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THE "NATURAL" RATE OF UNEMPLOYMENT

A STAFF STUDY

PREPARED FOR THE USE OF THE

SUBCOMMITTEE ON MONETARY AND FISCAL POLICY

OF THE

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LETTER OF TRANSMITTAL

DECEMBER 13, 1982.

Hon. HENRY S. REUSS,
Chairman, Joint Economic Committee,
Congress of the United States,
Washington, D.C.

DEAR MR. CHAIRMAN: I am pleased to transmit herewith a staff study entitled "The 'Natural' Rate of Unemployment." The staff study was prepared by Dr. Lowell E. Gallaway of the Joint Economic Committee staff and Dr. Richard K. Vedder, a former member of the Committee staff.

This staff study provides estimates of the magnitude of the rates of unemployment that are "normal" or "natural" for the American economy since 1960. These estimates show that the "natural" rate of unemployment has been increasing quite regularly and currently is in the vicinity of 7 percent of the labor force. The estimates contained in this staff study provide a benchmark that should prove useful in interpreting the true extent of U.S. unemployment.

Sincerely,

ROGER W. JEPSEN,
Chairman, Subcommittee on Monetary and Fiscal Policy.

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THE "NATURAL" RATE OF UNEMPLOYMENT

By Lowell E. Gallaway* and Richard K. Vedder**

I. INTRODUCTION

Possibly the most discussed indicator of the overall performance of the American economy is its unemployment rate. A seemingly straightforward statistic, measuring the percent of those able and willing to work and unable to find jobs,[1] it is, at the same time, an imprecise number. Unemployment is not homogeneous. It arises out of a variety of situations and its very heterogeneity makes it hard to interpret. What is most difficult is the concept of the "natural," or "normal," rate of unemployment in the economy, a notion that is important from the standpoint of evaluating the significance of any particular rate of unemployment. Historically, the "natural" rate of unemployment has been confused with the idea of "full" employment, a term that carries connotations of being a desirable level of employment and one that was given something of an aura of legal status in the immediate post World War II period with the enactment of the Employment Act of 1946. That tradition has been maintained. In its most recent form, the Employment Act of 1946 states:[2]

> The Congress further declares and establishes as a national goal the fulfillment of the right to full opportunities for useful paid employment at fair rates of compensation of all individuals able, willing, and seeking to work.

Until recently, "full" employment was never defined legislatively with any exactitude. Rather, through most of the post World War II era it has been something of a "will-o-the-wisp," always elusive, always just beyond, our grasp. Even at the low levels of employment attained in the 1960's, as low as 3.5 percent in 1969, there were pleas from high places for "better" performance. In 1966, Secretary of Labor Willard Wirtz advocated pushing on towards a goal of two-and-one-half percent unemployment[3] and, on October 15, 1982, in testimony before the Joint Economic Committee, he seemed to imply that the existence of *any* unemployment meant a failure to attain "full" employment.[4]

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**Dr. Richard K. Vedder is a former economist on the staff of the Joint Economic Committee.

[1] The basic definition of unemployment is one that emphasizes individual labor market choice, i.e., people deciding whether they wish to seek work. Thus, individuals classify themselves into labor force categories through their actions in the labor market.

[2] 60 Stat. 23. Public Law 304—79th Congress.

[3] Secretary Wirtz was commenting on the February, 1966, monthly report of unemployment. It indicated a jobless rate of 3.7 percent and he expressed confidence that an unemployment rate of 2.5 percent could, and should, be attained in the American economy.

[4] This hearing was entitled "The Employment Situation."

In 1978 the Congress amended the Employment Act of 1946.[5] One of the major changes was the provision of a definition of a medium term "full" employment goal of three percent unemployment among the labor force aged 20 years and over and four percent for the labor force 16 years of age and over.[6] This medium term goal has been achieved in only seven of the post World War II years, 1951–1953 and 1966–1969. The relative infrequency with which the legislative definition of "full" employment has been achieved raises the question of whether what has been mandated by the Congress as a goal is a level of unemployment that can be permanently maintained. Or, is it merely a subjective notion of what would be desirable? In short, is the legislatively decreed concept of "full" employment one that is consistent with the "natural" unemployment rate embedded in the basic structure of the economy?

