Rational Expectations and the Effects of Monetary Policy: A Guide for the Uninitiated

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THE success or failure of any course of action often depends on the ability to anticipate events that have not yet occurred, or that have occurred but are not yet known. The real return on an investment, for example, can be predicted but not actually known at the time the investment decision is made. Since the failure to predict accurately the consequences of today's decisions can have significant costs, it pays for individuals to attempt to anticipate these consequences. To do this, a "rational" individual uses all of the information at his disposal to improve predictive accuracy. In general, this includes information about how the economy works and how the government conducts policy. Such an individual, thus, would have "rational expectations."

It is difficult to argue with the notion of rational expectations as described above, since the alternative implies that the individual ignores accessible information that would increase his foresight. It is, therefore, not surprising that the assumption of rational expectations has gained wide prominence in economic theory, to the point that one hears reference to the rational expectations "revolution." Rational expectations models, however, generally contain an additional element that has little to do with the formation of expectations: the assumption of equilibrium. In other words, supply is assumed to equal demand in all markets at all times. This is a departure from traditional "Keynesian" analysis, in which structural rigidities create disequilibrium, and a return to classical (that is, pre-Keynesian) analysis. Therefore, rational expectations theory is also sometimes referred to as the "new classical" economics.

Rational expectations models have altered the way economists view the role of economic policy. In strictest form, these models imply that government policies, including monetary policy, have no effect on real output — the policy ineffectiveness proposition. This proposition contrasts sharply with the standard Keynesian analysis of the effects of monetary policy, that is, that increased money growth results in both greater real output and higher inflation, implying a trade-off between inflation and unemployment. It also contrasts with standard monetarist analysis, in which money is neutral in the long run, but has expansionary short-run effects. Not surprisingly, the policy ineffectiveness proposition has generated a great deal of controversy.[1]

This article has three major purposes: (1) to lay out the basic theory of rational expectations as it relates to monetary policy in a way that stresses its applicability to the real world, (2) to discuss some of the ways that rational expectations models can be altered to give results that refute the policy ineffectiveness proposition and, most importantly, (3) to assess the overall contribution of rational expectations theory to our understanding of the role of monetary policy. Regarding the latter, this paper stresses that the policy recommendation that frequently arises from rational expectations models — a more predictable monetary

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[1]For a sample of the variety of opinions among economists about rational expectations, see Lee (1984).

policy — is essentially the same as that recommended by monetarists and depends critically on there being substantial costs to money growth's unpredictability.[2]

A "CLASSICAL" ECONOMY WITH IMPERFECT INFORMATION AND RATIONAL EXPECTATIONS

Expectations are rational in the manner described by Muth (1961) as long as the public's expectation of a variable to be forecast is based on what it knows about how that variable is determined.[3] For example, individuals have some knowledge of how production, employment and pricing decisions are made, and they use this knowledge in making forecasts. Rational expectations models go beyond this fairly simple assumption, however, by stressing that all individuals make consistently optimal decisions. This is usually taken to mean that all markets are in equilibrium, since in disequilibrium, transactions could be made that benefit both buyer and seller.

An example of a model that incorporates these classical features is one in which each business firm maximizes the present value of expected real profit and each consumer maximizes the expected utility from real consumption. In such a model, a firm's production and employment of inputs generally depend on the current and expected future prices of its output and inputs relative to the general level of prices. Likewise, the demand for a firm's output is a function of its current and expected future relative prices and real consumer wealth.[4] A key element of the model is that the supply of output increases as the producer perceives an increase in the price of his output relative to prices in general.[5] As a simple example, consider a producer who uses only his own labor as an input, so that the relative price of his output equals his real wage. It pays for the producer to provide greater work effort in times of a higher real wage than in times of a lower real wage. This increase in labor supply results in greater output.[6]

Relative prices are always changing due to a multitude of factors including consumers' tastes and preferences, the technology used in producing various products and the availability of productive inputs. An unanticipated change in one of these factors can be called a "real" shock. It is possible for real shocks to affect the aggregate price level as well as relative prices. At the same time, the aggregate price level could be changing due to a change in the supply of money. An unanticipated change in the money supply is a "nominal" shock.[7] For simplicity, it is assumed below that "aggregate" shocks are synonymous with nominal shocks, and real shocks are simply "relative" shocks.

