

No. 7803

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Charles J. Smaistria and Adrian W. Throop

Revised May 1979

Research Paper



FEDERAL RESERVE BANK OF DALLAS

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There has been a growing acceptance of the idea that current inflation is of a new kind that is resistant to traditional monetary and fiscal policies operating on the overall level of demand in the economy. The idea is based on a belief that the structure of the U.S. economy has changed, so that prices and wages have become less responsive to the forces of supply and demand than they once were.

The Committee for Economic Development has expressed this view. In an August 1976 statement, it concluded that:

The 1973-1975 inflationary episode has offered the sharpest example of the role played by forces other than excess demand, forces that in the short term, at least, may be strong enough to override traditional economic stabilization policies. They include changes in the world economy, severe economic shocks, and structural changes in the domestic economic system. 1/

With respect to changes in the structure of the domestic economic system, the Committee went on to say:

In the past, efforts to contain the transmission process have concentrated on restrictive monetary and fiscal policies to reduce real demands; subsequently, unemployment and idle capacity were expected to exert strong restraint on the average level of prices and wages. Admittedly, this process has not always been well managed. But in recent years, there has been a more fundamental difference. High levels of unemployment have not quickly dampened nor effectively stopped the rise of prices and wages, and inflation has occurred despite the absence of demand pressures in the aggregate. Thus, the primary problem is not that the available tools are inadequate to control demand but that restraint of demand does not necessarily imply sufficient restraint of inflation. 2/

As shown in the accompanying table, wage and price inflation indeed did not slow down as much during the recession of 1974-1975 as in earlier recessions. For example, the rise in average hourly earnings slowed 7.2 percentage points between the 1948 peak and a year and a half later. Over the

same period, the rise in prices slowed 5.1 percentage points. By contrast, after the 1973 business cycle peak, both earnings and price inflation accelerated. For wages, in particular, the response to higher unemployment levels during the recessions has apparently been dampened.

WAGE AND PRICE INFLATION DID NOT SLOW AS MUCH
IN THE LATEST RECESSION AS IN EARLIER ONES

Business cycle peak	Changes from four quarters earlier (Percent)					
	Average hourly earnings index, manufacturing			Consumer price index		
	At peak	Two quarters after trough	Dif- ference	At peak	Two quarters after trough	Dif- ference
1948-Q4	9.1	1.9	-7.2	4.5	-0.6	-5.1
1953-Q3	5.8	2.4	-3.4	0.9	-0.6	-1.5
1957-Q3	5.0	3.6	1.4	3.5	1.9	-1.6
1960-Q2	3.1	2.6	-0.5	1.8	1.2	-0.6
1969-Q4	6.0	6.8	0.8	5.8	4.4	-1.4
1973-Q4	6.6	9.5	2.9	8.4	8.7	0.3

SOURCE: Council of Economic Advisers.

It is possible, of course, that the structure of markets in the U.S. economy has recently changed so that wages and prices are more resistant to the traditional market pressures of supply and demand. In the nonauction markets that predominate in the United States (as in most free-market economies), the cost of acquiring information about market-clearing prices tends to create temporary wage and price rigidities. But these rigidities

have no effect on the total, or longer-run, response of wages and prices to supply and demand conditions. Rather, their effect is to spread this response through time. While the importance of nonauction markets probably increased markedly in the 1930's and through World War II, there is simply not much evidence that prices became more impervious to market pressures in the 1970's than they were in earlier postwar years.

This article examines the underlying theory and statistical evidence bearing on the question of whether wages have, in fact, responded more sluggishly to unemployment in the 1970's than in earlier postwar years. Because wages are the most important part of unit costs, and hence prices, the degree of wage flexibility is crucial for the ability of aggregate demand policies to affect inflation. We find the evidence supports the view that the response of wages to unemployment, limited though it is by the existence of nonauction markets in the economy, is currently just as strong as it was in earlier postwar years. This finding is consistent with the view that there is no less flexibility in the markets of the 1970's than those of other postwar years. Rather, the major difference in the inflation of the 1970's is a deeply embedded inflationary psychology. This psychology is the product of successive years of experience with inflation and therefore cannot be eradicated overnight. Moreover, the evidence presented here suggests that price expectations are responding to recent experience in about the same way as they did in the past.

A Trade-off Between Inflation and Unemployment

The idea that a stable relationship exists between inflation and labor market conditions was sparked by the empirical research of a British economist, A. W. Phillips. He found that over a span of 96 years, periods of

Low unemployment in the United Kingdom were highly correlated with periods of rapidly rising wages.

Because unit labor costs are linked to wage rates by labor productivity and since prices tend to be closely related to unit labor costs, the relationship observed by Phillips was extended by others to link price inflation to the unemployment rate. For example, if both wages and labor productivity rise at a 2-percent rate, then the increase in productivity offsets any inflationary effect of the rise in wages. Prices would thus tend to remain stable even though wages were rising. But if the rate of increase in wages outpaces that of productivity, prices would tend to move up.

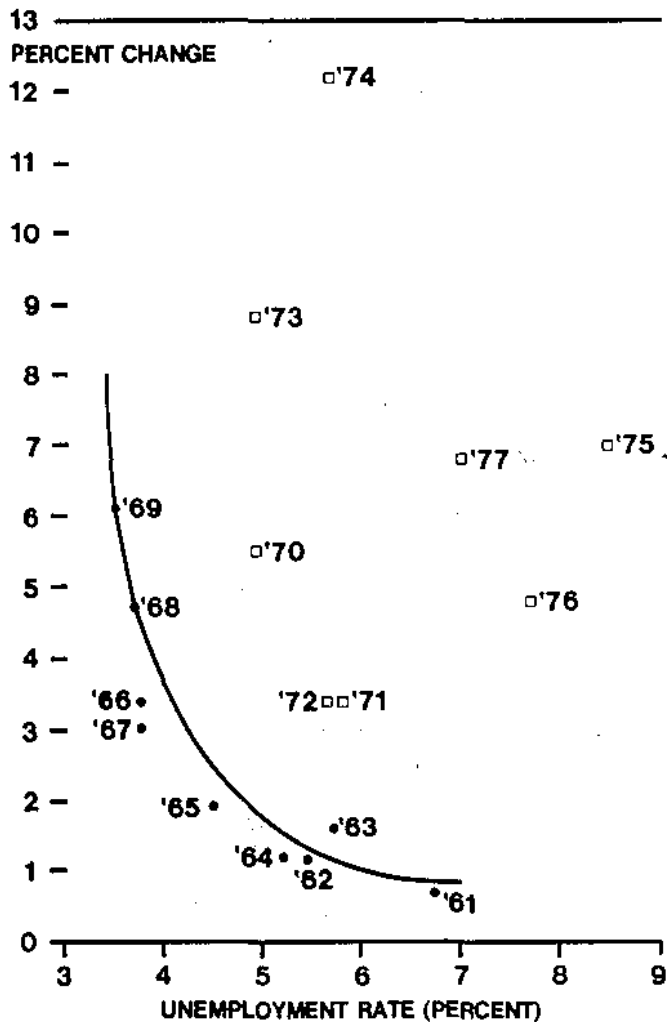
With this added link between price inflation and changes in wages, the Phillips hypothesis offered a trade-off--in the short run at least--between inflation and unemployment. If the unemployment rate is deemed to be unacceptably high, expansionary policy could be taken to lower it; one of the costs of the policy would be a higher rate of inflation. Conversely, a high rate of inflation could be restrained, but only at the cost of higher levels of unemployment.

The U.S. experience during the 1960's fitted the Phillips hypothesis fairly well. The average annual rates of unemployment and annual percentage changes in prices for the United States are plotted in Chart 1. In the early 1960's the unemployment rate was relatively high, ranging up to 6.7 percent in 1961, and the rate of price inflation was quite low, at around 1 percent. As the decade of the 1960's progressed, the unemployment rate fell to lower levels as the inflation rate rose. It did indeed seem possible to trade more inflation for less unemployment, although by the end of the decade the terms of the trade-off had become increasingly unfavorable. By the 1970's, however, unemployment and inflation were rising together, and the trade-off entirely disappeared.