Of course, it may be asked, "What is meant by the rubric 'natural'?" From the conceptual standpoint, it is relatively easy to define the "natural" rate of unemployment. Simply think of it as the minimum sustainable rate of unemployment for the economy given a stable rate of price inflation. Put another way, the "natural" rate of unemployment may be thought of as the "equilibrium" rate of unemployment. Viewed in this fashion, the concept is stripped of the subjective element of desirability embodied in the notion of "full" employment. Rather, the "natural," or "equilibrium," rate of unemployment can be thought of as a basic constraint that the economy faces, *independent of any aspirations we might have with respect to the rate of unemployment.* As has already been noted, knowledge of the nature of that constraint is important. It provides a benchmark to which the actual performance of the American economy can be compared. In this study, estimates of the "natural" rate of unemployment will be developed for the United States in the post World War II period. Since those estimates reveal that there has been a recent upward secular trend in the "natural" rate of unemployment, the sources of that trend also will be assessed.

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[5] The amendments are popularly known as the Humphrey-Hawkins bill, the title of which is The Full Employment and Balanced Growth Act of 1978.

[6] The Employment Act of 1946, as amended in 1978, establishes this goal in Sec. 4(b)(1).

II. THE TYPOLOGY OF UNEMPLOYMENT

Before proceeding to the development of the actual estimates of the natural rate of unemployment, it is helpful to describe more fully exactly what is meant by the concept. There are two components of the natural rate of unemployment, frictional and structural. Frictional unemployment denotes the level of unemployment that is the result of short run job changes resulting from the process of reallocating labor resources in a dynamic, changing, economy.[1] Since the unemployment statistics that are collected measure people's labor force status at a particular point in time, a certain number of individuals who are "between jobs," for either voluntary or involuntary reasons, will be recorded as unemployed when the monthly labor force survey is taken.[2] The potential for frictional unemployment is substantial. In the post World War II period, job separations among manufacturing workers averaged 4.3 percent a month, with voluntary "quits" outrunning involuntary "layoffs."[3] How many of these separations translate into recorded unemployment and how much of that unemployment should be regarded as frictional, is debatable. However, an approximate estimate of the typical level of frictional unemployment can be obtained if we define frictional as meaning a period of unemployment of less than 15 weeks duration. Then, by relating the unemployment rate to the proportion of unemployment that is for periods of longer than 15 weeks, via a regression equation of the form:

$$(1)\quad U_t = a + b(U_{LT})_t$$

where U_t is the unemployment rate in time t and (U_{LT}) is the percentage of unemployment that is long term (15 weeks or longer) in nature, the intercept term in (1) will tell us what the unemployment rate would be if all unemployment were short term, i.e., frictional. Earlier in the post World War II period, an analysis of this type suggested that frictional unemployment accounted for about two percentage points of the actual rate.[4] A replication of that procedure for the decade of the 1970's indicates that frictional unemployment amounts to about one-and-one-half percentage points.[5]

The structural component of the natural rate of unemployment is the more important one. It reflects certain underlying relationships in the economy, such as the distribution of skill levels, the skill demands of industry, the demographic composition of the labor force, institutional legal constraints in the labor market, and the behavioral responses of the population. Collectively, these factors shape and determine what the minimum permanently sustainable unemployment rate

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[1] The concept of "frictional" unemployment is described in A. C. Pigou, *Theory of Unemployment* (London: 1933).

[2] The reference here is to the Current Population Survey labor force statistics that are reported by the Bureau of Labor Statistics.

[3] In the period 1947–1979, quits averaged about 2.08 percent of the labor force, *per month*, while layoffs averaged 1.62 percent. Data from *Employment and Training Report of the President* (Washington, D.C.: various issues).

[4] N. J. Simler, "Long Term Unemployment, the Structural Hypothesis, and Public Policy," *American Economic Review*, vol. LIV 1964.

[5] The estimated regression equation for the 1970's is:

$$U_t = 1.42 + .2023\ U_{LT},\ R^2 = .88$$
$$(.0261)$$

where the number in parentheses beneath the regression coefficient is its standard error.

will be. For example, the wider the range of skills among the labor force, i.e., the greater the disparity among workers' ability to perform in the work place, the more likely it is that those at the bottom end of the skill distribution will be unable to find employment. Also, to the extent the skill demands of industry exceed the capabilities of certain segments of the labor force, structural unemployment may arise.

