

# The Importance of Systematic Monetary Policy for Economic Activity

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**H**ow the Federal Reserve reacts to economic activity has significant implications for the way the economy responds to various shocks. Yet the importance of these responses has received limited attention in the economic literature. Much of the literature devoted to the economic effects of monetary policy concentrates on the impact of random monetary policy shocks. By contrast, this article analyzes the effects of the systematic, or predictable, portion of policy. Specifically, I compare how different specifications of an interest rate rule affect a model economy's response to a technology shock and a monetary policy shock. In the case of a technology shock, the central bank's adjustment of the interest rate is totally an endogenous response to economic events. The experiments show that, when there are significant linkages between real and nominal variables, the economy's response to changes in technology depends on the behavior of the monetary authority. With a monetary policy shock—for example, an unexpected change in the interest rate—the effects of that shock will depend on how the central bank subsequently reacts to changes in inflation and output. In general, the way shocks propagate through the economic system is intimately linked to the systematic behavior of the monetary authority.

The results of the experiments have a number of significant implications. Most importantly, the specification of the interest rate rule, which dictates how the monetary authority moves the interest rate in response to inflation and real activity, fundamentally affects economic behavior. The economy's behavior

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■ Michael.Dotsey@rich.frb.org. I wish to thank Bob Hetzel, Andreas Hornstein, Pierre Sarte, and Mark Watson for a number of useful suggestions. I have also greatly benefited from many helpful discussions with Alex Wolman. The views expressed herein are the author's and do not necessarily represent the views of the Federal Reserve Bank of Richmond or the Federal Reserve System.

may be very different depending on the parameters that govern how the central bank reacts to inflation and the state of the economy, as well as the degree of concern it has for interest rate smoothing. For example, the central bank's systematic behavior can alter the correlations between variables in the model.<sup>1</sup> This type of policy effect calls into question whether changes in a policy instrument that are the result of a changing policy emphasis can be adequately approximated as shocks to an unchanging policy rule.

The article's emphasis on the effects of systematic monetary policy places it in a long tradition dating back to Poole (1970), who discussed the implications of different types of policy rules. In that paper, and in subsequent extensions to a flexible-price rational expectations environment, the primary purpose was to compare a policy that used a monetary instrument with one that employed an interest rate instrument.<sup>2</sup> An outcome of that literature was that the systematic component of monetary policy was important. Of significance was the way that informational frictions interacted with monetary policy, which allowed certain types of feedback rules to improve the information content of the nominal interest rate. This sharpening of information occurred only when the nominal interest rate was determined endogenously, implying that the systematic portion mattered only when money was the instrument of policy. Furthermore, the systematic portion mattered solely in the way that it affected expectations of future policy and not because it affected the current money stock.

In other types of models, such as those of Fischer (1977) and Taylor (1980), which included nominal frictions such as sticky prices and wages, an important element was the effect that systematic monetary policy had on the economy. In short, anticipated money mattered. But in these papers monetary policy was largely depicted through changes in money, rather than interest rates.

Recently, there has been renewed interest in the effects of monetary policy when the policy instrument is more accurately depicted as the interest rate. These investigations share some of the same features of the earlier models of Fischer and Taylor in that some nominal variables, usually prices, are assumed to be sticky. That is, the price level only adjusts gradually to its long-run equilibrium value. Some notable examples of this research can be found in Batini and Haldane (1997), McCallum and Nelson (1997), Rotemberg and Woodford (1997), and Rudebusch and Svensson (1997). The concern of these papers is, however, somewhat different than the one emphasized here. They concentrate on both the welfare effects and the variability of output and inflation that are induced by different forms of interest rate rules. In this article, I instead

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<sup>1</sup> Rotemberg and Woodford (1997) perform a detailed analysis of the effects that different parameter values have on the second moments of various variables and on whether or not their economy has a unique solution.

<sup>2</sup> Prominent examples of this literature are Dotsey and King (1983, 1986) and Canzoneri, Henderson, and Rogoff (1983).

emphasize the qualitatively different ways that a model economy behaves for a variety of specifications of monetary policy.

Both types of investigations are important and complementary. Economic welfare analysis is important because it is the primary concern of policy analysis. But welfare measures and variances cannot in themselves inform us whether various rules yield similar forms of behavior that are just more or less volatile, or if behavior is changed in more fundamental ways. On these key matters, the article is more in the spirit of the work of Christiano and Gust (1999) and McCallum (1999), who also investigate the differences in impulse response functions when the feedback parameters of a given policy rule are varied. Even so, they use models that are different from the one used here.

The article proceeds as follows. Section 1 sketches the underlying model that is common to the analysis. The key feature of the model is the presence of price rigidity. I also indicate how an economy with sticky or sluggishly adjusting prices behaves when the money stock is held constant, and when a policy rule that results in real business cycle behavior of real quantities is implicitly followed. The latter policy rule essentially negates the real effects of price stickiness by keeping the price level and the markup constant. This exercise provides some intuition on how the model works. Section 2 describes the form of the interest rate rules investigated. These rules derive from the work of John Taylor (1993). Under the first rule, the monetary authority responds both to deviations in lagged inflation from target and to lagged output from its steady-state value. The second rule adds a concern for smoothing the behavior of the nominal interest rate. In Section 3, I analyze the response of the model economy to a permanent increase in the level of technology. Section 4 investigates the effect of an unanticipated increase in the nominal interest rate on the economy. Section 5 concludes.

## 1. THE MODEL

For the purpose of this investigation, I use a framework that embeds sticky prices into a dynamic stochastic model of the economy. Under flexible prices and zero inflation, the underlying economy behaves as a classic real business cycle model. The model is, therefore, of the new neoclassical synthesis variety and displays features that are common to much of the current literature using sticky-price models.<sup>3</sup> Agents have preferences over consumption and leisure, and rent productive factors to firms. For convenience, money is introduced via a demand function rather than entering directly in utility or through a shopping time technology. Firms are monopolistically competitive and face a fixed

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<sup>3</sup> Examples of this literature are Goodfriend and King (1997), and Chari, Kehoe, and McGrattan (1998).

schedule for changing prices. Specifically, one-quarter of the firms change their price each period, and each firm can change its price only once a year. This type of staggered time-dependent pricing behavior, referred to as a Taylor contract, is a common methodology for introducing price stickiness into an otherwise neoclassical model.