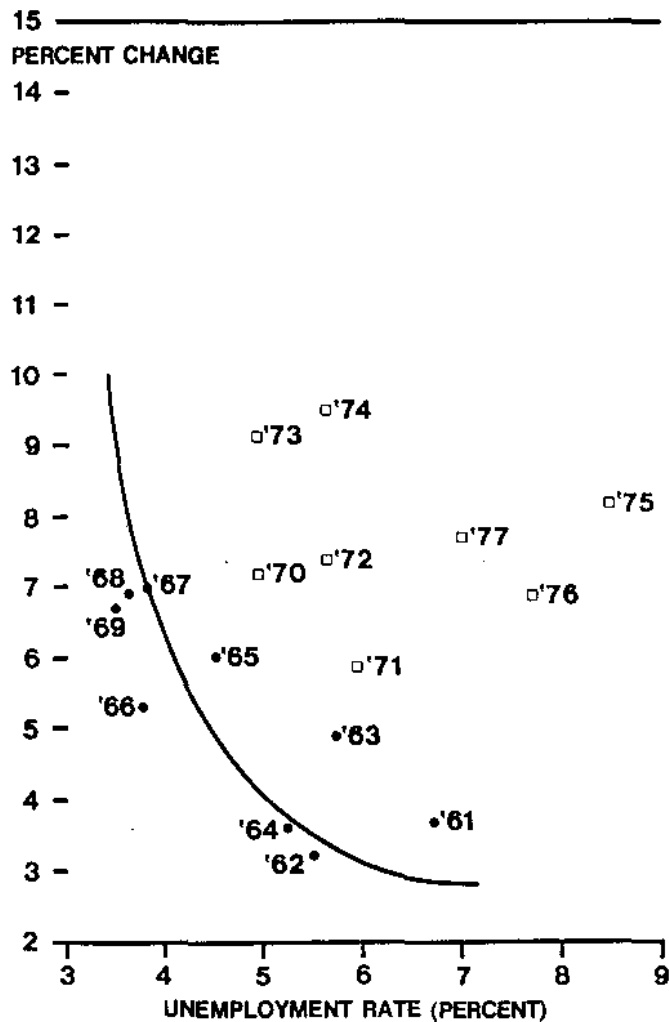
Chart 1

The Phillips curve so apparent in the 1960's disappeared in the 1970's

RATE OF CHANGE IN CONSUMER PRICE INDEX



RATE OF CHANGE IN HOURLY EARNINGS INDEX, PRIVATE NONFARM ECONOMY



SOURCE: U.S. Department of Commerce.

The most important reason for this disappearance is an implicit assumption in the simple Phillips relationship that expectations about future prices do not change. For most of the period originally studied by Phillips, the assumption of stable price expectations was probably satisfied. The assumption was also fairly reasonable for the United States until persistent acceleration in the inflation rate led to significant revisions in the public's expectations.

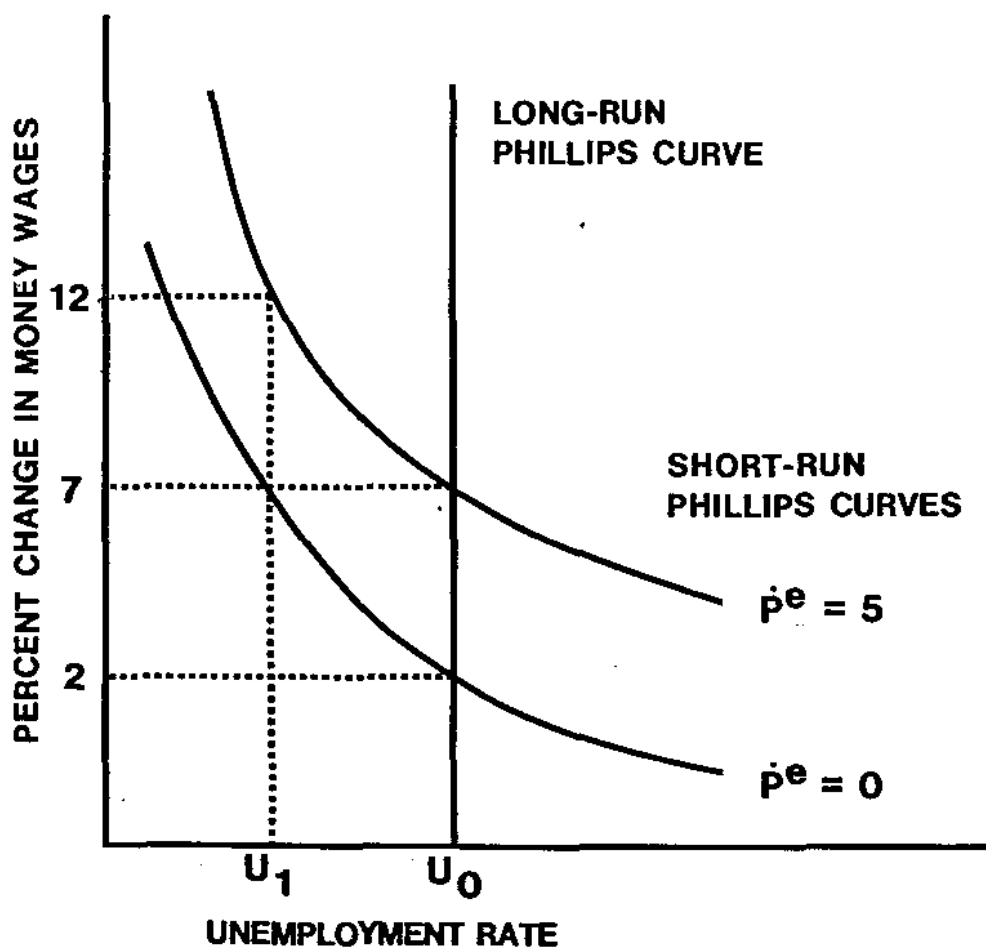
The Role of Price Expectations in Affecting the Trade-off

The importance of price expectations for a stable trade-off is illustrated in Chart 2. Job vacancies and unemployed persons exist simultaneously in an economy because of imperfect information in the labor market. If demand in the economy expands, the effect is to raise the number of vacancies, reduce the number of unemployed, and lower the average period of unemployment. ^{3/} When the number of job vacancies is approximately equal to the number of unemployed, there is full employment of labor in an economic sense, with no market pressure acting to bid up anticipated real wages faster than current increases in labor productivity. This full-employment rate of unemployment--sometimes called the "natural" rate--is denoted as U_0 on Chart 2.

At this rate of unemployment, the pace of money wage increases depends on the pace of price inflation that is anticipated. If no price inflation is expected because there has been none in the past, competition in the market tends to raise money wages by the growth of labor productivity, or about 2 percent a year in the United States. Moreover, with this balanced condition of employment in the labor market, the expected rate of inflation would be realized. A 2-percent annual increase in money wages would be offset by the 2-percent increase in labor productivity, leaving unit labor costs and prices unchanged.

Chart 2

Adjustments in price expectations
erase short-run trade-off between
unemployment and wage inflation



NOTE: \dot{p}^e denotes the expected rate of price inflation.

Moreover, such a balanced condition in the labor market is consistent with any rate of inflation. For example, suppose that a 5-percent rate of inflation is anticipated because that is what has occurred in the past. Competitive market forces would still lead to the 2-percent increase in anticipated real wages determined by the growth of labor productivity. But in order for expected real wages to rise 2 percent, money wages would have to increase 7 percent. Once again, expectations would be realized because unit labor costs and hence prices would rise by 5 percent (the 7-percent increase in money wages less the 2-percent increase in labor productivity).