There are other possible determinants of the level of structural unemployment. The demographic mix of the labor force may be an influence. If certain population sub-groups tend to have higher levels of unemployment than others, their relative importance in the labor force will affect the level of structural unemployment and the natural unemployment rate. Or, if there are institutional and legal constraints that hinder people's access to labor markets, such as discrimination and minimum wage laws, the volume of structural unemployment may be affected. Finally, there is the matter of the basic attitudes of people seeking work. If someone becomes displaced from a current job, that individual may search for alternative employment opportunities with varying degrees of vigor, depending on what alternative sources of income are available, such as private income transfers, savings, food stamps, unemployment compensation benefits, and other public income maintenance programs. The importance of these factors should not be underestimated. The intensity with which the unemployed search for a new job, as well as their willingness to accept certain jobs, determines how long they will remain unemployed and influences the observed unemployment rate via a change in the volume of structural unemployment.

Assuming that it is possible to empirically estimate the natural rate of unemployment,[6] the structural component of unemployment can be derived by subtracting from the natural rate the estimated contribution to unemployment that is frictional in nature.

Once the natural rate of unemployment is known, the third possible variety of unemployment, cyclical, can be estimated. Cyclical unemployment is defined as the actual rate of unemployment less the natural rate. Thus, it may be either positive or negative, depending on whether the actual rate is above or below the minimum permanently sustainable unemployment rate for the economy.

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[6] We make this assumption, hopeful that Milton Friedman's observations in "The Role of Monetary Policy," *American Economic Review*, vol. LVIII, 1968, to wit: "Unfortunately, we have as yet derived no method to estimate accurately and readily the natural rate of either interest or unemployment," are not a permanent injunction in this respect.

III. A MODEL OF UNEMPLOYMENT

Given a definition of the natural rate of unemployment that is couched in equilibrium terms, any attempt to empirically determine its level would seem to require a conceptual framework that focuses on labor market equilibrium. An extended model of that form is presented in Appendix I, a model that emphasizes the relationships between unemployment, the rate of price inflation, the rate of change in money wage rates, and the rate of growth in output per unit of labor input, or productivity.[1] The linkage among them is very straightforward. Price and productivity changes interact with money wage rate changes to determine the real cost of producing a unit of output, hereafter referred to as "real unit labor cost." [2] Unit labor cost itself, that is, unadjusted to reflect price changes, captures the impact of major cost, or supply, influences, either in the form of levels of money wage rates or levels of productivity per unit of labor input. Ceteris paribus, increases in unit labor cost, resulting from increases in money wage rates that exceed the rate of increase in productivity, reduce the level of profitability of industry, as well as levels of employment.[3] On the other hand, increases in the prices at which output is sold tend to increase profitability and employment.

The foregoing relationships imply a positive response of the unemployment rate to changes in the level of real unit labor cost. Admittedly, there are alternative theoretical paradigms that argue differently. However, they are inconsistent with the basic evidence. A discussion of them is contained in the more formal and technical exposition contained in Appendix I. The empirical evidence that leads to these alternatives being rejected and the positive relationship between real unit labor cost and unemployment being confirmed is also contained in Appendix I.

The empirical results presented in Appendix I embrace the entire period of the twentieth century, with the exception of the World War II years, and provide a very powerful test of the basic model that has been set forth. To illustrate, consider such disparate periods as The Great Depression of the 1930's and the interval 1962–1980. In the former, unemployment rises sharply to record levels, falls, rises, and falls again and, at the end of the period, wages and prices are rising and unemployment falling. In the latter, unemployment begins high, cycles through three full swings in economic activity, and the era closes with prices, wages, and unemployment all rising, the former two quite sharply. Together, the two periods embrace catastrophic depression, followed by modest recovery, relatively low levels of unemployment accompanied by modest price inflation, and substantial price inflation in association with rising levels of unemployment, i.e., "stagflation." You name it and it can be found in these years. Yet, the basic model postulated here does a remarkable job of explaining variations in un-

[1] The model presented in this study is not a new one. Its basic thrust is similar to ideas advanced by Irving Fisher. *The Money Illusion* (New York: 1930); A. C. Pigou, *op. cit.*; Friedrich A. Hayek, *Unemployment and Monetary Policy* (San Francisco: 1979); and W. H. Hutt, *The Keynesian Episode: A Reassessment* (Indianapolis: 1979).