### Consumers

Consumers maximize the following utility function:

$$U = E_0 \sum_{t=0}^{\infty} \beta^t [\ln(C_t) - \chi n_t^\zeta],$$

where  $C = [\int_0^1 c(i)^{(\varepsilon-1)/\varepsilon} di]^{\varepsilon/(\varepsilon-1)}$  is an index of consumption and  $n$  is the fraction of time spent in employment.

Consumers also face the following intertemporal budget constraint:

$$P_t C_t + P_t K_{t+1} \leq W_t n_t + [r_t + (1 - \delta)] P_t K_t + Div_t,$$

where  $P = [\int_0^1 p(i)^{1-\varepsilon} di]^{1/(1-\varepsilon)}$  is the price index associated with the aggregator  $C$ ;  $W$  is the nominal wage rate;  $r$  is the rental rate on capital;  $\delta$  is the rate that capital depreciates; and  $Div$  are nominal dividend payments received from firms.

The relevant first-order conditions for the representative consumer's problem are given by

$$(1/C_t)(W_t/P_t) = \chi \zeta n_t^{\zeta-1} \quad (1a)$$

and

$$(1/C_t) = \beta E_t (1/C_{t+1}) [r_{t+1} + (1 - \delta)]. \quad (1b)$$

Equation (1a) equates the marginal disutility of work with the value of additional earnings. An increase in wages implies that individuals will work harder. Equation (1b) describes the optimal savings behavior of individuals. If the return to saving ( $r$ ) rises, then households will consume less today, saving more and consuming more in the future.

The demand for money, which is just assumed rather than derived from optimizing behavior, is given by

$$\ln(M_t/P_t) = \ln Y_t - \eta_R R_t, \quad (2)$$

where  $Y$  is the aggregator of goods produced in the economy and is the sum of the consumption aggregator  $C$  and an analogous investment aggregator  $I$ . The nominal interest rate is denoted  $R$ , and  $\eta_R$  is the interest semi-elasticity of money demand. One could derive the money demand curve from a shopping time technology without qualitatively affecting the results in the article.

### Firms

There is a continuum of firms indexed by  $j$  that produce goods,  $y(j)$ , using a Cobb-Douglas technology that combines labor and capital according to

$$y(j) = a_t k(j)^\alpha n(j)^{1-\alpha}, \quad (3)$$

where  $a$  is a technology shock that is the same for all firms. Each firm rents capital and hires labor in economywide competitive factor markets. The cost-minimizing demands for each factor are given by

$$\psi_t a_t (1 - \alpha) [k_t(j)/n_t(j)]^\alpha = W_t/P_t \quad (4a)$$

and

$$\psi_t a_t \alpha [k_t(j)/n_t(j)]^{\alpha-1} = r_t, \quad (4b)$$

where  $\psi$  is real marginal cost. The above conditions imply that capital-labor ratios are equal across firms.

Although firms are competitors in factor markets, they have some monopoly power over their own product and face downward-sloping demand curves of  $y(j) = (p(j)/P)^{-\varepsilon} Y$ , where  $p(j)$  is the price that firm  $j$  charges for its product. This demand curve results from individuals minimizing the cost of purchasing the consumption index  $C$  and an analogous investment index. Firms are allowed to adjust their price once every four periods and choose a price that will maximize the expected value of the discounted stream of profits over that period. Specifically, a firm sets its price in period  $t$  to

$$\max_{p_t(j)} E_t \sum_{h=0}^3 \Delta_{t+h} \phi_{t+h}(j),$$

where real profits at time  $t + h$ ,  $\phi_{t+h}(j)$ , are given by  $[p_t^*(j)y_{t+h}(j) - \psi_{t+h} P_{t+h} y_{t+h}(j)]/P_{t+h}$ , and  $\Delta_{t+h}$  is an appropriate discount factor that is related to the way in which individuals value future as opposed to current consumption.<sup>4</sup>

The result of this maximization is that an adjusting firm's relative price is given by

$$\frac{p_t^*(j)}{P_t} = \frac{\varepsilon}{\varepsilon - 1} \frac{\sum_{h=0}^3 \beta^h E_t \{ \Delta_{t+h} \psi_{t+h} (P_{t+h}/P_t)^{1+\varepsilon} Y_{t+h} \}}{\sum_{h=0}^3 \beta^h E_t \{ \Delta_{t+h} (P_{t+h}/P_t)^\varepsilon Y_{t+h} \}}. \quad (5)$$

Furthermore, the symmetric nature of the economic environment implies that all adjusting firms will choose the same price. One can see from equation (5) that in a regime of zero inflation and constant marginal costs, firms would set their relative price  $p^*(j)/P$  as a constant markup over marginal cost of  $\frac{\varepsilon}{\varepsilon-1}$ . In general, a firm's pricing decision depends on future marginal costs, the future

<sup>4</sup> Specifically, the discount factor is the ratio of the marginal utility of consumption in period  $t + h$  to the marginal utility of consumption in period  $t$ .

aggregate price level, future aggregate demand, and future discount rates. For example, if a firm expects marginal costs to rise in the future, or if it expects higher rates of inflation, it will choose a relatively higher current price for its product.

The aggregate price level for the economy will depend on the prices the various firms charge. Since all adjusting firms choose the same price, there will be four different prices charged for the various individual goods. Each different price is merely a function of when that price was last adjusted. The aggregate price level is, therefore, given by

$$P_t = \left[ \sum_{h=0}^3 (1/4)(p_{t-h}^*)^{1-\varepsilon} \right]^{(1/(1-\varepsilon))}. \quad (6)$$

### Steady State and Calibration

An equilibrium in this economy is a vector of prices  $p_{t-h}^*$ , wages, rental rates, and quantities that solves the firm's maximization problem, the consumers' optimization problem, and one in which the goods, capital, and labor markets clear. Furthermore, the pricing decisions of firms must be consistent with the aggregate pricing relationship (6) and with the behavior of the monetary authority described in the next section. Although I will look at the economy's behavior when the Fed changes its policy rule, the above description of the private sector will remain invariant across policy experiments.

