The Reduction of Inflation by Slack Demand

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Summary

The persistence of inflation in the past decade has undermined confidence in our capability of reducing it. To many it appears intractable. While the inflation rate has declined in periods of business recession, it has revived and intensified in the subsequent periods of business expansion. The dissatisfaction with traditional monetary and fiscal measures has brought forth schemes to restrain price increases directly by taxes or subsidies, though these hold no more promise of being effective than have direct controls on prices or incomes policies in the past.

The dissatisfaction reflects in part the failure of inflation, in a business recovery such as 1975–1977, to continue to decline while excess unemployment is reduced. The belief that inflation should decline is based on the presumption that it always tends to decline so long as resources are not fully employed and markets exhibit slack. But that is not an accurate view of historical price behavior. The inflation rate has always fluctuated over the business cycle, falling during business contractions and rising during expansions, invariably beginning to rise early in business recoveries long before economic slack gives way to full-employment output. For a reduction in the inflation rate that outlasts the business cycle, the rate will be lower in corresponding stages of successive business cycles. For such a reduction in inflation, policy must reduce the expected rate of inflation. This rate reflects the anticipated long-run equilibrium trend of prices and underlies explicit and implicit contracts for future payments and the setting of wages and prices gen-

I am indebted to William Fellner, John Taylor, and the authors of this volume for helpful comments and to Fred Kittler for computer assistance.

erally. The expected rate gradually adjusts when actual rates deviate above or below it for an extended period. Even though the actual inflation rate continues to rise and fall over the business cycle, the expected average rate can still decline if business expansions do not intensify inflationary pressures and the actual rate remains below the expected rate on the average.

Estimates are presented of the effect of slack demand on the expected rate of inflation under two models, one based on adaptive expectations and the other on rational expectations. These two models are formulated to be consistent with the existence of slack markets and the procyclical fluctuations in the inflation rate, but they are nevertheless quite different in their theoretical assumptions and practical implications, though actual behavior may well be a mix of both. The effect of slack demand on the expected inflation rate, though hard to estimate with precision, is confirmed by the evidence. The effect of one percentage point average unemployment in excess of the level at full employment, maintained over a typical four-year business cycle, is estimated to reduce the expected, and therefore the actual, average annual inflation rate by about three percentage points under adaptive expectations, and by about half as much under rational expectations. The latter effect is smaller because rational expectations allow for cyclical fluctuations in the economy and so only an average amount of slack that is larger than expected over an entire business cycle reduces the expected inflation rate.

The small estimates of the effect help to explain the loss of confidence in policies to maintain it. The effect is hidden by the larger cyclical fluctuations in the inflation rate. In assessing an anti-inflation policy, however, the authorities and the public should not be misled by normal cyclical fluctuations in the inflation rate, characterized as "stagflation"; what matters is the noncyclical changes between corresponding stages of successive business cycles.

Expectations are likely to respond more strongly to restraints on aggregate demand once policy makers demonstrate their determination and ability to hold inflation at a lower rate. One reason the effect of excess unemployment is small is that policy has demonstrated the opposite since the mid-1960s by accommodating a rising average rate of inflation. A policy of reducing inflation, coming after a decade of accommodation, is hampered by pessimistic expectations of its capability.

Despite the general pessimism, however, an anti-inflation policy has a good chance of succeeding if it can avoid past errors of overstimulating business expansions to the point of reviving inflationary pressures, which is not an impossible task. Since the economic capability

exists, the pessimism in fact pertains to the political capability of translating concern over inflation into effective measures of restraint. Here the recent record has not been encouraging.

Introduction

Current economic policy is directed toward reducing inflation and unemployment. The *Economic Report of the President* in January 1978 states that "We must contain and reduce the rate of inflation as we move toward a more fully employed economy."[1] That has been the unquestioned intention of policy since inflation intensified in 1965, and it was the guiding spirit, even if not always the practical objective, in the previous years since World War II. The method of achieving the objective is to stimulate aggregate demand by monetary and fiscal measures to expand production and jobs up to—but not beyond—the point where new inflationary pressures emerge. The assumption is that it is possible in theory even if difficult in practice to reduce inflation by maintaining some slack in labor and product markets in the aggregate. A period of economic slack is accepted as the cost of subduing inflation.

The maintenance of slack in the economy, with the accompanying excess unemployment, is not, of course, attractive to policy makers. Monetary and fiscal measures designed to reduce inflation result in slack as a byproduct, not as an objective, of anti-inflation policy. U.S. policy has faced the dilemma of choosing between inflation and unemployment by targeting a path of aggregate demand which, in deference to political pressures, will produce as little slack as possible and still reduce inflation, even though the reduction of inflation will be slow. The justification for keeping the slack mild and reducing inflation gradually is based on the nature of the assumed trade-off between inflation and unemployed resources. Each addition to the amount of slack is thought to have diminishing effects in reducing the inflation rate. To avoid enduring a large amount of slack for little benefit, therefore, a slow reduction of inflation with mild slack has appeared optimal.[2]

In comparison with the precise objectives of policy, the large discrepancies between the results and the targets and the wide swings in business activity have been discouraging. When the Vietnam inflation

[1] *Economic Report of the President*, 1978, p. 5.

[2] The policy argument for reducing inflation slowly is discussed in Phillip Cagan, "The Reduction of Inflation and the Magnitude of Unemployment," in William Fellner, ed., *Contemporary Economic Problems 1977* (Washington, D.C.: American Enterprise Institute, 1977), pp. 41–50.

stepped up in early 1966, it was initially cut down by monetary restraint imposed during the second half of that year. But the monetary authorities, fearful of precipitating a business recession, switched to stimulus in early 1967 and the inflation revived. By 1969 inflation was firmly entrenched and escalating. The monetary restraint applied in 1969 was stronger than in 1966 and this time precipitated a recession in 1970, but the reduction in inflation appeared to be slight up to August 1971 when price and wage controls were imposed. In the meantime, monetary policy stimulated the economy during and following the 1970 recession to remove all but the minimum amount of slack thought sufficient to reduce inflation. The stimulus was carried too far, in part because policy was misled by the umbrella of controls, and by the end of 1972 the overexpansion of domestic aggregate demand was joined by worldwide inflationary pressures to produce an explosion of prices in 1973–1974. The ensuing disruption and confusion in business activity brought on a severe business contraction from the fourth quarter of 1973 to the first quarter of 1975. The considerable slack remaining in the economy after the contraction was viewed as excessive, and policy makers sought to remove most of it, though the recovery of activity in fact proceeded slowly. Despite policy targets which have consistently called for mild slack in the economy to subdue inflation, the amplitude of fluctuations in activity have been large and increasing. The latest business contraction of 1973–1975 was the most severe in the post-World War II period.

Although recovery from the 1973–1975 contraction was slow and appreciable slack continued at least through the end of 1977, the inflation did not continue to decline.[3] To be sure, the explosion of prices in 1973–1974 reflected in part world influences which proved to be temporary, and the rate of inflation fell sharply during the business contraction. But the average inflation rates for 1976 and 1977, based on the consumer price index, remained in the 5 to 6 percent range, well above the 3½ percent for 1971–1972 and on a par with the previous high rates of 1969–1970. At the beginning of 1977 the Council of Economic Ad-

[3] Rates of increase of major price indexes in 1977 rose over 1976 but remained below 1975. The following rates in percent are from fourth quarter to fourth quarter, except for the consumer price index (CPI) which is December to December.

	1975	1976	1977
Consumer price index	7.0	4.9	6.7
Deflator for:			
GNP	7.5	4.7	5.8
Private business sector	8.0	4.1	5.6
Nonfarm business sector	8.0	4.9	5.6

visers (CEA) had predicted that the inflation rate would continue unchanged at 5 to 6 percent for the year, which turned out to be accurate.[4] Inflation rose to higher rates unexpectedly during the severe winter months, but it is not clear whether this made any difference for the year as a whole. The positive deviations of the inflation rate from the basic trend in the winter were subsequently offset by negative deviations later in the year.

The CEA's prediction, though correct, departed from the widely accepted view that a slack economy would reduce inflation. The CEA chose to ignore previous estimates of the relation between changes in the rate of inflation and excess unemployment based on post-World War II data. These previous estimates had implied that, given the average unemployment rate of 7 percent for 1977, the inflation rate would decline one percentage point during the year.[5] For 1978 the new CEA again concludes that, apart from the effect of higher social security taxes and minimum wages, "prices would be expected to rise this year at a rate of 6 percent or somewhat above—the underlying rate for the past 2½ years."[6] Unit labor costs are projected to continue rising at an unchanged rate from 1977, and profit margins do not appear large enough to provide room for a decline which would allow prices to rise less than the rise in unit labor costs. Hence no progress against inflation is seen as likely to occur until these basic trends change. The CEA's projection seemed to imply that inflation would not be reduced by the previously accepted policy of maintaining slack in the economy, nor could inflation even be prevented from increasing in the unlucky event of supply shortages or excess aggregate demand.

The theory that economic slack reduces inflation was unquestioned for over a decade but is no longer widely accepted as viable. In recent years forecasters have predicted little or no decline in inflation despite their predictions of continued slack in the economy. Some prominent economists, doubtful of the desirability of traditional monetary restraints and even of straightforward price and wage controls, have proposed a system of taxes and subsidies to induce restraint in wage and price setting.[7] Another prominent economist with experience as a price controls administrator points to the regulatory morass and doubtful

[4] Council of Economic Advisers, *Annual Report*, 1977, p. 41.