Of course, there is a monetary requirement for such steady rates of inflation. With no inflation, the Federal Reserve System would need only to provide sufficient money balances to accommodate continued growth of output at stable prices. But with a 5-percent inflation rate, the growth of the money supply would have to be approximately 5 percent higher to provide for inflated levels of spending.

Thus, the full-employment rate of unemployment is consistent with any sustained rate of inflation. Moreover, in the long run, monetary and fiscal policies cannot influence the unemployment rate; they only affect inflation. But over a shorter period--before expectations can adjust to price changes--a trade-off between unemployment and inflation does exist, as in the simple Phillips curve. Suppose, for example, that in Chart 2 unemployment is initially U_0 and wages are rising at a 2-percent rate on the short-run Phillips curve where expected inflation is zero. Next, suppose that policies that increase aggregate demand are used to reduce the unemployment rate from U_0 to U_1 . In this tight labor market, firms would bid up anticipated real wages faster than increases in labor productivity in order to attract more labor, and strong demand would allow them to pass the increased costs along to consumers.

The relationship between demand pressure and anticipated real wage changes is assumed to be such that at U_1 anticipated real wages now rise 7 percent, or 5 percentage points more than the increase in labor productivity. As long as no inflation is expected, money wages would also rise by 7 percent. This leads to a 5-percent increase in unit labor costs (7-percent increase in wages less 2-percent increase in productivity) and hence a 5-percent increase in prices.

The unemployment rate cannot stay at U_1 forever, though, because the 5-percent price inflation is at odds with the price stability that market participants anticipate; as soon as price expectations adjust to actual experience the relevant Phillips curve is a new and higher one, as shown in Chart 2. Given the same underlying relationship between demand pressure and anticipated real wage changes, the increase in money wages at U_1 on the new short-run Phillips curve would now be 12 percent (5-percent anticipated inflation plus 7-percent increase in anticipated real wages). And at the natural rate of unemployment, U_0 , money wages would rise by 7 percent (5-percent expected inflation plus the 2-percent increase in anticipated real wages corresponding to the increase in labor productivity.) That is, once a 5-percent rate of inflation becomes anticipated, the trade-off disappears.

We see then that while there is a trade-off between wage changes and unemployment, the stable trade-off exists between anticipated changes in real wages and unemployment, not between simple money wage changes and unemployment as the original Phillips analysis supposed. There is a whole family of Phillips curves relating the change in money wages to the unemployment rate, each curve corresponding to a different rate of expected price inflation. 4/

Recent Shifts in the Trade-off

The introduction of price expectations into the wage-unemployment equation helps to explain the U.S. experience illustrated in Chart 1. Price inflation in the United States remained low in the early 1960's, with wage inflation barely exceeding the growth of labor productivity. In the latter part of the 1960's and into the 1970's, inflation accelerated. Higher anticipated inflation pushed up the short-run Phillips curve even during recessions, once in 1970 and again in 1974, causing a combination of rising unemployment and larger increases in money wages and prices, rather than an inverse relationship.

A second important factor affecting the relationship between unemployment and changes in wages and prices in this period was a changing composition of the labor force. The overall rate of unemployment is commonly used to represent the degree of labor market tightness. The logic of using it rests on the assumption that there is a fairly stable inverse relationship between the number of job vacancies and the number of unemployed. In this case, the unemployment rate is a reasonably good proxy for the difference between them, which in turn is a measure of the excess demand in the labor market. If the unemployment rate is inversely related to excess demand for labor and if changes in (anticipated real) wages are proportional to the size of this excess demand, then the Phillips relationship modified for the effects of price expectations is obtained.

But the rate of unemployment at any time reflects both the level of demand in the labor market and an amount of "frictional" unemployment. Frictional unemployment, or the presence of unemployment simultaneously with job vacancies, exists because some people are in the process of changing jobs while others are entering the labor force, either for the first time or after previously leaving the labor force.

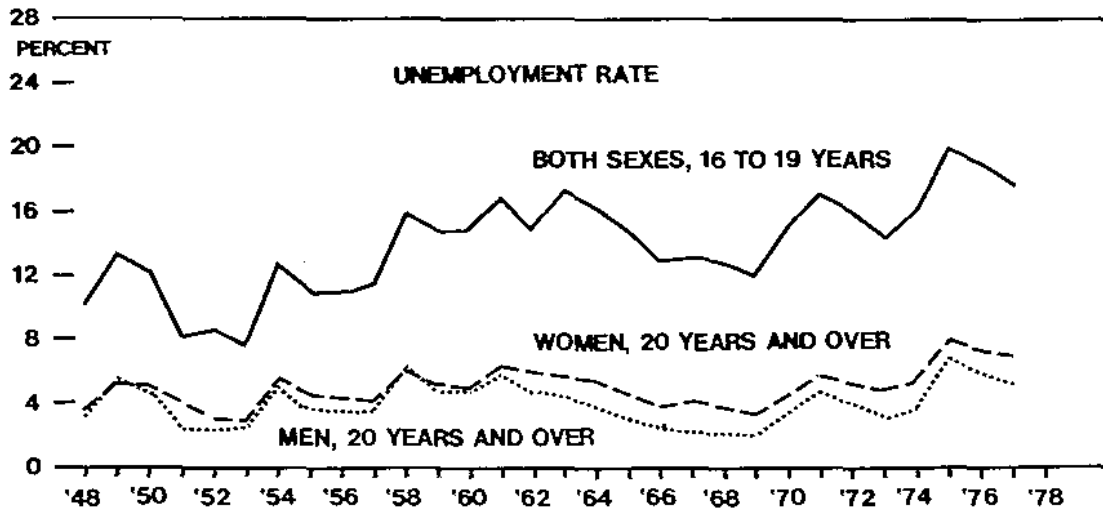
To function as an accurate indicator of the state of the labor market over time, the unemployment rate must be corrected for changes in the normal amount of frictional unemployment. Frictional unemployment has increased during the postwar period, primarily in response to changes in the composition of the labor force. These changes affect the overall frictional unemployment rate because the frequency and duration of periods of unemployment differ among various groups within the labor force.

As shown in Chart 3, during most of the postwar period, groups with relatively high unemployment rates have increased relative to those with low unemployment rates. In particular, the proportion of the labor force composed of men over the age of twenty declined from 65 percent of the labor force in 1955 to 60 percent in 1965; by 1977 it had fallen to 54 percent. These males have low unemployment rates compared with other age-sex groups.^{5/} The compensating increases in the remaining proportions of the labor force were concentrated among women and young people, groups with relatively high frictional unemployment rates. The percentage of the labor force composed of teenaged males rose from 3.6 percent in 1955 to 5.1 percent in 1977. For women, the percentage rose from 32 percent in 1955 to 41 percent in 1975. These changes in the labor force have increased the rate of frictional unemployment and thus the overall unemployment rate associated with any given level of excess demand in the labor market.