[2] Real unit labor cost is also the real wage rate adjusted for changes in the productivity of labor.

[3] The importance of industry profitability as a determinant of employment (unemployment) is clear. An examination of the relationship between the unemployment rate and the corporate profit share of national income one year earlier for the eleven employment cycle peaks and troughs since 1950, plus 1981, reveals a simple correlation between them of −0.85.

employment, as indicated by the graphic displays in Figures 1 and 2, which compare the actual unemployment rate with the rate predicted by the model. The correspondence between actual and predicted values is quite strong in both time periods.

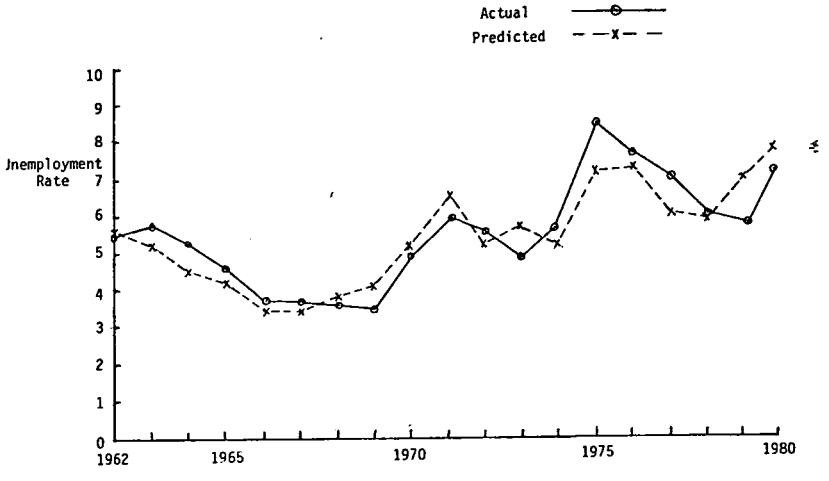

Figure 1

The Years From 1962 to 1980

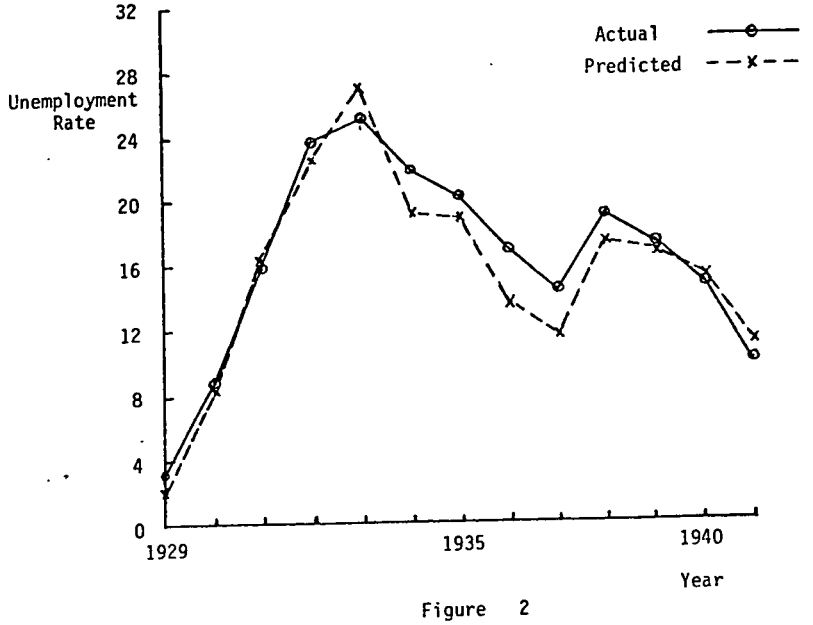

Figure 2

The Great Depression Years

The empirical relationships reported in Appendix I indicate that real unit labor cost moves in a cyclical fashion, generating cyclical movements in unemployment. This is the direct result of the nature of labor market adjustment mechanisms in the American economy. Money wage rates respond to changes in the levels of prices and productivity in a partial fashion in the short run. For example, the evidence contained in Appendix I indicates that, during the current year, a one percent rise in prices will lead to only a 0.83 percent rise in money wage rates in that year. Additionally, the partial adjustment of money wages to changes in productivity is even less complete; a one percent change in productivity produces only a 0.31 percent change in money wages. However, in the long run, when comparable points in the business cycle are compared, *until recently*, the average rate of change in money wage rates has been equal to the sum of the average rates of change in prices and productivity. Table 2 of Appendix I illustrates this phenomenon. Between 1948 and 1960 the average rate of change in productivity was 3.0 percent and in prices, 2.5 percent. The rate of change in money wage rates was 5.5 percent.[4] Between 1960 and 1969, both business cycle peaks, the relevant rates of change were 3.1 percent in productivity, 2.2 percent in prices, and 5.3 percent in money wages. From 1969 until 1973, productivity rose 2.3 percent a year, prices 4.6 percent, but money wages rose at a rate of 7.1 percent. And, from 1973 to 1979, productivity was up by only 0.7 percent a year, prices by 7.9 percent a year, and money wages by 9.0 percent a year. Thus, in the most recent swing of the business cycle,[5] money wages rose by 0.4 percent a year more than the sum of the rates of change in prices and productivity. As will be seen later, this has substantial implications for the level of the natural rate of unemployment.

[4] The data are from the *Employment and Training Report of the President, op. cit.*
[5] *Ibid.*

IV. THE RECENT HISTORY OF THE NATURAL RATE OF UNEMPLOYMENT