[5] See Cagan, "The Reduction of Inflation," pp. 21–26.

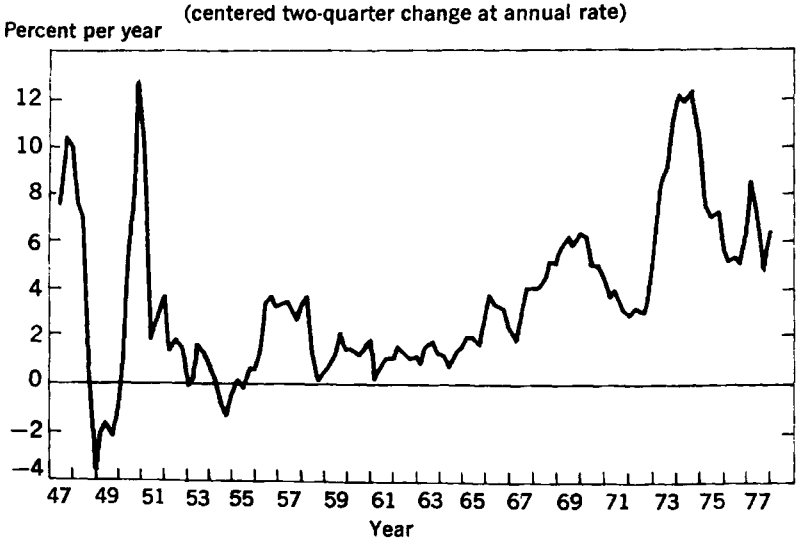
[6] CEA, *Annual Report*, 1978, p. 80.

[7] Walter Heller, Arthur Okun, Robert Solow, James Tobin, Henry Wallich, and Sidney Weintraub, Letter to the Editor, *New York Times*, March 12, 1978. See also Nancy A. Jianakoplos, "A Tax-Based Incomes Policy (TIP): What's It All About?" *Federal Reserve Bank of St. Louis Review*, vol. 60 (February 1978), pp. 8–12, and the discussions by Gottfried Haberler and Herbert Stein in this volume.

Figure 1

QUARTERLY RATE OF CHANGE OF CONSUMER PRICE INDEX, 1947–1977

(centered two-quarter change at annual rate)



Note: Business contractions are shaded.
Source: Department of Labor, Bureau of Labor Statistics.

success of such a system.[8] The fact that these proposals are even seriously considered is a symptom of the low confidence with which our capability of subduing inflation is now viewed.

Was the previously widely accepted presumption that the inflation rate is related to the amount of economic slack justified? Casual inspection of the post-World War II data does raise doubts. Figure 1 presents two-quarter changes in the consumer price index at annual rates plotted quarterly from 1947 to 1977. The figure shows periods of expansion and contraction in general business activity. The dates of business cycles are those of the National Bureau of Economic Research with the addition of the minor downturn from the fourth quarter of 1966 to the second quarter of 1967, which did not qualify as a full-fledged recession but produced a significant effect on prices. Apart from the upward trend since 1965, the inflation rate displays a typical pattern within each cycle. A steep drop in the rate of change during recessions (even below zero in the earlier cycles) is followed by a sharp

[8] Gardner Ackley, "Okun's New Tax-Based Incomes-Policy Proposal," *Economic Outlook USA* (Ann Arbor: Survey Research Center, The University of Michigan, Winter 1978), pp. 8–9.

recovery in the first part of the ensuing business expansion. The recovery in the rate tends to level off in the later stages of expansions and finally to decline, usually before the next downturn in business.[9] This pattern is also characteristic of prices in earlier business cycles.[10]

The latest two recessions display the same pattern but with a delayed peak or trough in the inflation rate. In 1973–1975 the rate rose through most of the business contraction; it then declined well into the business recovery, as it did in 1971–1972. The upturn in the rate in 1971–1972 was delayed partly or wholly by price and wage controls instituted in August 1971. Moreover, most of the price increases prevented by the controls may have been posted later.[11] (The recorded price increases in the data may also understate the actual increases owing to the controls.) When most of the controls were removed in January 1973, prices rose sharply. A substantial part of the rise in 1973 and 1974 reflected temporary world influences on basic commodities (feed grains and metals as well as petroleum). When these influences abated in 1975, the inflation rate came down rapidly, which countered the normal tendency of inflation rates to rise in a business recovery. The rise in the inflation rate in the first part of 1978 suggests that the normal tendency is now appearing, though this rise also reflects a reduction of economic slack to levels that have traditionally marked the beginning of renewed inflationary pressures. The altered timing in the last two cycles may therefore reflect special developments and not indicate a change in cyclical pattern that will be repeated.

Whether the cyclical pattern has changed or not, it is evident from the historical record that the rate of inflation is not to be explained simply by the amount of slack in the economy. Full employment of resources is not normally reached until late in business expansions. If a simple relation existed between the inflation rate and economic slack, the rate would continue to decline until the later stages of business expansions when slack finally begins to disappear. Actually, as the figure shows, the inflation rate fluctuates over business cycles in a procyclical pattern and begins to rise early in business recoveries at or shortly after the trough in activity. The only continuing declines in the

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[9] This pattern of price behavior has long been noted by business cycle analysts. For example, see Geoffrey H. Moore, *The Cyclical Behavior of Prices*, Report 384 (Washington, D.C.: Bureau of Labor Statistics, 1971), and "Lessons of the 1973–1976 Recession and Recovery," in William Fellner, ed., *Contemporary Economic Problems 1977* (Washington, D.C.: American Enterprise Institute, 1977), especially pp. 141–158.

[10] See Frederick C. Mills, *The Behavior of Prices* (New York: National Bureau of Economic Research, 1927).

[11] See Michael Darby, "The U.S. Economic Stabilization Program of 1971–74," *The Illusion of Wage and Price Controls* (Vancouver, B.C.: Fraser Institute, 1976).

rate, apart from business contractions, are in 1951–1952 following the sharp run-up of prices at the outbreak of the Korean War and in the early recovery stage of the last two cycles. The first of the latter two exceptions appears to be attributable to price controls and the second to foreign influences.

The theory that the reduction of inflation depends upon the amount of economic slack evolved in the 1960s from earlier theories of price behavior. The 1960s theory was a departure from traditional views and appeared for a time to rectify certain of their deficiencies. Its own deficiencies have in turn led to new theories of price behavior.

Old and New Theories of Price Behavior

Standard economic theory teaches that markets adjust to demand and supply with a rise in prices when demand exceeds potential supply and a decline in prices when demand falls short of potential supply. This was the virtually universal view of price behavior up to the 1930s and is still, with qualifications, commonly held. Strictly interpreted, it implies that the level of prices should generally rise in business expansions and decline in business contractions, propelled by associated fluctuations in aggregate demand. Such behavior is most clearly exemplified by prices sold on organized exchanges, such as agricultural products and basic commodities, and those sold in highly competitive markets. These prices are highly flexible, even volatile, and respond quickly to the shifting forces of demand and supply.

It has long been recognized, however, that prices of many other products, particularly manufactures and services, display considerably less flexibility and often decline quite slowly in the face of slack market conditions. Price inflexibility has often been viewed as somehow unnatural. In the 1930s Gardiner Means gained attention with his theory that inflexible prices were "administered" by producers in disregard of market conditions and thus did not respond to cyclical changes in demand.[12] Such behavior was attributed to the "market power" of producers, which they wielded to enhance their profits (exactly how was never clear). The prime example of inflexibility, of course, is wages, which have always displayed an extreme stickiness in the face of declining employment and even mass unemployment. It was no doubt the

[12] Gardiner C. Means, *Industrial Prices and Their Relative Inflexibility*, Senate Doc. 13, 74th Congress, 1st session, 1935. See also *Hearings on Administered Prices*, pt. 9, Senate Subcommittee on Antitrust and Monopoly, 86th Congress, 1st session, 1959, pp. 4745–4760; and National Resources Committee, *The Structure of the American Economy*, pt. 2 (Washington, D.C., 1939), p. 143.

inflexibility of wages in Britain during the mass unemployment of the 1920s that led Keynes largely to ignore cyclical changes in prices and wages in his influential *General Theory of Employment, Interest, and Money,* published in 1936. He assumed that wages and prices were constant when aggregate demand declined; and, though he acknowledged that they often increased when aggregate demand rose, the increase played no role in his theory. As so often happens with an influential work, the assumption made for simplification became widely accepted as fact and extended. For years thereafter theoretical economics usually treated price and wage levels in macro models of the economy as generally fixed until aggregate demand becomes excessive and then pulls them up. This view gained further currency in the 1950s with the notion that downward rigidity characterized wages and many prices—which meant that they never declined, even when markets were slack. Such price behavior was condemned in the 1950s as the major reason for the creeping inflation of that decade. If prices rose in the later stages of business expansions when demand was strong and failed to decline during business contractions, the price level would rise from cycle to cycle, and its long-run trend would be persistently and inexorably upward.[13] Shifts in demand among sectors of the economy, increasing prices in some and failing—because of downward rigidity—to reduce them in others, would have the same effect of raising the overall level of prices.[14] Downward rigidity was thought to be at variance with the normal behavior of prices in competitive markets; it reflected the inertia of custom in economic behavior and, since the 1930s, allegedly the growth of labor unions, product oligopolies, and the institutional rigidities of regulation.