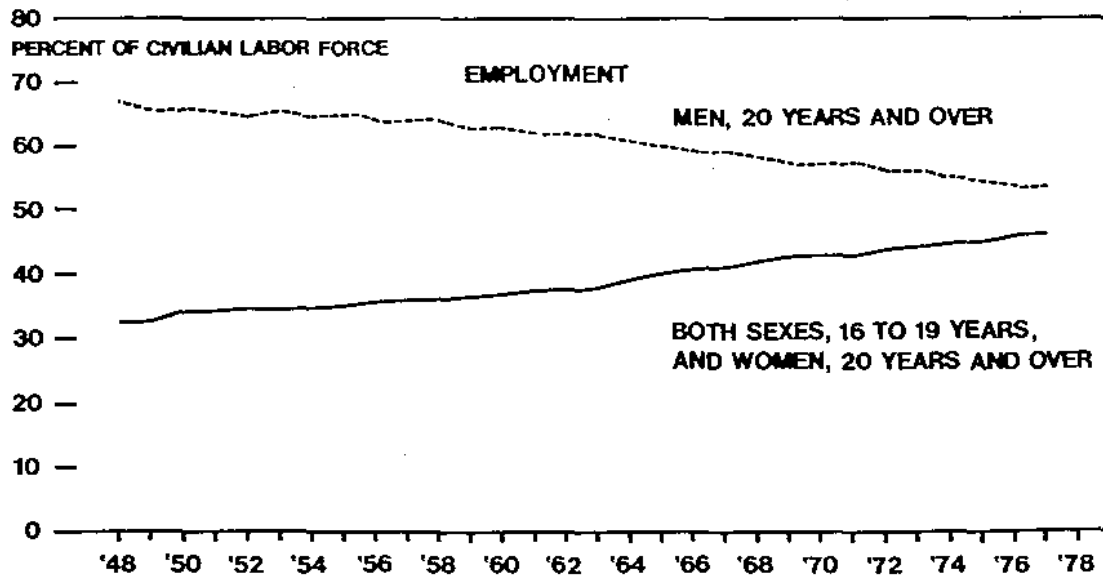
The increase in frictional unemployment resulting from these changes in the composition of the labor force has moved the short-run Phillips curve outward to the right over most of the postwar period. So, given price expectations, a higher rate of wage and price inflation is now associated with any level of unemployment. This is another important reason why inflation has appeared to be more resistant to policies working through aggregate demand.

Chart 3

Young people and women have higher average unemployment than adult males . . .



. . . and have been a growing proportion of the labor force



SOURCE: U.S. Bureau of Labor Statistics.

But a better measure of demand pressures in the labor market is all that is needed to account for the change. One such measure, which is more likely to have maintained a stable relation to demand pressures and which is therefore used in this study, is the unemployment rate for men aged 25 to 54, commonly referred to as prime-age males. 6/

A New Inflation in the 1970's?

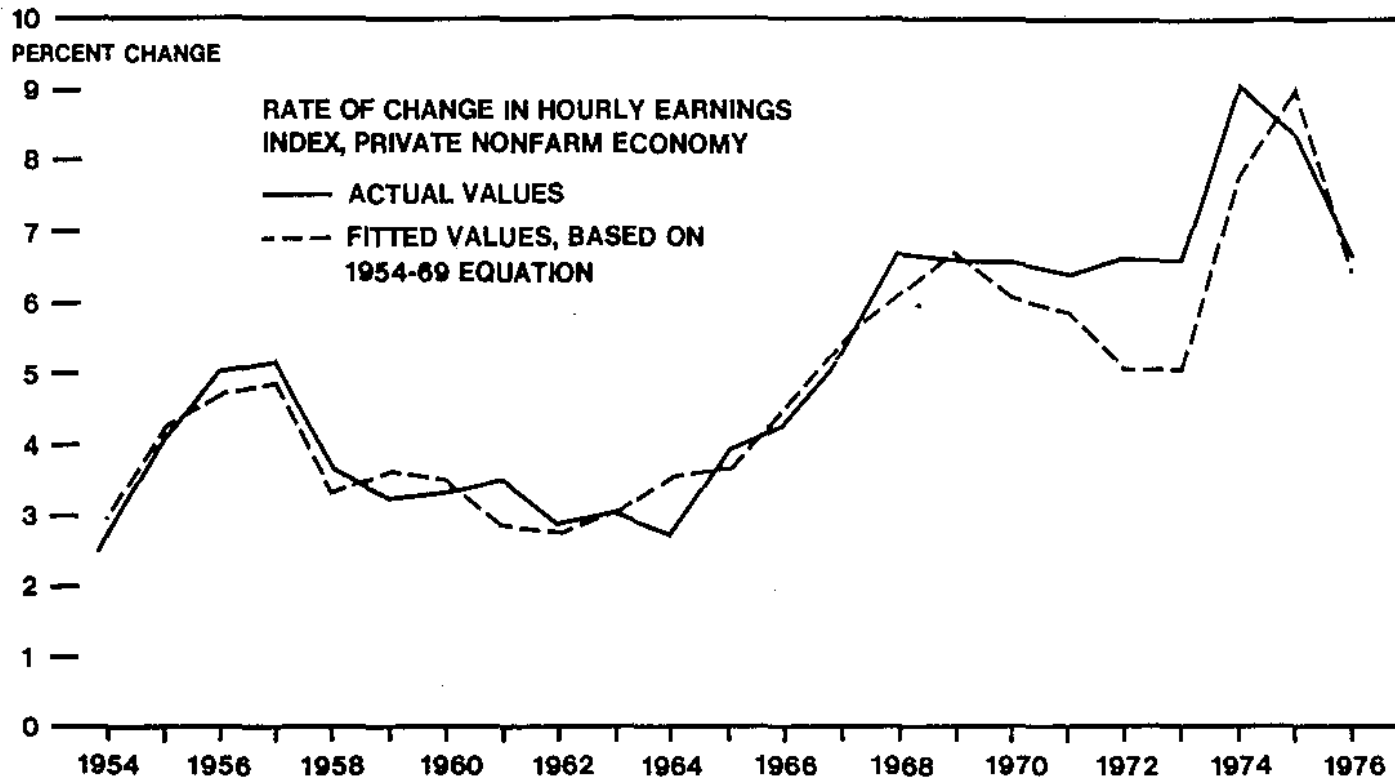
In this section we assess whether inflationary psychology and a changing composition of the labor force were the main new factors in the inflation of the 1970's or whether other factors somehow have had the effect of making inflation less susceptible to aggregate demand policies. A Phillips-type relationship, adjusted for the effects of price expectations and the changing composition of the labor force, was first estimated for the period 1954-1969. This estimated relationship was then used to predict wage changes during the years 1970-1976 using actual data on prices and unemployment for the period. 7/

This relationship is able to track wage changes quite closely (see Chart 4). The mean absolute error in estimating one-quarter wage changes (at annual rates) is .59 percentage points within the sample period. The equation also tracks reasonably well outside the sample period. The major error in this period is an underprediction of wage changes in 1972 and 1973 after the imposition of wage and price controls. This can be partially explained by the fact that our modified Phillips equation uses a weighted average of recent price increases to measure anticipated price inflation, which may underestimate inflationary expectations in this period since the controls were generally believed to be temporary.

Most importantly, though, statistical tests indicate that there was no change in the structure of the modified Phillips equation between the

Chart 4

Except for the period of price controls, wage changes are well tracked by a model based on demand pressures only



SOURCES: U.S. Bureau of Labor Statistics.
Federal Reserve Bank of Dallas.

earlier period and the 1970's. (Details of these tests and the equation estimates on which they are based are given in the Appendix.) More specifically, there is no evidence that the short-run trade-off between inflation and unemployment underwent any significant change between 1954-1969 and the 1970's. Nor is there any indication of greater rigidity in the formation of inflationary expectations. Aggregate demand policies for reducing inflation first affect the unemployment rate, which then tends to move the inflation rate down according to the terms of the short-term trade-off. Over a period of time, the lower inflation rate reduces price expectations to produce a lower inflation rate at any level of unemployment. Our tests suggest that the speed with which these processes occur is no different now than in earlier years.