Confusion Between Aggregate and Relative Shocks

An important feature of most rational expectations models is the incomplete flow of current information across markets. Both producers and consumers lack complete information about current prices in other markets, so that supply and demand depend on *perceptions* of current relative prices rather than the actual (unknown) relative prices.[8]

The producer who observes an unexpected increase in his price does not know whether it results from a relative shock — consumers are unexpectedly demanding more of his product and less of others — or an aggregate shock — consumers demand more of all goods because of greater-than-anticipated money balances, resulting in a higher aggregate price level. This is an important distinction since the producer wishes to adjust output only in response to changes in relative prices, since he is maximizing real, not nominal, profit. Thus, if producers knew that rising prices were due only to an increase in the money supply, they would not adjust their output; instead, prices would increase in proportion to the increase in money supply. If the rational producer has experienced both

[2]Other descriptive treatments of rational expectations include Federal Reserve Bank of Minneapolis (1977), Berkman (1980), Maddock and Carter (1982) and Sheffrin (1983).

[3]More specifically, the forecast of a variable is its mathematical expectation based on some knowledge of the process that generates that variable.

[4]The rate at which future returns are discounted may also be important in determining both supply and demand.

[5]There is a supposition in rational expectations models that any change in relative prices is viewed as temporary. This is a reasonable assumption since a persistently higher relative price would attract additional entrants to the industry, thus driving the relative price back down.

[6]If the producer has to hire labor in addition to his own, an increase in the relative price of output leads to increased demand for labor, which drives up the real wage. Both the quantity of labor supplied and the level of production increase. This analysis also can be applied to inputs other than labor.

[7]We ignore the possibility that shocks arise from unanticipated changes in the demand for money.

[8]A model with this kind of partial information was first used by Phelps (1970), but also has been used by Lucas (1973), Barro (1976) and many others.

relative and aggregate shocks in the past, then he cannot be sure that an unanticipated increase in the market price of his output reflects one kind of influence or the other; the producer will tend to assume, initially, that unanticipated price changes reflect some combination of both, until more information becomes available.[9]

Unanticipated money growth has real effects in the rational expectations model described above. When money holdings rise faster than the anticipated price level, consumers perceive an increase in their real wealth. They increase their demand for goods and services, causing an unanticipated increase in the general price level. Producers believe that their relative prices have increased and accordingly increase their output. Thus, the real effects of unanticipated money growth arise because perceived relative prices deviate from actual relative prices.[10]

THE NATURAL RATE HYPOTHESIS AND MONEY-INDUCED BUSINESS CYCLES

Although it was not stated explicitly, this analysis implies that unanticipated money growth causes output and unemployment to deviate from their "natural" levels in the short run. These natural levels refer to levels of output and unemployment that are consistent with a long-term rate of growth of output and a rate of unemployment to which the economy tends to return after a disturbance. This notion is referred to as the "natural rate hypothesis."

Business cycles can be viewed as persistent (but not permanent) deviations of actual output and unemployment from their natural levels. Rational expectations models have been used to explain the existence of business cycles, despite the fact that information on the aggregate price level becomes known to producers and consumers at fairly short intervals. Business cycles can occur if, for example, unanticipated money growth results in increased capital investment. This requires that firms consider currently perceived relative prices, which are affected by monetary surprises, to be a good indicator of future real returns on investment. The effect of a higher rate of investment is greater productive capacity and greater output over several periods.[11]

The behavior of inventories also plays a potential role in the persistence of the effect of nominal shocks. A firm that maintains an inventory can increase its sales in response to a perceived change in its relative price by selling out of its inventory. In later periods, the firm seeks to rebuild its inventory to its desired level, which requires additional production and employment. If firms gradually adjust inventories to their desired levels, then the effects of unanticipated money on output levels may persist for a fairly long period of time.[12]

Monetary surprises also can have persistent effects if the public is unable to distinguish perfectly between permanent and transitory shocks. Applied to money growth, this means that unanticipated money growth might represent either a one-time aberration with a return to the former expected money growth path, a permanent shift to a higher rate of money growth, or something in between. If rational forecasters have observed both permanent and transitory shocks in the past, then they will regard any unanticipated change in the growth rate of money as being partly permanent and partly transitory. This means, for example, that expectations will adjust only gradually to an increase in the money supply that really is permanent. Forecasters, therefore, will underpredict the increase in money growth until their expectations adjust completely. In this way, nominal shocks can cause persistent changes in output and employment.[13]

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[9]The more variable are aggregate shocks compared to relative shocks, the greater the proportion of a given unanticipated price increase attributed to aggregate influences. See Lucas (1973).

[10]Models that include this kind of wealth effect include Hercowitz (1981) and Cukierman (1982). They show that if the elasticities of supply and demand differ across markets, then monetary shocks also affect actual market-clearing relative prices and their variance.