The baseline steady state is solved for the following parameterization. Labor's share,  $1 - \alpha$ , is set at  $2/3$ ,  $\zeta = 9/5$ ,  $\beta = 0.984$ ,  $\varepsilon = 10$ ,  $\delta = 0.025$ ,  $\eta_R = 0$ , and agents spend 20 percent of their time working. These parameter values imply a steady-state ratio of  $I/Y$  of 18 percent, and a value of  $\chi = 18.47$ . The choice of  $\zeta = 9/5$  implies a labor supply elasticity of 1.25, which agrees with recent work by Mulligan (1999). A value of  $\varepsilon = 10$  implies a steady-state markup of 11 percent, which is consistent with the empirical work in Basu and Fernald (1997) and Basu and Kimball (1997). The interest sensitivity of money demand is set at zero. The demand for money is generally acknowledged to be fairly interest insensitive and zero is simply the extreme case. Since the ensuing analysis concentrates on interest rate rules, the value of this parameter is unimportant.

The economy is buffeted by a technology shock modeled as a random walk and assumed to have a standard deviation of 1 percent. Thus, increases in technology have a permanent effect on the economy. This specification is consistent with the assumptions of much of the empirical work in this area.

### The Model under Constant Money Growth

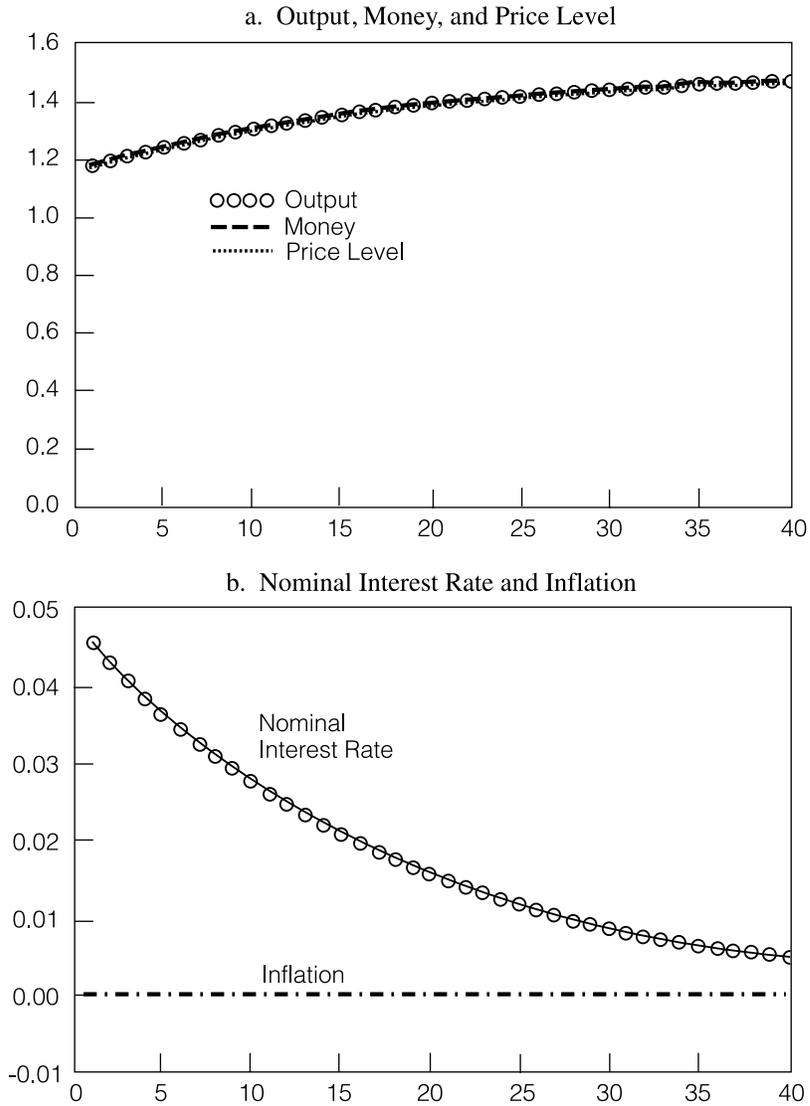
In this section, I analyze the response of the model economy to a technology shock under a constant money growth rule. As a preliminary matter, it is

worthwhile to recall how a standard real business cycle (RBC) model would behave when subjected to such shocks. The behavior of real variables in the baseline RBC model is closely mimicked in this model with a rule that keeps the price markup and the inflation rate close to their steady-state values. The behavior of the economy under such a rule is of independent interest as well, because some recent work indicates that a constant markup would be a feature of optimal monetary policy (e.g., King and Wolman [1999]).

The reason this policy produces a response in real variables very much like that obtained in a model with flexible prices can be seen by examining equation (5). If prices were flexible, then each firm would choose the same price, and relative prices would equal unity. Real marginal cost would then be  $\frac{\epsilon-1}{\epsilon}$ , which is exactly the steady-state value of marginal cost under staggered price setting and zero inflation. If the steady-state inflation rate were zero, then stabilizing real marginal cost at its steady-state value would imply that firms would have no desire to deviate from steady-state behavior and would keep their relative price constant at one. Thus, in an environment of zero average inflation, stabilizing marginal cost or the markup leads to firm behavior that replicates what firms would do in a world of flexible prices. In short, when inflation rates are close to zero, one can find a policy that virtually replicates the behavior found in a flexible price model.