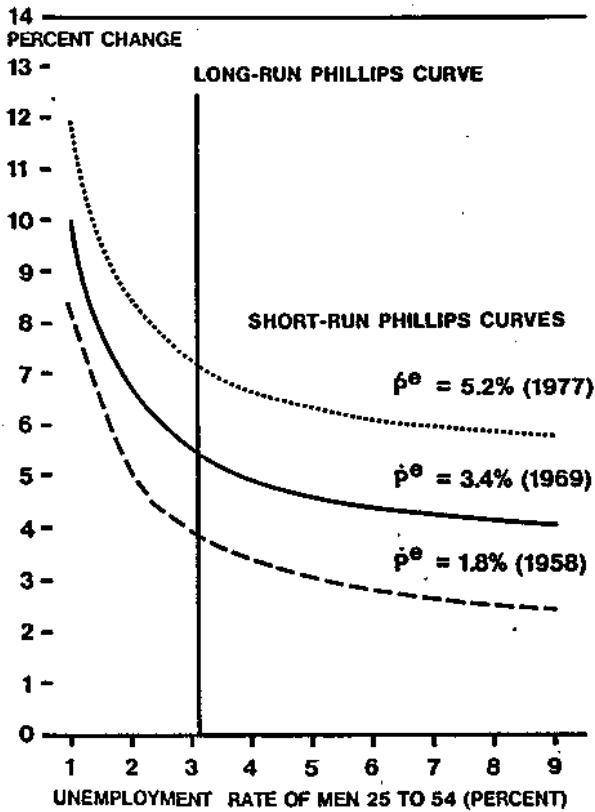
In Chart 5, the short-run Phillips curves implied by the estimated equation are plotted for three periods ending 1958, 1969, and mid-1977. The estimates indicate that in 1958 the public anticipated an inflation rate of around 1.8 percent, as measured by the nonfarm price deflator. According to the estimates, this expected inflation rate was fully incorporated into wage agreements as they were negotiated and was based on the actual inflation experience during the 20 previous quarters. By 1969, accelerating inflation produced a more pronounced inflation psychology, with the expected inflation rate at 3.4 percent; by mid-1977, the expected inflation rate reached 5.2 percent. As the inflationary psychology gained strength, the short-run Phillips curve shifted upward so that larger wage and price changes resulted at any given rate of unemployment.

It is also possible to infer the position of the long-run Phillips curve from our estimates. The long-run Phillips curve is vertical at the natural rate of unemployment. On the long-run curve, the rate of change in

Chart 5

Over the past two decades, inflationary psychology has become more pronounced, leading to a higher inflation rate at any level of unemployment.

RATE OF CHANGE IN HOURLY EARNINGS INDEX, PRIVATE NONFARM ECONOMY



NOTE: \dot{p}^e denotes the expected rate of price inflation. The short-run Phillips curves are plotted for different unemployment rates, assumed constant for eight quarters.

wages and consequent change in prices are consistent with the rate of price change anticipated by market participants, implying an equilibrium in the labor market. According to our estimates, a 3.1-percent rate of unemployment for prime-age males would increase wages at a rate about 2 percentage points more than the anticipated inflation rate, the 2-percent figure being equal to the average growth of labor productivity. Thus, we estimate the natural rate of unemployment for prime-age males to be about 3.1 percent. The difference between the unemployment rate for prime-age males and the total unemployment rate has averaged about 2.5 percent during the past five years. Our estimates therefore indicate that the natural rate of total unemployment is currently around 5.6 percent. According to these results, inflation will accelerate if unemployment is held for long below 5.6-percent; conversely, in order for inflation to decelerate, unemployment would have to average above 5.6 percent for some period of time. 8/

Some Implications for Policy

Our analysis suggests that wage inflation and the trend of price inflation can be as well explained by demand factors in the 1970's as in the years before. Of particular importance is our conclusion that the structural relationships by which demand affects inflation have not changed appreciably in the 1970's. The short-run trade-off between inflation and unemployment does not, in fact, appear to be any worse than in earlier years. 9/

In the recessions of 1954, 1957, and 1960, inflation was halted quite promptly by weak demand because inflation had not accelerated much in the previous expansions and so did not lead to greater inflationary expectations and pressures on wages after labor markets weakened. By contrast, the recessions of 1970 and 1974-1975 followed periods of rapidly accelerating inflation, which meant that inflationary psychology and its

impact on wages and prices gained strength even after economic activity had peaked.

Nor is there any indication that price expectations are formed differently now than in the past. The lags in the formation or elimination of inflationary psychology have always been, and remain, generally long. Our estimates suggest that it takes five years before past experience with inflation becomes fully embodied in expectations of future price behavior. Because of these long lags, slack in the economy has to be maintained for a relatively long time if inflation is to be reduced. But this conclusion should not be so surprising. Just as it took nearly a decade with unemployment rates below the natural rate for inflation to accelerate to its current levels, a program of deceleration might take equally long. Our estimates provide an idea of the magnitudes involved. According to them, an unemployment rate of 8 percent would have to be maintained for four years in order to bring the rate of price inflation down to 4 percent and 9 1/2 years to reduce it to 2 percent.

These estimates, of course, assume that the expectations of inflation will continue to be formed much as they have been in the past, depending greatly on recent price changes. But a more encouraging scenario is possible. If market participants could be persuaded that the Government is going to use monetary and fiscal policies in an effective and consistent manner to reduce inflation, then inflationary psychology could be eliminated mainly by the anti-inflation policies themselves, without the need for a longer, drawn-out response to experience. In this case, the short-run Phillips trade-off between inflation and unemployment would shift down much more rapidly in response to anti-inflation policies than would be the case if market participants were unaware of these policies or did not believe they

would be successful. And the cost of the policies in terms of foregone production and employment would be lessened. Fashioning a credible policy against inflation and informing the public of its expected effects is the great challenge facing Government today.

APPENDIX

The modified Phillips equation that was estimated is of the form:

$$\dot{W}_t = \alpha + \sum_{i=0}^m \beta_i U_{pm,t-i}^{-1} + \sum_{i=1}^n \lambda_i \dot{P}_{t-i} + \varepsilon_t.$$

U_{pm}^{-1} represents the inverse of the unemployment rate of males, ages 25 to 54, which is used to obtain a constant measure of the tightness of the labor market over the entire period. \dot{P} represents the percentage change in prices as measured by the nonfarm price deflator; it is lagged over a number of periods as a proxy for expected price inflation. \dot{W} is the percentage change in the hourly earnings index for the private nonfarm economy. ε represents a stochastic disturbance. All changes and levels were calculated at quarterly intervals from 1948 to 1977. 10/

The objective was to specify a Phillips curve relationship that was the same for the periods before and after 1970. If a stable relationship could be estimated, it would suggest that the same structural relationships that determined wages in the early period continued unchanged during the 1970's. A secondary objective was to find out how long it ordinarily takes for wages to respond to changes in unemployment and in expected price inflation, in order to obtain some idea of the normal lags in the effects of aggregate demand policies.

The coefficients were estimated using the Almon lag technique, which constrains the coefficients of the lagged variables to follow a polynomial of a degree that must be specified by the researcher. In order to use the Almon method, the researcher must also specify the number of periods over which the variables are lagged and whether the endpoints of the

polynomial are constrained to zero. Endpoint constraints were not used in this study.

If the degree of the polynomial or the number of periods is specified incorrectly, the Almon technique creates biased estimates and invalid tests for the significance of variables. Fortunately, several tests have been developed to detect specification errors caused by an incorrect lag or degree of polynomial. Specifically, it can be shown that an incorrect specification of lag or degree of polynomial will result in a nonzero expected value of the disturbance term. 11/

Two tests for nonzero mean of the residuals, RASET and RESET, were used. RESET is based on an F-test and assumes that the residuals have a multivariate normal distribution. RASET is an application of Spearman's rank correlation test and does not depend on the existence of normality. By applying RASET and RESET, the researcher can determine the absence or existence of a lagged relationship within Almon's method and can reject incorrect specifications of the length of the lag or the degree of the polynomial.

In this study, regressions were run for the sample period of 1954 through the second quarter of 1977 using all possible combinations of degree of polynomial, from 2 to 4, on the price and unemployment variables. The lag on unemployment varied up to 16 quarters; on prices, up to 24 quarters. RASET and RESET were used to eliminate equations with specification errors evident at the 95-percent confidence level.

