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Rational Expectations in the Macro Model

THE ANTICIPATIONS of households and firms played a central role in Keynes' *General Theory*, and in the thinking of every macro theorist since. My purpose in this paper is to examine the major new issues about anticipations raised by the recent explosion of theoretical and empirical work based on the theory of rational expectations.

In the *General Theory*, anticipations were taken, in general, as irrational in the sense to be defined below. Because they existed in the mind, anticipations were analyzed in psychological terms. They were determined by the "animal spirits" of businessmen, by speculators' guesses as to how other speculators would behave, by waves of optimism and pessimism. Changes in anticipations were held to be frequently or even usually self-fulfilling.

After World War II two developments led economists away from reliance on psychologically determined anticipations. First, the effort to build and estimate quantitative models of the business cycle involving expectational variables forced acceptance of the idea of anticipations functions formed on observable data, because without them such models could not be estimated and empirically tested. It was natural to argue that anticipations of

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the value of some variable, X, depend on recent experience. The assumption most often employed was that the anticipated value of X equals a weighted average of past values of X, with higher weights applied to the recent past than to the distant past. Most writers recognized that these functions could not be strictly correct because information other than that captured in the past history of a variable must affect anticipations. But they were thought to be serviceable approximations, especially when they yielded good fits in estimated models.[1]

The second significant development was a running controversy over whether speculation in an individual market was stabilizing.[2] In the literature, general agreement emerged that, except in pathological cases, economic theory implied that speculation ought to be stabilizing. Profitable speculation had to be stabilizing; and unprofitable speculation, while not necessarily destabilizing, would reduce the resources available to those who systematically made poor bets.

Disputes over the empirical validity of the theoretical presumption that speculation is stabilizing spurred the early statistical studies of speculative markets. Most of the studies concentrated on the stock market, but markets in bonds, commodities, foreign exchange, and stock options were also analyzed.

While this mass of statistical results was growing—most of it inconsistent with simple notions as to how destabilizing speculation might affect prices in speculative markets—an initially underappreciated paper was published by John Muth.[3] Muth argued that a theory of anticipations ought to assume rational, maximizing behavior. Given, in principle, an objective, discoverable model of the market—an uncertainty model with a specified stochastic structure—the trained economist or statistician would base his forecast, or anticipation, of the value of a variable X by calculating, say, the minimum-variance unbiased forecast implied by the model. Muth as-

1. Meanwhile, survey information on the spending plans of firms and households has continued to be of interest, especially for short-term forecasting. Some surveys include questions attempting to measure "mood," or feelings of "optimism" or "pessimism," and so are psychologically oriented in the sense intended above.

2. Keynes seems to have assumed as self-evident the proposition that stock-market fluctuations were the result of destabilizing speculation. "Day-to-day fluctuations in the profits of existing investments, which are *obviously* of an ephemeral and non-significant character, tend to have an altogether excessive, and even an *absurd*, influence on the market" (emphasis added). John Maynard Keynes, *The General Theory of Employment, Interest and Money* (Harcourt, Brace, 1936), pp. 153–54.

3. John F. Muth, "Rational Expectations and the Theory of Price Movements," *Econometrica*, vol. 29 (July 1961), pp. 315–35.

serted that rational agents in the market did the same: that the market's anticipated value of X equaled the model's expected value of X—"expected" in the statistical rather than psychological sense.

In the late 1960s Muth's paper was used to lay a theoretical foundation for the continuing statistical studies of price behavior in speculative markets. The careful development of the theory of "efficient markets" by Eugene Fama and others generalized Muth's fundamental contribution, suggesting new hypotheses to test and motivating new statistical work. This work strengthened the case for Muth's theory. In the opinion of most economists familiar with this literature, the argument that speculation is highly irrational and destabilizing has been demolished.[4]

In a different line of literature, starting in the late 1960s with the work of Friedman and Phelps, economists began applying the rational-expectations theory to macro problems.[5] The initial attack was on the then generally accepted proposition that the long-run Phillips curve is negatively sloped. Friedman and Phelps argued that anticipations of price and wage changes would eventually catch up to realized price and wage changes. Since behavioral functions depend on real rather than nominal magnitudes, a permanently higher rate of inflation cannot "buy" a permanently lower level of unemployment. The observed short-run Phillips curve must, therefore, arise from short-run discrepancies between anticipated and realized inflation. One need apply only a very weak form of the rational-expectations hypothesis to infer that inflation cannot be under- or overestimated year after year after year.

When the rational-expectations hypothesis was applied more rigorously by Lucas, the effect was to eliminate the distinction between the short and long runs in macro models.[6] Because rational forecasting requires that forecast errors be serially uncorrelated, and because above- or below-

4. The efficient-markets literature is so large that I will cite only three general sources; extensive bibliographies appear in each: Paul H. Cootner, ed., *The Random Character of Stock Market Prices* (M.I.T. Press, 1964); Eugene F. Fama, "Efficient Capital Markets: A Review of Theory and Empirical Work," *Journal of Finance*, vol. 25 (May 1970), pp. 383–417; C. W. Smith, "Option Pricing: A Review," *Journal of Financial Economics*, vol. 3 (January/March 1976), pp. 3–51.

5. Milton Friedman, "The Role of Monetary Policy," *American Economic Review*, vol. 58 (March 1968), pp. 1–17; Edmund S. Phelps, "Introduction: The New Microeconomics in Employment and Inflation Theory," in Phelps and others, *Microeconomic Foundations of Employment and Inflation Theory* (Norton, 1970).

6. Robert E. Lucas, Jr., "Econometric Testing of the Natural Rate Hypothesis," in Otto Eckstein, ed., *The Econometrics of Price Determination*, A Conference Sponsored by the Board of Governors of the Federal Reserve System and Social Science Research Council (Board of Governors, 1972), pp. 50–59.

normal unemployment was hypothesized to depend only on errors in forecasting wages and prices, no part of one period's unemployment could depend on the previous period's unemployment. Some of the propositions derived from this approach have been met with astonishment—and with delight or dismay, depending on attitudes toward Keynesian macro theory. The best example of such a proposition is one derived by Sargent and Wallace.[7] They showed that in a textbook *Keynesian* model, with rational expectations imposed, *no* systematic stabilization policy will change the variance of fluctuations in real income.

Practically all the recent work applying rational-expectations models to macro theory has been concerned with the Phillips-curve questions raised by Friedman, Phelps, Lucas, and others, but the macro implications of the efficient-markets literature have been largely neglected. This neglect is unfortunate, not only because the efficient-markets evidence is so strong but also because integration of the two literatures offers significant insights into issues of macro theory.

My purpose in this paper is to examine the implications of the two branches of the rational-expectations literature for macro theory within the context of an abstract, highly aggregated macro model. First, I will argue that the well-established part of the rational-expectations theory—its application to the behavior of speculative auction markets—has not yet been satisfactorily incorporated into the general macro model. To make this argument, I will refer especially to estimated econometric models, but primarily in order to give an explicit representation of ideas that are embodied in general, abstract models.

Second, I will argue that there is some period of analysis short enough that the rational-expectations model of aggregate price and wage behavior cannot possibly be correct. Expectations are not irrational, but preferences and adjustment costs make it desirable to set some prices and wages in advance for a more or less well-specified period of time. I will argue that, though these contractual (or contract-like) agreements reflect rational expectations concerning the environment in which the contracting parties will operate, the existence of such agreements makes inappropriate the "pure" rational-expectations macro models.

Third, I will emphasize the importance of maintaining consistency in the

7. Thomas J. Sargent and Neil Wallace, " 'Rational' Expectations, the Optimal Monetary Instrument, and the Optimal Money Supply Rule," *Journal of Political Economy*, vol. 83 (April 1975), pp. 241–54.

assumptions about the behavior of a given economic unit in different markets. In particular, the theory of consumption cannot be independent of the theory of wages, and the theory of investment cannot be independent of theories of prices and wages.

In the following section, the efficient-markets theory is outlined and its implications for auction markets—most financial markets and some commodities markets—are examined. Next, the aggregate-supply theory developed by Friedman, Phelps and others is reviewed. I argue that this theory is inconsistent with some of the facts of labor-market behavior and with some of the findings in the efficient-markets literature.

An examination of the contractual theory of wage and price behavior underpins an argument that it provides a much better understanding of wage and price behavior than does the Friedman-Phelps theory. The implications of the theory for consumption and investment behavior are discussed, as well as the role of rational expectations in determining contract provisions. The implications of the analysis for stabilization policy are examined. Finally, a brief summary section brings together the major points of the paper.

The Efficient-Markets Theory

The validity of the rational-expectations hypothesis as applied to prices in active auction markets has been extensively tested. Numerous investigators have analyzed an enormous amount of data using many different statistical techniques, and no serious departure from the predictions of the hypothesis has been found. Thus, there is very strong evidence in favor of the hypothesis.[8]

At a high level of abstraction, and without the qualifications to be discussed below, the accepted hypothesis can be described as follows. Consider the price, P, of the common stock of MVPT Corporation, and for simplicity suppose that the dividend yield on the stock is zero and that risk aversion can be neglected. Given these assumptions, investors will bid the price of the stock at time t to ${}_tP^*_{t+1}/(1 + r)$, where ${}_tP^*_{t+1}$ is the price that

8. The reader who is uneasy with this statement should first sample the efficient-markets literature in the Cootner, Fama, and Smith items listed in note 4. The Cootner book cites twenty-two papers, each of which itself refers to many other papers; the Fama paper has forty-seven references; and the Smith paper, seventy-eight. (These bibliographies overlap somewhat, of course.)

the market, at time t, anticipates will prevail at time $t + 1$. The interest rate, r, is the one-period rate that could be earned on an alternative investment, such as a Treasury bill.

To complete the basic argument, note that an objective observer could, in principle, estimate a model incorporating all the factors impinging on the price of MVPT common stock, and from this model calculate the expected value of the price, $\underset{t}{E}(P_{t+1})$, given all information available at time t. The rational-expectations hypothesis is that the market's psychological anticipation, ${}_tP^*_{t+1}$, equals the true model's expectation, $\underset{t}{E}(P_{t+1})$. Moreover, the market uses the rationally formed expectations efficiently by pushing prices on financial assets to levels such that the expected rates of return on different assets are equal.[9]

This simple statement of the hypothesis must be qualified to allow for transactions and related costs, risk aversion, and inside information. Consider first the pure arbitrage example of the market forces equating the prices of General Motors stock on the New York and Midwest exchanges. The two prices cannot be *exactly* the same *all* the time; if they were the returns to arbitrage would be zero and no arbitrageurs would operate. But without arbitrageurs, there is no mechanism to insure that the two prices are even "almost" the same.[10]

The New York and Midwest prices on G.M. stock must differ by enough, on the average, to cover the accounting, informational, labor, and other costs of the arbitrage business. The owners can be expected to earn "the" normal competitive rate of return on their capital investment. If price differentials are arbitraged too much, returns will be too low and resources will be withdrawn from the arbitrage industry. Transactions costs ought not to affect the unconditional (or long-run) expected rate of return; however, period by period, the expected return conditional on current information may be above or below the unconditional expected return to the extent that transactions costs make further trades unprofitable.

By the same argument, resources should be devoted to pure speculation up to the point at which normal competitive returns are realized. Successful

9. A distinction is sometimes made between the rational formation of expectations and the efficient use of those expectations. This distinction is not made here because it has little operational significance; efficient use of irrational expectations ordinarily cannot be distinguished in the data from inefficient use of rational expectations.

10. For an abstract analysis of this problem, see Sanford J. Grossman and Joseph E. Stiglitz, "Information and Competitive Price Systems," *American Economic Review*, vol. 66 (May 1976), pp. 246–53.

speculation on next year's MVPT Corporation stock price may, however, require a greater degree of skill than pure arbitrage, and so it would not be surprising if pure speculators earn a higher wage than pure arbitrageurs. Even assuming, for the sake of argument, that this conjecture is correct, the existence of a large number of millionaire speculators is unlikely. Extremely profitable speculation—other than that due to chance—appears most often to result from innovation in information gathering or knowledge creation, and casual observation suggests that informational monopolies break down quickly.

In the case of a physical commodity, P_t and P^*_{t+1} must differ by enough to cover the costs of storing the commodity over time as well as transactions and related costs. After allowing for these factors, economists generally attribute long-continuing differences in expected rates of return on assets traded in auction markets to risk aversion and, indeed, the evidence suggests that above-average returns are generally realized on assets with above-average price volatility. For such reasons, the expected yield on an asset with a volatile yield like MVPT stock might well exceed the corresponding safe yield on Treasury bills.