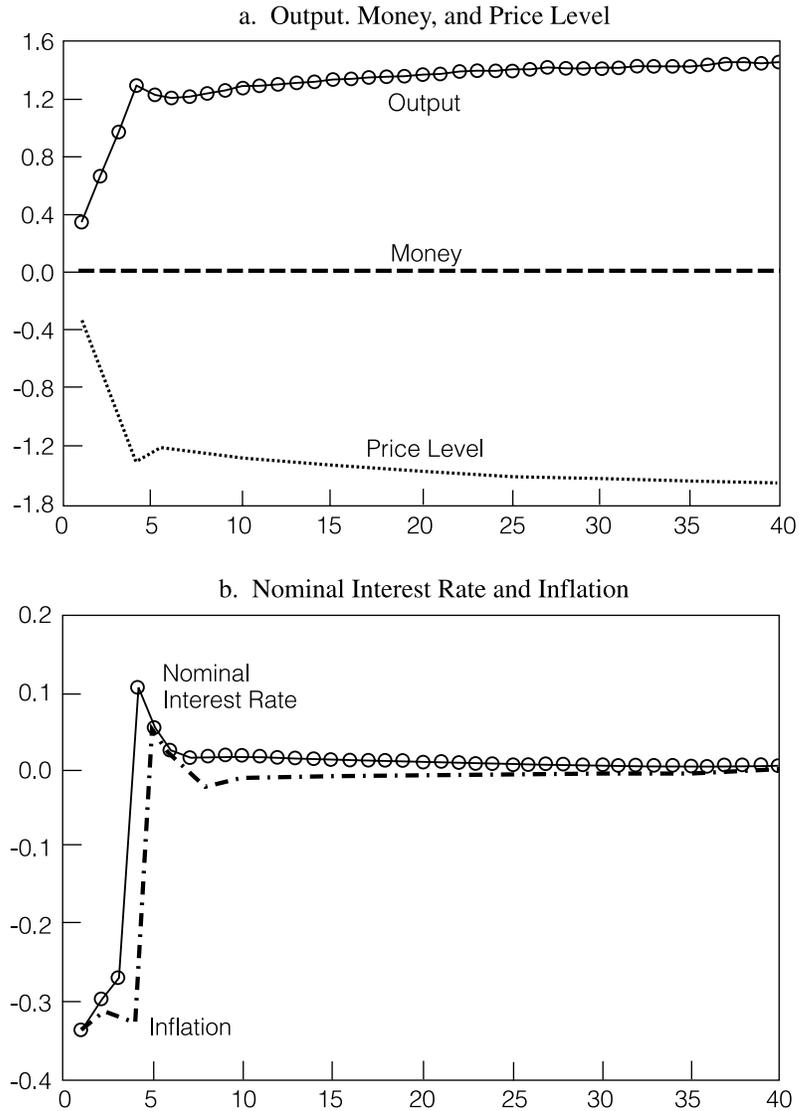
Figures 1a and 1b show the deviations of output, money stock, price level, nominal interest rate, and inflation from their steady-state values in response to a permanent increase in the level of technology under a rule that keeps the markup approximately constant (it varies by less than 0.0002 percent from its steady-state value of 0.11). Output initially jumps by 1.2 percent and then gradually increases to its new steady-state value. The money supply grows one-for-one with output, and given an income elasticity of one and an interest elasticity of zero, its behavior is consistent with prices growing at their steady-state rate of 2 percent. Consequently, inflation remains at its steady-state rate. The slight uptick in the nominal interest rate is, therefore, entirely due to a small increase in the real rate of interest.

In contrast, Figures 2a and 2b depict the behavior of the economy in response to the same shock but with money supply growth kept at its steady-state rate of 2 percent. From the money demand curve, equation (2), it is clear that nominal income growth cannot deviate from steady state. If prices were flexible, they would fall by enough so that output would behave as shown in Figure 1a. But, because 75 percent of the firms are unable to adjust their prices, the price level declines by much less, and as a result the response of real output is damped. As additional firms adjust their price over time, the price level falls and output eventually reaches its new steady state. Falling prices imply disinflation and a decline in the nominal interest rate. This behavior is shown in Figure 2b.

**Figure 1 Constant Markup and Technology Shock**

By analyzing the various interest rate rules, it will become evident that they differ in their ability to produce the type of output behavior associated with flexible prices. The above discussion should help in clarifying why that is the case.

**Figure 2 Constant Money Growth and Technology Shock**



**2. MONETARY POLICY**

For studying the effects that the systematic part of monetary policy has on the transmission of the various shocks to the economy, I shall be fundamentally

concerned with two basic types of policy rules. These rules employ an interest rate instrument and fall into the category broadly labeled as Taylor (1993) type rules. Both rules are backward-looking and allow the central bank to respond to deviations of past inflation from its target and past output levels from the steady-state level of output. However, one rule implies interest smoothing on the part of the monetary authority. Specifically, the first rule is given by

$$R_t = \bar{r} + \pi^* + 0.75(\pi_{t-1} - \pi^*) + 0.6(Y_{t-1} - \bar{Y}_{t-1}), \quad (7)$$

where  $\pi^*$  is the inflation target of 2 percent, and  $\bar{Y}$  is the steady-state level of output. Under this rule, the central bank responds only to readily available information when adjusting the nominal rate of interest. When inflation is running above target or output is above trend, the central bank tightens monetary policy by raising the nominal interest rate. This type of rule restores the inflation rate to 2 percent after the shock's effects dissipate. The rule differs from the original one proposed by Taylor in that it includes a response to last quarter's lagged inflation rather than current yearly inflation, and the coefficient on inflation is somewhat smaller than that initially specified by Taylor (1993). This specification is adopted for two reasons. First, as emphasized by McCallum (1997), the elements of a feedback rule should involve only variables that are readily observable. Although contemporaneous output and inflation are observed in the stylistic setting of the model, in practice these variables may be observed only with a lag.<sup>5</sup> Second, the rule specified in (7) is explosive for the parameters chosen by Taylor. In the above lagged specification, explosive behavior results if the monetary authority responds too aggressively to both inflation and output.<sup>6</sup>

The second rule is similar to the first but adds a degree of interest rate smoothing. The actual interest rate can be thought of as a weighted average of some target that depends on the state of the economy and last period's nominal interest rate. The greater the weight on the nominal interest rate, the more concerned the monetary authority is for smoothing the interest rate. This rule is given by<sup>7</sup>

$$R_t = \bar{r} + \pi^* + 0.75R_{t-1} + 0.75(\pi_{t-1} - \pi^*) + 0.15(Y_{t-1} - \bar{Y}_{t-1}). \quad (8)$$

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<sup>5</sup> In actuality the Fed does not observe potential or steady-state output either. It must respond to estimates.

