SOME RECENT DEVELOPMENTS IN PHILLIPS CURVE ANALYSIS

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Economists' views of the Phillips curve concept have changed drastically in recent years. The original interpretation of the Phillips curve as a stable trade-off relationship between inflation and unemployment has given way to the view that no such trade-off exists for policymakers to exploit. As a result, some economists now argue that economic stabilization policies are incapable of influencing output and employment, even in the short-run.

Instrumental to this change were several key developments in Phillips curve analysis, most notably the so-called *natural rate* and *rational expectations* hypotheses. The purpose of this article is to explain these developments and their policy implications and to show how they altered economists' perceptions of the Phillips curve. Accordingly, the first half of the article traces the evolution of Phillips curve analysis focusing particularly on the natural rate hypothesis. The second half concentrates on the rational expectations idea, currently the most hotly-debated aspect of Phillips curve analysis.

Early Versions of the Phillips Curve Phillips curve analysis has evolved through at least five major stages since its inception in 1958. The first stage involved the formulation of a simple, stable trade-off relation between inflation and unemployment. The initial Phillips curve depicted a relationship between money wage changes and unemployment. But the assumption that product prices are set by applying a constant mark-up to unit labor costs permitted the Phillips relationship to be transformed into a price-change equation of the form[1]

$$(1) \quad p = ax$$

where p is the percentage rate of price inflation, x is overall excess demand in labor and hence product markets—this excess demand being proxied by the inverse of the unemployment rate—and a is a coefficient expressing the numerical value of the trade-off between inflation and excess demand.

This equation expresses the early view of the Phillips curve as a stable, enduring trade-off permitting the authorities to obtain permanently lower rates of unemployment in exchange for permanently higher rates of inflation or vice-versa. Put differently, the equation was popularly interpreted as offering a menu of alternative inflation-unemployment combinations from which the authorities could choose. Being stable, the menu never changed.

Economists soon discovered, however, that the menu was not as stable as originally thought and that the Phillips curve had a tendency to shift over time.[2] Accordingly, the equation was augmented with additional variables to account for such movements.

Introduction of Shift Variables The addition of shift variables to the trade-off equation marked the second stage of Phillips curve analysis. The inclusion of these variables meant that the Phillips equation could now be written as

$$(2) \quad p = ax + z$$

where z is a vector of variables—productivity, profits, trade union effects, unemployment dispersion and the like—capable of shifting the inflation-excess demand trade-off. Absent at this stage were variables representing price expectations. Although the past rate of price change was sometimes used as a shift variable, it was rarely interpreted as a proxy for anticipated inflation. Not until the late 1960's were expectational variables fully incorporated into Phillips curve equations. By then, of course, inflationary expectations had become too prominent to ignore and many analysts were perceiving them as the dominant cause of observed shifts in the Phillips curve.

The Expectations-Augmented Phillips Curve and the Adaptive-Expectations Mechanism Three innovations ushered in the next stage of Phillips curve

[1] For simplicity, the additive constant term contained in most empirical Phillips curve equations is disregarded in equation 1.

[2] Indeed, Phillips himself in his 1958 article had recognized the possibility of such shifts.

analysis. The first was the respecification of the excess demand variable. Originally defined as the inverse of the unemployment rate, excess demand was redefined as the discrepancy between actual and normal capacity real output or, equivalently, as the gap between the actual and the natural rates of unemployment. The natural rate of unemployment itself was defined as the rate that, given the frictions and structural characteristics of the economy, is just consistent with demand-supply equilibrium in labor and product markets. This innovation effectively identified full-employment equilibrium (i.e., zero excess demand) with normal capacity output and the natural rate of unemployment.

The second innovation was the introduction of price anticipations into Phillips curve analysis resulting in the expectations-augmented equation

$$(3) \quad p = ax + p^e$$

where p^e is the price expectations variable representing the anticipated rate of inflation. This expectations variable entered the equation with a coefficient of unity, reflecting the assumption that price expectations are completely incorporated in actual price changes. The unit expectations coefficient implies the absence of money illusion, i.e., it implies that sellers are concerned with the expected real purchasing power of the prices they receive and so take anticipated inflation into account. As will be shown later, the unit expectations coefficient also implies the complete absence of a trade-off between inflation and unemployment in the long-run when expectations are fully realized. Note also that the expectations variable is the sole shift variable in the equation. All other shift variables have been omitted, reflecting the view, prevalent in the early 1970's, that changing price expectations were the predominant cause of observed shifts in the Phillips curve.