In some cases, high rates of return—both expected (by certain individuals) and realized—are clearly related to "inside" information—particular knowledge that an individual has as a result of his special station rather than his special skill. However, such information does not, for present purposes, differ in principle from the information obtained by an especially skilled speculator or observer through superior understanding and insight.

If new information typically became available through a gradual diffusion process, price changes in one direction should be followed by still more in the same direction—a tendency for persistence or positive serial dependence of price change. However, extensive research, including analysis of daily price data, has built a strong empirical case against the gradual-diffusion hypothesis. Near-zero persistence in price changes is found in almost all cases. Indeed, statistical studies claiming to have found substantial persistence have so often been overturned by subsequent work—usually on the basis of problems in statistical technique or data collection—that great skepticism greets new studies that claim to find it. There seems to be relatively little inside information relevant to auction-market prices, and public release of whatever exists generates essentially instantaneous changes in prices.

Active auction markets are confined almost entirely to financial assets, agricultural commodities, and primary metals. In all of these cases transactions and storage costs are small relative to the price fluctuations observed. Differences in average returns across assets attributable to risk aversion are also relatively small. Consequently, ex ante knowledge of transactions, storage, and risk costs allows prediction of only a small fraction of a typical year's changes in auction-market prices.

The value of an economist's specialized knowledge in predicting auction-market prices also appears small relative to the typical magnitude of those changes. Since price changes in individual items traded in auction markets often amount to 50 or 100 percent per year, or even more, economists and the firms they advise should accumulate large fortunes if their forecasts are any good at all. That they don't suggests that economists are unable to forecast with much accuracy the typical year's price changes in auction-market goods.

Economists can earn a normal competitive rate of return in speculation for their own accounts and justify their consulting fees if they can predict prices just a little better than the market does. But, although predicting 5 percent of the price variance may easily justify the consulting fees, the inability to predict the remaining 95 percent justifies the conclusion that price changes in auction markets are largely unpredictable.

At any given state of knowledge of economic processes, then, the vast bulk of price changes in auction markets must be attributed to unpredictable new events, or to the unforeseen implications of prior events. Oddly enough, the accumulation of knowledge through research should not be expected to improve the economist's rate of return in speculation; rather it should reduce price volatility through changes in firms' policies regarding production, inventory management, capital investment, and other matters that improve economic efficiency by better anticipating changes in supply and demand conditions.

Confidence in the efficient-markets theory is strengthened by other considerations. Auction markets are well organized, the items traded are highly standardized, and a large number of individuals and firms trade in them. Because there are numerous specialized and well-financed professional traders in the market, ample resources are available to counteract the effects of irrational traders. Because transactions and storage costs are low and price fluctuations large, substantial incentives exist to gather new information. Even if most buyers and sellers of a financial asset or a com-

modity traded in auction markets had strong preferences for relatively slow adjustment of prices, speculators are able to force prices to adjust to the levels consistent with "all available information." In short, the assumptions of the economic theory of competitive, atomistic markets are closely satisfied.

IMPLICATIONS FOR MACRO THEORY

Although the prices of some commodities are determined in auction markets, the prices of most of the goods and services in the gross national product accounts are not. As a close first approximation, therefore, the role of auction markets in the pricing of GNP goods and services in the aggregate may be neglected. In contrast, however, the prices of most financial assets are either determined directly in auction markets or are closely tied to those markets. While the nonauction parts of the financial market—especially the markets in the liabilities of financial intermediaries—are of great importance, the auction markets in stocks and bonds cannot be neglected even as a first approximation.

The macro implications of the efficient-markets theory will be illustrated by examining issues relating to the term structure of interest rates. In the analysis it will be assumed that the efficient-markets theory can be taken as literally correct. The qualifications to the theory will be ignored in the same spirit in which distribution effects and aggregation problems are ignored.

The key macro implication of the efficient-markets theory is that long-term interest rates adjust immediately and fully in response to new information. Gradual adjustment of long-term interest rates implies gradual adjustment of bond prices and, therefore, gradual and predictable receipt of capital gains or losses. An unpredicted event that changes equilibrium bond prices must, according to the efficient-markets evidence, change actual bond prices immediately. The same argument applies to stock prices.

The business cycle is characterized by persistence, or serial dependence, in both the level of unemployment and the change in GNP prices, as will be detailed more carefully below. The efficient-markets results imply, therefore, that slow adjustment in nominal interest rates on securities traded in auction markets cannot be responsible for the persistence that characterizes the business cycle.[11]

11. This sentence must be interpreted carefully. What is being ruled out is slow adjustment in interest rates due to lags in perception and information dispersal.

To explain the problem with the standard term-structure equation, it is convenient to review the strategy frequently used in testing the efficient-markets hypothesis.[12] Since the true model as seen by the hypothetical "perfect observer" is never known, the strategy has been to look for signs that $P^* \neq E(P)$. The most common approach has been to search for signs of serial dependence in the time series of stock (or other asset) prices, $P_1, P_2, P_3, \ldots$ Since such a time series is readily available to all auction-market participants, there ought to be no pattern of price fluctuations that would permit any success in forecasting prices. For example, the application of a regression model such as

$$\log P_{t+1} = a + b_0 \log P_t + b_1 \log P_{t-1} + b_2 \log P_{t-2} + \cdots + b_n \log P_{t-n}$$

to a sample of data should, except for normal sampling error, yield an estimate of $\log(1 + r)$ for a, an estimate of 1.0 for b_0, and estimates of 0.0 for $b_1, b_2, \ldots, b_n$. If b_1 were not zero but, say, 0.2, a clear profit opportunity would exist because at time t the expected change in $\log P$ would be $a + 0.2 \log P_{t-1}$, a rate of return above or below r.

The term-structure equation typically has the form

$$R_t = a + \sum_{i=0}^{n} b_i r_{t-i} + e_t, \tag{1}$$

where R is a long-term interest rate, r is a short-term rate, and e_t is a disturbance that may or may not be serially correlated. For convenience in the analysis below it will be assumed that the disturbance term is not serially correlated and in some cases the summation will run from $i = 0$ to $i = \infty$, it being understood that $b_i = 0$ for $i > n$.

Equation 1 has been justified by an argument of the following type. Except for a possible liquidity premium, which may be ignored for the purposes at hand, the long rate ought to equal a suitably weighted average of expected short rates over the life of the long-term bond. Enough investors are assumed indifferent to the maturity of the bond they hold that the return on, say, a ten-year bond held to maturity will equal the expected return from holding ten successive one-year bonds. Or, equivalently, the

12. For other discussions of some of the same issues examined in the analysis immediately below, see Charles R. Nelson, "Rational Expectations and the Estimation of Econometric Models," *International Economic Review*, vol. 16 (October 1975), pp. 555–61; John Rutledge, *A Monetarist Model of Inflationary Expectations* (Lexington Books, 1974).

expected return from holding a ten-year bond for one year ought to equal the known return from holding a one-year bond to maturity. After the passage of a year, the observed one-year bond rate will in general differ from the one-year rate that, one year earlier, had been expected to prevail. This forecasting error will lead investors to modify—in a manner that depends on the particular model—their expectations of one-year bond rates. The rate on long-term bonds will then adjust to reflect these revised expectations. Because realized one-year rates provide the information leading to revisions in expected one-year rates, the long-term bond rate is a function of current and past one-year rates, as in equation 1.

The basic problems with this theory can be illustrated with a two-period discount bond for the "long" rate, and a one-period discount bond for the "short" rate. The return from holding a two-period bond to maturity ought to equal the expected return from holding two successive one-period bonds, as in equation 2:

$$(1 + R_t)^2 = [1 + r_t]\,[1 + \underset{t}{E}\,(r_{t+1})], \tag{2}$$

where $\underset{t}{E}\,(r_{t+1})$ denotes the expected short rate. Multiplying out the terms in equation 2 yields

$$1 + 2R_t + R_t^2 = 1 + r_t + \underset{t}{E}\,(r_{t+1}) + r_t\,\underset{t}{E}\,(r_{t+1}),$$

or

$$R_t \approx 1/2\,[r_t + \underset{t}{E}\,(r_{t+1})]. \tag{3}$$

The equation 3 approximation—which is quite accurate because an interest rate, being a small decimal fraction, becomes insignificant when squared—will be used for convenience below, but exact expressions could be used.

Outlined loosely above was the argument that revisions in expected one-year rates might depend on the error in forecasting the present short-term rate. If these revisions are to be rational, some model by which short rates are generated must be assumed. Because the term-structure equation ordinarily includes no variables other than interest rates, the appropriate model is one in which the behavior over time of the short rate is given by a stable stochastic process such as

$$r_{t+1} = \sum_{i=0}^{\infty} c_i\, r_{t-i} + v_{t+1}. \tag{4}$$

When a term-structure equation is estimated, some restrictions must be

placed on the c_i, such as assuming $c_i = 0$ for $i > m$; but for present purposes the infinite sum in equation 4 may be retained. It will also be assumed that the disturbances, v, have mean zero and are serially independent.[13] Since the major issue explored below involves first differences, the constant term in equation 4 is not shown explicitly.

With rational expectations,

$$\underset{t}{E}(r_{t+1}) = \sum_{i=0}^{\infty} c_i r_{t-i}.$$

Substituting this expression into equation 3 yields

$$(5) \quad Rt = 1/2\,(r_t + \sum_{i=0}^{\infty} c_i r_{t-i}) = 1/2\,(1 + c_0)\,r_t + 1/2 \sum_{i=1}^{\infty} c_i r_{t-i}.$$

Equation 5 is identical in form to equation 1—the standard term-structure equation—except that it has no disturbance term.

In this model new information affects both the short and the long rates. The effect on the short rate in period t is v_t and the expected effect on short rates may be found by solving equation 4 recursively for $t + 1, t + 2, \ldots,$ with $v_{t+1}, v_{t+2}, \ldots$ set equal to zero. Once the expected short rates are calculated—$\underset{t}{E}(r_{t+1})$ is the only expectation needed in the current example—the effect of v_t on the long rate may be calculated through the term-structure equation—equation 5 in this example. The model assumes that equation 4 is the only information investors have about the future course of interest rates.

In general, however, investors know much more than that about future interest rates. For example, the short rate may rise either because of an increase in government expenditures financed by new bond issues and accompanied by partial monetary accommodation or because of monetary restriction. Long rates might, therefore, rise in the first case and fall, or at least rise less, in the second.

An estimated term-structure equation should have coefficients reflecting the relative frequency of the various types of disturbances in the particular sample period, and these coefficients should be consistent with those for

13. The Modigliani-Shiller model, to be discussed below, has a term-structure equation similar to equation 1 but with a distributed lag on the inflation rate added to reflect the effects of inflation on expected short rates. This addition is irrelevant to my point because it simply requires another time-series model (similar to equation 4) for the inflation rate.

the short rate in equation 4. Modigliani and Shiller, who first made this argument precise, provided evidence supporting this view.[14]

The Modigliani-Shiller findings, however, do not justify using the ordinary term-structure equation in a macro model. To argue that the behavior of the long and short rates in a particular sample period is consistent is not the same as saying that the long rate is determined by a market process yielding a term-structure equation with constant coefficients. If equation 4 is not immutable, the term-structure equation cannot be considered a structural equation since its parameters cannot be independent of other equations, including those describing government policy, in the economy. Indeed, the fact that the Federal Reserve gets a great deal of policy advice based on the expectation that it can, and on the hope that it will, alter the behavior of the short rate over time suggests that many believe that equation 4 is not immutable.

The argument is the same as that for the random-walk model of stock prices. Changes in stock prices are not "uncaused," as some interpret the meaning of "random," but serially uncorrelated *because* investors react rationally when responding to unpredictable causal events. The rational-expectations theory restricts the behavior of stock prices over time; it also restricts the relationship in a particular sample period between the coefficients in a time-series model of the short rate and the coefficients in a term-structure model of the long rate.

The interpretation of the term-structure equation as a structural relationship is inconsistent with the efficient-markets theory. Suppose the long-term rate in the term-structure equation 1 is the Aaa bond yield. Advancing the time subscript by one and taking the first difference of equation 1 yields

$$(6) \quad R_{t+1} - R_t = b_0 (r_{t+1} - r_t) + \sum_{i=1}^{n} b_i (r_{t+1-i} - r_{t-i}) + e_{t+1} - e_t.$$

This equation implies that as of time t the expected change in the bond yield is a function of the expected change and of the *known* past changes in the short rate. For at least some historical patterns in short rates, and for some patterns proposed to central bankers, the expected changes in yield imply expected capital gains or losses that would produce an expected one-

14. Franco Modigliani and Robert J. Shiller, "Inflation, Rational Expectations, and the Term Structure of Interest Rates," *Economica*, vol. 40 n.s. (February 1973), pp. 12–43.

period yield substantially different from the known yield on a one-period bond. The term structure model is, therefore, strictly inconsistent with rational expectations unless all the b_i for $i \geq 1$ are zero. Only the new information reflected in r_{t+1} ought to matter since all the old information is already incorporated in R_t.[15] The same argument applies to the term-structure error term, e_t, in equation 1. At time t, e_t can be calculated from equation 1. From equation 6 the expected change in the long rate depends on e_t unless $\underset{t}{E}(e_{t+1}) = e_t$. In this case the term-structure error term follows a random walk, a specification with obvious problems that need not be discussed here.