<sup>6</sup> If the interest rate rule was specified in terms of the deviation of a four-quarter average of inflation from target, then a coefficient on inflation's deviation from target of 1.5 and a coefficient on output's deviation from a potential of 0.5 would produce well-behaved economic responses to shocks. For a detailed discussion of issues regarding determinacy and instability, see Rotemberg and Woodford (1997) and Christiano and Gust (1999).

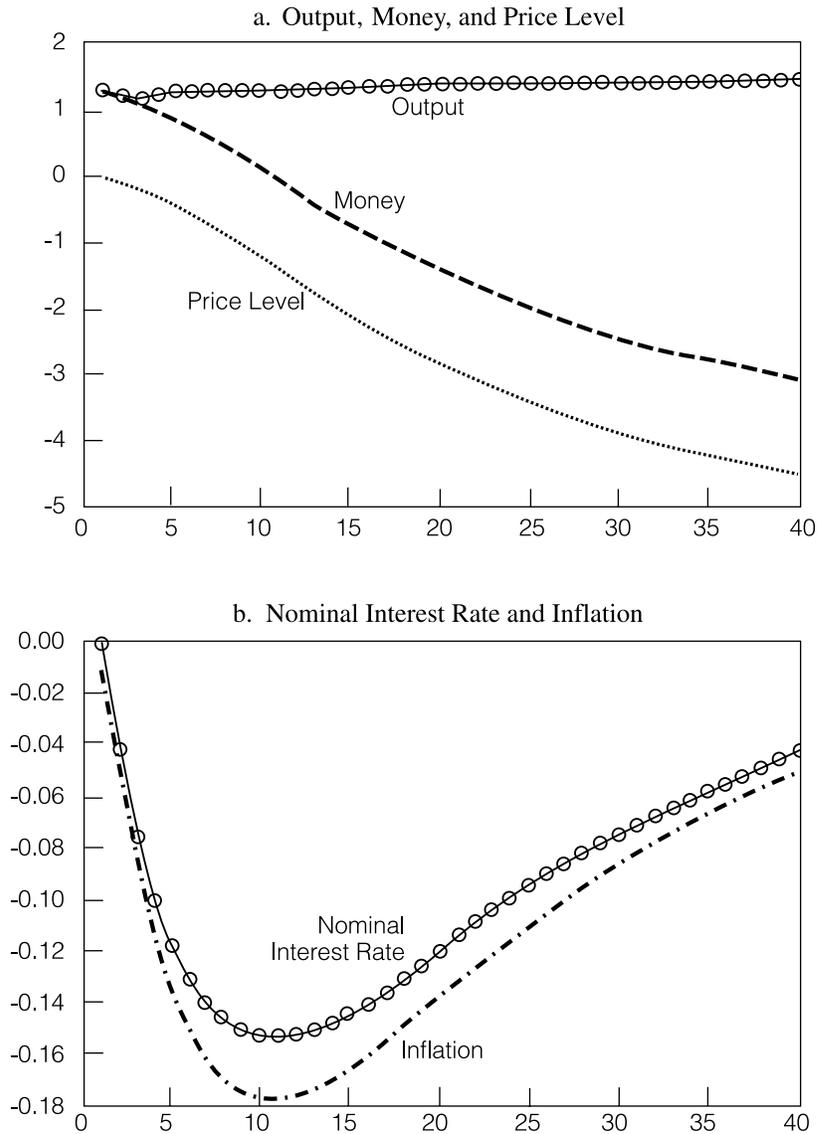
<sup>7</sup> I initially tried to use the same coefficient on output as in the first rule, but the behavior of the economy was erratic. Scaling down the coefficient on lagged real activity produced more reasonable behavior.

Contrary to many theoretical and empirical studies, the model experiments I run in the ensuing section take a far-from-typical perspective concerning the effects of monetary policy than is usually taken in theoretical and empirical studies. Standard investigations attempt to determine how the economy reacts to policy shocks represented as unexpected disturbances to either money growth rates or the interest rate set by the Fed. While those analyses tackle an interesting problem, only recently have economists begun to analyze the economic effects of the systematic component of policy. By concentrating on the sensitivity of the economy's responses to various shocks under different policies, the article has a different emphasis from much of the recent work on systematic policy. The analysis is, therefore, similar in emphasis to recent papers by McCallum (1999) and Christiano and Gust (1999).