The third innovation was the incorporation of an expectations-generating mechanism into Phillips curve analysis to explain how the price expectations variable itself is determined. Generally a simple *adaptive expectations* or *error-learning* mechanism was used. According to this mechanism, expectations are adjusted (adapted) by some fraction of the error that occurs when inflation turns out to be different than expected. In symbols

$$(4) \quad \dot{p}^e = b(p - p^e)$$

where the dot over the expectations variable indicates the rate of change (time derivative) of that variable, $p - p^e$ is the expectations error (i.e., the difference between actual and expected price inflation), and b is the adjustment fraction. Assuming, for example, an adjustment fraction of ½, equation 4 says that if the actual and expected rates of inflation are 10 percent and 4 percent, respectively—i.e., the expectational error is 6 percent—then the expected rate of inflation will be revised upward by an amount equal to half the error, or 3 percent. Such revision will continue until the expectational error is eliminated. It can also be shown that equation 4 is equivalent to the proposition that expected inflation is a geometrically-weighted average of all past rates of inflation with the weights summing to one. Therefore, the error-learning mechanism can also be expressed as

$$(5) \quad p^e = \Sigma\, w_i\, p_{-i}$$

where Σ indicates the operation of summing the weighted past rates of inflation, i represents past time periods, and w_i stands for the weights attached to past rates of inflation. These weights decline geometrically as time recedes, i.e., people are assumed to give more attention to recent than to older price experience when forming expectations. How fast the weights fall depends on the strength of people's memories of inflationary history. Rapidly declining weights indicate that people have short memories so that price expectations depend primarily on recent price experience. By contrast, slowly declining weights imply long memories so that expectations are influenced significantly by inflation rates of the more distant past. Both versions of the adaptive expectations mechanism (i.e., equations 4 and 5) were combined with the expectations-augmented Phillips equation to explain the mutual interaction of actual inflation, expected inflation, and excess demand.

The Natural Rate Hypothesis These three innovations—the redefined excess demand variable, the expectations-augmented trade-off, and the adaptive-expectations mechanism—formed the basis of the so-called natural rate and accelerationist hypotheses that radically altered economists' views of the Phillips curve. According to the natural rate hypothesis, there exists no permanent trade-off between unemployment and inflation since real economic variables tend to be independent of nominal ones in long-run equilibrium. To be sure, trade-offs may exist in the short-run. But they are inherently transitory phenomena that stem from unexpected inflation and that vanish when expectations adjust to inflationary experience. In the long-run, when inflationary surprises disappear and expectations are realized, unemployment returns to its natural (equilibrium) rate. This rate is consistent with all fully-anticipated steady-state rates of inflation, implying that the long-run Phillips curve is a vertical line at the natural rate of unemployment.

Equation 3 embodies these conclusions. That equation, when rearranged to read $p - p^e = ax$, states that the trade-off is between *unexpected* inflation (the difference between actual and expected inflation $p - p^e$) and excess demand. The equation also says that the trade-off disappears when inflation is fully anticipated, i.e., when $p - p^e$ is zero. Moreover, if the equation is correct, excess demand must also be zero at this point, which implies that unemployment is at its natural rate. Zero excess demand and the natural rate of unemployment are therefore compatible with *any* rate of inflation provided it is fully anticipated. In short, equation 3 asserts that if inflation is fully anticipated there will be no relationship between inflation and unemployment, contrary to the original Phillips hypothesis.

The Accelerationist Hypothesis Equation 3, when combined with equation 4, also yields the accelerationist hypothesis. The latter, a corollary of the natural rate hypothesis, states that since there exists no long-run trade-off between unemployment and inflation, attempts to peg the former variable below its natural (equilibrium) level must produce ever-accelerating inflation. Such acceleration will keep actual inflation always running ahead of expected inflation, thereby perpetuating the inflationary surprises that prevent unemployment from returning to its equilibrium level.