The sample period was next divided into the period from 1954 through 1969 and the period from 1970 through the second quarter of 1977. The coefficients of the remaining equations were estimated for each period, and a standard F-test was used on each set of equations to test the null hypothesis that the coefficients did not change from one period to the next. 12/

The tests indicated that at the 95-percent confidence level, two equations are stable between the two periods; in both equations a second-degree polynomial is imposed on prices and unemployment. Prices are lagged over 20 periods in both equations; in the first, unemployment is lagged over eight quarters, and in the second, over 12 quarters:

$$\dot{w}_t = -0.019 + 1.626 U_{pm}^{-1} + 0.987 \dot{p} + e_t \quad \bar{R}^2 = .7595 \\ (-.163) \quad (6.20) \quad (11.20) \quad \text{S.E.} = .2047$$

$$\dot{w}_t = -0.017 + 1.611 U_{pm}^{-1} + 0.991 \dot{p} + e_t \quad \bar{R}^2 = .7602 \\ (-.143) \quad (5.91) \quad (10.06) \quad \text{S.E.} = .2404$$

The coefficients reported are the sum of the coefficients over the lagged period. The numbers in parentheses are t-ratios. The standard error (S.E.) is expressed in percent change per quarter. Except for the constant term, all coefficients are significant at the 1-percent level. The estimates are not especially sensitive to the difference in the length of lag on unemployment. The first equation was used to obtain the fitted values for Chart 5. 13/

Besides the stability of these equations, what is particularly noteworthy is that in neither equation is the coefficient of the lagged changes in prices significantly different from unity. Since the distributed lag on price changes is interpreted here as a measure of anticipated inflation, this result implies that anticipated inflation is fully taken into account by participants in the wage-setting process.

FOOTNOTES

1. Committee for Economic Development, Fighting Inflation and Promoting Growth (New York: Committee for Economic Development, 1976), p. 15.
2. Ibid., p. 63.
3. The labor force participation rate tends to vary directly with the level of aggregate demand in the U.S. economy, modifying somewhat the relationship between demand and unemployment. For example, if aggregate demand falls, potential entrants into the labor force tend to be discouraged from looking for a job by the higher unemployment rate. Since these discouraged workers are not part of the labor force, the effect operates to reduce labor force participation. However, the response of labor force participation is not so large that a decrease in aggregate demand could produce a decrease in the unemployment rate, but rather it makes the increase in unemployment less than what it would otherwise be.
4. Assuming a linear relationship for illustrative purposes, the stable curve relating the expected change in real wages to the unemployment rate can be written as: $\dot{W} - \dot{P}^e = a + bU$, where the dot over the variable indicates a rate of change, \dot{W} is the rate of wage inflation, \dot{P}^e is the anticipated rate of price inflation, and U is the unemployment rate. The difference between \dot{W} and \dot{P}^e measures the anticipated change in real wages. Transposing terms, we obtain: $\dot{W} = a + bU + \dot{P}^e$, or a Phillips curve modified for the effects of price expectations. An equation of this general form was used in the present study to estimate whether the effect of aggregate demand policies on wage and price inflation is now different than before.

5. The higher unemployment rates of most groups relative to males occur because these groups become unemployed more often, even though they remain unemployed for a shorter period in each instance of unemployment. The greater frequency of unemployment dominates the lower duration. For women, the greater frequency of unemployment has been rooted in a desire to leave the labor force from time to time, to raise families or care for the home, and subsequently to reenter it. The high frequency of unemployment of young people also appears due to a weaker attachment to the labor force or to particular jobs.
6. No attempt was made to adjust for other, relatively minor, factors that have worked to increase the level of frictional unemployment in recent years. These include a longer duration of unemployment benefits, extended coverage of a minimum wage, and the requirement that welfare and food stamp recipients register for work.
7. The relationship and an explanation of the statistical procedures used to estimate it are presented in the Appendix.
8. Furthermore, since no allowance was made for the factors listed in Footnote 6 that have increased the level of frictional unemployment in recent years, the estimate is probably biased downward.
9. Using a different test for stability than the one employed here, a recent study by Michael Wachter goes so far as to suggest that the influence of unemployment on inflation is greater today than it was in the 1950's. But some discussants of his study suggest that this conclusion is overdrawn and that the evidence is more consistent with there being no change in the relationship. See Michael L. Wachter, "The Changing Cyclical Responsiveness of Wage Inflation," Brookings Papers on Economic Activity, no. 1, (1976): pp. 115-59, and the discussion following.

10. The source of the hourly earnings index was Current Wage Developments, Bureau of Labor Statistics, U.S. Department of Labor; the unemployment rate, Employment and Earnings, Bureau of Labor Statistics; and the nonfarm price index, Survey of Current Business, Bureau of Economic Analysis, U.S. Department of Commerce.
11. See J. B. Ramsey, "Tests for Specification Errors in Classical Linear Least-squares Regression Analysis," Journal of the Royal Statistical Society, ser. B, 31 (1969): 350-71. Also see Charles P. Harper, "Testing for the Existence of a Lagged Relationship Within Almon's Method," Review of Economics and Statistics, 59 (May 1977): 204-10.
12. See Jan Kmenta, Elements of Econometrics, Macmillan Series in Economics (New York: Macmillan Co., 1971), pp. 373-74.
13. To obtain the fitted values for Chart 4, a regression equation was estimated with prices lagged over 20 quarters and unemployment lagged over 12 quarters, using data from 1954 to 1969. The estimated equation was:

$$\dot{W}_t = 0.259 + 1.278 U_{pm}^{-1} + 0.632 \dot{P} + e_t \quad \begin{array}{l} \bar{R}^2 = .6962 \\ \text{S.E.} = .1866 \end{array}$$

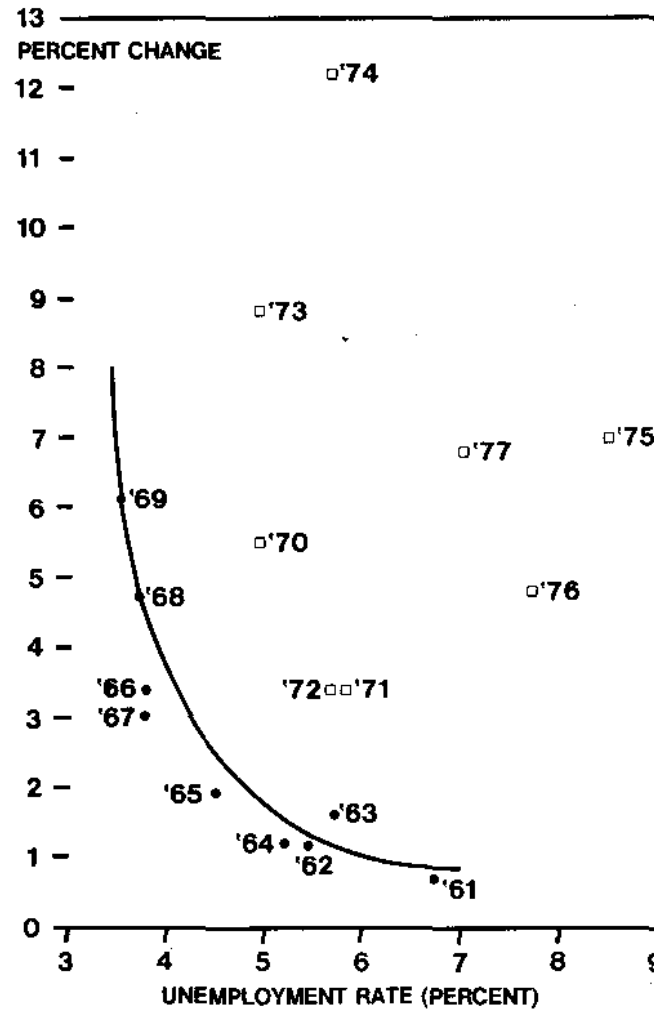
(2.16) (3.31) (2.52)

This equation was then used to construct the predicted values for the 1970-1977 period in Chart 4. Note that although the value of the price coefficient is lower in this equation, the t-test rejects the hypothesis that it is significantly different from unity at the confidence level of 90 percent or above.

