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MONETARY EFFECTS ON INTEREST RATES: A NOTE ON THE POSITIVE RESPONSIVENESS OF INTEREST RATES

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Monetary Effects on Interest Rates: A Note on The Positive Responsiveness of Interest Rates

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In recent years monetarists have argued that the rapid feedback effects of expansive monetary operations cause higher interest rates (as well as higher real output levels in the short run and nominal output levels in the long run). Recently economists embracing the rational expectations view of the world have also argued for the positive responsiveness of interest rates to expansive monetary operations (with no effect on real output). On the other hand, income expenditurists have always tended to argue that interest rates remain lower, at least temporarily, after an expansive monetary operation. The purpose of this note is to show that certain parameter assumptions, which maximize the short-run impact of money on output, minimize the positive response of interest rates to expansionary monetary policy, and that the only sufficient condition for maximizing both responses is that the partial derivative of output with respect to the interest rate (X_r) tend toward $-\infty$. For maximizing both positive output and interest rate responses to an increase in money it is not theoretically sufficient to show that the partial derivative of money demand with respect to the interest rate (L_r) is small and/or that the partial derivative of aggregate demand with respect to wealth is positive and large.

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*Financial Economist, Federal Reserve Bank of Dallas. The initial drafts of this paper were written while I was an Assistant Professor at Florida State University and so thanks go to my colleagues there for providing a thought-provoking environment. At the Dallas Fed I would like to thank Dale K. Osborne for helpful comments. Remaining errors are, of course, my own responsibility.

The equilibrium response of interest rates to monetary policy can be divided into component parts: the liquidity effect, the real feedback effect, the price level feedback effect, and the price expectations feedback effect.[1] The controversy between monetarists, rational expectationists, and income expenditurists with respect to interest rate determination centers on which of the four effects are emphasized and the size of the parameter values determining those effects. Some of the parameter values determining those effects are the same values which determine the response of output to changes in the money supply.[2]

The large econometric models, which have been built since the late 1960's, have characterized the income expenditure view of the world. [16] These models have incorporated the liquidity, real feedback, and price level feedback effects; only recently have they recognized the price expectation feedback effect. Using a version of the FMP model which did not include the price expectations feedback effect, Meyer [15] conducted various simulation experiments in order to study the response of interest rates. He concluded that

> (1) The results support the Keynesian view that monetary change produces a sustained inverse response in interest rates. (2) We find that the liquidity effect dominates the response of interest rates to monetary change. While feedback effects are evident, they begin to offset a sizable portion of the liquidity effect only after three or four years. (3) The liquidity effect exhibits an interesting dynamic pattern; the impact effect on the short-term rate is several times larger than the effect after thirty-six quarters...[(15), p. 403]

Income expenditurists view the liquidity effect as significant. They believe that the feedback effects operate slowly, thus the inverse relation between money and interest rates is empirically verifiable.

Finally, income expenditurists tend to believe that there are lags in the demand specifications of the financial markets.[3] The effect of such behavioral specifications is to reinforce a significant liquidity effect. If money demand only partially responds in any period to an increase in money, then interest rates must decline more in the current period than in equilibrium to reequilibrate money demand and supply in the current period.

On the other hand, monetarists have asserted that the response of interest rates to monetary changes is positive. Monetarists' empirical works (for example,[11]) show that the liquidity effect of an increase in money supply on the interest rate is small. Gibson and Kaufman suggest that "the impact of changes in money on any specific interest rate is both too brief and too weak to be either captured statistically or identified as a strategic variable in the transmission process." [(11), p. 3] The fact that the liquidity effect may be small with respect to any one interest rate is significant; a small liquidity effect increases the probability that feedback effects will offset the decline in that interest rate.

Monetarists believe that the feedback effects operate very rapidly. Friedman and Meiselman indicate that they view the real feedback effect as more powerful than income expenditurists view them. The initial decline in rates need not be large because of the breadth of the portfolio response to the monetary operation. "If monetary policy impinges on the whole balance sheet, its effects can be manifested in the whole range of expenditures." [(8), p. 218] In later work Meiselman [12] suggests that if the partial of aggregate demand with respect to output is greater than one, then the IS curve would be upward sloping. If this were the case then the real feedback effect would more than offset the initial decline in interest rates.