### **3. A COMPARISON OF THE POLICY RULES**

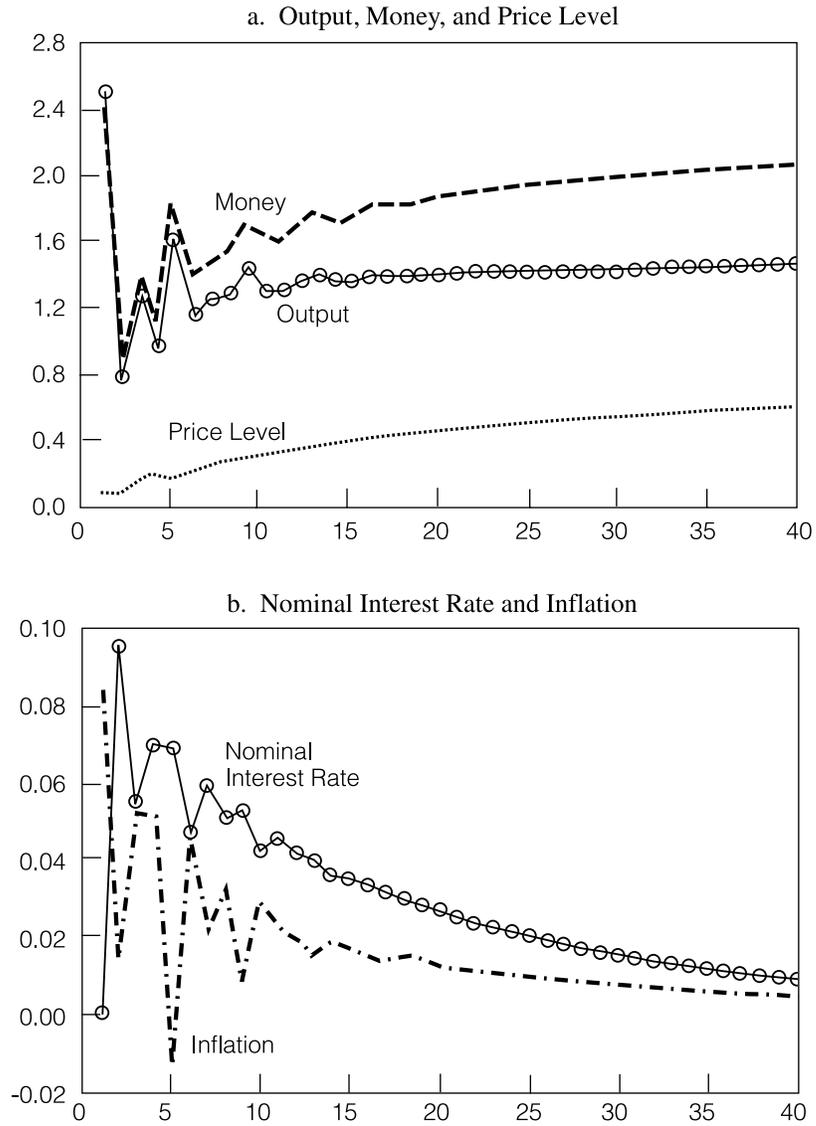
This section analyzes the way the model economy reacts to a technology shock under the two different interest rate rules. These responses are depicted in Figures 3 and 4, where as before all changes represent deviations from steady-state values. Figures 3a and 3b and Figures 4a and 4b refer to rules 1 and 2, respectively. The differences across the policy rules are striking, especially when one also considers the behavior depicted in Figures 1 and 2. Although output increases on impact under each rule, the magnitude of the increase varies greatly across policy regimes, ranging from less than 0.4 percent for a money growth rule to approximately 2.5 percent under the Taylor rule that uses interest rate smoothing. The impulse response for output under the Taylor rule that does not employ interest rate smoothing is closest to the response shown in Figures 1 and 2 for a standard RBC model.

The nominal behavior of the economy is also very different under the various rules. Under the first rule the price level barely moves on impact but then falls as the effect of the technology shock works its way through the economy. This behavior is in sharp contrast to that associated with the constant money growth rule in which the price level declines on impact. It is, therefore, not staggered price setting that is responsible for the initial stickiness of the price level but the specification of the interest rate rule. Because the nominal interest rate responds only to lagged variables, it doesn't react initially. Consequently, all the money demanded at the initial interest rate is supplied, and there is no need for price adjustment to equilibrate the money market. With output slightly below its new steady-state value, the nominal interest begins to decline, and it continues to decline in response to falling prices. It is important to emphasize that the decline in the interest rate does not represent an easing of policy but rather an endogenous response to an economic shock. That is, the central bank is not attempting to independently stimulate the economy.

**Figure 3 Taylor Rule and Technology Shock**

Under the second rule the economy booms. Output rises by an extraordinary 2.5 percent, and with it is an accompanying increase in marginal cost as firms must bid up the wage to induce additional labor supply. The increase in marginal cost implies that adjusting firms will raise their prices. In contrast

**Figure 4 Smooth Taylor Rule and Technology Shock**



to the previous example, the economy experiences inflation in response to the increase in technology. Because prices will be rising over time, the current period is a relatively good time to consume, and output demand is high as well. The increase in inflation as well as the increase in output above its new

steady-state level causes the central bank to raise interest rates. As in the previous case, the subsequent rise in the interest rate should not be interpreted as an attempt to shock an overheated economy but simply as the central bank's usual response to strong economic growth. The endogenous rise in the interest rates, as we shall see in the next section, is responsible for the dramatic fall in economic activity. The initial overshooting is subsequently corrected, and output then gradually approaches its new steady-state level. It is important to note that under the two rules the marked difference in the impulse response functions is not due to the somewhat smaller coefficient on lagged output in the second rule. If that coefficient were increased to 0.6, then the response of the economy would be similar but the volatility, or saw-toothed behavior, of the variables would be more pronounced.

The difference in the functions is due to the interest rate smoothing present in the second policy rule. Under the first policy rule, any increase in inflation is aggressively reacted to because the monetary authority does not have to take into account the past level of the interest rate. Knowing the relatively aggressive nature of policy, individuals and firms expect less inflation, creating less pressure to raise prices. The subsequent downward path of prices makes postponing purchases optimal. As a result, there is less demand pressure in response to the shock. Output does not rise to its new steady-state level on impact, and there is no upward pressure on marginal cost. Under the second policy rule, the monetary authority will be less aggressive, so prices are expected to rise. Such expectations spur consumers to purchase goods today, resulting in relatively strong aggregate demand. The economy booms and the combined effect of expected inflation and upward pressure on marginal cost causes firms to raise prices.

There are a number of points to take away from the analysis presented in this section. First and foremost is that the systematic component of monetary policy is key in determining the economy's reaction to shocks. For example, with no interest rate smoothing, inflation and prices are negatively correlated with output, while they are positively correlated when the monetary authority smooths the interest rate. As a consequence of sticky prices, both positive and negative correlations between real and nominal variables are possible. The type of correlation observed may be entirely due to the systematic behavior of monetary policy and have nothing to do with the structure of the economy.

#### **4. A FURTHER INVESTIGATION OF TAYLOR RULES**

In this section I illustrate the sensitivity of the model economy's responses under the two policy rules to a transitory tightening of monetary policy as reflected in a 100 basis point increase in the nominal interest rate. As with the case of the technology shock, the responses are very different. These responses

are displayed in Figures 5 and 6, with 5a and 5b depicting the response under the first rule and 6a and 6b reflecting behavior under the second rule.

Under rule 1 output actually rises on impact, while under the interest rate smoothing rule output falls. This difference in behavior occurs because the unexpected rise in the nominal rate under the first rule will accommodate modest inflation. As long as inflation doesn't accelerate—behavior the rule is designed to prevent—the nominal rate will gradually return to steady state, and there will be upward movement in prices as well as strong economic growth. The economy only suffers a mild recession four quarters into the future.