Phillips and Pippenger estimated equation 6, rewritten with R_t moved to the right-hand side, and found insignificant coefficients for all of the r_{t-i} for $i \geq 1$.[16] The history of the short rate provided no information useful in predicting R_{t+1} that was not already incorporated in R_t. This finding is in keeping with the efficient-markets theory and with the findings on the stock market of numerous investigators.

The above analysis is of the same kind that Lucas first made precise.[17] Lucas argued that the equations for consumption and investment typically used in econometric models were, in a sense, inconsistent with accepted theories. For example, in consumption theory the short-run marginal propensity to consume depends on the relative variances of permanent and transitory income. A new government policy, perhaps based on simulations of econometric models, would alter the relative variances and thereby change the parameters of the consumption function upon which the simulations were based.

While this argument is surely correct, its quantitative importance for the aggregate consumption function might be questioned on the ground that—

15. This argument does not quite hold for the Aaa bond index since the passage of a year will bring the individual bonds in the index one year closer to maturity. As long-term bonds become short-term bonds they are replaced in the sample from which the index is calculated. Since the investor buys bonds and not the index, there can be expected changes in the Aaa yield index without any expected capital gains or losses. However, this consideration is of minor importance since the issues in the index have long terms to maturity and the composition of the index changes only slowly.

16. Llad Phillips and John Pippenger, "Preferred Habitat vs. Efficient Market: A Test of Alternative Hypotheses," Federal Reserve Bank of St. Louis, *Review*, vol. 58 (May 1976), pp. 11–19.

17. Robert E. Lucas, Jr., "Econometric Policy Evaluation: A Critique," in Karl Brunner and Allan H. Meltzer, eds., *The Phillips Curve and Labor Markets* (Amsterdam and New York: North-Holland, 1976).

apart from the extremes of great depressions and great inflations—most of the variance of household income is determined by micro factors. A 10 percent change in real GNP relative to potential in one year is a "sharp slump" or a "runaway boom." Yet, changes in the income of an individual household of 10 percent or more when GNP is at its potential are by no means uncommon. A worker's promotion or demotion, or five weeks of unemployment, can easily entail such a change.

The Lucas argument, it seems to me, has much greater force when applied to the determination of interest rates. Consider what might happen if the Federal Reserve announced (credibly) that money growth would remain constant for the next ten years. Monetarists and Keynesians would argue about the outcome, but no one would be surprised if securities prices changed dramatically immediately after the announcement. Ignoring the effects of public perceptions of government policy on consumption behavior may be no worse than ignoring distribution effects on consumption; but ignoring the effects on interest rates is a far more serious matter. Ample experience shows that identifiable events cause immediate and dramatic changes in the prices of securities of particular issuers, and the efficient-markets literature provides strong evidence for the proposition that these revaluations correctly assess the import of new information.

If this argument is accepted, a severe problem is raised for econometric models. Many models have a structure in which (a) one or more short-term interest rates appear in a money-market sector, which includes a demand-for-money equation and one or more equations determining the supply of money through the banking system; (b) short-term interest rates determine one or more long-term rates through term-structure equations; and (c) the long-term interest rates appear in investment equations that determine a significant portion of aggregate demand. In addition, long-term interest rates may be related to dividend yields, which in turn affect the level of the stock market, household wealth, and consumption. Model dynamics depend importantly on the lagged adjustment of long rates to short rates in the term-structure equation. According to the argument above, these dynamics cannot be trusted.

In principle, the proper approach to linking short-term and long-term interest rates might be as follows. First, simulate the model with the standard term-structure equation. Next, abandon the standard equation and recalculate the long-term rate period by period, using the simulated future short-term rates and the theoretical term-structure model based on

expectations under the assumption that the future short rates are properly anticipated. Simulate the model again, treating the calculated long rates as exogenous. In this simulation a new path of short rates will appear, and the long rates can then be recalculated for the next iteration.

If this iterative procedure converged, the result would be identical to that derived analytically by Muth in his very simple theoretical model of an agricultural market. Expectations of short rates, as incorporated in the current long rate, would be rational because the total model solution *given* those expectations would generate simulated short rates equal to the expected short rates.[18]

This proposal may not be computationally feasible in any but the smallest models, but it helps to indicate the dimension of the problem raised for econometric modeling. More generally, this line of argument suggests that the role of financial markets in the business cycle does not arise from faulty pricing of securities, where "faulty" is interpreted in the ex ante sense. Interest rates and the decisions based on them will, of course, frequently prove to have been faulty ex post in the light of new information. Rather than emphasize the "animal spirits" of businessmen and speculators, it seems more appropriate to look for the events that generate business fluctuations in spite of properly laid plans. This notion underlies the Friedman-Phelps aggregate supply function, but before getting into that subject a brief comment on forecasting seems in order.

IMPLICATIONS FOR FORECASTING

As emphasized above, the efficient-markets evidence supports the proposition that current securities prices are efficient predictors of future securities prices. The predictions are not necessarily very accurate, but they are efficient in the sense of incorporating all available information and in being hard to beat.

In many cases auction markets provide direct data on market anticipations. Futures markets exist in a number of commodities and foreign currencies, and in January 1976 a futures market in three-month Treasury bills was opened. Even if these prices were determined inefficiently, they should

18. In the context of simulations designed to explore the effects of alternative policy assumptions, the iterative procedure is equivalent to assuming that the market learns of policy changes as soon as the policymakers do. While this assumption may seem a bit extreme, it has a better theoretical justification than any particular assumption involving lagged reactions. Indeed, the market, by correctly anticipating events that will force policymakers to act, probably learns of some policy changes *before* the policymakers do.

be used for some purposes. In equations requiring expectational variables, surely futures-market prices should be employed rather than either survey data on, say, interest-rate anticipations or hypothesized time-series models in which anticipated values are modeled as distributed-lag functions of realized values.

A particularly interesting problem is raised by the new futures market in Treasury bills. While, previously, interest-rate anticipations could be inferred from the yields on securities of different maturities, the futures market in bills probably generates more accurate data because the transactions costs of dealing in futures are so much lower than those of dealing in securities.[19]

Suppose a six-quarter simulation of a forecasting model generates simulated bill rates that differ from those observed in the futures market. If the forecaster accepts the efficient-markets hypothesis, the simulation will have to be redone so that it generates bill rates equal to the observed rates in the futures market. The forecaster will have to decide whether to change his money-demand function, his assumptions about central-bank behavior, or the simulated level of income (and hence other equations in the model). At a minimum, forecasters ought to see what model adjustments are needed to simulate the bill-rate path observed in the futures market. Anyone with great confidence in the efficient-markets model will, I believe, want the forecaster to make his simulation match the futures-market path exactly. This argument does not imply that model forecasting is useless, because there are many variables, especially quantities, for which no observable market forecasts exist.

To summarize this section, the efficient-markets literature substantially documents the proposition that auction markets function efficiently. The predictions of the theory are not satisfied exactly—nor should that be expected—but the theory comes close enough to reality that for most macro problems nothing is gained by attempting to "beat the market." In building macro models, one should not assume that financial markets are characterized by lagged adjustments; and those making forecasts of interest rates and commodity prices would be well advised to consult data on prices in futures markets before speaking.

19. The standard contract in the futures market is for $1 million of bills. The round-trip transactions cost is about $60 per contract. Brokers are required to put up $1,500 per contract on margin account, and individuals dealing through brokers must put up that much or more (the amount fluctuates).

Friedman-Phelps Aggregate Supply Theory

The central issues raised for macroeconomic theory by recent work employing the rational-expectations hypothesis concern the relationships between prices and wages on the one hand and output and employment on the other. The argument put forth by Friedman, Phelps, Lucas, Sargent and Wallace, and a growing number of other economists is that fluctuations in output and employment are caused by errors of firms and workers in predicting prices and wages in an environment in which the predictions are rational. In the theory no distinction need be made between wage and price behavior because the theory does not attempt to explain the business cycle by cyclical differences in wage and price adjustments. For convenience of exposition, the theory will be referred to as the "Friedman-Phelps aggregate supply theory," since these investigators apparently were the first to state the hypothesis clearly.

The Friedman-Phelps theory relies, in some respects, on a rational-expectations argument very different from that discussed in the previous section. The financial-market theory has emphasized the determination of the *prices* of financial assets rather than of the *quantities* "produced." In that theory, the market drives today's price to equality (ignoring transactions and storage costs and the like) with the price expected to prevail tomorrow, given expectations rationally formed on all of today's information. In the context of a securities trader's decision to hold an inventory of common stocks, the quantities purchased (or sold short) today depend on the expected relationship between today's and *tomorrow's* prices.

The flavor of the Friedman-Phelps theory, on the other hand, is that today's quantities of goods produced (or labor services sold) depend on the relationship of today's price to *yesterday's* expectation of that price. Output and employment change today because information about today that is in principle "available" is not in fact gathered and processed, and so mistakes are made. The producer (worker) is assumed to use rationally the information contained in today's price (wage) in his market, but he is also assumed to have incomplete information about the relationship between that price and the general price level. The individual producer (worker) interprets part of an increase in his price (wage) as an increase in his relative price (wage) justifying an increase in the amount of goods (hours) offered for sale. Thus, employment and output rise even when the

wage and price increases are general and the perceived changes in money wages and prices do not in fact reflect changes in relative wages and prices.[20]

The Friedman-Phelps theory must invoke lags of some type to explain the persistence of unemployment since in the theory output deviates from "potential" or "normal" output only as a result of a discrepancy between realized and previously expected prices. The theory is consistent with a business cycle caused by a run of forecasting errors (similar to a run of "heads" in a coin-tossing game) but not with a cycle exhibiting serially correlated unemployment. Since forecast errors cannot be serially correlated under rational expectations, the theory must, therefore, appeal to some other mechanism to explain the observed persistence (serial dependence) of unemployment.

The Friedman-Phelps theory has to find a way to explain persistence because persistence is so great. In a model estimated by Lucas, the cyclical component of annual output in the United States depends on the lagged cyclical component with a coefficient of 0.887.[21] Sargent, in a recent paper employing a similar aggregate supply function, reported coefficients on four lagged values of unemployment in a quarterly U.S. model. His coefficients were 1.47, −0.59, −0.03, and 0.04, and also show considerable persistence.[22]

In the Friedman-Phelps theory persistence might arise from technologically determined lags in the aggregate supply function. An example of such a lag would be physical limitations on the speed with which a blast furnace can be brought into production because it must be heated slowly to avoid cracking its brick lining. But a technological explanation is unsatisfactory given the occasionally rapid changes in output.

Many economists have argued that the Friedman-Phelps Phillips-curve

20. The emphasis in this paragraph on the comparison of today's price with yesterday's expectation is exaggerated in that some expositions of the theory rely on a somewhat different mechanism. See Robert J. Barro and Stanley Fischer, "Recent Developments in Monetary Theory," *Journal of Monetary Economics*, vol. 2 (April 1976), pp. 133–67, especially pp. 155–61.

21. Robert E. Lucas, Jr., "Some International Evidence on Output-Inflation Tradeoffs," *American Economic Review*, vol. 63 (June 1973), pp. 326–34.

22. Thomas J. Sargent, "A Classical Macroeconomic Model for the United States," *Journal of Political Economy*, vol. 84 (April 1976), pp. 207–37. Robert King has pointed out to me that the lagged unemployment coefficients estimated by Sargent are almost identical to those estimated in an ARIMA model by Charles R. Nelson, "The Prediction Performance of the FRB-MIT-Penn Model of the U.S. Economy," *American Economic Review*, vol. 62 (December 1972), pp. 902–17. The price-forecasting error term in Lucas-type equations explaining unemployment contributes very little to the R^2.

theory is inconsistent with observed behavior in the labor market. In addition, Hall has argued that information lags cannot possibly be long enough to rescue the theory.[23] This argument can be strengthened by referring to the efficient-markets evidence. If firm A changes its selling price the evidence suggests that this action, through its effects on the profits of firm A and its competitors, is reflected immediately in the prices of securities issued by the firms involved. It is unreasonable to believe both that the securities markets correctly evaluate the new information and that the new information spreads only gradually to the firms' managers. Moreover, the magnitude of the lost wages and lost profits in a recession seems to justify large expenditures by workers and firms on information gathering in the effort to minimize mistakes made in sorting out relative from general price changes. My impression is that information gathering—job search, for example—is not nearly as extensive as the Friedman-Phelps theory seems to require.