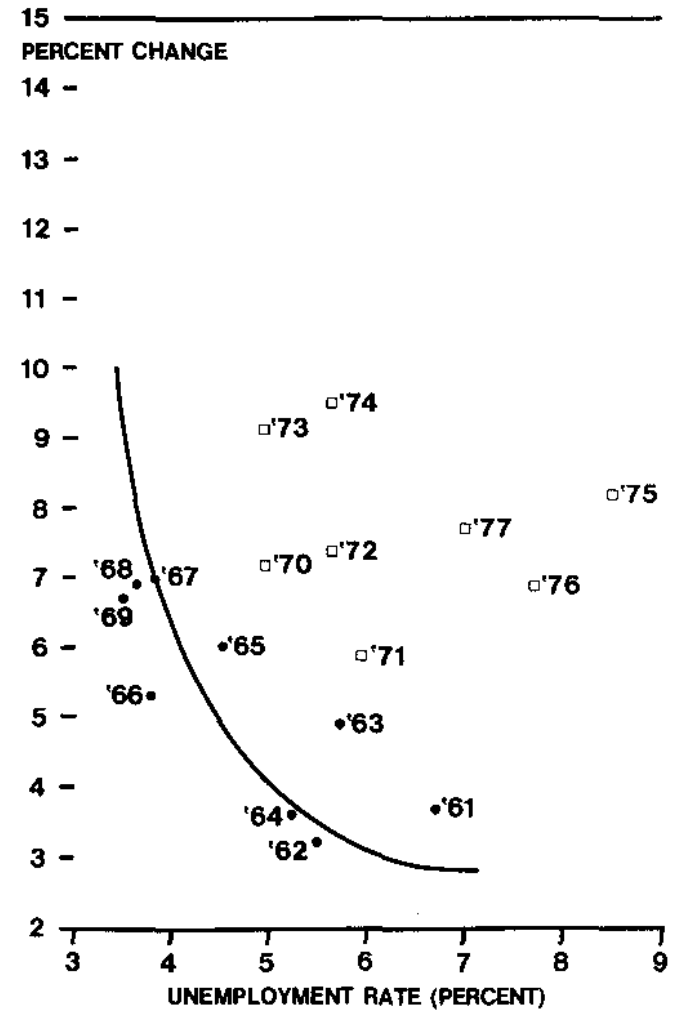
Chart 1

The Phillips curve so apparent in the 1960's disappeared in the 1970's

RATE OF CHANGE IN CONSUMER PRICE INDEX



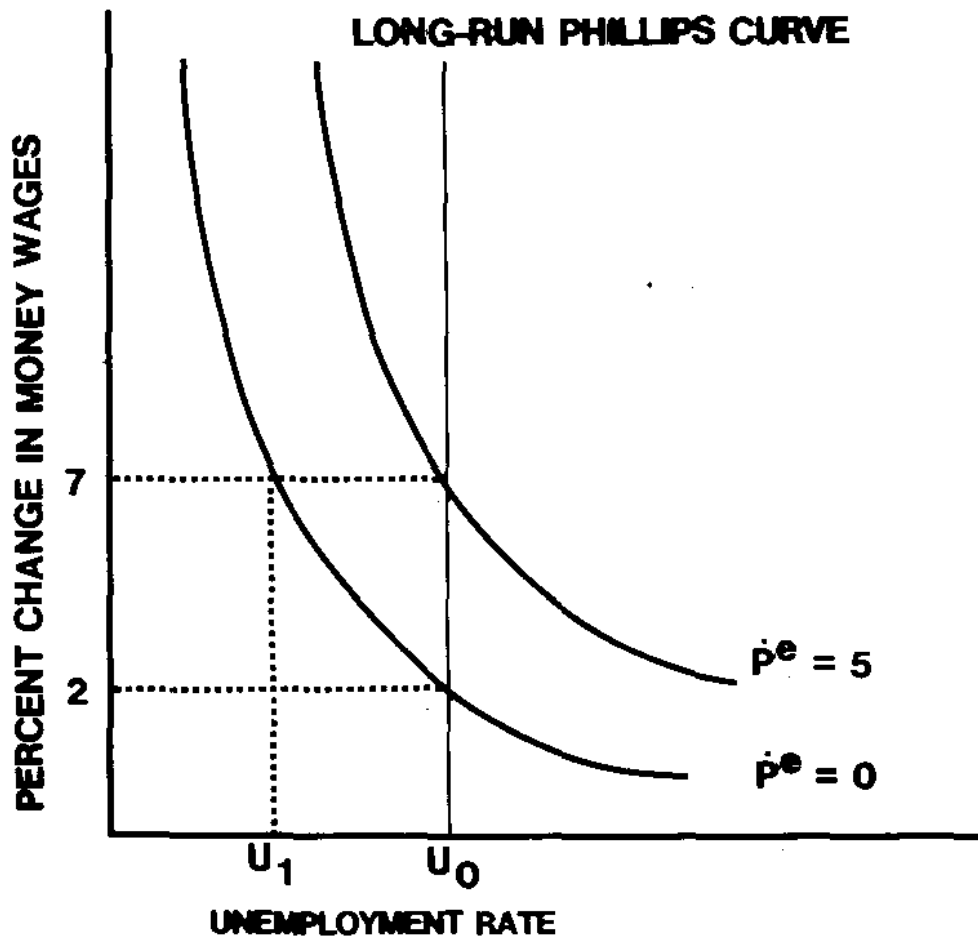
RATE OF CHANGE IN HOURLY EARNINGS INDEX, PRIVATE NONFARM ECONOMY



SOURCE: U.S. Department of Commerce.

Chart 2

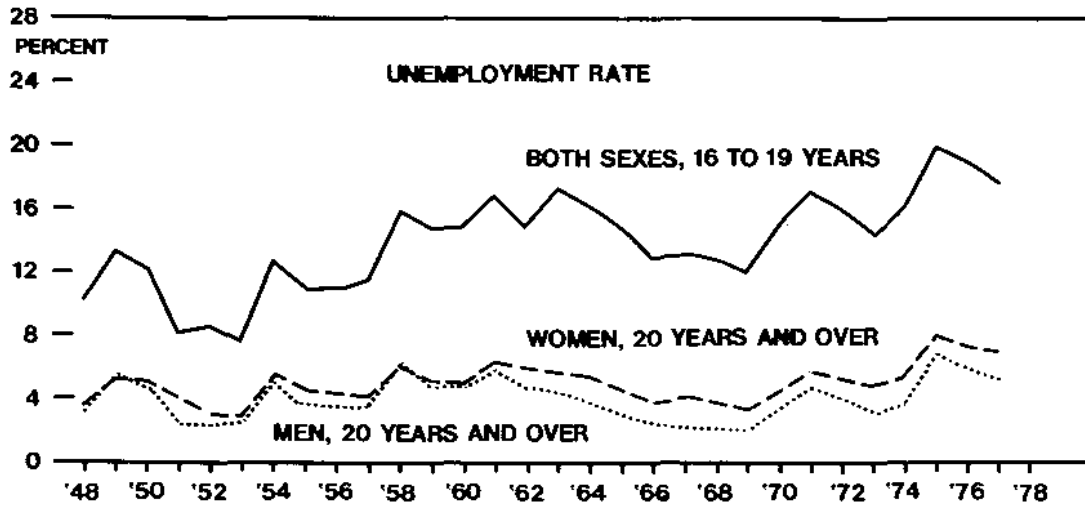
Adjustments in price expectations
erase short-run trade-off between
unemployment and wage inflation