By the end of the 1960s it began to appear that downward rigidity was only half the problem. Prices and wages could continue rising, and not merely fail to decline, when demand was slack. The theory that developed to account for such behavior combined a Phillips curve with price expectations. As described by the Phillips curve, prices respond to excess or deficient demand too slowly to keep markets cleared. A shortfall in aggregate demand, for example, produces a gap at prevailing prices between demand and the potential supply of output. The slack generates pressures for prices to fall below their trend path. Since prices respond slowly, markets in the meantime remain slack. What prevents prices and wages from adjusting rapidly to clear markets and

[13] Arthur F. Burns, *Prosperity Without Inflation* (New York: Fordham University Press, 1957).

[14] Charles L. Schultze, "Recent Inflation in the United States," U.S. Congress, Joint Economic Committee, *Study of Employment, Growth, and Price Levels,* Study Paper no. 1, 86th Congress, 1st session (September 1959).

reduce the gap to zero? The main reasons usually given are that changes in market conditions may at first be viewed as temporary, and firms find it costly and awkward to adjust prices to temporary fluctuations in demand and supply; that explicit and more often implicit contracts bind firms to offer their products and purchase resources at a predetermined price or to make changes only under specified conditions, particularly with respect to wages; and that firms in all but highly competitive industries seek to coordinate prices (without overt collusion) so as to avoid the confusion to buyers and the disarray in the market of selling the same product at different prices. For all these reasons prices are constrained from deviating from the expected equilibrium path. Unanticipated disturbances and short-run fluctuations in demand are largely ignored, and firms base selling prices on their unit costs of production at a standard level of output. They rely on these unit costs as an indicator of the long-run equilibrium path of prices likely to prevail in the industry.

The gradual response of prices to a gap between demand and supply is expressed in the Phillips relationship by the dependence of the rate of change of prices upon the size of the gap. But this dependence does not explain why prices rise when demand falls short of potential supply and is deficient by any reasonable measure. Such behavior is explained by expectations. When the growth trend of nominal aggregate demand exceeds that of output, the expected equilibrium path of wages and prices has an upward trend. Economic decisions are geared to this expected upward trend of prices. Deviations of aggregate demand from the expected trend are generally not anticipated. A fall in aggregate demand in a business recession, for example, reduces the actual rate of price increases below the trend rate. Unless the recession is unsually severe, however, most prices continue rising, though at a slower rate. During business expansions prices rise faster than the trend rate. As long as the growth trend in aggregate demand does not change from cycle to cycle, long-run expectations are confirmed and the trend rate is maintained. A persistent deviation above or below the trend would indicate a change in the trend, however, and lead gradually to the revision of expectations.

Expectations are also influenced by the monetary regime and political environment in which monetary and fiscal policies operate. The gold standard was less inflationary than managed currencies, and expectations under the present managed currency system undoubtedly take that difference into account. There is evidence that prices have gradually become less responsive to changes in aggregate demand in the business cycles since World War II. This diminishing responsiveness is caused in part, no doubt, by a decline in the expected capability

of monetary and fiscal policies to contain inflation, as demonstrated by the accommodation of higher and higher rates of inflation.[15] Although the statistical analysis reported below ignores changes over time in the way expectations are formed, there is no intention to deny the importance of such changes.

The rate of change of prices at any time, $\dot{p}_t$ (where the overhead dot denotes the rate of change), may therefore be represented by two influences: (1) the pressure of the concurrent gap between demand and potential supply—deficient or excess demand as measured by the difference between the actual rate of unemployment of resources, U_t, and the full-employment rate of unemployment, $\overline{U}$; and (2) the anticipated trend path of prices, $\dot{p}_t^e$, which has been incorporated into wage contracts and past pricing decisions and so raises input costs as it is passed along the production pipeline:

$$[1] \qquad \dot{p}_t = F(U_t - \overline{U}) + \dot{p}_t^e.$$

This is the standard Phillips curve combined with expectations. F is a function which declines as $U_t - \overline{U}$ increases. The coefficient of $\dot{p}^e$ is unity on the assumption that there is no long-run trade-off between inflation and unemployment. The equation summarizes the view that policy can reduce the inflation rate by restraining aggregate demand, in which the amount of restraint is measured by the amount of slack that results. If $\dot{p}$ is thereby kept below $\dot{p}^e$, $\dot{p}^e$ will eventually be revised downward, after which the slack can be removed and $\dot{p}$ and $\dot{p}^e$ will be equal at a reduced rate of inflation.

When applied to experience in 1977, such an equation, as noted earlier, seems to suggest that inflation should have declined. In that year $\overline{U}$ was about 6 percent of the total labor force. This may seem high by past standards, but the rate of unemployment at which inflation neither increases nor decreases has been rising because structural changes in the labor force have added to recorded unemployment. The actual unemployment rate averaged 7 percent in 1977, giving unemployment in excess of $\overline{U}$ of one percentage point. (Most estimates of excess unemployment for 1977 were even higher.) With this excess unemployment the actual rate of inflation should have been below the expected rate, which would then gradually decline, thus reducing the actual rate for any given amount of excess unemployment. But the inflation rate did not decline in 1977. The CPI increased at the same 4.3 percent annual rate from the third to the fourth quarters of both 1976

[15] See Phillip Cagan, *The Hydra-Headed Monster: The Problem of Inflation in the United States* (Washington, D.C.: American Enterprise Institute, 1974).

and 1977. Year over year the rate actually rose, from 4.9 percent in 1976 (December to December) to 6.7 percent in 1977. (Most forecasts for 1978, including the CEA's, see no decline in the inflation rate, but, as noted, this is not inconsistent with the above equation. Unemployment fell to the 6 percent level in the first part of 1978, which by the preceding estimate of $\overline{U}$ is the full-employment level and puts the economy at the threshold of increasing inflationary pressures.)

What explanation can be given for a rise in the *rate* of inflation or even constancy early in business recoveries, when aggregate demand still falls short of the potential supply? Prices of crude materials, which are highly sensitive to market conditions, contribute to this rise (see Figure 2). They typically decline sharply in business recessions (that is, have negative rates of change) and then begin to rise as the forces of recovery spread through the economy. They exemplify the behavior that economic theory attributes to competitive prices. Their fluctuations contribute to procyclical movements in the rate of change of a general price index. But they do not dominate the behavior of the general price level and by themselves cannot account for its procyclical fluctuations. The inflation rate for most intermediate and finished goods also displays a procyclical pattern. Crude materials make up too small a part of the total cost of production of most intermediate and finished goods to dominate the movements in their input costs.

One explanation for a rising inflation rate when slack demand exists pertains to the price expectations term in equation [1]. A reduction in $\dot{p}^e$ is presumed to occur whenever $\dot{p}$ falls below $\dot{p}^e$. If $\dot{p}^e$ changes too slowly, however, the cyclical fluctuations in the first term of equation [1] will dominate to produce a procyclical pattern in $\dot{p}$. A slack-induced reduction of inflation that outlasts the business cycle therefore requires that $\dot{p}^e$ respond to $\dot{p}$ and that the net effect be downward. If over the business cycle $\dot{p}$ rises above $\dot{p}^e$ as much as it falls below, there will be no net reduction in $\dot{p}^e$. Inflation has escalated since 1965 because U on the average has been below $\overline{U}$. The reduction of inflation requires that for a while U be above $\overline{U}$ on the average.

This relationship can be expressed in simple mathematical terms which provide a form for regression analysis. If price expectations are revised gradually, an adaptive revision may be described by

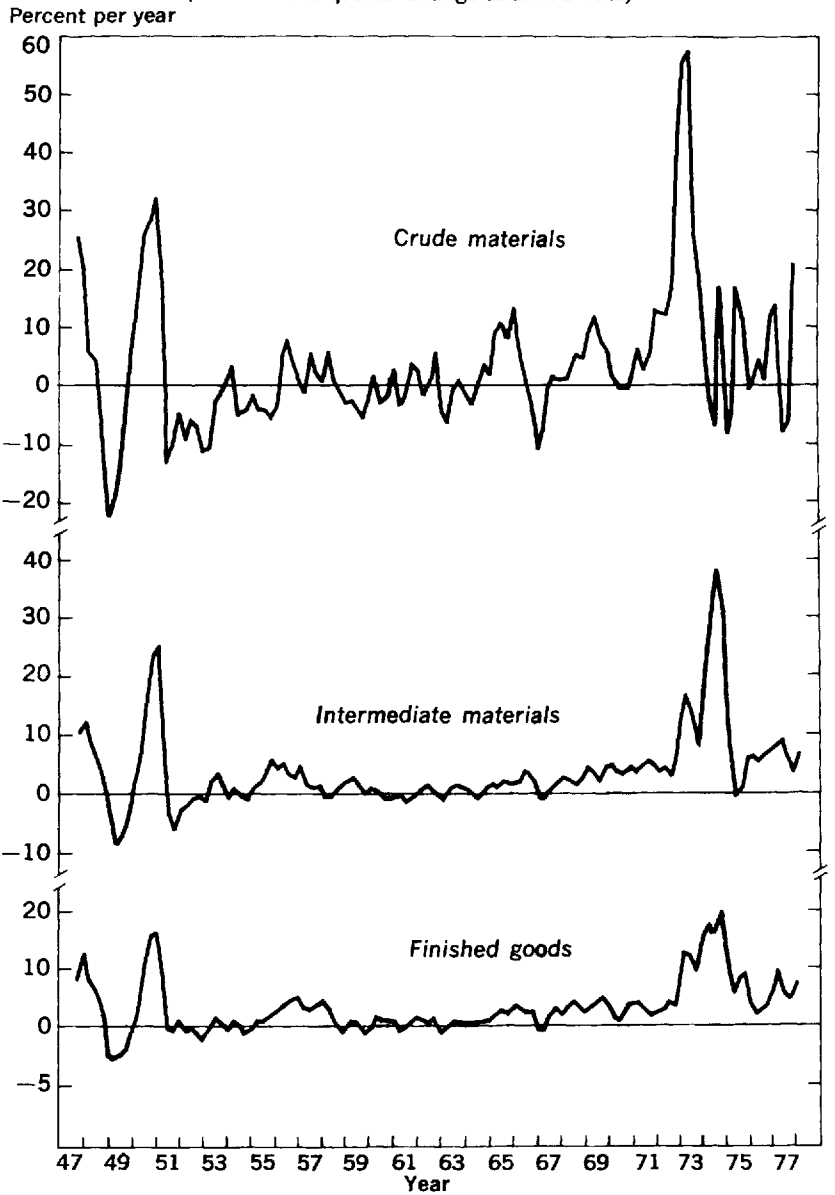
$$[2] \qquad \frac{d\dot{p}_t^e}{dt} = b(\dot{p}_t - \dot{p}_t^e),$$