Besides the real feedback effect, which causes interest rates to rebound from the level induced by the liquidity effect after a monetary operation, Gibson [10] and Cagan and Gandolfi [1] emphasize the rapid responses of the price level and price expectation feedback effects. In each of their empirical works, interest rates "overshoot" their initial level in a very short period of time.

Gibson and Kaufman [11], as well as Zwick [20] and Meiselman [12], do not limit the monetary response of interest rates to the direct and indirect effects identified thus far. They suggest that money has a direct effect on expenditures. This direct effect (as distinct from the wealth effect) shifts the IS curve increasing the possibility of an equilibrium positive response of interest rates to monetary change.

There is no one model which incorporates the rational expectations (RE) view of the world. Moreover, the rational expectationist conclusions about the effectiveness of policy seem crucially dependent upon the specification of the marco model [(3), pp. 416-417]. However, the rational expectationists tend to argue that the impact of money on real output is zero because, while

> ...it's undeniable that Federal Reserve action to buy securities and expand bank reserves results in bidding interest rates down, that response is temporary and fleeting. The point is that rational lenders and investors, who look ahead to later chapters of the story, see than any Federal Reserve push to expand money growth rates will ultimately raise the growth in the general price level. Foreseeing that outcome, lenders...would add an 'inflation premium' to the interest rates they are willing to settle for--a little insurance policy against the heightened prospects for inflation. And interest rate levels finally settled on in the financial markets have got to reflect that premium. [(4), p.5]

Thus, the RE view holds that the response of interest rates to monetary change is positive due to the pervasive operation of the price level and price expectation feedback effects.

In summary, monetarists tend to argue that the response of interest rates to stimulative monetary operations is positive for four main reasons: liquidity effects are small; there exists rapid, extended portfolio responses such that many interest rates are affected; the feedback effects operate quickly and powerfully over a broad range of expenditures; and, there are positive direct effects of money on expenditures. While rational expectationists also argue that the response is positive, they emphasize the "fleeting" liquidity effect and the powerful operation of the price level and price expectations feedback effects. Income expenditurists tend to argue that there is a negative response of interest rates to monetary change for four main reasons: only some feedback effects are stressed; feedback effects operate slowly; a narrow portfolio response is relevant in characterizing financial markets; and, there are lags in the behavioral structure equations which represent the financial market.

The next two sections of the paper detail the exact behavioral determinants of the liquidity and feedback effects. The analysis proceeds on the basis of two traditional IS-LM type models and thus the conclusions drawn are necessarily model specific.[4]

The Liquidity Effect and Real Feedback Effect

A traditional flexible output-fixed price level model is specified in Table 1, Model A. There are two assets, money and government bonds; the bonds are variable price-fixed coupon bonds, and each bond has a coupon of $1. The price level is assumed constant, and price expectations are assumed to be zero. Aggregate supply is assumed to be accommodative. The equilibrium multiplier for the change in the interest rate induced by an increase in the money supply via an open market operation is

$$(1)\quad \frac{dr}{dm}\Bigg|_{dm = -\frac{db}{r},\ \bar{P},\ \frac{(\dot{P})^e}{P} = 0} = \frac{1}{(L_r - \frac{L_a b}{r^2}) + \left[\frac{L_x\ (X_r - \frac{X_a b}{r^2})}{(1 - X_x)}\right]}$$

The multiplier is a combination of the liquidity and real feedback effects. The size of the liquidity effect is determined by L_r and $\frac{L_a b}{r^2}$ (the expression in parentheses) and is negative.

The real feedback effect is determined by the following factors: L_x, X_r, X_a, X_x, b, and r, which are all included in the bracketed term in the denominator of (1). This feedback effect enlarges the denominator (in the negative direction) making the equilibrium negative response of the interest rate less negative. The real feedback effect cannot cause a positive interest rate response unless $X_x > 1$. Holding other factors constant, the smaller L_r, the larger the equilibrium decline in the interest rate; the larger X_r and X_a, the smaller the equilibrium decline in the interest rate.