These conclusions are easily demonstrated. As previously mentioned, equation 3 states that excess demand can differ from zero only as long as actual inflation deviates from expected inflation. But equation 4 says that, by the very nature of the error-learning mechanism, such deviations cannot persist unless inflation is continually accelerated so that it always stays ahead of expected inflation. If inflation is not accelerated, but instead stays constant, then the gap between actual and expected inflation will eventually be closed. Therefore acceleration is required to keep the gap open if excess demand is to be maintained above its natural equilibrium level of zero. In other words, the long-run trade-off implied by the accelerationist hypothesis is between excess demand and the rate of acceleration of the inflation rate, in contrast to the conventional trade-off between excess demand and the inflation rate itself as implied by the original Phillips curve.[3]

Policy Implications of the Natural Rate and Accelerationist Hypotheses Two policy implications stem from the natural rate and accelerationist propositions. First, the authorities can either peg unemployment or stabilize inflation but not both. If they peg unemployment, they will ultimately lose control of inflation since the latter eventually accelerates when unemployment is held below its natural level. Alternatively, if they stabilize the inflation rate, they will lose control of unemployment since the latter will return to its natural level at any steady rate of inflation. Thus, contrary to the original Phillips hypothesis, they cannot peg unemployment at any constant rate of inflation.

A second policy implication stemming from equations 3 and 4 is that the authorities can choose from among alternative transitional adjustment paths to the desired steady-state rate of inflation. Suppose the authorities wish to move to a lower target inflation rate. To do so they must lower inflationary expectations, a major component of the inflation rate. But equations 3 and 4 state that the only way to do this is to create slack capacity (excess supply) in the economy, thus causing the actual rate of inflation to fall below the expected rate, inducing a downward revision of the latter. The equations also indicate that the speed of adjustment depends on the amount of slack created. Much slack means fast adjustment and a relatively rapid attainment of the inflation target. Conversely, little slack means sluggish adjustment and relatively slow attainment of the inflation target. Thus the policy choice is between adjustment paths offering high unemployment for a short time or lower unemployment for a long time.

Statistical Tests of the Natural Rate Hypothesis The fourth stage of Phillips curve analysis involved statistical testing of the natural rate hypothesis.

[3] The proof is simple. Equation 3 states a relationship among actual inflation, expected inflation, and excess demand. From that equation it follows that the relationship among the **rates of change** of those variables is given by the expression $\dot{p} = a\dot{x} + \dot{p}^e$ where the dots indicate rates of change (time derivatives) of the attached variables. Substituting equation 4 into this expression yields $\dot{p} = a\dot{x} + b(p-p^e)$, which, by equation 3's assertion that the expectational error $p - p^e$ is equal to ax, further simplifies to $\dot{p} = a\dot{x} + bax$. Finally, if excess demand is unchanging so that $\dot{x}$ is zero—as would be the case if the authorities were pegging x at some desired level—this last expression reduces to $\dot{p} = bax$ showing a trade-off relation between the rate of acceleration of inflation $\dot{p}$ and excess demand x.

These tests led to criticisms of the adaptive-expectations or error-learning model of inflationary expectations and thus helped prepare the way for the introduction of the alternative rational-expectations idea into Phillips curve analysis.

The tests themselves were mainly concerned with estimating the numerical value of the coefficient on the price-expectations variable in the expectations-augmented Phillips curve equation. If the coefficient is one, as in equation 3, then the natural rate hypothesis is valid and no long-run inflation-unemployment trade-off exists for the policymakers to exploit. But if the coefficient is less than one, the natural rate hypothesis is refuted and a long-run trade-off exists. This can be seen by writing the expectations-augmented equation as

$$(6) \quad p = ax + \phi p^e$$

where ϕ is the coefficient attached to the price expectations variable. In long-run equilibrium, of course, expected inflation equals actual inflation, i.e., $p^e = p$. Setting expected inflation equal to actual inflation as required for long-run equilibrium and solving for the actual rate of inflation yields

$$(7) \quad p(1 - \phi) = ax.$$

This shows that a long-run trade-off exists only if the expectations coefficient is less than one. If the coefficient is one, however, the trade-off vanishes.

Many of the empirical tests estimated the coefficient to be less than unity and concluded that the natural rate hypothesis was invalid. But this conclusion was sharply challenged by economists who contended that the tests contained statistical bias that tended to work against the natural rate hypothesis. These critics pointed out that the tests invariably used adaptive-expectations schemes as empirical proxies for the unobservable price expectations variable. They further showed that if these proxies were inappropriate measures of expectations then estimates of the expectations coefficient could well be biased downward. If so, then estimated coefficients of less than one constituted no disproof of the natural rate hypothesis.