which by [1] equals bF. The coefficient b may change over time, but for simplicity it is assumed to be constant. In theory it can be any positive number. To incorporate such adaptive expectations into the modi-

Figure 2

QUARTERLY RATE OF CHANGE OF WHOLESALE PRICES, 1947–1977

(centered two-quarter change at annual rate)



Note: Business contractions are shaded.
Source: Department of Labor, Bureau of Labor Statistics.

fied Phillips relationship, equation [1] is differentiated with respect to time,

$$[3] \qquad \frac{d\dot{p}_t}{dt} = F' \frac{dU_t}{dt} + \frac{d\dot{p}_t^e}{dt}$$

and [2] substituted into [3],

$$[4] \qquad \frac{d\dot{p}_t}{dt} = F' \frac{dU_t}{dt} + bF.$$

If the F function is a simple proportional relationship $F = a(U_t - \overline{U})$, and differentials are treated as discrete first differences, and $\overline{U}$ is constant, then

$$[5] \qquad \dot{p}_t - \dot{p}_{t-1} = a(U_t - U_{t-1}) + ba(U_t - \overline{U}).$$

An indication of the effect of slack demand on the inflation rate that outlasts the business cycle is given by estimates of ba, which is the product of the speed of revision of price expectations, b, and the cyclical effect of slack on the inflation rate, a. Estimates of this effect of slack demand are presented below.[16]

A different way of formulating the effect of slack demand on inflation is suggested by the new theory of rational expectations. This theory starts from the presumption that expectations formed about

[16] A similar equation was derived by Lucas Papademos, "Optimal Aggregate Employment Policy" (Ph.D. diss., Massachusetts Institute of Technology, September 1977), p. 23 (equation 23). The equation usually given in the Phillips curve literature is quite different in theory and implications. It has the same right side as [5] above but with the inflation rate rather than its change on the left. (For a review of empirical work on such equations, see R. A. Gordon, "Wages, Prices, and Unemployment, 1900–1970," *Industrial Relations*, vol. 14 [October 1975], pp. 273–301.) Such an equation is unable to explain rising prices in a recession since both variables are then positive, and, given the appropriate negative coefficients, the two terms will be negative. What the standard Phillips curve lacks is a term representing *long-run* price expectations, which equation [5] includes.

Much of the literature finds that the rate of change of wages is more closely related to changes in the unemployment rate than to the rate itself. (See E. Kuh, "A Productivity Theory of Wage Levels—An Alternative to the Phillips Curve," *Review of Economic Studies*, vol. 34, no. 4 [October 1967], pp. 333–360.) In the literature the change in the unemployment rate has been interpreted as reflecting *short-run* expectations of changes in demand. (See William G. Bowen and R. Albert Berry, "Unemployment Conditions and Movements of the Money Wage Level," *Review of Economics and Statistics*, vol. 45 [May 1963], pp. 163–172.) This implies a relation between changes in the rate of change of wages and the second derivative of the unemployment variable. Such a relation has no importance for the effect of slack demand on inflation as formulated here.

economic developments make full use of all available information. Given the incentives to market participants to use information to full advantage, expectations of price changes and other variables will not be subject to repeated errors of forecast in the same direction insofar as available information could avert such biased forecasts, though errors can of course be large because of developments that no one is able to foresee. The theory evolved in reaction to the assumption, commonly made in economic analysis, that expectations adjust slowly to new developments as new information is absorbed gradually through an adaptive error-learning process. Slow revisions of expectations produce a series of similar and avoidable errors during the time in which new information is being acquired by economic agents and behavior has not yet fully adjusted to it. Such lags in response may pertain to habitual behavior, but, when substantial costs can be avoided or profits are to be made by fully utilizing new information, economic agents will try to avoid lags in revising expectations. New information will thus be reflected rapidly in prices that are influenced by expectations of future development. Rapid—virtually instantaneous—use of new information is certainly characteristic of commodity and financial exchanges, where expectations of future movements are critical and new information is extremely important. Analysis of price movements on exchanges indicates that errors of expectations, insofar as they can be measured, are unsystematic, essentially unpredictable, and reflect only new developments which were not foreseen. Such prices are characterized by jumps from one position to another, because everyone is aware of a new development that justifies a change in price, and all transactions occur immediately at the changed price.

In its extreme form the theory of rational expectations requires that prices clear markets at every moment. Since a price that does not equate demand and supply is subject to pressures to change until it does so, market participants acquire and make rational use of information about such pressures and do not transact at a price that they know is subject to further change in a particular direction. Prices so determined always equate all demand and supply offers at the moment. The theory offers no explanations for most prices and wages in the economy, which change smoothly and usually follow the same trend for months at a time in markets often characterized by persistent slack or excess demand. Most prices and wages are either subject to institutional constraints or, if influenced by "rational" expectations, not as yet fully understandable by economic theory.

But a modified form of the theory can be espoused which seems more realistic and accommodates prices which do not clear markets. Faced with a fall in demand, an individual firm or industry, given its

costs of production and the desire to maximize profits or minimize losses, will not cut prices far enough to prevent a decline in its sales in real terms and the necessity of reducing its output. Explicit or implicit contracts to supply labor and materials at predetermined wages and prices are one reason for lack of market clearing and a decline in sales, but it seems doubtful that such contracts are the only reason. Another likely reason is the sheer complexity of a full adjustment of the entire price system to changes in demand. The restoration of demand to its original level in real terms only through changes in prices, after a general fall in aggregate demand in a recession, would require a quite large decline in the *general level* of prices and wages, in which each individual firm and industry plays a small part.[17] Individual firms and industries do not know to what extent deflation in the whole economy will reverse a decline in aggregate real demand, and we may suppose that they act on the basis of the demand they face at the moment. There is no reason to suppose that rational expectations of developments elsewhere in the economy, of which individual firms and industries can have only limited knowledge, would significantly affect prices in individual markets, nor that such knowledge would therefore imply an immediate fall in all prices to a level that would restore a shortfall in demand to its original real level. When demand falls, individual firms and industries will cut prices and output, and their action may still be based on rational expectations in that their estimate of sales and the prices that will prevail is neither high nor low on the average. Their reduction of output will, of course, contribute to a continuation of the decline in aggregate demand. With each fall in demand, prices and output will be cut further. If expectations are rational, however, there is no systematic delay in the response of prices to changes in demand. Hence the level of demand will determine the level, not the rate of change, of prices.[18] Such a relationship is formulated below.

Rational expectations may thus be made consistent with the existence of slack markets, but an explanation of rising prices in a recession is still missing. To explain that anomaly, we may also suppose that the anticipated long-run trend of prices is upward, and price changes over the business cycle occur as cyclical deviations from the trend. Then it is

[17] This is the implication of the theory of aggregate disequilibrium. The spillover effects of reduced output and employment in one industry make demand lower in other industries. The restoration requires an increase in the purchasing power of money balances through a decline in the price level—an increase sufficient to raise the demand for goods and services to the original level of expenditures in real terms.

[18] A rational expectations model with this relationship is presented in Allan H. Meltzer, "Anticipated Inflation and Unanticipated Price Change," *Journal of Money, Credit, and Banking*, vol. 9 (February 1977), pp. 182–205.

possible that cyclical declines in prices combined with the rising trend can produce prices that rise in a recession—a rise that is less than the trend, to be sure, but a rise nevertheless. The long-run trend would presumably also be subject to rational expectations. The long-run expectations would be based on the anticipated trend of prices from cycle to cycle, after the cyclical ups and downs are netted out. An upward trend would affect prices in recessions as well as expansions for at least two reasons. First, an anticipated rising trend would be incorporated into price and wage contracts for resource inputs and would continue to inflate costs in recessions. Second, the price trend would influence the cyclical price at which storable materials and goods as well as some labor services would be supplied; sellers would withhold supplies as prices in a recession fell further and further below the anticipated trend price. The withholding of supplies would limit the decline in prices during a recession and would even cause prices to continue rising if the anticipated trend were rising fast enough.