The Price Level and Price Expectation Feedback Effects

In order to illustrate the price level and price expectations feedback effects a flexible price model must be utilized; Table 2 contains such a model. The implicit assumption is that the system is already at full employment, so that an increase in the money supply can only increase prices. Allowing prices to vary while holding the expected inflation rate to zero, the equilibrium multiplier for an open market increase in the money supply is

$$(2)\quad \left.\frac{dr^n}{dM}\right|_{(\frac{\dot{P}}{P})^e = 0} = \frac{1}{P[(L_{rn} - \frac{L_a B}{P(r^n)^2}) + (M - L_a A)(\frac{Xr}{X_a A} - \frac{B}{AP(r^n)^2})]},$$

where the nominal interest rate (r^n) is still equal to the real interest rate (r). The denominator is ambiguous. However, the use of comparative static techniques implies a basic assumption that the model is stable. When the model is stable, the stability conditions for the model will sign the denominator, and dr/dM will be negative.[5]

To this point the response of interest rates to monetary stimulus has been studied holding expectations about future price level movements constant. We have been concerned with the determination of the real rate of interest, where the real and nominal rates did not differ. When an increase in the money supply generates an increase in real output and the price level, wealthowners may come to expect future price increases. Irving Fisher [5] suggested that in order to induce wealthowners to buy bonds when they expect prices to increase over the holding period, the return must be adjusted to reflect the decline in purchasing power over the period. Fisher's hypothesis about the general equilibrium relation between real and nominal rates of interest has become known as $r^n = r + k(\dot{P}/P)^e$, where $k = 1.0$.

Increases in the money supply in prior periods which generate price expectations may cause (depending upon the size and interaction of the direct and indirect effects identified previously) the equilibrium nominal rate to be higher than the initial interest rate. The extent to which nominal interest rates increase due to expected price increases is

called the price expectation feedback effect of an increase in the money supply on the interest rate.

How large is this feedback effect? That is, given an expected increase in prices of 10 percent generated by an increase in the money supply, will nominal interest rates increase 10 percent, more than 10 percent, or less than 10 percent? Mundell addressed himself to this question in 1963 and concluded

> ...that the money rate of interest rises by less than the rate of inflation and therefore that the real rate of interest falls during inflation. The conclusion is based on the fact that inflation reduces real money balances and that the resulting decline in wealth stimulates increased saving. Real conditions in the economy are altered by the purely monetary phenomenon. [(17), p. 283]

From Model B the effect of increased price expectations on the nominal interest rate can be calculated as follows:

$$(3) \qquad \frac{dr^n}{d(\dot{P}/P)^e} = \frac{1}{1 - \frac{X_a B}{X_r P(r^n)^2} - \frac{X_a AL_{rn}}{X_r(L_a A - M)} + \frac{X_a AL_a B}{X_r(L_a A - M)\, P(r^n)^2}},$$

where X_r, X_a, $L_r n$, and L_a equal, respectively, the partial derivatives of aggregate demand with respect to the real interest rate and real wealth and the partial derivatives of money demand with respect to the nominal interest rate and real wealth.

If we assume that $L_r n < 0$, $X_a > 0$, and $X_r < 0$, then $0 < \frac{dr^n}{d(\dot{P}/P)^e} < 1$. Only when parameter values take on extreme values will Fisher's hypothesis describe the general equilibrium response of nominal rates to an increase in the expected inflation rate. Presuming M and B are greater than zero, only when X_a tends toward zero or X_r tends toward negative infinity will $\frac{dr^n}{d(\dot{P}/P)^e}$ tend toward one.

Parameter Values and The Response of Interest Rates

Are the monetarist and income expenditurist views of the response of interest rates to monetary policy consistent with the underlying parameter value assumptions which have characterized their positions regarding the response of output to monetary policy? The effects of the typically monetarist assumptions on the direct and indirect effects of an open market increase in the money supply are summarized in Table 3. Of course, the income expenditurist assumptions can be characterized as the opposite of the monetarist assumptions. Hence, for the income expenditurist view the pluses and minuses of Table 3 would be reversed. From Table 3 and the analysis presented in this paper, the following results are apparent:

(1) Monetarist parameter value assumptions regarding L_r and X_a do not lead to maximum positive responses for both output and interest rates. To the extent that the monetarist belief in the positive response of both interest rates and output depends upon L_r and X_a, their position is inconsistent. Similarly, income expenditurists assumptions which tend to minimize the effect of money on real output do not lead unequivocably to a lower interest rate after expansive open market operations.