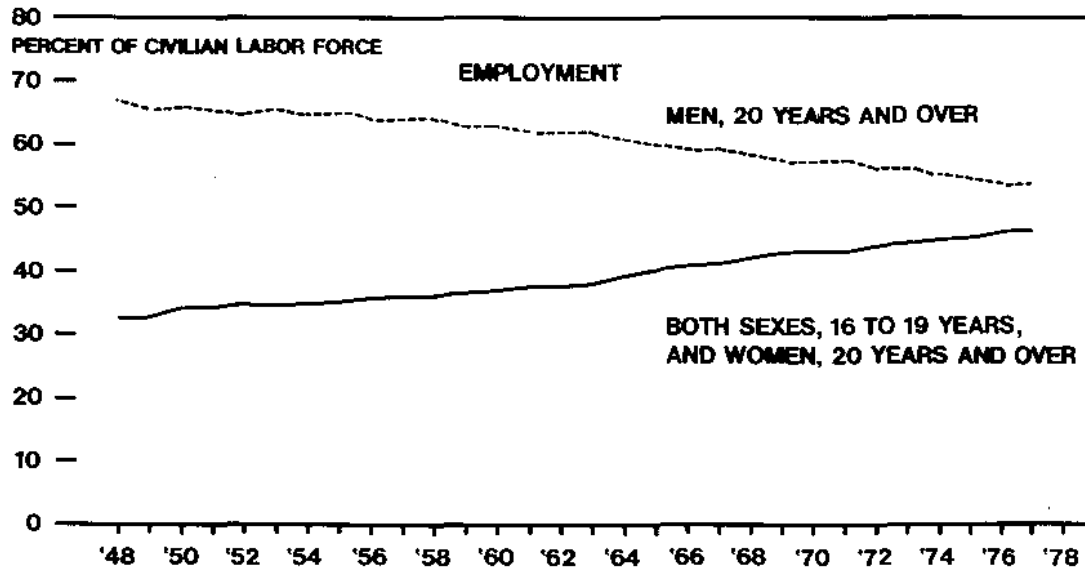
NOTE: \dot{p}^e denotes the expected rate of price inflation.

Chart 3

Young people and women have higher average unemployment than adult males . . .



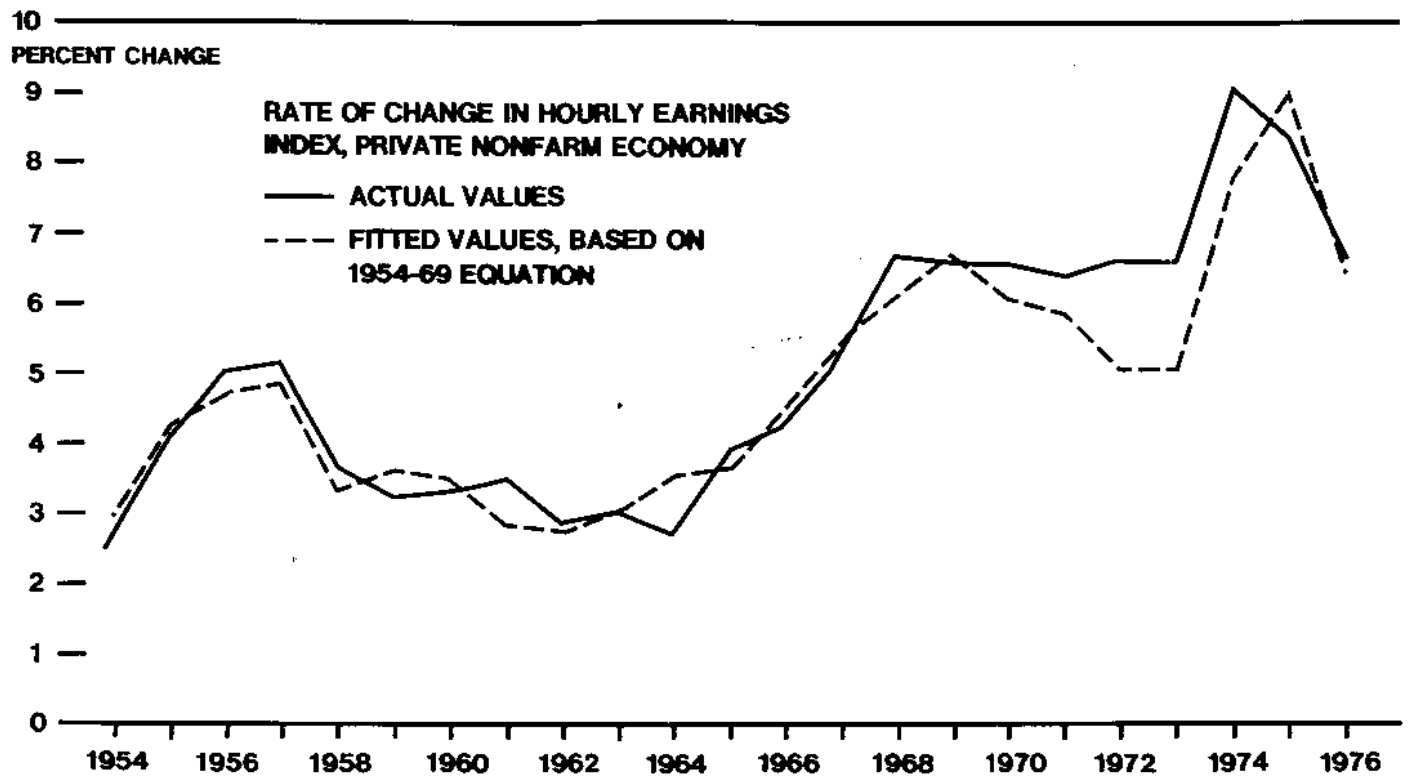
. . . and have been a growing proportion of the labor force



SOURCE: U.S. Bureau of Labor Statistics.

Chart 4

Except for the period of price controls, wage changes are well tracked by a model based on demand pressures only

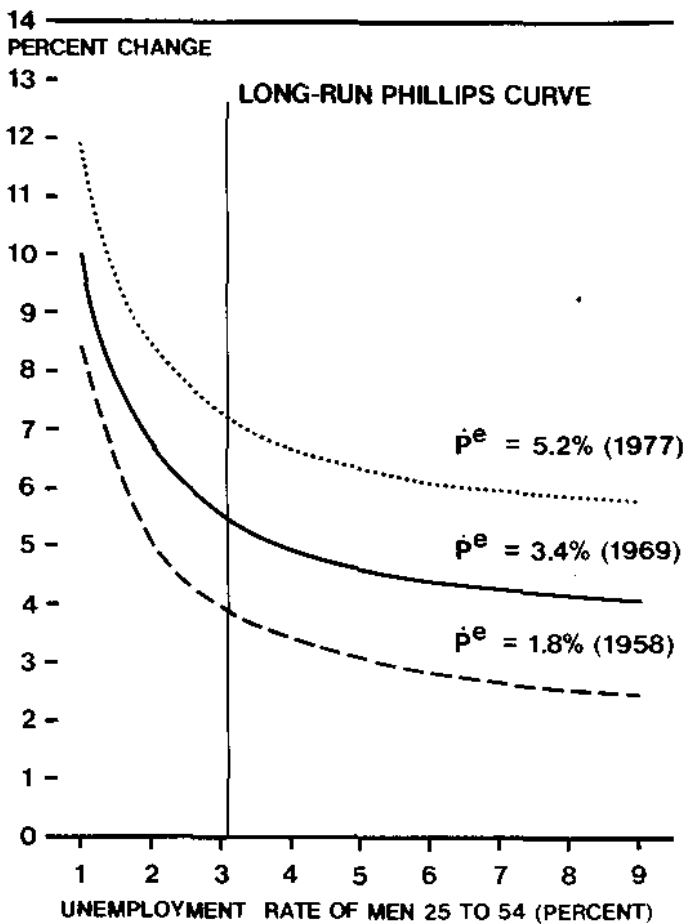


SOURCES: U.S. Bureau of Labor Statistics.
Federal Reserve Bank of Dallas.

Chart 5

Over the past two decades, inflationary psychology has become more pronounced, leading to a higher inflation rate at any level of unemployment

RATE OF CHANGE IN HOURLY EARNINGS INDEX, PRIVATE NONFARM ECONOMY



NOTE: \dot{p}^e denotes the expected rate of price inflation. The short-run Phillips curves are plotted for different unemployment rates, assumed constant for eight quarters.