Under rational expectations, the anticipated trend of prices would presumably not be influenced by anticipated developments within the business cycle that were reflected in cyclical price changes; rational expectations allow for cyclical fluctuations. But trends can and do change without being clearly foreseen. Rational economic agents will revise their expectations of the price trend when they become aware of a change occurring or about to occur, for example, a business recession more severe or a period of slack demand more prolonged than expected. Hence slack demand may also affect anticipated price trends under rational expectations, but the effect would depend upon the amount of slack in the economy both currently and in the past. Certainly it would not depend upon the current amount only, since the current amount would be largely indistinguishable from expected cyclical fluctuations. This means that the expected trend of prices would be related to the cumulative amount of slack over an extended period. Such a relation contrasts with the modified Phillips equation, in which expected price changes can be related to the discrepancy between actual and expected changes (and this discrepancy can in turn be related to the current amount of slack). The two theories differ because, in accordance with the slow adjustment of prices underlying the Phillips curve, economic decisions are based, not on rational expectations of current price movements, but on an adaptive error-learning process in which current price movements contain relevant unused information for the revision of expectations.

We can express the theory of price behavior under rational expectations in a mathematical form for regression analysis. The theory implies that the *level* of prices depends upon both the expected price level

and the *level* of demand or, equivalently, the gap between demand and potential supply as indicated by unemployed resources; namely,

$$[6] \qquad p_t = G(U_t - \overline{U}) + p_t^e ,$$

where the symbols are the same as those introduced above and G is a function which declines when $U_t - U$ increases. When differentiated with respect to time, the relationship becomes

$$[7] \qquad \dot{p}_t = G'\left(\frac{dU_t}{dt}\right) + \dot{p}_t^e ,$$

where as above the overhead dots denote the rate of change on the assumption that the price variables are measured in logarithms.

On the proposition that the expected price trend is influenced by the cumulative amount of slack over an extended period,

$$[8] \qquad \dot{p}_t^e = [\text{noncyclical trend of prices}] + c_0(U_t - \overline{U}) + c_1(U_{t-1} - \overline{U}) + \ldots + c_n(U_{t-n} - \overline{U}).$$

The noncyclical trend of prices may be represented by the average inflation rate over the length of a typical business cycle, which is roughly four years. Whether the average is a little more or less than four years will not materially affect the results. Substituting [8] into [7] and assuming a proportional G function and discrete first differences, we have

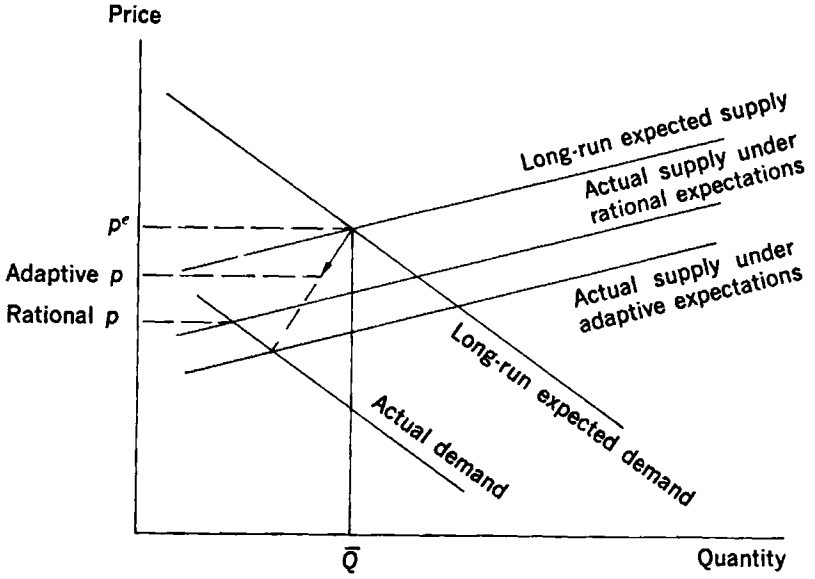
$$[9] \qquad \dot{p}_t - \sum_{i=1}^{16} \frac{\dot{p}_{t-i}}{16} = a(U_t - U_{t-1}) + c_0(U_t - \overline{U}) + c_1(U_{t-1} - \overline{U}) + \ldots + c_n(U_{t-n} - \overline{U})$$

where the average rate of inflation, which has a coefficient of unity, has been transferred to the left side of the equation. The coefficient a of the first term reflects the temporary effect of changes in slack demand on the inflation rate. The lasting effect over a business cycle is given by the sum of the c coefficients.[19]

[19] An alternative formulation suggested by other rational expectations models would be to use past monetary growth and other basic determinants of the price level, known to rational economic agents, as indicators of the expected noncyclical trend of prices. Then, in theory, slack demand would be superfluous and would not affect the inflation rate. (For example, see Meltzer, "Anticipated Inflation and Unanticipated Price Change.") In such models, however, a decline of monetary growth and consequent reduction in inflation still produces a period of slack demand. Equation [9] can be interpreted as reflecting the amount of slack which is associated in such models with reductions in the expected trend of prices.

Figure 3

RESPONSE OF PRICE TO DOWNWARD SHIFTS OF DEMAND AND SUPPLY: ADAPTIVE AND RATIONAL EXPECTATIONS



$\bar{Q}$ corresponds to $\bar{U}$.

Collecting terms into a form suitable for regression analysis, we have

$$[10] \qquad \dot{p}_t - \sum_{i=1}^{16} \frac{\dot{p}_{t-i}}{16} = (a + c_0)(U_t - \bar{U}) + (c_1 - a)(U_{t-1} - \bar{U}) + c_2(U_{t-2} - \bar{U}) + \ldots + c_n(U_{t-n} - \bar{U}).$$

In theory n should be the length of a business cycle, but for statistical convenience most of the estimates of this equation, presented below, are based on only six U terms. Results for fifteen and seventeen terms, however, are not dissimilar.

The difference between rational and adaptive price behavior is illustrated in Figure 3. The price at any particular time is influenced by the expected shift in demand and supply schedules owing to inflation and by deviations of the actual schedules from the expected ones. Only one set of expected schedules is shown in the figure, although rational and adaptive expectations would not ordinarily have the same set.

Given the expected price under either theory of behavior, the actual demand and supply will cause the price to deviate from the expected price. The adaptive response will result in a price that partially reflects the actual change in demand and supply in relation to the expected change. The rational response will result in a price which equates actual demand and supply. As argued above, this rational price will not ordinarily prevent a fall in output because contracts predetermine some prices and because supplies may be held off the market in anticipation of more favorable prices in the future.

Therefore, when the earliest and the most recent theories of price behavior are modified to account for procyclical fluctuations in the inflation rate, they are not necessarily inconsistent with a Phillips type of relation between the inflation rate and the amount of excess capacity. As suggested above, however, the correlation between procyclical fluctuations in the inflation rate and in the amount of excess capacity is evidence of only a temporary effect of slack in reducing inflation. For a lasting effect economic slack must reduce the expected trend rate of inflation. Let us examine the record for evidence of an effect of economic slack on price expectations. In estimating this effect, we shall analyze the data in terms of the two theories discussed above.[20]

Statistical Estimates of the Effect of Slack Demand

The two theories formulated above allow for a noncyclical effect of slack demand on the inflation rate through price expectations. In the first theory the *current* amount of slack determines long-run expectations, but in the second it does not because it is largely reflected in short-run expectations and the current price level. Equations [5] and [10], each based on one of the two theories, were designed to distinguish the cyclical and noncyclical effects of slack demand on the inflation rate. Statistical regressions of these equations were fitted to U.S. quarterly data beginning in the first quarter of 1953, which avoids the large price swings associated with the Korean War, and ending in the fourth quarter of 1977, the latest date available, and alternatively in

[20] Although equations [5] and [10] have many apparent similarities, they differ crucially in the form of the left-hand variable. Their difference does not, however, provide an acceptable statistical test for choosing between the two theories. The fit of these equations to the data is not sufficiently close to produce a clear preference for one or the other, nor to indicate whether or not certain forms of the variables or their lags should be included in the regression equation. A satisfactory test of the two theories of price behavior requires different techniques and evidence from that provided here. Nevertheless, we may examine the reasonableness of the estimates from the two theories for the effect of slack demand on the inflation rate.

1969 to exclude the last two business cycles. Various series were used to provide a broad indication of how the parameter estimates are affected by different measures of prices and slack demand. The results are presented in the appendix to this chapter.

The regression equations do not in general fit the data closely, as is evidenced by the low levels of significance of many of the regression coefficients. (The total correlation coefficients are high simply because they include an adjustment for serial correlation in the error terms; they have not been reported.) Our principle interest here is the values of the coefficients as estimates of the effect of slack demand on the inflation rate. The lack of a close fit does not appear to bias the estimates of the coefficients and so does not invalidate the statistical results, though it does of course widen the range of error of the estimates.