(2) Only when X_r takes on extreme negative values is the monetarist position regarding the maximum positive response of interest rates and output to monetary expansion logically consistent. Moreover, only when X_r tends toward zero will the income expenditurist view hold that there is a negative response of interest rates to monetary expansion.

(3) Even if expectations are rational, the nominal interest rate will only adjust fully to the perfectly anticipated price increase under very extreme conditions. Only when X_a tends toward zero, X_r tends

toward negative infinity, or there is no outside wealth will the response of the nominal interest rate to a change in price expectations be complete.

Perhaps the most important result of this paper is the second result. It is important because it suggests that future research seeking to support monetarist conclusions regarding the positive association between money and both interest rates and real output in the short run should be directed toward documenting the size of X_r. For maximizing both positive responses it is not theoretically sufficient to show that L_r is small. The only sufficient condition for maximizing both positive responses is that the sensitivity of aggregate demand with respect to the interest rate approach negative infinity.

Table 1

A Two Asset-Flexible Output Model

Model A

LM: $m = L(r, X, a);\ L_r < 0,\ L_X > 0,\ 0 \leq L_a \leq 1$

IS: $X = X(r, X, a) + G;\ X_r < 0,\ 0 < X_X < 1,\ X_a > 0$

$$a = m + \frac{b}{r} + K_0$$

Symbol Key

r	Interest rate
X	Real output
a	Real wealth
b	Real coupons (exogenous)
m	Real money supply (exogenous)
K_0	Real capital stock (exogenous)
G	Real government spending (exogenous)

Table 2

A Two Asset-Flexible Price Model

Model B

LM: $\frac{M}{P} = L(r^n, X_f, \frac{A}{P} + K_o)$; $L_{rn} < o$, $LX_f > o$, $o \leq L_a \leq 1$

IS: $X_f = X(r^n - (\dot{P}/P)^e, X_f, \frac{A}{P} + K_o)$; $X_r < 0$, $0 \leq X_{X_f} \leq 1$, $X_a > 0$

$$\frac{A}{P} = \frac{M}{P} + \frac{B}{r^n P}$$

Symbol Key

M	Nominal money supply (exogenous)
r^n	Nominal interest rate
$r^n - (\dot{P}/P)^e$	Real interest rate (r)
X	Real output
A	Nominal Wealth $(M + \frac{B}{r^n})$
B	Nominal coupons (exogenous)
P	Price Level
$\frac{A}{P} + K_o$	Real Wealth (a)

TABLE 3

PARAMETER VALUE ASSUMPTIONS OPERATING TO CAUSE A POSITIVE (+) OR NEGATIVE (-) RESPONSE OF INTEREST RATES TO EXPANSIONARY OPEN MARKET OPERATIONS

	Direct and Indirect Effects			
Assumptions	Liquidity Effect	Real Feedback Effect	Price Level Feedback Effect	Price Expectations Feedback Effect
L_r tends to 0	(-)		(-)	(+)
X_r tends to $-\infty$		(+)	(+)	(+)
X_a tends to $+\infty$		(+)	(-)	(-)

FOOTNOTES

1. The basic framework for analyzing the response of interest rates to monetary change has been discussed by Gibson [9], Friedman [6], and Meyer [13].

2. Recall that monetarists traditionally have argued (relative to income expenditurists) that the interest rate elasticity of money demand is small, the interest rate elasticity of aggregate demand is large, and wealth effects on aggregate demand exist and are positive.

3. See de Leeuw [(2), Chapter 13].

4. For a good description of the IS-LM framework see [19]. For a lucid discussion for the role of the balance sheet identity in macromodels see [14]. Use of the IS-LM framework requires the assumption that the supply sector adjusts to provide an amount equal to the equilibrium level of X^d.

5. This result was obtained by using Olech's Theorem. For a discussion of the technique see James Quirk and Richard Ruppert [18].

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