[11]See Lucas (1975). Because the capital stock is not affected in the long run by nominal shocks, it must decline from its greater-than-normal levels at some point in the future. It is worth noting that, despite the fact that the anticipated real return on investment is increased by unanticipated money growth, the actual real rate of interest declines. A monetary surprise implies that the money stock rises above anticipated inflation; that is, perceived real money balances increase. This induces individuals to increase their purchases of securities and goods until the real interest rate declines by enough to induce them to hold the larger amount of money. See Barro (1981).

[12]Blinder and Fischer (1981) bring out this point and analyze the case in which desired inventory levels are related negatively to the real interest rate. The declining real rate induced by unanticipated money growth (see footnote 11) leads to an increase in production and employment so that inventories can rise to the new desired levels. Brunner, Cukierman and Meltzer (1983) take a different approach to the issue. In their model, goods have prices and quantities fixed for one period, but financial markets are free to adjust continually. The lower real interest rate caused by unanticipated money growth results in greater current consumption. With the demand for goods higher than their fixed supply, firms sell off part of their inventories, then replenish them in later periods.

[13]See Brunner, Cukierman and Meltzer (1980). Note that this permanent/transitory confusion implies that forecasts can display a persistent bias when viewed *ex post*, yet be completely rational *ex ante*.

THE POLICY INEFFECTIVENESS PROPOSITION

The rational expectations model presented above is based on three major assumptions: (1) there exist distinct markets across which information does not flow smoothly, (2) prices adjust instantaneously so that each individual market is in equilibrium in every period, and (3) expectations are formed rationally. Sargent and Wallace (1975) have shown that, in such a world, output is not affected by the decision to follow any systematic monetary policy or "rule" — the policy ineffectiveness proposition. For example, it is irrelevant to the determination of output whether the monetary authority chooses to control interest rates or the money supply. The public expects a certain rate of money growth and adjusts its behavior in advance so that when the money growth actually occurs, it affects nominal magnitudes (the price level and the nominal rate of interest) but not real magnitudes. Only money growth that deviates from the rate implied by the monetary rule affects output, since it is unanticipated.[14]

This differs from the outcome when expectations are not formed rationally, that is, when individuals ignore information that helps to predict future money growth and inflation. In such a case, policymakers could exploit a trade-off between unemployment and inflation, increasing the growth rate of money in order to expand the economy. Since prices would lag behind changes in money, even policy actions that could be anticipated would affect real output and unemployment. Thus, to the extent that expectations are not rational, the particular monetary rule adopted has implications for the real sector.

The Importance of Flexible Prices

The assumption of price flexibility in this analysis is critical to the conclusion that anticipated money growth has no effect on output. In reality, some prices do not adjust immediately to either aggregate or relative shocks. Fixed-price contracts and the costs of adjusting prices mitigate against instantaneous price adjustment.[15]

Price contracts exist, at least partly, as a means of economizing on search costs for buyers. Fluctuating prices make it more difficult for buyers to find the seller with the lowest price for a given product. Therefore, firms have an incentive to announce their prices in advance, because they will lose some customers who value this information if they do not.[16] Given the heterogeneity of goods produced in the economy, differing degrees of price flexibility arise. For example, goods that are storable tend to have less flexible prices than goods that are not storable, because firms can adjust inventory levels instead of prices to fluctuations in demand. In addition, goods that have customized features are more likely to have their prices fixed for some period than goods that are standardized across sellers.[17] Therefore, some prices respond quickly to changes in the money stock while others respond more slowly.

As long as some prices are set in advance of the time that monetary policy actions are taken, even anticipated money growth can have short-term real effects. For example, suppose a producer has a contract that specifies a nominal wage for his work force that remains fixed for a period of time. Assuming the contract cannot be renegotiated, any information that arrives after the contract is signed will not affect the nominal wage until the contract expires. The monetary authority, however, is free to react to the new information in accordance with its policy rule. If this policy action causes money growth (and the price level) to be higher than originally anticipated, the producer will anticipate a decline in the real wage it pays to labor over the remaining term of the contract. When the anticipated real wage declines, the quantity of labor demanded increases and so do employment and production.[18]

The existence of long-term contracts, therefore, im-

[14]Note that if there were perfect information about all markets, then money growth could never affect output, for, as Lucas (1975, p. 12) points out, "... in an economy in which all trading occurs in a single, competitive market, there is 'too much' information in the hands of traders for them ever to be 'fooled' into altering real variables." This suggests that efficiency would be increased if there were a clearinghouse for contemporaneous price information. It is unlikely, however, that such an institution could provide complete information in a timely manner in a large economy.