For equation [5] the estimates of ba represent the noncyclical effect of slack demand on the inflation rate. These are reproduced in Table 1 for the regressions using the unemployment rate to measure slack demand.[21] The estimated effect of slack demand is similar for the consumer price index and wholesale finished goods prices (and is statistically significant, as shown in the appendix, Table 3, except for the wholesale price series over the shorter period). The estimated effect differs for the other price measures. The estimates for wholesale crude and intermediate materials prices are erratic and reflect their lack of regular cyclical pattern. The estimates for average hourly earnings are quite small, reflecting the lower response of wages to the business cycle. The estimated effect for the GNP deflator is also small (and actually nonexistent in the 1953–1969 regression), apparently because of its broader coverage of industries.[22] Many of the results are not strongly significant for the basic reason that moderate slack works slowly and its effect is hard to identify. But it seems to exist overall in these data, and the estimates appear credible in magnitude.

If we tentatively accept the results for the consumer price index and wholesale finished goods, which are statistically the strongest, as the clearest indication of the size of such an effect, the estimates are around 0.2 and imply that excess unemployment maintained at one per-

[21] The other measures of slack give a similar result if we note that they register the same slack with two and a half to three times the magnitude shown by the unemployment rate.

[22] Results for the GNP deflator of the private nonfarm sector (not shown) are similar. In a recent study of 1954–1971, Robert J. Gordon ("The Impact of Aggregate Demand on Prices," *Brookings Papers on Economic Activity*, no. 3 [Washington, D.C.: Brookings Institution, 1975], pp. 613–662) also finds, for the GNP chain deflator of the private sector excluding food and energy, that current and lagged changes in the GNP gap affect the inflation rate while the current and past levels do not.

Table 1

ESTIMATES OF CHANGES IN VARIOUS MEASURES OF THE INFLATION RATE FROM EXCESS UNEMPLOYMENT, EQUATION [5]

(change per quarter in annual percentage rate from excess unemployment of one percentage point)

Measures of the Inflation Rate	Period of Estimate	Total Change (ba)	Total Due to		Estimated Change in Inflation Rate for 1977 over 1976
			a	b	
Consumer price index	1953–69	−0.17	−0.70	0.24	−0.02
	1953–77	−0.23	−0.95	0.24	−0.21
GNP deflator	1953–69	0.01	−0.26	−0.04	—
	1953–77	−0.12	−0.57	0.21	+0.03
Wholesale crude materials	1953–69	−0.43	−0.23	1.87	−0.88
	1953–77	−0.02	−0.06	0.67	+0.33
Wholesale intermediate goods	1953–69	0.02	−0.58	−0.03	—
	1953–77	−0.13	−2.38	0.05	+1.44
Wholesale finished goods	1953–69	−0.20	−0.66	0.30	−0.13
	1953–77	−0.28	−1.22	0.23	−0.10
Average hourly earnings	1953–69	−0.05	−0.56	0.09	+0.10
	1953–77	−0.11	−0.52	0.21	−0.06

Note: The value of b is derived by dividing ba by a. Estimated change for 1977 over 1976 is a $(-0.65) + 4ba\,(4.6 - \bar{U})$, where $\bar{U}$ for each row is given in Table 3. (The unemployment rate for prime-age men in 1977 was 4.6 percent, and the decline in the average level from 1976 to 1977 was 0.65.)

Dash (—) indicates not calculated because estimates of ba and b are of wrong sign.

Source: Based on regressions in appendix, Table 3, for unemployment rate of prime-age men.

centage point would reduce the annual inflation rate by 0.2 percentage points per quarter and by 0.8 percentage points per year. By this evidence the noncyclical trend of inflation is reduced by economic slack, but quite slowly when the amount of slack is moderate. The slowness of the effect reflects the small revision of the expected price change per period of time, shown by the value of b. The immediate effect, shown by a, is larger, but the part of the effect that has not been translated

into a reduction of the expected price change disappears when the slack is removed.

The results in Table 1 seem to suggest that the effect of slack on inflation has increased in recent years; the estimates of ba generally have larger negative values for the full than for the shorter period. This would be consistent with the theory that the increasing variability of inflation rates in recent years has caused fluctuations in aggregate demand to be translated more into prices than into output (which would increase the value of a), contrary to evidence cited earlier that prices have become less responsive to the business cycle. The larger values of ba for the full period can indeed be attributed to a, which may, however, simply reflect the large rise and subsequent decline in the inflation rate in 1973–1975 stemming from the extraneous foreign influences. The estimates for average hourly earnings suggest that b is higher for the full period, but the overall effect shown by ba, though larger, remains low, indicative of the smaller and slower response of wages to economic slack compared with the response of prices. It is therefore doubtful that the effect of slack in reducing inflation has increased much at all, although there is no indication of a decrease either.

The failure of the inflation rate to decline continually when slack exists is reflected in the large negative value of a, which represents the cyclical effect of changes in slack and which dominates the noncyclical effect. In a business expansion the continued existence of slack works to reduce the expected rate of inflation, but, until the decline in slack slows down, the net effect can be no change or even an increase in the current inflation rate. The last column of Table 1 gives the change in the inflation rate as estimated by each regression for 1977. Despite the existence of substantial slack in the economy in 1977, but because of the decline in amount of slack, most of the estimates show a slight decline—practically no change—in the inflation rate for the year. Actually, as noted earlier, the inflation rate increased in 1977; this upward deviation from the equation suggests that the severe winter generated direct upward pressures on prices which were accommodated by aggregate-demand policy but did not affect the measures of excess unemployment.

The implications of the regressions can be derived for 1978, based on estimates of the slack that will exist. The CEA projects an unemployment rate for all workers of 6 to 6¼ percent for the end of 1978.[23] Since the rate in December 1977 was 6.4 percent, the implied average rate for 1978 is only slightly above 6 percent, close to the full-employment rate cited earlier. This would represent a decline of about

[23] CEA, *Annual Report, 1978*, p. 79.

Table 2

ESTIMATES OF CHANGES IN VARIOUS MEASURES OF THE INFLATION RATE FROM AVERAGE EXCESS UNEMPLOYMENT, EQUATION [10]

(change per indicated period in annual percentage rate from excess unemployment of one percentage point)

Measures of the Inflation Rate	Period of Estimate	Sum of c Coefficients (1)	Effect per year (0.37 × col. [1])[a] (2)	Effect over Business Cycle, Continuous Adjustments (1.72 × col. [1])[a] (3)
Consumer price index	1953–69	−0.80	−0.30	−1.38
	1953–77	−1.46	−0.54	−2.51
	1953–77	−0.99[b]	−0.37	−1.70
Wholesale finished goods	1953–69	−0.88	−0.33	−1.51
	1953–77	−1.87	−0.69	−3.22
Average hourly earnings	1953–69	−0.84	−0.31	−1.44
	1953–77	−0.78	−0.29	−1.34

[a] See footnote 24.

[b] Estimated from regression with fifteen terms of U.

Source: Appendix, Table 4.

three-fourths of a point from the average rate of 7 percent for 1977. (Although the results in Table 1 are based on the unemployment rate for prime-age men, we may assume that it will change roughly by the same amount as the rate for all workers.) According to the estimates for the consumer price index in Table 1, the decline in the unemployment rate would raise the annual inflation rate in 1978 over 1977 by a half to three-fourths of a percentage point, while the small average amount of excess unemployment in 1978 would reduce inflation very little. According to these estimates we shall have to look beyond 1978 for any progress in reducing inflation.

The results for equation [10], based on rational expectations, are presented in the appendix, Table 4, and summarized in Table 2. The sum of the c coefficients gives the lasting effect of slack demand in reducing the expected trend of prices. The additional c coefficients beyond the first two are not collectively significant statistically, and this remains true when the number of them in the regression is increased. Consequently, the estimate of their sum is subject to a wide range of

error. The lack of significance may also mean that rational expectations are an inappropriate basis for describing these data, or it may possibly mean that expectations of the inflation trend cannot be adequately represented by past unemployment. We may nevertheless examine these estimates as an alternative indication of the effect of slack demand on inflation, since they suggest a slower response than does the adaptive expectations model.

The estimates of the sum of the c coefficients in Table 2 vary from 0.8 for the shorter period 1953–1969 to over 1.5 for the full period 1953–1977. The larger sum for the full period probably reflects the unusual fluctuations of 1973–1975, however. As the number of U terms in the regression is increased to provide a longer perspective on the cumulative effect of slack demand, the sum declines toward unity (third row of table). We may therefore take a value of unity or a little lower as the central estimate of the effect. The implications for the average inflation rate are shown in columns (2) and (3) of the table. Column (2) shows the effect per year for an assumed four-year business cycle. Column (3) shows the cumulative effect over a full business cycle of any length, under the likely assumption that adjustments in the expected trend are made continuously.[24] For the central estimate of the sum of c coefficients of unity in the third row, the annual inflation rate would be reduced by 0.37 percentage points per year for each one percentage point of average slack maintained over a business cycle, and reduced as much as 1.70 percentage points over the entire business cycle with continuous adjustments. This effect is about a half or less of the effect estimated above for adaptive expectations over the same length of time. Rational expectations have a smaller effect because it

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[24] The sum of the c coefficients gives the estimated effect of excess unemployment on the difference between the current inflation rate and the noncyclical trend. For a business cycle of n periods in which this difference is maintained at C,

$$\dot{p}_t - \sum_1^n \frac{\dot{p}_{t-i}}{n} = \sum_0^n c_i(U_{t-i}-\bar{U}) = C,$$

the cumulative effect can be expressed by

$$\dot{p}_{t+n} = C\left(1+\frac{1}{n}\right)^{n-1} \quad \text{and} \quad \sum_1^n \frac{\dot{p}_{t-i}}{n} = C\left(1+\frac{1}{n}\right)^{n-1} - C.$$

For n=16 quarters, the average rate is 1.48C or .37C per year.

