate should be raised by 50 basis points in response to a one percentage point deviation of inflation from target. Although macroeconomists continue to debate the optimal reaction of the federal funds rate to inflation deviations, simulation experiments performed by Henderson and McKibbin (1993) suggest that Taylor's proposed coefficient of 0.5 would generate reasonably stable output and inflation.

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inflation deviations in order to ensure that the inflation rate returns to target.

A higher coefficient would reflect a more aggressive response to inflation deviations, but would tend to generate higher output volatility; whereas a lower coefficient would tend to generate less output volatility and less stable inflation compared with Taylor's rule.

(4) Resource gap. If real GDP and employment deviate from their estimated potential levels, the fourth component of Taylor's rule indicates that the federal funds rate should be adjusted to help push the economy back toward potential. When economic activity is relatively weak, this component of Taylor's rule reflects the effect of an interest rate cut in stimulating output and employment. This component also serves to reduce fluctuations in the inflation rate: when economic activity exceeds potential, raising the federal funds rate can help avoid an overheated economy and associated upward pressure on wages and prices.

Taylor's rule indicates that the federal funds rate should be raised by 50 basis points in response to a one percentage point deviation of real GDP over potential. If unemployment is used as the indicator of economic activity, Taylor's rule indicates a one percentage point adjustment of the federal funds rate in response to a one percentage point deviation of unemployment from its natural rate, consistent with Okun's law.

To make the fourth component of Taylor's rule operational, it is necessary to select measures of potential economic activity. For this purpose, we use FRB staff estimates of potential GDP and the natural unemployment rate, whereas Taylor utilized a linear trend to estimate potential GDP.

The Implications of Taylor's Rule

Taylor's rule can provide a useful benchmark for examining the current stance of monetary policy, by considering the contribution of each component to the target federal funds rate under alternative assumptions, rather than viewing the rule as a "black box" that yields a single number. Table 1 reports current values for the four components of Taylor's rule depending on the choice of inflation measure, the choice of inflation target, and the choice of economic activity measure. Given a particular perspective on each of the four components, the appropriate federal funds rate can be derived by adding up the corresponding elements from each of the columns. Four such examples are presented in Table 2.

Table 1
Alternative Values of Taylor Rule Components

Contribution to Federal Funds Rate from:	Percentage Points
I. **Expected Inflation Proxy**	
A. Core CPI	3.0
B. Chain-weighted GDP price deflator	2.6
II. **Equilibrium Real Federal Funds Rate**	
A. Taylor's (1993) estimate	2.0
B. Taylor's (1995) adjustment for deficit reduction	1.85
C. Adjustment for current financial market developments	2.75
III. **Inflation Gap**	
A. Current Inflation on Target	0.0
B. Core CPI (Target = 2 percent)	0.5
C. Chain-weighted GDP deflator (Target = 2 percent)	0.3
IV. **Resource Gap**	
A. Unemployment Gap	0.1
B. Real GDP Gap	0.0

Table 2
Policy Implications under Alternative Assumptions
(inflation measure = core CPI, resource gap = UNAT-U = 0.1)

	$\pi^* = \pi$(95Q3)	$\pi^* = 2$
r* = 2	**5.1** (I.A + II.A + III.A + IV.A)	**5.6** (I.A + II.A + III.B + IV.A)
r* = 2.75	**5.85** (I.A + II.C + III.A + IV.A)	**6.35** (I.A + II.C + III.B + IV.A)

Table 1 indicates two alternative values for expected inflation, the first component of Taylor's rule. The value of this proxy variable is fairly sensitive to the choice of a particular measure of current inflation. The four-quarter change of the chain-weighted GDP index amounted to about 2.6 percent in the third quarter of 1995, while the core CPI rose by almost exactly 3 percent over that period.

The most difficult problem in operationalizing Taylor's rule is to estimate the equilibrium real interest rate, since the equilibrium rate presumably changes in response to persistent aggregate demand shocks (e.g., fiscal policy, consumer confidence, and autonomous investment). Table 1 reports Taylor's original estimate of 2 percent, and a somewhat lower value of 1.85 percent reflecting Taylor's more recent assessment of the impact of a balanced budget package. In addition, Table 1 includes a higher value of 2.75 percent, reflecting aggregate demand pressures due to the recent run-up in equity and longer-term bond prices.

Table 1 reports three values for the third component of Taylor's rule, namely, the extent to which current inflation deviates from the target rate. Since the inflation rates of both the chain-weighted GDP price index and the core CPI (2.6 percent and 3 percent, respectively) are quite close to their average values over the past four years, one might deduce that current inflation is approximately on target. In this case, this component of Taylor's rule would not affect the target federal funds rate.

Alternatively, to reduce inflation to a target rate of 2 percent, the chain-weighted GDP price inflation rate would have to decline by a minimum of 0.6 percentage points, while core CPI inflation would have to fall by at least a full percentage point. The associated contribution to the federal funds rate prescribed by Taylor's rule would be 30 and 50 basis points, respectively.

Finally, Table 1 reports alternative values for the fourth component of Taylor's rule, based on either the deviation of real GDP from potential output (currently about 0 percent) or the deviation of unemployment from its natural rate (currently about 0.1 percent). On this basis, the Taylor rule would prescribe a value of 0 to 10 basis points for this component of the federal funds rate target.

Table 2 summarizes the implications of Taylor's rule for the current stance of monetary policy, using the core CPI to measure inflation, and the natural rate of unemployment to measure

the resource gap. If inflation is viewed as being approximately on target, and Taylor's original original estimate of the equilibrium real rate is considered appropriate, then Taylor's rule yields a federal funds rate target of 5.1 percent, as shown in the upper-left corner of Table 2.

However, Table 2 provides a rationale for the current federal funds rate of 5.75 percent under two alternative sets of assumptions. The upper-right corner of Table 2 reports a federal funds rate target of 5.6 percent, based on Taylor's original estimate of a 2 percent equilibrium real rate, and an inflation target of 2 percent for the core CPI. Alternatively, if current inflation is viewed as approximately on target, and if recent financial market developments have raised the equilibrium real rate to 2.75 percent, then the lower-left corner of Table 2 indicates a federal funds rate target of 5.85 percent. Finally, as reported in the lower-right corner of Table 2 Taylor's rule would indicate a 50 basis point increase in the federal funds rate, based on an inflation target of 2 percent and a equilibrium real rate of 2.75 percent.

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