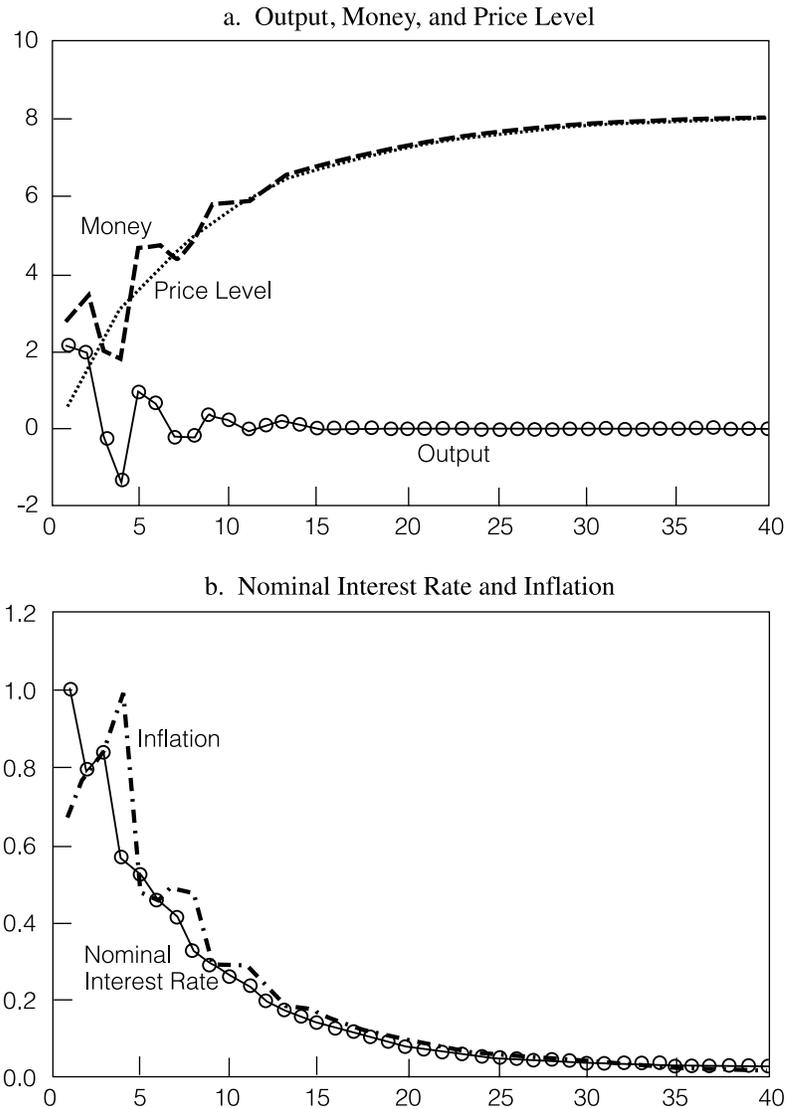
The presence of interest rate smoothing in this case means that any upward movement in real economic activity or inflation will drive the interest rate even higher. Rather than acting as an anchor as in the previous section, the interest smoothing term implies a much more aggressive response to nominal growth. Because today's interest rate is high, all things being equal, the next period's interest rate will be high as well. Individuals and firms understand the nature of the rule, and, therefore, an increase in nominal activity is inconsistent with interest rate behavior under this rule. Output, prices, and inflation decline immediately in response to the rise in the nominal interest rate. It is noteworthy that the nominal interest is more volatile under the policy rule that reflects a concern for interest rate smoothing.

Thus, if the Fed were to significantly and periodically alter its reaction to the past behavior of interest rates, policy would appear to operate with variable impact effects and variable lagged effects. It would do so not because the changes in the policy rule are reflected in small quantitative differences in the economy's response to policy shocks but because these changes in policy may actually lead to an economy that qualitatively responds in a different way altogether.

Admittedly, the behavioral changes analyzed may be severe and the model economy may not reflect important elements of actual behavior, but the experiments in this and the preceding section send a strong message that the form of the policy rule is far from innocuous.