The estimate of C is not affected greatly by changes in n beyond a small number, and we may assume C remains the same as n increases. In particular, we may derive the effect for continuous adjustments where the periods approach zero in length and n approaches infinity, for which the limit of $\left(1+\frac{1}{n}\right)^{n-1}$ is e or 2.72. Hence the total effect for a full cycle of continuous adjustments, which is independent of the length of the cycle, is 1.72C.

is assumed that most of the cyclical fluctuation in slack demand is expected and already incorporated in the expected trend, and that only the cumulative amount of slack, if more or less than expected, affects the expected trend of prices.

Although these estimates show a small effect of slack demand, they pertain to the initial effect within the span of a business cycle; the longer-run effect could well be larger. Presumably the slack produced by a business recession will not reduce the expected trend of prices very much if it is expected that the pressure on prices of slack markets in the recession will be offset in the subsequent expansion. The recent cyclical fluctuations, in which the final stages of the expansion have encountered increasing inflationary pressures, give a rational basis for such an expectation. For policy makers to restrain inflation effectively given the recent history of failures, they must demonstrate over the course of a business cycle that the restraint will persist. Once this is demonstrated for one business cycle, however, the effect is likely to be considerably stronger in the next.[25] In the late 1950s the inflation rate was widely viewed as intractable because it was not eliminated by the recession of 1957–1958 (see Figures 1 and 2). Yet the subsequent business expansion did not overshoot, and the inflation rate remained lower than it had been in the previous expansion. Although the inflation stubbornly resisted further decline in the subsequent business contraction of 1960–1961, it rapidly disappeared during the second half of 1961 when the business recovery proved to be mild. With the benefit of hindsight, it appears that the inflation of the 1950s was finally conquered not so much by the business recessions as by the avoidance of renewed inflationary pressures during the business expansions.

The adaptive and rational models imply different time patterns for the effects of slack demand on the expected rate of inflation. The effects under adaptive expectations occur faster and, for a given initial period of excess unemployment, appear to be about twice as large. Given the cyclical fluctuations in slack demand over the business cycle, however, the initial change in the expected inflation rate will be partially or fully offset over a full cycle. Under rational expectations, although slack demand has an immediate effect on price levels, its effect on the expected trend of prices is slight initially, may even be negligible during a recession, and occurs mainly with a lag the length of the business cycle. But the response of the expected rate of inflation to slack demand is likely to be stronger—and this applies to adaptive expectations as well—when a change in aggregate-demand policy demonstrates

[25] This is emphasized in William Fellner, *Towards a Reconstruction of Macroeconomics* (Washington, D.C.: American Enterprise Institute, 1976).

that the change will be maintained by outlasting the course of a business cycle.

Although our statistical results slightly favor adaptive over rational expectations, it is not clear which model describes economic behavior more accurately. Actual behavior may well be a mix of both.

The Political Problem of Reducing Inflation

The statistical results add an important qualification to the proclaimed policy goal of reducing both inflation and unemployment. The goal can be accomplished only if the reduction of unemployment is not carried all the way to full employment but stops short of that goal and maintains some excess unemployment for a long period. No such limitation has been evident in the pursuit of the goal over the past decade. Business expansions, whether intended by policy or not, have carried aggregate demand up to and beyond the zone of increasing inflationary pressures. Policy makers have also set up an unattainable goal by claiming that cyclical rates of both inflation and unemployment can be reduced at the same time.

Although there are no economic barriers to reducing inflation, a political problem has erected a barrier. The problem centers on two implications of the economic relation between inflation and slack demand. First, changes in the amount of slack reflect cyclical fluctuations in aggregate demand which produce cyclical fluctuations in the rate of inflation. Restraint imposed on the growth in aggregate demand increases the amount of economic slack and reduces the inflation rate. But while the restraint is being applied the rate declines far more than can be maintained after the economy begins to recover. As the amount of slack declines, the inflation rate increases, which makes it appear as though the hard-earned gains against inflation are slipping away. In fact, however, most of those gains are temporary cyclical fluctuations and cannot be counted as reductions in the long-run inflation rate. The real progress against inflation is to be measured by the rate that prevails after slack has declined to an acceptable level. At that point the inflation rate can be somewhat lower, compared with the average for the previous cycle, because of the cumulative effect of economic slack during the business contraction and recovery. It is conceivable that fluctuations could be avoided by imposing an amount of slack which, once reached, is kept constant thereafter until the long-run rate of inflation has declined to an acceptable level. But fluctuations in business activity owing to policy measures as well as to other sources of cyclical fluctuations in the economy have not been avoided in the past and are well beyond our capability of avoiding in the foreseeable future. Since

cyclical fluctuations in the inflation rate will surely continue, a "true" reduction in the rate would mean that the *expected* rate has declined, as implied by a decline in the actual rate between corresponding business cycle stages in which the amount of slack is the same.

A second implication of the relation between inflation and slack demand is an obvious one with touchy political consequences. It is that the reduction of inflation "almost" certainly requires slack demand. The qualification is added to cover the possibility implied by the theory of rational expectations that an announced and widely believed change in policy which reduced the growth path of nominal aggregate demand would immediately reduce the expected growth path and thereby its contribution to the trend of prices. An argument sometimes made for controls is that, if accompanied by announced restraints in aggregate-demand policy, they could help to reduce expected price changes along with the targeted decline in the inflation rate, thus avoiding the period of slack demand produced by a discrepancy between actual and expected price changes. The purpose of the controls would be to make the announced change in aggregate-demand policy believable, though in the light of past experience it is questionable whether they ever have or now would have such an effect. There is no doubt, however, that the stance and credibility of policy affects expectations. Market decisions about wages and prices are guided at least in part by rational expectations of the direction of policy. To the extent that prices behave according to the theory of rational expectations, the persistence of the trend rate of inflation in the face of slack demand is consistent with the proclaimed desire of policy makers to subdue inflation only if they are generally not believed to be capable of carrying it out. Since the evidence suggests that the economic capability exists, the lack of credibility concerns the political capability. In such circumstances and in view of our past experience, the desire to subdue inflation is obviously not enough and must be confirmed by performance. The conclusion appears inescapable, therefore, that the reduction of inflation requires the maintenance of slack demand, and the less that policy hides its intention to maintain it, the faster the reduction will be.

The political incentives to hide the intention have created serious barriers to achieving it. Hidden intentions can mislead economic agents into expecting higher inflation than policy measures are designed to allow, thus slowing down the reduction in the expected rate of inflation and holding back the reduction in the actual rate. In addition, policy makers are trapped into publicly adopting targets of economic slack which are unrealistic and, if pursued, unable to reduce inflation. The 4 percent level of unemployment held as a goal in the Humphrey-Hawkins bill can no longer be considered a reasonable estimate of the

noninflationary rate of full employment—if it ever was. Budget projections in 1978 are also based on a full-employment rate of less than 5 percent. More realistic estimates, as noted, indicate that this rate is now close to 6 percent. If these higher estimates are correct and if policy makers mistakenly try to achieve a lower unemployment rate, it will not be possible to reduce the actual unemployment rate much below 6 percent. Nor will the widely deplored high rates for youths and minority groups be reduced much by any degree of economic stimulation that would conceivably be undertaken. But the attempt to achieve these unattainable goals would, of course, push the economy into the zone of increasing inflationary pressures. Even if realism prevails in the adoption of goals and the maintenance of a credible amount of slack demand is acknowledged as necessary, the chances of success are greatly diminished by targeting too little slack, because the slightest disturbance raising aggregate demand or restricting supplies can rapidly eliminate a small amount of slack and set off new inflationary pressures. In times past, when the general price level was relatively stable, such disturbances were not important and the response of prices to them was weak; but in recent years, when experience with inflation alerts everyone to the likelihood of new outbursts, the response is rapid.

Although the maintenance of slack demand is necessary to subdue inflation, the imposition of slack can give the appearance of not working, because it takes time and is dominated by cyclical fluctuations that inevitably accompany the attempt to restrain the growth in aggregate demand. This behavior of the inflation rate is hardly ideal for maximizing political statesmanship or for resisting the political temptation to make promises whose impracticality is revealed much later. But despite all the hand wringing over the political obstacles to subduing inflation, it is still true that avoidance of new outbursts of inflation is viewed as politically acceptable and that the rising trend of inflation has largely reflected the failure of policy to contain new outbursts. The evidence gives more support than denial to the traditional view that, without outbursts and with the maintenance of some slack in the economy, inflation will gradually decline. There is a basis for hope that each of the various kinds of mistakes which allow the economy to overheat will be made only once, and that eventually policy makers will proceed without further serious mistakes to bring inflation effectively under control.