[15]The analysis below treats price inflexibility as though it arises solely from the existence of explicit price contracts; we recognize that there also are other potential causes.

[16]See Alchian (1969).

[17]For a more detailed discussion of the differences in price flexibility across products, see Bordo (1980), Gordon (1981) and Carlton (1982).

[18]See Fischer (1977). For an analysis of price inflexibility that takes a somewhat different approach, see Phelps and Taylor (1977). The problem with the analysis presented in the text is that it neglects the short-term labor supply effects that are so important in most rational expectations models. If both the supply and the demand curve for labor are relevant in the short run, then deviations of actual from expected inflation in either direction result in lower employment and output. Furthermore, if a firm's output price is fixed while its input prices and the output prices in other markets are flexible, then unanticipated inflation causes the price of inputs to rise relative to the fixed output price and the relative price of the fixed-price good to decline generally, resulting in reduced supply. It does not seem likely, however, that a firm that does not choose to have contracted wages would choose to have a contracted price.

plies the potential for the monetary authority to affect real output in the short run, even if it follows a systematic policy. The structure of contracts depends, however, on the particular policy rule chosen. For example, if the policy rule allows the inflation rate to vary a great deal as a result of various shocks, then the expectations upon which contracts are based are more likely to be confounded than if the inflation rate is kept fairly stable. Therefore, under the former policy rule, contracts are more likely to include cost-of-living adjustment clauses and provisions for reopening contract negotiations and to have shorter duration than under the latter policy rule. This suggests that a change in policy from a rule in which inflation remains stable to one in which it is allowed to vary would not be effective in the long run, because the structure of contracts would change. These changes would cause prices to be more flexible, which would reduce or eliminate the effects of anticipated policy on the level of output [19]

Expected Inflation and Capital Accumulation

If the public expects the growth rate of money to increase, it will also expect higher inflation in the future. Given certain institutional characteristics of the economy, there are a number of ways in which expected inflation can affect the accumulation of capital, even with rational expectations. Thus, anticipated money will have real effects, and the policy ineffectiveness proposition will not hold. For example, higher expected inflation causes people to shift part of their money balances into real capital, because money provides a very low or negative real return during times of inflation.[20] On the other hand, higher expected inflation drives up the replacement cost of capital, while current tax law provides for depreciation allowances for businesses based on the historical cost of capital. Thus, the expected real return on capital investment is lowered, resulting in less capital accumulation.[21]

If the monetary authority were to continually exploit the existence of either a very low real return on money holdings or distortions arising from the tax treatment of capital depreciation, however, it is likely that these institutional characteristics would be eliminated. This is not as straightforward as the adjustment of private contracts discussed above, since it implies legislative rather than private action. But as inflation persists, there will be a growing demand for savings instruments that combine the transaction features of money with a market rate of return, and investors will seek to eliminate the effects of inflation on the real value of depreciation allowances.[22] If the political system allows these adjustments to occur, then the policy ineffectiveness proposition would still hold in the long run.

THE CASE FOR PREDICTABLE MONETARY POLICY

The foregoing analysis implies that, if a policy rule were to be enforced perfectly by the monetary authority, then in the long run everyone would have complete knowledge of the monetary rule, and contracts and institutions would adjust to it. Thus, the behavior of the money supply would not affect real output, and any cyclical behavior would arise purely from nonmonetary sources.[23] On the other hand, the monetary authority can affect the behavior of output in the short term by departing from the rule or by altering the rule to take advantage of institutional arrangements that likely would not continue to exist if they were continually exploited.[24]

An important contribution of the rational expectations movement, therefore, is that it shows that the state of expectations and the institutional structure adjust to the way policy is conducted, thereby altering

[19]Friedman (1977) discusses the response of contracts to variable inflation.

[20]See Tobin (1965). Fischer (1979) incorporates the Tobin effect in a rational expectations model.

[21]See Feldstein and Summers (1978). A tax on nominal interest also implies that expected inflation affects capital accumulation, if borrowers and lenders of investment funds have different tax rates. For a discussion of the impact of expected inflation on real interest rates, see Holland (1984).

[22]Casual evidence suggests that these kinds of institutional adjustments are indeed occurring, as transaction balances now may pay interest, and the recent Treasury Department proposal to reform the tax system includes a provision to alter the way inflation affects the depreciated value of capital. The recent change to an indexed personal income tax can also be viewed in this light if the taxation of nominal interest has affected capital accumulation (see footnote 21).