Empirical work based on this theory has dealt with unemployment persistence by adding lagged unemployment rates to the basic model. The questionable nature of this procedure is perhaps most apparent in the Lucas paper, "Some International Evidence." In that paper, the aggregate supply function is

$$y_{ct} = \alpha (P_t - \bar{P}_t) + \lambda y_{ct-1},$$

where y_c is the cyclical component of income, and P and $\bar{P}$ are the actual and expected price levels. The parameter α depends on the relationship between the variance in relative and absolute prices; as the variance in the absolute price level increases, α declines.

Lucas closed the model by inserting additional equations, and then fit it separately to time-series data for eighteen countries. He found that the estimate of α—strictly speaking, of a parameter functionally related to α, denoted π—was dramatically lower for the two countries in the sample with dramatically higher price-level variance.

But the estimated λ turns out to be negatively correlated with a country's mean rate of price change as well as with the variance of its price changes.[24]

23. On the first point, see Robert J. Gordon, "Recent Developments in the Theory of Inflation and Unemployment," *Journal of Monetary Economics*, vol. 2 (April 1976), pp. 185–219. On the second, see Robert E. Hall, "The Rigidity of Wages and the Persistence of Unemployment," *BPEA, 2:1975*, pp. 301–35; see especially Sims' comment, p. 337, and Hall's reply, pp. 344–45.

24. Lucas, "Some International Evidence," tables 1 and 2.

The two correlation coefficients are −0.45 and −0.24, respectively. Moreover, the Lucas π is as highly correlated with the *mean* price change as with the *variance*; the two correlation coefficients are −0.69 and −0.67, respectively. Finally, the correlation coefficient between π and λ is 0.35.[25]

As Lucas has made particularly clear in a recent paper, a theory of the persistent business cycle cannot rely on the assumption of rational expectations applied to complete information, where "complete" is interpreted as the information available to an omniscient outside observer.[26] In this paper Lucas builds a theoretical cycle model on the assumptions that economic units have incomplete knowledge of the current state of the economy and that there are lags in acquiring information on past states of the economy. Period by period, the available, but imperfect, information is optimally used in determining prices and quantities in auction, or auction-like, markets. The information lags generate the persistent cycle.

The introduction of information lags into a model obviously can produce serial dependence, and yet the device seems no more satisfactory than the direct assumption of adaptive expectations.[27] To exaggerate a bit, in the efficient-markets literature, prices at time t are determined on the basis of all available information—every scrap of data that could in principle have been gathered at time t—and prices change over time in response to events that are, in principle, unpredictable at time t. The distinction between knowledge of the past and present on the one hand and knowledge of the future on the other, while not as straightforward as it may appear on the surface, seems nevertheless to be a much more solid basis for building a theory of the cycle than is the distinction relied upon by Lucas—that between known and unknown current data.

Lucas has made especially clear the need to specify informationally dis-

25. In fact, these results are consistent with theories asserting that anticipated inflation has real effects. The estimates imply that the benefits of inflationary policies are two-fold: the slope of the Phillips curve is steeper and the persistence of unemployment, when it occurs, is less. Nevertheless, these implications ought not to be accepted because the Friedman-Phelps theory is built on the assumption that prices and wages are reset period by period as if in auction markets. This point is discussed more extensively below.

26. "An Equilibrium Model of the Business Cycle," *Journal of Political Economy*, vol. 83 (December 1975), pp. 1113–44.

27. Indeed, in "Rational Expectations," Muth showed how adaptive expectations could be rational under certain assumptions as to the stochastic structure of the market if the adaptive parameter reflected that structure. However, it remains true that adaptive expectations are not rational if other information besides the past behavior of a variable can improve predictions.

tinct markets in the macro model.[28] His approach has emphasized spatially separate auction-like markets as the source of information failures. The alternative is to emphasize the *temporal* separation of nonauction markets. A nonauction market is not necessarily a noncompetitive market. Agents in nonauction markets do not necessarily earn returns above those available in auction markets nor do they necessarily have any substantial discretion over their price and output policies. Given the problems with a theory based on informationally separate auction markets, it seems more promising to rely on nonauction markets with agents who are severely constrained by competitive forces to follow the nonauction policies of setting wages and prices in advance and accepting the quantity adjustments determined by market demands. The reasons for this behavior are the subject of the burgeoning literature on contractual theories of wage and price determination, to which I now turn.

Contractual Wage and Price Theories

Underlying the contractual theories is the observation that most labor services cannot be sold in auction markets. In an auction market a seller has no particular reason to maintain a relationship with any particular buyer; goods can be sold period by period to whoever offers the best price. And even when buyer-seller relationships develop, an auction market behaves as if they were unimportant. Labor markets, however, cannot work this way. There is no arbitrage mechanism to force rapid adjustment because adjustment costs prohibit minute-by-minute changes in the employer to whom labor services are sold. Like a household's decision on the purchase of consumer durables, a decision of a firm to make a job offer, or of an individual to accept it, necessarily involves a calculation over a period stretching into the future. Calculations of this type are emphasized in the job-search literature.

All of this seems straightforward enough, and the implication is that for any particular economy (specified by a given set of stochastic properties) there must be some time period—a quarter, a month, or whatever—short

28. "The introduction of separate, informationally distinct markets is . . . an analytical departure which appears essential (in some form) to an explanation of the way in which business cycles can arise and persist in a competitive economy." (Lucas, "An Equilibrium Model," p. 1132.)

enough that the Friedman-Phelps theory cannot possibly be correct.[29] But the question remains as to why an employee's attachment to a firm takes the form of an arrangement with a relatively predetermined wage and variable hours.

Recent work on contractual theories provides a much more solid explanation of stable wages than older notions depending on rigidities and institutional factors.[30] Wage adjustment may be slow because it is rational for it to be slow, and the institutions are shaped by economic forces.

The contractual theories are built on two basic ideas: differences in risk aversion between employers and employees and information costs.

Suppose the wage clause in a contract with fixed hours and variable wages consists of a formula by which the firm's value added is divided quarter by quarter between employees and owners.[31] All wages consist of profit sharing. Sharecropping provides an example of this arrangement.

Azariadis, Baily, Gordon, and others argue that the variable-wage contract increases the variance of the employee's income compared with the contract that has a fixed wage and variable hours. Being risk averse compared with the firm, employees prefer the fixed-wage contract and "pay" the firm in the form of lower expected real wages.

Informational considerations, however, may be more important than risk considerations. In the profit-sharing method of defining variable wages, for example, a firm's owners have an incentive to understate profits—as they already do because the corporate income tax makes the government a profit sharer. Since a strike might be the only method by which workers could enforce their views of appropriate accounting rules, it is not difficult

29. The argument is much the same as Friedman's permanent-income theory of consumption: daily consumption cannot be a function of daily income receipts.

30. Costas Azariadis, "Implicit Contracts and Underemployment Equilibria," *Journal of Political Economy*, vol. 83 (December 1975), pp. 1183–1202; Martin N. Baily, "Wages and Employment under Uncertain Demand," *Review of Economic Studies*, vol. 41 (January 1974), pp. 37–50; Donald F. Gordon, "A Neo-Classical Theory of Keynesian Unemployment," *Economic Inquiry*, vol. 12 (December 1974), pp. 431–59; Arthur M. Okun, "Inflation: Its Mechanics and Welfare Costs," *BPEA, 2:1975*, pp. 351–90. For references to additional papers in this rapidly growing line of literature, see Gordon, "Recent Developments," pp. 216–19.

31. With variable wages, hours are not necessarily "fixed" but can be chosen by the employee. When real wages decline the contract might provide that hours decline, reflecting the value of leisure. However, the evidence suggests that the average workweek is not much affected by interindustry differences and secular changes in real wages. For simplicity, therefore, it seems reasonable to discuss the fixed hours-variable wage contract, interpreting "fixed" quite literally.

to see how a variable wage-fixed hours contract might evolve into a fixed wage-variable hours contract.

R. J. Gordon criticizes the insurance argument on the ground that its logic calls for a further step: contracts should provide for fixed wages *and* fixed hours. A tenure contract, however, has an obvious problem.[32] Suppose that within a fixed total aggregate demand, demand shifts from firm A to firm B. With a tenure contract there is no reason for labor resources already in place to be reallocated, although new entrants into the labor force will be hired by firm B. Ignoring new entrants for simplicity, the two firms will maintain output roughly unchanged; the price of firm A's goods will fall and the price of firm B's goods will rise in order to clear the market. In order to honor its tenure contract, firm A will have to operate at a loss, but it will operate its fixed capital and fixed labor stock to produce goods as long as prices cover materials costs. The loss is offset during periods when the demand for its goods is high.

To avoid bankruptcy questions for the moment, suppose demand shifts are always temporary—that is, demand goes from General Motors to Ford and back again. If the potentially variable factor, labor, is not reallocated as demand shifts, then the productive process will be less efficient. In contrast, the fixed-wage contract will reallocate labor as workers are laid off by some firms and then hired by others. Indeed, the reallocation of labor through layoffs and new hires as micro disturbances occur may generate a pattern of wages and employment across industries not much different from what would come about in the classical auction-market model with a high degree of labor mobility. In that model small changes in relative wages are sufficient to induce workers to move to new jobs; and so the end result of the adjustment to a micro disturbance is a reallocation of labor without lasting wage differentials.

32. Indeed it has several problems. Probably more important than the factors analyzed below is that a firm may have difficulty in getting a worker to perform under a tenure contract. If a worker is not paid when he does not appear at the job, his contract is one providing for fixed wages and variable hours at the worker's option rather than, as discussed above, either tenure or fixed wages and variable hours at the firm's option. An unreliable tenured worker loses no current wages by "going fishing" but does lose future wages by developing a "bad reputation." In contrast to auction markets, reliability is important in the labor market and many product markets because of the costs imposed on others. The absence of a "key" man may shut down a production process and leave other workers with nothing to do. For a further discussion of these issues, see Herschel I. Grossman, "Risk Shifting and Reliability in Labor Markets," *Scandinavian Journal of Economics*, forthcoming.

The key point about the tenure contract, then, is that it does not contain a mechanism to reallocate labor. While full employment will be sustained by the tenure contract in the face of a macro disturbance, the allocative inefficiencies in the face of micro disturbances will require that all firms, when negotiating contracts, offer wages lower than those that could be offered under fixed-wage contracts.

The size of this wage differential will depend on the effects of the fixed-wage contract in generating unemployment. The employee negotiating a fixed-wage contract must make an allowance for the expected costs of being unemployed (expected hours unemployed times the difference between the after-tax wage and the value of leisure time plus unemployment benefits, and so forth); and these costs must be compared to those associated with the allocative inefficiencies of tenure contracts.

Since the U.S. economy is characterized by substantial and continuous micro reallocation, expected incomes may well be enough higher under fixed-wage contracts than under tenure contracts to persuade most employees to forgo the security of tenure. This argument seems convincing because changes in tastes and technology are so often permanent and unidirectional rather than temporary and reversible; the failure of tenure contracts to reallocate labor would generate large costs compared with cyclical unemployment. Moreover, the possibility that tenure contracts would bankrupt the firms that offer them means that some of the contracts may not be honored anyway.

Tenure need not be permanent, of course, but the distinction between two-year tenure contracts and fixed-wage contracts is not great. Many workers already have quasi-tenure through formal or informal seniority practices, and for many there may not be much difference ex ante between the expected cost of layoffs with two weeks' notice and the expected cost of nonrenewal of tenure at specified contract termination dates.

This discussion suggests that fixed-wage contracts are generally optimal, but leaves open the question as to why contracts are not constructed so as to provide enough wage flexibility to avoid prolonged cyclical unemployment. Consider the same question applied to predictable seasonal unemployment. No disequilibrium of any kind need be implied when a resort hotel pays its labor a constant wage rate, independent of season, and offers seasonally fluctuating employment. All that is required is that the wage rate be high enough, given the seasonal pattern of hours, to compensate hotel workers on an annual basis as required to call forth a sufficient amount of

labor. The compensation will, of course, reflect the tastes of workers for leisure time in the off season and their opportunities elsewhere in the economy (including those for off-season work). Depending on the pricing policy of the hotel, the wage rate week by week may or may not equal the value of marginal product, but on average over the year it ought to do so. The marginal condition need not be met week by week—at least not for all employees—precisely because labor is hired by the year rather than by the week.