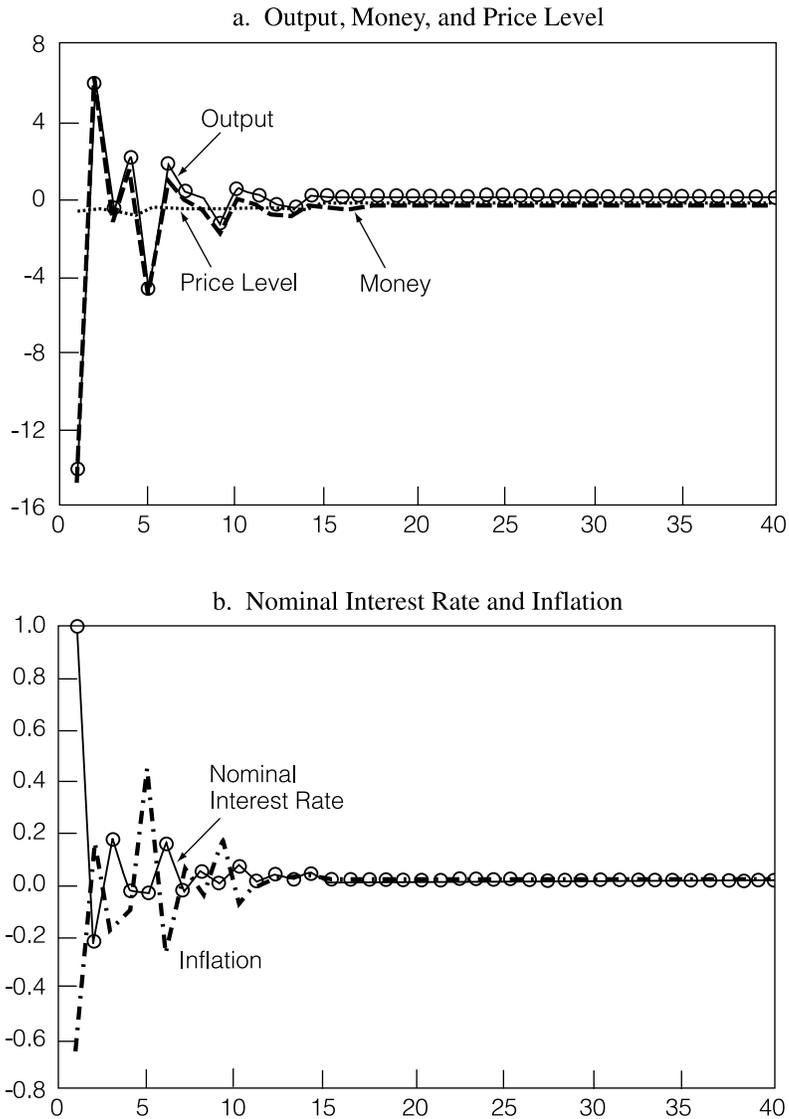
## 5. CONCLUSION

The basic conclusion of this article is that money matters. More to the point, monetary policy matters, and specifically the systematic part of monetary policy matters. While most studies have devoted a great deal of effort to understanding and quantifying the economic effects of monetary policy shocks, my results indicate that it may be equally if not more important to determine the appropriate design of a policy rule. From my own perspective, which is influenced by numerous (or perhaps endless) policy debates, what is typically discussed is not what monetary disturbance should impact the economy but what response

**Figure 5 Taylor Rule and Policy Shock**

should policy have to the economy. Significant tightenings of policy are generally not an attempt to shock the economy but the Fed's realization that inflation and expected inflation have risen and that tightening is appropriate. The degree of the response may, and probably does, vary in different periods. And it

**Figure 6 Smooth Taylor Rule and Policy Shock**



may be inappropriate to model these changes as shocks to an unvarying rule. As I have shown, the sign of correlations among economic variables can differ across rules. That type of behavior would not be captured by appending a shock to a given policy rule. The message from the above exercises is that it may be

more appropriate to model the coefficients in the response function as random, rather than attaching some randomness to an invariant rule.

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## REFERENCES

- Basu, Susanto, and John Fernald. "Returns to Scale in U.S. Production: Estimates and Implications," *Journal of Political Economy*, vol. 105 (April 1997), pp. 249–83.
- Basu, Susanto, and Miles S. Kimball. "Cyclical Productivity with Unobserved Input Variation," *NBER Working Paper* 5915. February 1997.
- Batini, Nicoletta, and Andrew G. Haldane. "Forward-Looking Rules for Monetary Policy," in John B. Taylor, ed., *Monetary Policy Rules*. Chicago: University of Chicago Press, 1999.
- Canzoneri, Matthew, Dale Henderson, and Kenneth Rogoff. "The Information Content of Interest Rates and the Effectiveness of Monetary Policy Rules," *Quarterly Journal of Economics*, vol. 98 (November 1983), pp. 545–66.
- Chari, V. V., Patrick J. Kehoe, and Ellen R. McGrattan. "Sticky Price Models of the Business Cycle: Can the Contract Multiplier Solve the Persistence Problem?" Staff Report 217. Minneapolis: Federal Reserve Bank of Minneapolis, May 1998.
- Christiano, Lawrence J., and Christopher J. Gust. "Taylor Rules in a Limited Participation Model," *NBER Working Paper* 7017. March 1999.
- Dotsey, Michael, and Robert G. King. "Informational Implications of Interest Rate Rules," *American Economic Review*, vol. 76 (March 1986), pp. 33–42.
- . "Monetary Instruments and Policy Rules in a Rational Expectations Environment," *Journal of Monetary Economics*, vol. 12 (September 1983), pp. 357–82.
- Fischer, Stanley. "Long-Term Contracts, Rational Expectations, and the Optimal Money Supply Rule," *Journal of Political Economy*, vol. 85 (February 1977), pp. 191–205.
- Goodfriend, Marvin S., and Robert G. King. "The New Neoclassical Synthesis and the Role of Monetary Policy," *NBER Macroeconomics Annual 1997*. Cambridge, Mass.: MIT Press, 1997.
- King, Robert G., and Alexander L. Wolman. "What Should the Monetary Authority Do When Prices are Sticky?" in John B. Taylor, ed., *Monetary Policy Rules*. Chicago: University of Chicago Press, 1999.
- McCallum, Bennett T. "Analysis of the Monetary Transmission Mechanism: Methodological Issues." Manuscript. February 1999.

- \_\_\_\_\_. “Comment” [on “An Optimization-Based Econometric Framework for the Evaluation of Monetary Policy”]. *NBER Macroeconomics Annual 1997*. Cambridge, Mass.: MIT Press, 1997, pp. 355–59.
- \_\_\_\_\_, and Edward Nelson. “Performance of Operational Policy Rules in an Estimated Semiclassical Structural Model,” in John B. Taylor, ed., *Monetary Policy Rules*. Chicago: University of Chicago Press, 1999.
- Mulligan, Casey B. “Substitution over Time: Another Look at Life Cycle Labor Supply,” *NBER Macroeconomics Annual 1998*. Cambridge, Mass.: MIT Press, 1999.
- Poole, William W. “Optimal Choice of Monetary Policy Instruments in a Simple Stochastic Model,” *Quarterly Journal of Economics*, vol. 84 (May 1970), pp. 197–216.
- Rotemberg, Julio J., and Michael Woodford. “Interest Rate Rules in an Estimated Sticky Price Model,” in John B. Taylor, ed., *Monetary Policy Rules*. Chicago: University of Chicago Press, 1999.
- Rudebusch, Glenn D., and Lars E. O. Svensson. “Policy Rules for Inflation Targeting,” in John B. Taylor, ed., *Monetary Policy Rules*. Chicago: University of Chicago Press, 1999.
- Taylor, John B. “Discretion versus Policy Rules in Practice,” *Carnegie-Rochester Conference Series on Public Policy*, vol. 39 (December 1993), pp. 195–214.
- \_\_\_\_\_. “Aggregate Dynamics and Staggered Contracts,” *Journal of Political Economy*, vol. 88 (February 1980), pp. 1–24.