[23]By a perfectly enforced monetary rule, I mean one in which there is no deviation of the quantity of money from what was intended due, for example, to changes in the demand for money. Shocks to money demand could have transitory effects on real output and employment.

[24]Taylor (1975) presents a different analysis of the behavior of output following a change in the monetary rule. In his model, there is a transition period during which forecasts display a persistent bias due to lack of knowledge about the nature of the change in policy. This is very similar to the notion of confusion between permanent and transitory shocks discussed above. The policy ineffectiveness proposition does not hold during this transition period, since the change in the monetary rule has real effects.

the results of the policy. Thus, the effects of a given policy will not necessarily be the same every time it is used. This implies that econometric models that do not incorporate rational expectations are unlikely to predict accurately the results of a change in policy. This is the basis of the "Lucas critique."[25]

Since it is often possible to attain important short-term benefits with policy measures that confound expectations, one might expect proponents of rational expectations to recommend secrecy in the conduct of monetary policy. This is not the case, however. Instead, they recommend that monetary policy be made as predictable as possible by sticking closely to pre-announced rules.[26] Implicit in this policy recommendation is the assumption that monetary variability — taken here to be synonymous with uncertainty — imposes long-term costs in excess of its short-term benefits.

The Effects of Monetary Variability

In general, greater monetary variability reduces the efficiency of the price system by making it more difficult to distinguish relative price increases from general inflation. In the standard rational expectations model, it is difficult to distinguish between relative and aggregate shocks, and the variability of each kind of shock plays an important role. If aggregate shocks, taken to be monetary surprises, become more variable compared to relative shocks, then a firm is more likely to perceive any change in its price as the result of aggregate rather than relative forces. It, therefore, will respond less — in terms of changing its levels of output, employment and investment — to an actual change in relative prices, even when the change is due to relative shocks. This means that the price system is less effective as a mechanism for allocating resources.[27]

Reduced efficiency in allocating resources lowers the natural level of output and potentially raises the natural rate of unemployment. The economy has ways of adapting, however, to the greater uncertainty caused by more variable money growth, including the greater use of indexing and the shortened duration of contracts. These adjustments reduce the risk associated with monetary variability, implying that the real effects of monetary variability should diminish as high levels of variability persist through time. The adjustments impose their own costs, however, since a larger amount of resources is diverted to the contracting process from other, presumably more efficient, uses.[28] Thus, the economy still is likely to operate more efficiently in an environment of policy certainty than policy uncertainty. The analysis, therefore, implies that efficiency is enhanced by the use of well-defined and well-publicized policy rules.[29]

CONCLUSIONS

The incorporation of rational expectations into macroeconomic analysis leads one to the conclusion that the effects of monetary policy actions on real output and employment depend critically on the state of expectations and the existing institutional structure. If the public has sufficient knowledge about how policy is conducted and if institutions have adjusted to the conduct of policy, then the growth of the money supply will have no effect on real output or employment at all.

The monetary authority can always affect output in the short run by acting in a way that confounds expectations. Proponents of rational expectations, however, generally recommend that the policy authority not attempt to fool the public as a way of achieving short-term goals, since there are potentially serious long-term costs associated with unpredictable policy. The most important of these are reductions in the "natural" levels of output and employment and a higher "natural" unemployment rate.

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[25]See Lucas (1976).

[26]See, for example, Lucas and Sargent (1979).

[27]Cukierman (1982) shows that the difference between the perceived and actual relative price of a product grows larger, ceteris paribus, as monetary variability gets larger, implying a reduced efficiency of the price system. Cukierman and others also have shown that, under certain conditions, greater monetary variability is associated with greater variability of relative prices. Furthermore, greater monetary variability also has the potential to affect real interest rates. The instability created by highly variable money growth makes for increased uncertainty about future returns on capital and interest-earning assets and raises the demand for money relative to these assets. This causes higher real interest rates. In other words, risk-averse lenders require that a greater "risk premium" be added to interest rates to offset the greater uncertainty associated with the future real return (see Mascaro and Meltzer (1983)). The effect is not unambiguously positive, however, since risk-averse borrowers reduce their demand for loanable funds as risk increases, which would tend to reduce the real rate.

[28]Gray (1978) presents a model in which greater monetary variability leads to both greater use of indexing and reduced duration of contracts. She also shows that greater use of wage indexing has another potential cost: by preventing changes in real wages, it reduces the ability of the economy to respond to real shocks.

[29]In this analysis, the term monetary variability refers to the variability of unanticipated money growth. Note, however, that if there are long-term contracts, even the variability of anticipated money growth can have permanent real effects due to changes in the structure of contracts. For an example, see Canzoneri (1980).

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