A similar analysis can be applied to cyclical changes in employment. Hourly wage rates may be cyclically unresponsive although they should be higher in the more cyclical industries than in the less cyclical ones. The cyclical case differs from the seasonal case only in that the pattern of labor demand over time is less predictable. In both, however, new contracts (broadly construed to include contract-like arrangements) should reflect newly formed expectations as to hours of work over the lives of the contracts. New contracts need not differ from old ones if expected real wages and expected cyclical unemployment are unchanged. However, these expectations may well change if real wages, cyclical unemployment, government policies, and any other relevant factors differed during the old contract from expectations when those contracts were signed, provided that these once unexpected conditions are now expected to persist.

The cyclical case, nevertheless, differs from the seasonal case in that, in the former, the real wage and amount of unemployment can differ from expectations by far larger amounts. Indeed, cyclical uncertainties should be analyzed along with uncertainties stemming from micro disturbances. Again, why do contracts not provide for greater flexibility in order to reduce the costs of both cyclical and micro disturbances? If fixed-wage contracts serve an insurance function, the losses due to cyclical (and other) unemployment are analogous to the administrative costs of a life insurance company. Might there be a way for contracting parties to reduce these losses and to share the gains? In principle, contingency clauses could provide a mechanism to reduce the losses that arise as contracts get out of date.

It is, however, no trivial problem for contracting parties to agree on the proper measurement of and response to possible future states of the world that would justify wage adjustment. Many known possible states will not be hedged because the costs of the attempt are too high, and other states will arise that are not even in the set of known possible states at the time a contract is signed. The most widely used contingency clause is the cost-

of-living escalator, and the difficulties with such clauses are nicely illustrated by the growing literature on the problems with escalators when firms are hit by supply shocks.

As an economy's variance increases, the response of contracting parties should be to increase the use of contingency clauses, but because such clauses are only partial remedies, contract periods should also shorten. Negotiating relatively often to change wages on the basis of current information will be cheaper than bearing the costs of contracts that have been outdated in spite of efforts to allow for contingencies.

In summary, whereas the Friedman-Phelps theory explains unemployment by assuming that workers and firms are unable to distinguish between relative and absolute price changes period by period, the contract model explains unemployment by assuming that wages and prices are predetermined period by period. However, the contract model with rational expectations provides much more than a rationale for Keynes' "sticky" wages. It also provides, in principle, an analysis of the effect of the economy's characteristics on contract clauses and terms. The more stable is an economy, the longer should be the terms of formal contracts and the longer should be the contract-like understandings that produce lasting customer-firm and employee-firm relationships. The major thrust of the Friedman-Phelps theory remains intact, but the theory is reinterpreted as applying to contract clauses and contract periods rather than to calendar periods.

Contract theory is not yet sufficiently developed to provide much guidance to how economic conditions affect clauses and durations. There is, therefore, little on which to build structural wage and price equations. A reasonable assumption is that expectations of future employment will be affected by current employment and, therefore, that the Phillips-curve approach to wage formation is serviceable. Nevertheless, the contract theory makes clear that this approach can be expected to break down whenever labor-market anticipations assume an environment substantially different from the past. Similarly, an aggregate price equation specified on standardized unit labor costs and the current state of demand in the product markets will probably be satisfactory so long as the underlying environment is stable.

Of special importance is the fact that contractual arrangements include escape clauses. Both parties to a contract understand that there are circumstances in which even legally binding contracts should be reopened: per-

haps one party may realize that it would be unfair or impossible to enforce contract compliance on the other. Thus, wage and price stability—in the sense of wages and prices predetermined period by period—can break down quickly *because* the contracting parties desire to maintain their relationships and so must consider the effects of their demands on each other.

IMPLICATIONS FOR CONSUMPTION AND INVESTMENT FUNCTIONS

The contractual theory of wage and price determination has implications for the macro model that extend well beyond the wage and price equations. As first argued by Clower,[33] the Keynesian consumption function makes theoretical sense only in a world in which hours of work are not a choice variable for the worker. In the auction-market model the worker chooses hours of work, consumption, and saving simultaneously, given his tastes and given the market wages, prices, and interest rates. In the contractual model hours of work are not, in the short run, a choice variable but are determined by firms through decisions on layoffs and overtime work (within limits).

In accepting a (more or less formal) contractual relationship with a firm, the worker understands that hours will be determined by the firm in the short run. His choice of occupation and employer will be determined in accordance with the neoclassical model. This choice will reflect his *expectations* as to hours of work and the real wage rate over the (perhaps vaguely defined) contract period and, therefore, his expectations as to consumption and saving. Given that choice, in any short period actual hours and actual real wages—and therefore actual real income—may differ from those expected. To the extent that income differs within the range of normal variation, real consumption need not be affected, for the reasons suggested by the permanent-income theory of the consumption function.

Some fluctuations of income, however, will be larger than those expected, or at least larger than those for which the worker is prepared to adjust saving to hold consumption constant. In the business-cycle context these fluctuations may still not be large enough to make it worthwhile for many contracting parties to abandon their contractual relationships, and so the worker will adjust his consumption to reflect his changed income. Here is the Keynesian consumption function in its permanent-income form.

33. Robert Clower, "The Keynesian Counterrevolution: A Theoretical Appraisal," in F. H. Hahn and F. P. R. Brechling, eds., *The Theory of Interest Rates* (London: Macmillan, 1965).

An analogous argument, though one much less frequently heard, applies to the investment function.[34] Assuming, as seems the case, that a great deal of pricing in product markets is also based on contractual considerations, firms are constrained *both* to maintain contractual prices *and* to deliver goods at those prices. Just as the worker may feel compelled to sacrifice his Saturday afternoon to overtime work at his employer's request so also the firm may feel compelled to deliver goods at a short-run loss, and to expand physical plant to do so, in order to maintain a profitable longer-term customer relationship.

The neoclassical investment function has the firm jointly deciding output and investment given the production function, current and expected market prices for output and for capital goods, and the interest rate. This model has no room for the investment accelerator because output is a choice variable. From the discussion above, however, this approach must be modified to admit the accelerator to the extent that the contractual pricing theory is accepted.

SOURCES OF BUSINESS-CYCLE FLUCTUATIONS

The contractual theory of wage and price behavior was originally developed to provide a more solid understanding of the Keynesian notion of wage and price rigidity. As emphasized above, the theory has implications for equations in the macro model other than the wage and price equations because quantity adjustments are implied by price rigidity; but it also points to the sources of business-cycle fluctuations.

The contract theory calls for wages and prices to be *predetermined* but not necessarily unchanging or even smoothly changing. "Rigidity" of wages and prices should be interpreted as unresponsiveness to *current* demand and not as absence of response over time. At the micro level some contractual understandings involve dramatically changing prices, as in seasonal and peak-load pricing and in wage adjustments after probationary employment periods. Some contracts provide for substantial predetermined changes in price reflecting expectations as to market demands; an example is the not uncommon practice of giving one or two months' free

34. The role of the accelerator in investment theory has long been questioned. As far as I know, the first clear justification for the accelerator based on the assumption that firms are constrained in determining output appears in Herschel I. Grossman, "A Choice-Theoretic Model of an Income-Investment Accelerator," *American Economic Review*, vol. 62 (September 1972), pp. 630–41.

rent on a one-year apartment lease, an offer the tenant understands is unlikely to be repeated when the lease comes up for renewal.

These examples, as well as the wide fluctuations in wages and prices actually observed, make clear that "wage and price predetermination" should be substituted for "wage and price rigidity." This substitution is not just a matter of terminology. If wages and prices were really rigid, or even really smoothly changing, there could be no errors in wage and price forecasting. But important errors can arise when, for example, a contractual wage is not accompanied by the product prices expected by the contracting parties.

In the Keynesian view of the business cycle, errors in price forecasting play a small role. The Keynesian position is, I believe, well summarized by Tobin: "According to [the general equilibrium approach to monetary theory], the principal way in which financial policies and events affect aggregate demand is by changing the valuations of physical assets relative to their replacement costs."[35] The production of new physical assets changes because existing "used" assets have valuations—and market prices when such markets exist—that differ from the prices of new equipment.[36]

The replacement costs of physical assets may, however, differ from the valuations of existing physical assets because either one changes while the other remains constant. Policies and events—"disturbances"—will alter the relationship between valuations and replacement costs if the disturbances are imperfectly forecast by sellers of newly produced physical assets with predetermined prices that are (at least in part) based on the forecast.

The importance of contractual pricing for understanding the business cycle is suggested by the following illustration. Consider a firm in a recession, with an idle machine similar or even identical to one purchased only a few months earlier during the expansion phase of the cycle. Relationships among wages, materials costs, and prices are much like those at the time

35. James Tobin, "A General Equilibrium Approach to Monetary Theory," *Journal of Money, Credit and Banking*, vol. 1 (February 1969), p. 29.

36. Identical goods cannot, of course, sell at different prices, but changes in the valuations of existing assets may be interpreted as bringing about changes in the prices of newly produced assets, thereby changing the flow supply of these assets. Alternatively, if the quoted prices on newly produced assets do not change, perhaps for the contractual reasons discussed earlier, order backlogs will change or new assets will be produced and put into service as rapidly as the adjustment costs of new investment justify. These costs alter the effective price to the buyer so that the total cost of the new assets equal the valuations of the old, except in the event that production of new assets drops to zero.

the new machine was purchased.[37] At the time the investment was put in place, it was expected to have a positive return. Suppose, moreover, that the depreciation of capital is a function of time rather than of usage. If the profitability of operating the machine in the future is independent of the profitability of operating it during the recession, then, whatever the expected life of the idle machine, its lifetime rate of return can be increased if a way can be found to operate it to produce goods that can be sold for more than the variable costs of production. Why doesn't the firm cut prices to a level only slightly above operating costs?[38]

If firms operate in competitive markets, in the sense that they have little freedom to act independently, the persistence of idle capital accompanied by an unchanged real wage rate must stem from factors linking the profitability of production in one period to the expected profitability of production in subsequent periods. The individual firm can find it profitable to keep capital idle only if operating the capital in the recession would reduce the expected profitability of operating it when the firm expects to be using it anyway.[39] Put another way, the firm that lowers its price in this contractual-pricing environment—which links today's pricing decision to tomorrow's—believes that the present value of the expected effects of that decision on today's and tomorrow's profits is positive. This type of linkage of pricing decisions over time does not exist in the auction-market competitive model, in which the firm, period by period, sets output at the point where marginal cost equals the market-determined price.

The contractual-pricing theory suggests that the expected rate of return on an investment project—even on equipment with a short physical life—is determined primarily by the contribution of the investment to an enduring line of business requiring enduring customer relationships. Investment behavior can be viewed as very similar to consumption behavior. The considerations emphasized in the neoclassical investment theory explain firms' decisions to enter (or expand) or leave (or contract) a line of business.

37. This statement is justified by the observation that real wages display little cyclical pattern—that is, the relationship between nominal prices and nominal wages is not very (if at all) cyclical.

38. The force of this argument is somewhat reduced for capital that depreciates with usage rather than with time because the variable cost then includes depreciation as well as material and labor costs. This type of capital ought to be used so long as the net revenues generated exceed the present value of expected net revenues.

39. In this theory the individual firm has no discretion over keeping capital idle in a recession. If the firm does not maximize long-run profits, it earns less than the normal competitive rate of return and so cannot survive.

Given these decisions, which imply expected requirements for capital plant over time, the current level of aggregate demand will induce levels of investment that depart from those expected earlier. This argument suggests that investment might play a relatively small role as a causal force in the business cycle.

For the sake of expositional clarity, take a set of assumptions generating results at the opposite extreme from the Keynesian emphasis on the importance of investment in the business cycle. Suppose that (a) the neoclassical consumption and investment models together determine a real rate of interest that, averaged over the cycle, is constant in the long run and is so recognized by business firms; (b) all investment is long-lived because physical capital has a long life, or contractual considerations require long-term commitments to a line of business, or some combination of the two; (c) the "long run" is a length of time spanning a number of expected business cycles of normal duration, but of unexpected timing.[40]

With these assumptions, the short-run elasticity of investment demand with respect to the real interest rate will be high.[41] In the Keynesian model, the IS function will be almost flat at a nominal rate of interest equal to the long-run equilibrium real rate plus the expected rate of inflation. Policies and events move this IS function by affecting the expected rate of inflation; changes in the expected return on capital are *assumed* to be unimportant by virtue of the assumption that firms confidently expect the real rate of return to remain essentially constant.