Finally, the critics argued that the adaptive-expectations scheme is a grossly inaccurate representation of how people formulate price expectations. They pointed out that it postulates naive expectational behavior, holding as it does that people form anticipations solely from a weighted average of past price experience with weights that are fixed and independent of economic conditions and policy actions. This implies that people look only at past price changes and ignore all other pertinent information—e.g., money growth rate changes, exchange rate movements, announced policy intentions and the like—that could be used to reduce expectational errors. It seems implausible that people would fail to exploit information that would improve expectational accuracy. In short, the critics contended that adaptive expectations are not wholly rational if other information besides past price changes can improve predictions.

Many economists have since pointed out that it is hard to accept the notion that individuals would form price anticipations from *any* scheme that is inconsistent with the way inflation is actually generated in the economy. Being different from the true inflation-generating mechanism, such schemes will produce expectations that are systematically wrong. If so, rational agents will cease to use them. For example, suppose inflation were actually accelerating or decelerating. According to equation 4, the adaptive expectations model would systematically underestimate the inflation rate in the former case and overestimate it in the latter. Perceiving these persistent expectational mistakes, rational agents would quickly abandon the error-learning model for more accurate expectations-generating schemes. Once again, the adaptive-expectations mechanism is implausible because of its incompatibility with rational behavior.

From Adaptive Expectations to Rational Expectations The shortcomings of the adaptive expectations approach to the modeling of expectations led to the incorporation of the so-called rational expectations approach into Phillips curve analysis. According to the rational expectations hypothesis, individuals will tend to exploit *all* the pertinent information about the inflationary process when making their price forecasts. If true, this means that forecasting errors ultimately could arise only from random (unforeseen) shocks occurring to the economy. At first, of course, forecasting errors could also arise because individuals initially possess limited or incomplete information about the inflationary mechanism. But it is unlikely that this latter condition would persist. For if the public is truly rational, it will quickly learn from these inflationary surprises and incorporate the new information into its forecasting procedures, i.e., the sources of forecasting mistakes will be swiftly perceived and systematically eradicated. As knowledge of the inflationary process improves, forecasting models will be continually revised to produce more accurate predictions. Eventually all systematic (predictable) elements influencing the rate of inflation will become known and fully understood, and individuals' price expectations will constitute the most accurate (unbiased) forecast consistent with that knowledge.[4] When this happens people's price expectations will be the same as those implied by the actual inflation-generating mechanism. As incorporated in natural-rate Phillips curve models, the rational-expectations hypothesis implies that thereafter, except for unavoidable surprises due to purely random shocks, price expectations will always be correct and the economy will always be at its long-run steady-state equilibrium.

Policy Implications of Rational Expectations The strict rational-expectations approach has some radical policy implications. It implies that systematic policies—i.e., those based on feedback control rules defining the authorities' response to changes in the economy—cannot influence real variables even in the short-run, since people would have already anticipated what the policies are going to be and acted upon those anticipations. To have an impact on output and employment the authorities must be able to create a divergence between actual and expected inflation. This follows from the proposition that inflation influences real variables only when it is unanticipated. The authorities must be able to alter the actual rate of inflation without simultaneously causing an identical change in the expected future rate. This may be impossible if the public can predict policy actions.

Policy actions, to the extent they are systematic, are predictable. Systematic policies are simply rules or response functions relating policy variables to lagged values of other variables. These policy response functions can be estimated and incorporated into forecasters' price predictions. In other words, rational agents can use past observations on the behavior of the authorities to predict future policy moves. Then, on the basis of these predictions, they can correct for the effect of anticipated policies beforehand by making appropriate adjustments to nominal wages and prices. Consequently, when stabilization actions do occur, they will have no impact on real variables since they will have been discounted and neutralized in advance. The only conceivable way that policy can have even a short-run influence on real variables is for it to be unexpected, i.e., the policymakers must either act in an unpredictable random fashion or secretly change the policy reaction function. Apart from such tactics, which are incompatible with most notions of the proper conduct of public policy, there is no way the authorities can influence real variables. They can, however, influence a nominal variable, namely the inflation rate, and should concentrate their efforts on doing so if some particular rate is desired.