Appendix

For Tables 3 and 4 in this appendix, regressions were fitted to quarterly data by the Cochrane-Orcutt method, which adjusts for first-order serial correlation in the residuals. (The total correlation coefficient is

Table 3

ESTIMATED EFFECT OF ECONOMIC SLACK ON INFLATION ASSUMING ADAPTIVE EXPECTATIONS

Regression Eq. [5]: $\dot{p}_t - \dot{p}_{t-1} = a\left(\frac{U_t - U_{t-2}}{2}\right) + ba\left(\frac{U_t + U_{t-1} + U_{t-2}}{3} - \bar{U}\right)$

Price Series	Period	Regression Coefficients (and t Values) a	ba	$\bar{U}$
		U: Unemployment rate		
Consumer price index	1953–69	−0.70 (2.7)	−0.17 (2.1)	3.9
	1953–77	−0.95 (3.4)	−0.23 (2.6)	3.7
GNP deflator	1953–69	−0.26 (0.7)	+0.01 (0.1)	—
	1953–77	−0.57 (1.8)	−0.12 (1.2)	3.9
Wholesale crude materials	1953–69	−0.23 (0.1)	−0.43 (0.9)	4.0
	1953–77	−0.06 (0.0)	−0.02 (0.0)	8.2
Wholesale intermediate goods	1953–69	−0.58 (1.2)	+0.02 (0.1)	—
	1953–77	−2.38 (2.0)	−0.13 (0.3)	4.4
Wholesale finished goods	1953–69	−0.66 (1.6)	−0.20 (1.6)	3.9
	1953–77	−1.22 (2.0)	−0.28 (1.5)	3.8
Average hourly earnings	1953–69	−0.56 (1.5)	−0.05 (0.4)	3.3
	1953–3/77	−0.52 (1.4)	−0.11 (0.9)	3.7
		U: Excess capacity		
Consumer price index	1953–69	−0.07 (1.2)	−0.05 (2.3)	17.7
	1953–77	−0.15 (2.6)	−0.08 (3.4)	17.6
GNP deflator	1953–69	−0.05 (0.7)	+0.01 (0.2)	—
	1953–77	−0.11 (1.7)	−0.04 (1.7)	17.8
Wholesale crude materials	1953–69	+0.01 (0.3)	−0.08 (0.6)	19.0
	1953–77	−0.22 (0.4)	+0.06 (0.3)	—
Wholesale intermediate goods	1953–69	−0.25 (2.4)	+0.01 (0.2)	—
	1953–77	−0.77 (3.3)	−0.06 (0.6)	18.9
Wholesale finished goods	1953–69	−0.16 (1.7)	−0.06 (1.7)	18.0
	1953–77	−0.34 (2.8)	−0.09 (2.0)	17.8
Average hourly earnings	1953–69	−0.11 (1.3)	−0.02 (0.7)	16.2
	1953–3/77	−0.11 (1.5)	−0.04 (1.3)	17.4
		U: Potential in excess of actual GNP (CEA)		
Consumer price index	1953–69	−0.17 (1.4)	−0.08 (2.1)	2.7
	1953–77	−0.27 (2.2)	−0.12 (3.4)	2.9
GNP deflator	1953–69	−0.21 (1.3)	−0.01 (0.2)	9.2
	1953–77	−0.19 (1.4)	−0.07 (1.8)	3.1

Table 3 (Continued)

Price Series	Period	Regression Coefficients (and t Values)		
		a	ba	$\bar{U}$
Wholesale crude materials	1953–69	+0.16 (0.2)	−0.14 (0.7)	3.3
	1953–77	−1.12 (1.1)	−0.05 (0.2)	5.9
Wholesale intermediate goods	1953–69	−0.48 (2.2)	−0.03 (0.4)	5.3
	1953–77	−1.36 (2.7)	−0.20 (1.3)	3.2
Wholesale finished goods	1953–69	−0.28 (1.4)	−0.10 (1.7)	2.8
	1953–77	−0.60 (2.4)	−0.16 (2.3)	3.0
Average hourly earnings	1953–69	−0.19 (1.1)	−0.03 (0.6)	1.7
	1953–3/77	−0.07 (0.4)	−0.04 (1.0)	2.8
U: Potential in excess of actual GNP (St. Louis)				
Consumer price index	1953–69	−0.21 (1.7)	−0.08 (2.2)	2.4
	1953–2/77	−0.37 (3.0)	−0.11 (2.9)	3.1
GNP deflator	1953–69	−0.19 (1.2)	−0.01 (0.2)	7.1
	1953–2/77	−0.23 (1.6)	−0.06 (1.5)	3.0
Wholesale crude materials	1953–69	−0.07 (1.0)	−0.12 (0.6)	3.4
	1953–2/77	−1.46 (1.4)	+0.03 (0.1)	—
Wholesale intermediate goods	1953–69	−0.41 (1.9)	−0.01 (0.1)	14.7
	1953–2/77	−1.72 (3.3)	−0.13 (0.8)	3.2
Wholesale finished goods	1953–69	−0.31 (1.6)	−0.08 (1.4)	2.7
	1953–2/77	−0.81 (3.1)	−0.13 (1.7)	3.3
Average hourly earnings	1953–69	−0.17 (0.9)	−0.04 (0.8)	1.2
	1953–2/77	−0.09 (0.5)	−0.06 (1.2)	2.2

Note: The values of the t statistic omit negative signs and were not calculated for $\bar{U}$.

Dash (—) indicates not calculated because of wrong signs.

Source: Consumer price index (all items), wholesale prices, average hourly earnings of production workers (adjusted to exclude overtime and interindustry shifts), and unemployment rate of prime-age men aged twenty-five to fifty-four are from the Department of Labor, Bureau of Labor Statistics. GNP deflator is from the Department of Commerce, Bureau of Economic Analysis. Excess capacity in manufacturing (the complement of capacity utilization) is from the Federal Reserve Board. Potential in excess of actual GNP as estimated annually by the Council of Economic Advisers (logarithmic interpolations used to derive quarterly data) is given in the *Annual Report*, 1978, p. 84, and as estimated quarterly by the Federal Reserve Bank of St. Louis is given in Robert H. Rasche and John A. Tatom, "Potential Output and Its Growth Rate—The Dominance of Higher Energy Costs in the 1970s," *U.S. Productive Capacity: Estimating the Utilization Gap*, Center for the Study of American Business, Washington University, Working Paper no. 23 (December 1977), p. 80.

All series are seasonally adjusted.

Table 4

ESTIMATED EFFECT OF ECONOMIC SLACK ON INFLATION, ASSUMING RATIONAL EXPECTATIONS

Regression Eq. [10]: $\dot{p}_t - \sum_{i=1}^{16} \frac{\dot{p}_{t-i}}{16} = (a + c_0)(U_t - \bar{U}) + (c_1 - a)(U_{t-1} - \bar{U}) + \sum_{i=2}^{5} c_i(U_{t-i} - \bar{U})$

U: Unemployment rate

Period	Regression Coefficients (and t Values)							
	$a + c_0$ (1)	$c_1 - a$ (2)	c_2 (3)	c_3 (4)	c_4 (5)	c_5 (6)	$\bar{U}$ (7)	Sum of cols. (1)–(6) (8)
				p: Consumer price index				
1953–69	0.08	−1.03	0.14	−0.20	0.10	0.12	4.1	−0.80
	(0.2)	(1.8)	(0.3)	(0.4)	(0.2)	(0.3)		
1953–77	−0.26	−1.00	0.26	0.22	−1.01	0.33	3.9	−1.46
	(0.7)	(2.0)	(0.5)	(0.5)	(2.1)	(0.9)		
				p: Wholesale finished goods				
1953–69	−0.80	0.27	−0.22	−1.00	1.51	−0.67	3.6	−0.88
	(1.1)	(0.3)	(0.2)	(1.0)	(1.5)	(1.0)		
1953–77	−0.84	−1.09	1.65	−1.50	−0.17	0.08	3.7	−1.87
	(0.9)	(0.8)	(1.2)	(1.1)	(0.1)	(0.1)		
				p: Average hourly earnings				
1953–69	−1.24	1.04	−0.67	−0.43	0.48	−0.01	3.3	−0.84
	(2.4)	(1.3)	(0.8)	(0.6)	(0.6)	(0.0)		
1953–77	−1.10	1.39	−1.01	−0.17	0.09	0.03	3.7	−0.78
	(2.2)	(1.7)	(1.3)	(0.2)	(0.1)	(0.1)		

Source and note: Same as for Table 3.

made misleadingly high by this adjustment and is not shown.) The period of fit began and ended with the first quarter of the years indicated, with certain exceptions because of unavailability of data. Units of inflation rates are percent per year, and of unemployed resources are percent. Hence units of coefficients are the change per quarter in annual percentage rate for each unit of quarterly change in U for a and for each unit of excess U for ba and the c's. The noninflationary rate of unemployed resources, $\overline{U}$ in percent, is estimated by the constant term of the regressions divided by ba in Table 3 and by the sum of c's in Table 4. The method of calculating the variables was as follows.

$\dot{p}_t$ is the rate of change between quarterly levels of the price series in t and $t-1$ (not the two-quarter change as used in Figures 1 and 2 to smooth the rate).

U_t is an average for the quarter. For equation [5] in Table 3, where the dependent variable is the change in the inflation rate, the two independent variables representing the change and level of unemployed resources have three-quarter spans. Thus all the variables in equation [5] have the same span of coverage. For equation [10] in Table 4, even though $\dot{p}_t$ covers two quarters of data and U_t only one quarter, a comparable span was not necessary because the set of six lagged U variables covers six quarters.

The unemployment rate of prime-age men aged twenty-five to fifty-four years was used in preference to the rate for all workers, because structural changes in the labor force have affected the total rate but are far less important for prime-age men. (See Cagan, "The Reduction of Inflation and the Magnitude of Unemployment.") This rate was about half the rate for all workers in 1977.