This set of analytical results contrasts with the standard Keynesian view that the real rate of interest ought to have a marked cyclical pattern. In terms of the IS-LM model, shifts in the IS function induce positively correlated changes in real income and real interest. While shifts in the LM function cause negatively correlated changes in income and interest for a given IS function, the latter function, as conventionally interpreted, cannot in fact remain fixed due to the operation of the investment accelerator.

The view outlined above depicting a fairly stable and flat IS curve may appear, on its face, to be inconsistent with the observed cyclical volatility of both investment expenditures and stock-market valuations of existing capital. But, given the assumptions above, these features of the business cycle should not be interpreted within the neoclassical model of investment.

40. This assumption is needed to make this argument consistent with the earlier one that contractually determined wages and prices do not perfectly anticipate disturbances.

41. Changes in the first several coupons on a perpetuity will, for a given price of the perpetuity, have a minor effect on the rate of return.

Under the assumptions of the contractual-pricing model, the real rate of return on investment does not fluctuate cyclically as much as the cyclical behavior of investment would suggest. In a boom, much of the investment has a low return when calculated in the conventional manner over the life of the physical assets involved; but this investment is nevertheless required to meet customer demands at predetermined prices. In a recession, much of investment reflects commitments to new markets promising relatively higher long-run returns.

Fluctuations in the stock market reflect not only changes in anticipated rates of return but also realized returns. A firm whose factory burns down is worth less than before regardless of anticipated returns on *new* investment. Similarly, firms sometimes make investments that prove worthless and hence reduce their worth.

With the onset of recession the typical firm will have made these kinds of mistakes. It will have made some capital investments with short lives, will have accumulated some excess inventories, and will have made some investments in hiring and training labor that are completely lost when workers who are laid off do not return. A decline in the stock market, therefore, need not reflect any change in the valuation of the representative firm's long-term capital which consists of both the long-lived physical assets and the "good will" that reflects the capitalized value of the firm's relationships with its customers.

In a similar vein, this approach also can account for declines in the stock market when aggregate demand is excessive. In a boom, firms must meet greater than expected demands at contractually determined prices, and the costs of doing so will be high. If the demands had been anticipated, prices would have been higher, or investment expanded earlier, to provide additional capacity with normal and efficient lead times.

Because demands fluctuate unexpectedly, the firm constrained by contractual pricing will want to maintain some capacity that is "excess" in a physical sense but not in an economic sense. Customers, by the contractual theory, are willing to pay a higher expected price in return for the benefits of a contractually determined price and the assurance that their demands at that price will be met.

Corporate profits should be highest when realized demands are above those expected but below those that strain capacity.[42] Firms receive a windfall by operating at these levels because their contractual-price and capacity

42. Output is rarely strictly constrained by physical limitations, but a careful definition of "physical capacity" is complex and unnecessary for the purposes at hand.

decisions provided for some excess capacity. The windfall gains occur for the same reasons as the unexpected losses discussed in the two preceding paragraphs.

The above analysis was based on the extreme assumption that in the aggregate firms correctly perceive that the long-run expected real rate of return to investment is constant. Actual returns differ from those expected because actual demands differ from those expected; and, in this model, unanticipated demands will be reflected in aggregate output. In fact they will also be reflected in unanticipated price changes. The unexpected demands on firms subject to contractual-pricing constraints will generate derived demands in the auction markets for primary materials, and newly "negotiated" contracts will provide for changes in prices. These price changes will be unanticipated because the demands that occasioned them were unanticipated.

Unanticipated price changes get little weight in the Keynesian analysis, which emphasizes changes in the expected return on investment. While the Keynesian considerations may have been relatively important in the United States during the 1930s, there is evidence that unanticipated price changes have been important forces in the period since World War II. A recent study of the Treasury bill market by Eugene Fama suggests that, for his sample period (January 1953 to July 1971), errors in forecasting prices played a relatively important role in the cyclical process.[43] Fama's findings, which are discussed below, provide direct evidence on the magnitude of such errors. In addition, they are suggestive of a highly interest-elastic IS function if it can be assumed that the expected yields on different types of securities move together. This assumption is not unreasonable, as applied to Treasury bills and common stocks, but in the present context the possibility that the risk premium on equities might have a cyclical pattern poses an important question.[44]

Fama examined the behavior over time of the realized real rate of return on U.S. Treasury bills—the nominal holding-period yield plus the rate of change in the purchasing power of money (calculated from the consumer price index)—and found that the ex post real rate of interest has a sub-

43. Eugene F. Fama, "Short-Term Interest Rates as Predictors of Inflation," *American Economic Review*, vol. 65 (June 1975), pp. 269–82.

44. The efficient-markets literature provides a presumption that the risk premium has no cyclical pattern. As far as I know, there is no evidence that a stock-market trading rule based, say, on the most recently observed unemployment rate promises higher returns than a buy-and-hold strategy.

stantial variance and is serially uncorrelated. The absence of serial correlation in the real rate on bills is surprising, given the Keynesian position, in light of the high serial correlation of unemployment.

Fama reports that, over his entire sample period, the mean and standard deviation of the annual real rate of return from holding one-month bills are 0.89 percent and 2.36 percent, respectively. On three-month bills the corresponding figures are 1.22 percent and 1.48 percent. Over a shorter sample period, March 1959 to July 1971, Fama found the mean and standard deviation on one-month bills to be 1.08 and 2.03 percent, respectively; on three-month bills, 1.49 and 1.23, respectively; and on six-month bills, 1.76 and 0.89, respectively.[45]

Since the standard deviations are relatively large compared with the means, accelerating or postponing planned purchases of goods frequently would have been profitable if price changes on goods could have been anticipated. Since Fama found a substantial degree of serial dependence in changes in the CPI but none in the real interest rate, and since serial dependence provides information useful for forecasting, a reasonable inference is that short-run price speculation, in the form of changes in the timing of goods purchases, does exist. According to Fama's results, this speculation eliminates serial dependence from the real rate on bills but not from changes in the CPI. The latter result stands in marked contrast to the behavior of prices of commodities traded in auction markets.

Within the context of a goods-bills-money inventory model,[46] the implication is that an increase in expected inflation leads buyers of goods to expand their inventories of goods and reduce their inventories of bills and money. The sellers of contractually priced goods are quantity takers in the short run, and so they end up with larger inventories of bills and money. Their physical inventories of goods may decline or they may expand output or both. Since many economic units are simultaneously buyers and sellers in markets characterized by contractual pricing, the aggregate effects of short-run price speculation are a change in the bill rate and some mix

45. Ibid., table 7, p. 280. Fama's table reports results at rates per period; I have multiplied by 12, 4, and 2 as appropriate to express his results at annual rates.

46. Such models have been worked out by Edgar L. Feige and Michael Parkin, "The Optimal Quantity of Money, Bonds, Commodity Inventories, and Capital," *American Economic Review*, vol. 61 (June 1971), pp. 335–49; and by Anthony M. Santomero, "A Model of the Demand for Money by Households," *Journal of Finance*, vol. 29 (March 1974), pp. 89–102.

of changes in aggregate activity and aggregate business inventories.[47] With contractual pricing the firm presumably makes relatively small errors in forecasting its own selling prices in the near term because it sets those prices and knows its own plans. But the representative firm can, and apparently does, make errors with respect to the prices of goods it buys.[48]

It appears reasonable, then, to believe that short-run speculation takes place on changes in the CPI. But the magnitude of the price forecasting errors in Fama's findings, along with the evidence that the short-run Phillips curve is far from vertical, implies that firms must frequently be surprised by changes in demand. This inference is justified by the fact that many firms are involved simultaneously in the goods markets and in the bill market. A firm that makes forecasting errors in the one must also make forecasting errors in the other.

As noted earlier, the absence of serial correlation in the ex post real rate on bills is consistent with the view that changes in the expected rate of return on investment play only a small role in the cyclical process and is inconsistent with the standard Keynesian view that the real interest rate has a marked cyclical pattern. However, Fama's conclusion in this regard might be criticized on the ground that he should have employed a cyclical variable, such as the unemployment rate, to pick up the cyclical behavior of the ex ante (or expected) real rate of interest. If this argument were correct, an equation using only the Treasury bill rate to forecast inflation—one in which the cyclical variable is omitted—should have serially correlated residuals because the omitted variable is known to be serially correlated. But Fama found no evidence of significant serial correlation.

In a comment on the Fama paper, Nelson and Schwert argue that Fama's test for constancy in the ex ante real rate of interest is very weak.[49] The ex

47. Note that for intermediate products, price speculation may simply redistribute inventories between buyers and sellers of such products and yet may affect the bill rate.

48. Strictly speaking, this argument does not apply to the CPI since that index covers goods purchased by households. It is certainly possible that input prices are forecast with little error, that the bill rate adjusts to reflect those forecasts as firms alter their inventories of bills and input goods, and that the variance of the real rate of return on bills calculated from the CPI stems from the resulting variability of the bill rate rather than from errors in forecasting CPI prices. Since households own a relatively small fraction of the dollar value of outstanding bills, they have no way of switching between bills and goods inventories. While this argument may have some validity, many large retailing firms must be buying CPI goods at prices highly correlated with those that final consumers actually pay; these firms do have the option of adjusting their goods and bills inventories.

49. C. R. Nelson and G. W. Schwert, "On Testing the Hypothesis that the Real Rate of Interest Is Constant," *American Economic Review*, forthcoming, 1977.

post real rate on Treasury bills equals the ex ante real rate plus the error in forecasting the rate of inflation. If the inflation forecasting errors are serially independent, as they should be under rational expectations, the higher is the variance of the forecasting error relative to the variance of a serially correlated ex ante real rate of interest, the lower will be the serial correlation of the ex post real rate.

Employing several different time-series models of the monthly CPI and some simplifying assumptions, Nelson and Schwert conclude that the standard deviation of the monthly ex ante real rate on bills is between 0.7 and 1.3, expressed at an annual rate.[50] Consider a first-order process for the real rate, i, such as

$$i_t = k\, i_{t-1} + w_t.$$

Various pairs of k and σ_w^2 appear consistent with the evidence, but if k is almost 1.0—so that the serial dependence is high—σ_w^2 is small enough that the variance of i is still small compared with the variance of the inflation forecast errors. Nelson and Schwert find that the inflation forecasting errors are 60 to 80 percent of the total variance of about 5.2 percent annual rate in the ex post real rate on Treasury bills month to month for the period from January 1953 through July 1971.

For the purposes of this paper, therefore, the Nelson and Schwert findings reinforce the Fama findings. Changes in the CPI are serially correlated to a significant extent, and whatever the serial correlation in the ex ante real rate, its variance is small compared with that in inflation forecasting errors. These findings suggest that fluctuations in real activity in the United States since 1953 are more likely to be related to price forecasting errors than to responses to interest rates given smoothly changing, and therefore predictable, prices.[51]

50. Ibid.

51. A nearly constant ex ante real rate of interest could be the result of a nearly horizontal LM function rather than of a nearly horizontal IS function, but this explanation seems unsatisfactory. The demand for real money balances is almost universally specified as a function of the nominal rate of interest (interest on money is assumed zero); and since the interest elasticity of the demand for money is not high—at least at the present time—a flat LM function relative to the *real* rate of interest would require that the central bank be reasonably successful in adjusting the nominal money stock proportionally to fluctuations in both the general price level and real income. But it is quite clear that, historically, central bank policy has emphasized stabilization of the nominal rate of interest rather than of the real rate.

CONTRACTUAL PRICING: SOME FURTHER COMMENTS

The contractual theory of wage and price determination has great appeal. In qualitative terms its predictions fit the facts of the labor market and of many product markets. It is consistent with the permanent-income theory of consumption and with a theory of investment assigning a major role to the accelerator, theories that have proven successful in empirical studies of cyclical fluctuations.

The difficulty with the contractual theory at the current state of its development is that it offers more insight into why wages and prices are unresponsive to current demand than into why they change. What is needed is an explanation of the factors that determine the place of particular markets on the continuum between the three-year wage contract and the auction market. The same analysis ought to be capable of explaining why three-year labor contracts characterize stable periods and weekly (or shorter) contracts emerge in hyperinflation. Presumably the answer has something to do with the volatilities in the aggregate price level and in relative prices, and perhaps the type of analysis worked out by Lucas provides the ingredients essential to the needed theory.