To summarize, the rationality hypothesis denies the existence of exploitable Phillips curve trade-offs in the short-run as well as the long. In so doing it differs from the adaptive expectations version of natural-rate Phillips curve models. Under adaptive expectations, short-run trade-offs exist because expectations do not adjust instantaneously to policy-engineered changes in the inflation rate. With expectations adapting to actual inflation with a lag, monetary policy can generate unexpected inflation and consequently influence real variables in the short-run. This cannot happen under rational expectations where both actual and expected inflation adjust identically and instantaneously to anticipated policy changes. In short, under rational expectations, systematic policy cannot induce the expectational errors that generate short-run Phillips curves.

A Simple Illustrative Model The preceding arguments can be clarified with the aid of a simple illustrative model. The model contains five relationships including an expectations-augmented Phillips curve equation, an inflation-generating mechanism, a policy reaction function, a rational price expectations equation, and finally a rational money-growth expectations equation. Taken together, these equations show that deterministic policies, by virtue of their very predictability, cannot induce the expectational errors that generate short-run Phillips curves. Phillips curves may exist, to be sure. But they are entirely the result of unpredictable random shocks and cannot be exploited by policies based on rules. In sum, the model shows that, given expectational rationality and the natural rate hypothesis, systematic trade-offs are impossible in the short-run as well as the long.[5]

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[4] Put differently, rationality implies that current expectational errors are uncorrelated with past errors and all other known information, such correlations already having been perceived and eliminated in the process of improving price forecasts.

[5] Note that the rational expectations hypothesis also rules out the accelerationist notion of a stable trade-off between excess demand and the rate of acceleration of the inflation rate. If expectations are formed consistent with the way inflation is actually generated, the authorities will not be able to fool people by accelerating inflation or by accelerating the rate of acceleration, etc. Indeed, **no** systematic policy will work if expectations are formed consistently with the way inflation is actually generated in the economy.

Phillips Curve Equation The first component of the model is the expectations-augmented Phillips curve equation

$$(8) \quad p - p^e = ax$$

that expresses a trade-off relationship between unexpected inflation and real excess demand. In the rational expectations literature this equation is often treated as an aggregate supply function stating that firms produce the normal capacity level of output when actual and expected inflation are equal but produce in excess of that level when fooled by unexpected inflation. This view holds that firms mistake unanticipated general price increases for rises in the particular (relative) price of their own products. Surprised by inflation, they treat the price increase as special to themselves and so expand output.

An alternative interpretation of the equation treats it as a price-setting relation according to which businessmen raise their prices at the rate at which they expect other businessmen to be raising theirs and then adjust that rate upward if excess demand appears. Either interpretation yields the same result. Expectational errors cause real economic activity to deviate from its normal capacity level. The deviations disappear when the errors vanish.

Inflation-Generating Mechanism The next relationship describes how inflation is generated in the model. Written as follows

$$(9) \quad p = m + \epsilon$$

it expresses the rate of inflation as the sum of the growth rate of money m per unit of capacity real output and a random shock variable ϵ, the latter assumed to have a mean (expected) value of zero. The capacity-adjusted money growth rate is simply the difference between the respective growth rates of the nominal money stock and capacity real output, the latter variable serving as a proxy for the trend rate of growth of the real demand for money. In essence, equation 9 says that while the rate of inflation is determined basically by the growth rate of money per unit of capacity output, it is also influenced by transitory disturbances unrelated to money growth. For convenience, it is assumed in what follows that the growth rate of capacity output is zero so that the capacity-adjusted money growth rate is identical to the growth rate of the nominal money stock itself.

Policy Reaction Function The third ingredient of the model is a policy-reaction function stating how the monetary authorities respond to changes in the level of economic activity. Written as follows

$$(10) \quad m = m(x_{-1}) + u$$

it states that the current rate of money growth is a function of last period's excess demand x_{-1} and a random disturbance term u, the latter assumed to have a mean value of zero. The interpretation of the equation is straightforward. The authorities attempt to adjust money growth in the current period to correct real excess demand or supply occurring in the preceding period according to the feedback control rule $m = m(x_{-1})$. Money growth cannot be controlled perfectly by the feedback rule, however, and the slippage is represented by the random term u that causes money growth to deviate unpredictably from the path intended by the authorities. Note that the disturbance term u can also represent deliberate monetary surprises engineered by the policy authorities.

Price Expectations Equation The fourth element of the model is a price-expectations equation describing how rational inflationary anticipations are formed. By definition, rational expectations are the same as the predictions yielded by the actual inflation-generating process, represented in the model by equation 9. And since that equation states that the actual rate of inflation is equal to the actual money growth rate plus a random variable, it follows that the expected rate of inflation predicted by the equation is equal to the expected money growth rate plus the expected value of the random term. The latter, however, is zero and thus drops out, leaving anticipated inflation equal to expected money growth. In symbols

$$(11) \quad p^e = m^e.$$

Note that these symbols now have a dual interpretation. They represent anticipations formulated by the public. They also represent mathematical expectations—i.e., expected (mean) values of the stochastic inflation and money growth variables—calculated from a model that, in principle at least, is a true representation of the inflationary process. Here is the essence of the notion that people's expectations are rational when they are the same as those implied by the relevant economic model.[6]

[6] Analysts often stress this point by expressing anticipated inflation formally as the mathematical expected value of the actual inflation rate, conditional on information available when the expectation was formed. Symbolically, $p^e = E(p|I)$ where E is the mathematical expectation and I is known information. Since this information includes the inflation-generating mechanism summarized by equation 9, it follows that anticipated inflation will be equal to the mathematical expectation of that mechanism, i.e., to the sum of the expected values of the money growth rate and the random term, respectively.

Anticipated Money Growth Equation Finally, rational expectations are employed to determine the anticipated rate of monetary growth. Here rational expectations are the same as the predictions of the actual money growth generating mechanism, represented in the model by equation 10 (the policy-reaction function). Put differently, the expected value of the reaction function constitutes the rational expectation of money growth. And since the function contains a systematic (predictable) component whose expected value is simply itself and a random term with an expected value of zero, that expectation is

$$(12) \quad m^e = m(x_{-1}).$$

In short, the anticipated rate of monetary growth is given by the predictable component of the policy-reaction function. Rational agents know everything in the policy-reaction function except the random element. They know the constant terms, the coefficients, and the predetermined variable. They use all this information in formulating expectations of the rate of monetary growth, expectations which are given by equation 12.

The Reduced Form Equation Equations 8-12 constitute the fundamental relationships of the rational-expectations model. The model can be condensed to a single reduced-form expression by substituting equations 9-12 into equation 8 to yield

$$(13) \quad \epsilon + u = ax$$

which states that Phillips curve trade-offs result solely from inflationary surprises caused by random shocks. Note in particular that only that part of monetary growth arising from unpredictable random disturbances enters equation 13. The systematic component is absent. This means that systematic monetary policy cannot affect real economic activity (as represented by excess demand x). Only unexpected money growth matters.

The foregoing implies that the authorities can influence economic activity in only two ways. First, they can pursue a random policy, altering monetary growth in a haphazard unpredictable manner. That is to say they can manipulate the disturbance term u in the policy reaction function in a totally unpredictable way. Second, they can secretly change the feedback control rule, thereby affecting output and employment during the time people are learning about the new rule. It is unlikely, however, that this latter policy would prove effective for very long since rational agents would learn to predict rule *changes* just as they predict the rule. This leaves random policy as the only way to affect economic activity. But randomness seems hardly a proper basis for public policy.

To summarize, the strict rational-expectations approach implies that expectational errors are the only source of departure from steady-state equilibrium, that such errors are short-lived and random, and that systematic policy rules will have no impact on real variables since those rules will already be fully embodied in rational price expectations. Thus, except for unpredictable random shocks, steady-state equilibrium always prevails and systematic monetary changes produce no surprises, no disappointed expectations, no transitory impacts on real economic activity. Trade-offs are totally adventitious phenomena that cannot be exploited by systematic policy even in the short-run. In short, no role remains for countercyclical stabilization policy. The only thing such policy can influence is the rate of inflation, which adjusts immediately to expected changes in money growth. The full effect of anticipated policy actions will be on the inflation rate. It follows that the authorities should concentrate their efforts on controlling this variable if it is desirable to do so since they cannot systematically influence real variables.

Evaluation of Rational Expectations The preceding paragraphs have shown what happens when rational expectations are incorporated into a model containing feedback policy rules, an inflation-generating mechanism, and an expectations-augmented Phillips curve or aggregate supply function embodying the natural rate hypothesis. An evaluation of the rational-expectations approach is now in order.

One advantage of the rational-expectations hypothesis is that it treats expectations formation as a part of optimizing behavior. By so doing, it brings the theory of price anticipations into accord with the rest of economic analysis. The latter assumes that people behave as rational optimizers in the production and purchase of goods, in the choice of jobs, and in making investment decisions. For consistency, it should assume the same regarding expectational behavior.