In any event, the contract theory should be interpreted as an explanation of the failure of wages and prices to behave as if they were determined in auction markets; the theory does not imply that all the wages and prices relevant to individual decisionmakers are highly predictable. Even if changes in the expected rate of return on capital are large, there should be no business cycle if the market-clearing wages and prices implied by volatile expected returns are predictable. Some wages and prices might be smoothed for the convenience of the parties involved, as in the payment of nine-month teacher salaries in twelve equal installments, but no one would knowingly insist on wages and prices that would lead to large-scale unemployment. Uncertainty is exactly what generates the demand for contractually determined wages and prices and so wage and price forecasting errors must play some role in the cyclical process.

Even if the argument deemphasizing changes in the expected return on investment is viewed as non-Keynesian, the argument just made is decidedly Keynesian in that it emphasizes wage and price "rigidities." The argument is also decidedly Keynesian in its stress on induced changes in expenditures, which arise not only from the Keynesian consumption function and the "multiplier" that may be calculated from it, but also from the

investment accelerator mechanism. In the light of these observations, the monetarist view of the cycle should be regarded as non-Keynesian only in the sense of emphasizing monetary disturbances rather than disturbances in the expected return on capital.

Policy in a Rational-Expectations Model

In contrast to the Sargent-Wallace results, the argument made here retains both the potential for government macro policy to be stabilizing and the rational-expectations hypothesis. It is against their own interests for individual households and firms to behave in such a way as to offset all the aggregate effects of unforeseen disturbances. If the government can identify short-run disturbances and offset them, macro policy can be successful.

Suppose, for a moment, that government policy responses are well defined and measurable, and that they offset some of the effects on aggregate output that would occur in their total absence. With contractual pricing, such offsets are possible because the government can seek to mitigate disturbances that private parties, bound by contracts, must endure. This result does not depend on differential information: it requires only that when new information arrives the government be able to respond in ways not available to private parties bound together in contractual relationships.

If the government response function is optimally formed, contracting parties need do nothing but "grin and enjoy it." However, if the response is systematically too much or too little, private parties might want to define contract contingency clauses on government policy variables just as they now do on the CPI. In addition, because of varying tastes in the population, "optimal" policy adjustments by the government cannot be defined precisely. Private attitudes toward unemployment and inflation differ, and so in principle some private contract clauses could be tied to government policy variables in one way, and some in another.

This line of argument might appear to rescue the Sargent-Wallace results in a world of contractual pricing since the tastes of contracting parties could undo any action the government might take reflecting *its* tastes. But its emptiness can be seen by going one step further. Rather than change policy, the government could simply announce its view on the optimal change in the aggregate price level. Private parties would then change their

wages and prices as required by a contract clause reflecting the relation of their tastes to the government's. If a clause could be written on a policy variable, one could also be written on the government's announcement of the "optimal" price level.

If contingency clauses written on underlying disturbances cannot be satisfactorily defined—as was argued in the section on the contract theory—it is difficult to imagine that clauses defined on government policies could be satisfactorily defined. In addition, such clauses obviously would pose a moral hazard. For better or worse, much private activity is already motivated by a desire to avoid regulations and taxes.

Attempts to restore the Sargent-Wallace results through the contingency-clause arguments are not credible and so the feasibility of stabilization policy cannot be theorized away. Nevertheless, a rational contracting theory does amend traditional policy analysis in two interesting ways.

First, the predictable part of stabilization policy has two effects. These arise because wages are determined contractually, and therefore are predetermined in the short run, but, at the same time, the length of contracts and the willingness of contracting parties to reopen them depend on the variance of the economy. If stabilization policy is successful, in the sense of reducing the short-run variance of both output and prices, not only is the economy stabilized but price and wage predetermination spreads as it becomes optimal for the private sector to lengthen contracts. The persistence of unemployment, when it occurs, is also increased. The converse of this argument—the effects of a stabilization policy that aggravates instability by failing to offset other disturbances—also holds.

Once an economy has adjusted fully to a new policy by changing contract periods and other "institutions," the policy will not be as stabilizing or destabilizing in terms of employment as would have been estimated before it was introduced. When the stabilization authorities are successful, the private sector will devote fewer resources to such activities as frequent renegotiation of contracts. As the public learns and adapts to a new policy, the policy will come to appear less successful, or less harmful. Old policies "won't work the way they used to." Stabilization activists may search for new policies, while the incentive to reform poor policies may fall as the private sector adapts and reduces the damage done.

Second, when the economy is well adjusted to a successful policy, it will be more dependent on that policy. With longer contracts in force, less short-run wage and price flexibility is available. If, after a successful era,

government policy stops offsetting private disturbances and instead itself becomes a source of disturbances, aggregate activity will be seriously affected. If this line of argument is supported by additional evidence, it may explain why the 1920–21 collapse of prices was accompanied by a recession while the 1930–33 collapse was accompanied by a depression: the turmoil of World War I made it relatively easy to adjust in 1920, while the stability of the 1920s contributed to the disaster of the 1930s.

A Few Final Comments

My purpose has been to see how far the rational-expectations hypothesis can be pushed while still yielding predictions consistent with the principal empirical regularities of business cycles, and to explore the implications of the hypothesis for macro theory.

The assumption of short-run wage and price predetermination appears consistent with observed behavior in the labor market, with the observed serial dependence in changes in general wages and prices, with the observed serial dependence in unemployment, and with the absence of a pronounced cyclical pattern in the real rate of interest on securities. Wage predetermination, in turn, arises because individuals and firms have an incentive to protect investments in a job and a community, and because no direct market mechanism exists through which spatial and temporal wage differentials in excess of those reflecting equalizing differences can be arbitraged away by specialized and efficient arbitrageurs. The observed difference in behavior of wages and auction-market prices is consistent with the difference in storage costs of labor and auction-market goods. Finally, the observed cross-section differences in Phillips-curve slope parameters and unemployment-persistence parameters appear consistent with rational adjustment of contracting conventions and institutions to an economy's variance.

The implications of the rational-expectations hypothesis for macro modeling are profound because of the need to solve simultaneously for the currently anticipated value of a variable and its future value calculated from the model. This point is of greatest importance for the auction markets in financial assets and commodities. These markets embody efficient mechanisms of futures trading and inventory speculation. In the labor market the mechanism forcing consistency between present anticipations and true ex-

pected values is weaker; hence, it is possible that neither current nor anticipated near-term market conditions will have much effect on current wages. However, reactions that seem irrationally sluggish are frequently the result of prior contractual agreements or new contracts that reflect correctly formed expectations about averages, which tend to change slowly, over a fairly long contract period. Thus, private labor markets do react eventually to changed conditions, and may be no more sluggish in their reactions than would the "perfect observer" bound by contractual considerations. Hence, any predictions or policy advice based on the assumption of irrationally sluggish behavior should be made with great caution.

The rational-expectations theory should not be interpreted so tightly as to leave no room for learning behavior. When scientific knowledge advances, presumably the producer of the advance knows of it first. In terms of fundamental knowledge of business-cycle processes, it is reasonable to presume that ordinarily the economist is ahead of the market; however, it should not be presumed that the economist has a large margin of superiority in obtaining and interpreting the significance of routine information within the context of the "established" state of knowledge. Superiority in the creation of fundamental knowledge does not necessarily imply superiority in its application.

Rational-expectations theory might be regarded, in principle, as only slightly amending perfect-certainty models. One need only substitute the assumption of perfect knowledge of probability distributions for the assumption of perfect knowledge of outcomes. For problems in which probability distributions are reasonably stable and in which the distributions can be estimated, stochastic models quite clearly have been productive.

I would conjecture, however, that the major source of the uneasiness many economists feel about rational-expectations theories is not the substitution of stochastic models for certainty models per se but the existence of learning behavior. No economist is disturbed about stochastic models of gambling behavior in Las Vegas based on the assumption that the probability distributions are known; and when the games are changed, economists' predictions of betting behavior quite naturally change. In business-cycle theory, however, the rules of the games played are rarely well defined. While the rational-expectations literature does make clear that *when* the game odds change—either because the environment changes or because knowledge of the environment changes—changes in behavior are to be expected, the literature does not offer much guidance for predicting the

speed with which economic agents learn of the changed odds. If the odds change by relatively small amounts, it is not a priori unreasonable to build models of behavior on the assumption that people learn slowly, provided that it is assumed that people do learn.

The existence of learning behavior poses a major problem for assessing the rationality of past behavior. It is not surprising, for example, that data publicly available in 1929 can now be interpreted as convincing evidence that the handwriting was on the wall. But the rationality of 1929 market participants, government policymakers, and economists ought not to be judged by 1976 standards.

At this stage of its development, rational-expectations theory has provided much more insight into the failures of empirical macro models than into the construction of successful ones. The application of rational-expectations theory to the construction of empirical models and to the analysis of behavior requires joint tests of behaviorial hypotheses of the usual type *and* hypotheses concerning what *at any particular time* it was "rational" for people to believe about the future paths of exogenous variables and about the system solution determining the endogenous variables. Economists have progressed from Keynes' apparently untestable assertions about psychologically determined anticipations to a theory that calls for, among other things, modeling the political process to determine what it is rational to believe about future government behavior. But because all "new" information is, after all, unpredictable in the rational-expectations theory, "miscellaneous spirits" determine the paths of exogeneous variables, requiring only slight amendments to the role assigned to "animal spirits" in the *General Theory*. Since point forecasts, whether rationally or irrationally formed, are almost never exactly correct, the importance of the rational-expectations theory for macro problems is less a matter of de-emphasizing forecasting errors than a matter of providing theoretical guidance into why such errors might be associated with the business cycle. The key contribution of this literature for business-cycle analysis, then, is that it lays the foundations for an economic theory to replace an institutional theory of wage and price rigidity.

Comments and Discussion

Edmund S. Phelps: There are two key propositions in William Poole's discussion of the wage sector. The first of these is that the models in the "Phelps volume" cannot explain the observed persistence of booms and slumps: "Since forecast errors cannot be serially correlated under rational expectations, the theory must . . . appeal to some other mechanism to explain the observed persistence . . . of unemployment." He is referring to that version of the theory in which all prices and wages are reset period by period—say, quarterly. And the critical mechanism omitted in that version is thought to be the practice of long-lived wage contracts.

I would not dream of suggesting that those models are serviceable for each and every episode of boom and bust in the history of the world. Certainly, there are features of the Great Depression that the "textbook" version of the theory cannot explain well or at all—not, at any rate, without amendments or extensions. Nevertheless, I am surprised at the growing consensus that the framework of the models in the Phelps volume cannot account for any systematic persistence of unemployment above or below the natural rate.

We all agree that stochastic disturbances that are serially independent can produce series of "runs" in forecast errors and hence deviations of unemployment from the natural rate. We also agree that we want the theory to be able to explain "more" persistence than that. Let me give a couple of examples that go further—the second much further than the first—toward explaining the degree of persistence shown by the unemployment rate, without invoking some "other mechanism" like long-lived contracts.

Consider a war of unknown duration. In each quarter that it persists it is financed with newly printed money amounting to k in real terms. At the end of any period in which the war is still on, there is a fairly high proba-

bility—but less than 100 percent—that the war will persist for at least the next period; if no war were on, the corresponding conditional probability of a war (of size k) would be pretty small. Then, even if the war proves to be of only average duration, it elicits a series of underestimates of new money printed because the persistence of the war for that long was never a certainty. What is noteworthy about this example is that the serial dependence of wars tends to produce serial dependence in the algebraic *sign* of the expectational errors: if money creation was underpredicted last period, the probability is high that it will be underpredicted again this period if the primary disturbance, like a war, exhibits imperfect serial dependence. A limitation of this example, obviously, is that quite possibly the conditional expected value of unemployment next period is independent of the unemployment rate this period while the war is on. The interesting feature is that, in warlike epochs, low unemployment in the current period is followed more times than not by low unemployment in the next period; when peace breaks out, unemployment rises a lot.

My second example is one to which rational expectations simply cannot be applied. Situations may arise—and maybe the rise in the price of oil was one—in which an expectational impasse occurs: labor expects the central bank to raise the money supply in order to increase employment, and so does not lower the money wage. But, since the central bank expects labor to reduce its money wage to the same end, it does not raise the money supply. Neither does the job because each expects the other to do it. This impasse and resulting disappointment of expectations can go on quarter after quarter unless and until the "two" parties start talking to each other. I suspect that this kind of noncooperative-conflict model of inconsistent expectations opens up possibilities for a theory of *catastrophic* depressions and hyperinflations, and that such an approach will prove to be more plausible than models that, insisting on rational expectations, purport to solve the problem by recourse to very long-lived money-wage contracts.

Let me add, in connection with Poole's characterization of the "Friedman-Phelps" theory, that the longevity of wage bargains was recognized to some degree. My paper on money-wage dynamics discussed a leapfrog process in which firms take turns revising their money-wage commitments lasting a year or so. But it is fair to say that in those days we did not yet have a satisfying theory of the longevity of wage commitments. Nor had we come to grips with the ways by which such commitments might be indexed. This brings us to recent contract theory.

The second proposition in Poole's paper that I want to discuss is his contention that the mid-seventies contract theory of Azariadis and Baily and Gordon rescues the potency of monetary policy from the jaws of Sargent-Wallace. I think Poole's notion is that overlapping wage contracts cause some money wage rates in the economy to be predetermined; hence, the central bank can control the ratio of the current money supply to the current average money wage and thus exercise some leverage over output and employment, even though it is making a predictable response to a current disturbance not previously anticipated when ongoing wage contracts were written.

Unquestionably, current research is pointing in this direction, but the road is paved with difficulties. It is possible, though not totally realistic, that each contract presets a variable path of the money wage for some period of time. Then, for example, if every outstanding contract expired within a year, and expectations are rational, the system can be "expected" to return to the natural unemployment rate within a year after a disturbance; predictable monetary policy can make a difference (for the speed of the return) only over those 365 days. So are we to take it, in accounting for the persistence of slumps and booms, that most contracts are longer-lived than one year? Or do contracts instead specify a single number for the money wage, and, if so, why?

A second difficulty is that contract theory has not yet really determined the length of implicit wage contracts. In Azariadis' model, one doesn't know whether the contract extends over the life of the worker or just for one day.

The last difficulty is that, when imbedded in a standard macro model, contract theory, far from rescuing monetary policy, actually neutralizes it because the theory implies that money wages would be indexed to certain nominal variables like the price level, or the money supply itself, or both, in such a way that employment and the real wage were invariant to the currently expectable stock of money. Optimal contracts would help to "automate" the Sargent-Wallace results. This conclusion is no doubt an overliteral reading that neglects many real-world aspects, but the neutrality implication is there.

My colleague Guillermo Calvo and I have begun the development of an employment-contingent contract theory that escapes the neutrality implication. Existing contract theory is state-contingent: every worker, as well as every manager, can observe the state without cost or can inform himself of the state without risk of deception. In the new theory only readily visible

variables like employment and the price level are observed by workers and contracts are expressed in those terms. A rise of the price level (relative to the money supply) serves as a signal to workers that a supply shock (or something analogous) has occurred so that the unobserved state warrants a fall of the real wage (at each level of employment). Monetary policy can then play the useful role of amplifying this signal by boosting the price level. Rational contracts will not undo the central bank's effort to be helpful by perversely adopting the 100 percent escalator clause or other neutralizing indexations.

Martin N. Baily: Overall I enjoyed this paper very much, and found it full of interesting and provocative ideas, many of which I agreed with. In particular, I was pleased to see that Poole recommends that the contract approach be applied to wages and prices.

The greater part of the paper discusses rational expectations and their implications. Poole first asserts that speculation must be stabilizing if it is profitable and that only speculators who make a profit will remain in the market. This assertion should be qualified in two ways. Speculation could be stabilizing most of the time and hence profitable overall, but speculators still could be subject to periodic panics or booms that were disruptive in the short run. Further, even though a loss-making speculator may leave the market, a new "sucker" may arrive to replace him, thereby maintaining the stock of loss-makers.

Poole then argues that even though some individuals may have irrational expectations, the market overall will still have rational expectations because other individuals, rational and well informed, arbitrage or offset the irrational ones. However, a sane man in an insane world does not necessarily make money. The idea that there is no easy way to make large profits in an asset market by using widely available information is well documented and almost certainly correct. This is not necessarily evidence of a close link between market expectations and some true probability distribution that may be derived from an understanding of the underlying economic process. I have always felt that the assumption of rational preference orderings by consumers was pretty strong, and rational expectations represent a higher order of rationality that may be violated more often. In addition, many outcomes are unique and cannot be broken down into elementary, equally likely events. In such cases the true probability distribution is undefined.

Having said all this, I remain generally sympathetic to the rational-

expectations assumption. My aim is only to caution against being carried away by it.

Poole then criticizes the econometric model builders by invoking the efficient-market results directly. He challenges forecasters who purport to predict more accurately than the market—as reflected in futures prices—to use their predictions to speculate and make money. Specifically, he examines the bond market and argues that equations of the type used by Modigliani and Shiller are inconsistent with an efficient market. I would stress that this analysis ignores risk aversion. To arbitrage the bond market would require vast resources. The large corporations and financial institutions certainly talk as if they are concerned with risk. Divergences from market efficiency may remain because it is not worth the risk of arbitraging them.

On the more general question of using the information generated by futures markets, I think Poole's point is well taken in many cases. However, there are different uses for price equations. For example, a model of the world copper industry that I helped to build contains a price equation that is not particularly suited to making price predictions for speculative purposes. The aim, rather, was to run some "what-if" simulations of possible policy changes by the Chilean government. Admittedly, we were overtaken by events in Chile; but the point is that such questions cannot be answered by futures markets. Many of the macro model builders are in a similar game. They wish to explore the consequences of policy changes, structural changes, and various kinds of "what-if" experiments.

Poole goes on to discuss evidence that the ex ante real rate of interest has remained constant. Having rejected the possibility that a flat LM curve gave rise to this constancy, he suggests that it resulted from a flat IS curve. If both curves move around over the cycle, why must we conclude that either curve is flat? In particular, my reading of the evidence from investment functions does not suggest a flat IS curve—certainly not in the short run. Perhaps the movements in the LM curve caused by monetary policy or by international capital flows have led to the observed constancy.

Poole turns to a consideration of contract theory and argues, I think correctly, that the implications of rational expectations for the adjustment of wages and prices must be modified in a world with contractual arrangements. He points out that it may be rational to distinguish, or to try to distinguish, between temporary and permanent shifts in demand (and hence in equilibrium values of wages and prices) and respond to the latter but not the former. Slow adjustment, therefore, will result not from slow diffusion

of information about the current state of the world, but rather from a correct view that the current state of the world is temporary.

Poole may be giving too much credit to the new contract theory in suggesting that it introduces the idea of intertemporal dependence of demand on price. The Phelps and Winter and the Mortensen papers in the Phelps volume also do this.

William Poole: I believe that the evidence is not consistent with Baily's comment that occasional destabilizing speculative "panics" may be an important feature of actual behavior. In a world in which runs of speculative behavior occur, the variance of n-period price changes—where n is chosen so that the runs have had sufficient time to reverse themselves—will be less than n times the variance of one-period price changes. The empirical work with which I am familiar does not support this hypothesis.

I am also unconvinced by Phelps' war story. I still believe that the Friedman-Phelps theory cannot, by itself, generate serial correlation in unemployment unless contracts or some other mechanisms are introduced. The war story rightly points out that, if up-side and down-side risks are asymmetrical, rational expectations can generate a run of errors in the same direction. Thus, in such a world, one might well find longer and more frequent strings of pluses (or minuses) than would emerge from flipping a coin. But when the low-probability event occurs (in Phelps' story, the end of the war), it produces a big surprise and hence a large error in the opposite direction. That large error would tend to offset the whole previous run of small errors. In such a world, any test that took into account the size as well as the direction of changes should show no serial dependence. In particular, the autocorrelation of the unemployment rate would be zero, rather than significantly positive as it is in fact. Autocorrelation rather than runs tests are appropriate because the theory is based on expected *values* rather than expected *directions* of changes.

General Discussion

Several participants suggested amendments and qualifications to Poole's views on the scope and significance of the rational-expectations approach.

Otto Eckstein felt that there was an overemphasis on the term structure of interest rates as a "laboratory" for tests about expectations. While low transactions costs, unique liquidity, and abundant arbitrage ensure that

the markets for government bills and securities generate a consistent yield curve, other markets, even markets for industrial bonds, have different participants, who use different sources of information, and have different expectations and different assessments of risks. And other markets differ more drastically in many dimensions.

Eckstein noted that commodities-futures markets cover only a limited range of products and, as a result, have only limited usefulness to a macroeconomist. He also said that he found it hard to believe that the intensive processing of information in a full-scale econometric model would add nothing to the information available to the units in the economy. If this were true, macroeconomics could be terminated as a field of study. Arthur Okun questioned Poole's notion of the appropriate scope for forecasting. He observed that Poole had distinguished between forecasting things for which futures markets exist and those for which they did not. He felt that Poole had come dangerously close to implying that if, say, an efficient market was established that traded in predictions of real GNP, nobody should forecast it any more. Okun stressed that attempts to second-guess the market were what caused it to incorporate new information.

Charles Holt and Paul Samuelson recounted instances in which people had compiled sustained records of successful speculation. While they both accepted George Perry's comment that these were the outliers in a sample of unknown size, Holt stressed the success of some research efforts in finding profitable strategies. In general, most participants agreed that the rational-expectations paradigm was appropriate for auction markets.

Robert Solow contended that only for such organized auction markets was it legitimate to speak of and to measure "the market's expectations." In contrast, for things like the general price level, there might be a host of different expectations that are never made consistent by the trading of a piece of paper in a single market.

William Fellner cautioned against very narrow interpretations of rational expectations that had unnecessarily extreme implications. The notion of rationality presented in the paper does not seem grounded upon a decision theory that is based upon probability distributions and utility functions. It proceeds as if people can enjoy infinite diversification costlessly so that variance does not affect them. It is this feature that leads to the proposition about the flat IS curve: such a curve implies the possibility of changing the asset mix of the public via monetary and fiscal policy without changing relative rates of return among assets. The same feature also leads to the notion that a single price determined in the futures market serves as an

appropriate unbiased guide to prices in the future. Thomas Juster underscored the point that expectations are not a single number but have a variance, which is in principle measurable. Michael Wachter said that the liquidity premium or risk factor might be sufficiently difficult to estimate that the term structure of interest rates could not be utilized to generate forecasts of future long rates.

Poole responded to some of these issues. He recognized the existence of market research, risk premiums, liquidity considerations, and the like; but he felt that they explained only a tiny portion of the variance of prices. For example, because of risk and liquidity premiums, the yield on common stocks may well be greater than that on Treasury bills over the long run; and yet that difference in yield is very small compared with the variance of ex post yields on stocks resulting from variations in their prices. Hence, Poole doubted that much additional explanatory power could accrue from taking risk aversion into account. Furthermore, he had more confidence in expectations that were imbedded in futures markets than those reported in survey data. In general, he found it useful to stress new information, rather than the working out of the lags of the past, as the basic source of fluctuations in prices. The major story lies in surprises rather than long distributed lags, he concluded.

The remainder of the discussion focused on the macro implications of the paper. Robert Hall noted that, of the equations that appear in a typical macro model, expectations play a major role in five: the Phillips curve, the relation between real and nominal interest rates, the term structure of interest rates, the consumption function (in the permanent-income version), and the investment function (through expected demand). These are treated econometrically through distributed lags; and, as Poole pointed out, that treatment is inconsistent with rational expectations. To Hall, the key question was: In comparing models based on rational expectations and on distributed lags, what is the difference in the responses, especially with respect to shocks and to changes in fiscal and monetary policy? He wished that Poole, in his excellent summary of current thought, had tried to reach some overall conclusion on that issue.

Hall was also concerned that the paper may have given an incorrect impression that an explicit expectations variable was necessary to deal econometrically with expectations; for most purposes, Hall felt, it would suffice to treat expectations as unobserved variables that merely have the property of not containing serially correlated errors.

Martin Feldstein noted that Poole's formulation attributed the business

cycle mainly to supply factors—especially, errors in predicting prices and wages—and thus relegated aggregate demand to a minor role. Feldstein suspected that this framework slighted the importance of the basic Keynesian insights about the significance of shifts in aggregate demand. After some discussion, it was generally agreed that Poole's formulation could be viewed as an attempt to explain why supply shifts failed to offset demand shifts, thereby producing the observed cyclical pattern of output and employment. Hall noted that the rational-expectations approach had to invoke long informational lags, often three or more years, to account for the cycle and the persistence of unemployment. Martin Baily joined Hall in finding such long lags implausible. Baily rejected the view that people were rational and yet took three years to read the information on the financial pages of their daily newspapers. Lawrence Klein pointed out that it made a big difference whether information comes out all at once or builds up gradually over the hypothetical three-year period. Distributed-lag effects are felt, in part, at an early stage. It is only for the buildup of the full effect that long periods are required.

Wachter, Hall, and R. J. Gordon then focused on the question of whether, if one accepted the long informational lags in the rational-expectations approach, that model was empirically distinguishable from the contracts approach. Gordon remarked that information about the same event must reach various markets essentially simultaneously; this implied that any demonstration that some sectors of the economy respond more rapidly to events than others would be evidence in favor of the contracts approach.