In this sense, the rational-expectations theory is superior to rival explanations, all of which imply that expectations are always consistently wrong. It is the only theory that denies that people make systematic expectation errors. Note that it does not claim that people possess perfect foresight or that their expectations are always accurate. What it does claim is that they perceive and eliminate *regularities* in their forecasting mistakes. In this way they discover the actual inflation-generating process and use it in forming price expectations. And with rational expectations the same as the mean value of the inflation-generating process, those expectations cannot be wrong on *average*. Any errors will be random, not systematic. The same cannot be said for other expectations schemes, however. Not being identical to the expected value of true inflation-generating process, those schemes will produce biased expectations that are systematically wrong.

Biased expectations schemes are difficult to justify theoretically. Systematic mistakes are harder to explain than is rational behavior. True, nobody really knows how expectations are actually formed. But a theory that says that forecasters don't continually make the same mistakes seems intuitively more plausible than theories that imply the opposite. Considering the profits to be made from improved forecasts, it seems inconceivable that systematic expectational errors would persist. Somebody would surely note the errors, correct them, and profit by the correction. Other forecasters would make similar corrections. Together, the profit motive and competition would reduce forecasting errors to randomness.

Criticism of the Rational-Expectations Approach Despite its logic, the rational-expectations approach has many critics. Some still maintain that expectations are basically nonrational, i.e., that people are too stupid, naive, or uninformed to formulate unbiased price expectations. A variant of this argument is that expectational rationality will be attained only after a long learning period during which expectations will be nonrational.

Most of the criticism, however, is directed not at the rationality assumption per se but rather at three other assumptions underlying the rational-expectations approach, namely the assumptions of (1) costless information, (2) no policymaker information advantage, and (3) price flexibility. The first states that information used to form rational expectations can be obtained and processed costlessly. The second holds that private forecasters possess exactly the same information as the authorities regarding the inflationary process. The third assumption states that prices and the rate of inflation respond fully and immediately to anticipated changes in monetary growth and other events. In effect, this last assumption denies that prices are sticky and costly to adjust.

Critics maintain that all of these assumptions are implausible and that if any are violated then the strong conclusions of the rational-expectations approach cease to hold. In particular, if the assumptions are violated then activist policies can have systematic effects on real variables. Indeed, the critics have demonstrated as much by incorporating constraints representing information costs, policymaker informational advantages, and sluggish price adjustment into rational-expectations models similar to the one outlined above.

Proponents of the rational-expectations approach readily admit that such constraints can restore the potency of activist policies. But they still insist that such policies are inappropriate and that the proper role for policy is not to systematically influence real activity but rather to neutralize the constraints. Thus if people form biased price forecasts, then the policymakers should publish unbiased forecasts. If information is costly to collect and process, then a central authority should gather it and make it available. If the policy authorities have informational advantages over private individuals, they should make that information public rather than attempting to exploit the advantage. Finally, if prices are sticky and costly to adjust, then the authorities should minimize these price adjustment costs by following policies that stabilize the general price level.

In short, advocates of the rational expectations approach argue that feasibility alone constitutes insufficient justification for activist policies. Policies should also be *desirable*. Activist policies hardly satisfy this latter criterion since their effectiveness is based on deceiving people into making expectational errors. The proper role for policy is not to influence real activity via deception but rather to reduce information deficiencies and perhaps also to minimize the costs of adjusting prices.

Conclusion This article has examined some recent developments in Phillips curve analysis. The chief conclusions can be stated succinctly. The Phillips curve concept has changed radically over the past 20 years as the notion of a stable enduring trade-off has given way to the view that no such trade-off exists for the policymakers to exploit. Instrumental to this change were the natural-rate and rational-expectations hypotheses, respectively. The former attributes trade-offs solely to expectational errors while the latter holds that systematic policies, by virtue of their very predictability, cannot possibly generate such errors. Taken together, the two hypotheses imply that systematic policies are incapable of influencing output and employment, contrary to the claims of policy activists. True, critics of the rational-expectations model have shown that relaxation of its more stringent assumptions restores the short-run potency of stabilization policy. But members of the rational-expectations school reply that activist policies are undesirable in any case since those policies must rely on deception. Whatever the verdict on the rational expectations approach, one must at least agree that it has posed a provocative challenge to proponents of activist stabilization policies.

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