In order to distinguish between cyclical and structural unemployment and, by implication, determine the natural rate of unemployment, a more explicit understanding of how cyclical unemployment is generated by the unemployment model described in Appendix I is necessary. An excellent case in point is the 1961–1969 trough to peak business cycle. Beginning in 1961, the sum of the rates of change in productivity and prices consistently exceeded the rate of change in money wage rates through 1965. By 1965, this sequence of changes had produced a 23-percent increase in the corporate profit share of national income.[1] Also, real unit labor cost had drifted downward by 3.3 percent. This all occurred because of the operation of a money illusion effect in labor markets. The real wage rate paid to labor rose less rapidly than did labor's productivity, redistributing income from employees to employers. The result was an expansion of employment opportunities and a fall in the unemployment rate, *with a lag of about one year.*[2]

After 1965, though, the long run labor market adjustment mechanism took hold and the rate of change in money wages exceeded the sum of the rates of change in prices and productivity, *despite an escalation of the rate of price inflation to almost five percent a year.* In 1969, real unit labor cost surged back to its 1961 level, the corporate profit share of national income fell sharply, and, in 1970, a year later, the unemployment rate averaged 4.9 percent, 1.4 percentage points higher than in 1969. A graphic representation of these changes is shown in Figure 3.

The 1961–1969 experience is classic. It illustrates how a mild burst of unanticipated inflation (about five percent between 1961 and 1965) can be used to push the unemployment rate *temporarily* below its equilibrium level by redistributing real income from workers to employers. However, *the reduced unemployment is only temporary.* As the longer term labor market adjustment begins to operate, the income redistribution is reversed and the unemployment rate returns to a level that is more capable of being maintained on a permanent basis. The general rule is that labor market adjustment mechanisms will pull the economy towards the equilibrium, or natural, rate of unemployment. For sure, any stable rate of price inflation will produce, quite quickly, the natural rate of unemployment. Building on these principles, it is possible to define an expression that will measure the natural rate of unemployment over any particular period of time (see Appendix I for details). When this expression is used to calculate natural rates of unemployment for the period 1961–1979, it becomes evident that there has been an upward drift in the natural rate, from 4.38 percent in 1961–1979 to 6.62 percent in 1973–1979, a rise of about two-and-one-quarter percentage points.

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[1] The corporate profit share of national income rose from 11.33 percent in 1961 to 13.98 percent in 1965. Source: Department of Commerce, Bureau of Economic Analysis.

[2] The choice of a one year lag in the relationship is based on experimentation with various lag structures. The one-year lag produces the best fit between the variables. The logic of some type lag is appealing. Employers may well respond to increasing real unit labor cost by searching for alternatives other than the laying off of a labor force that is experienced in its tasks. Also, once it becomes clear that labor force reductions are necessary, it is tempting to accomplish them through a process of attrition, simply not replacing workers who quit, die, or retire.

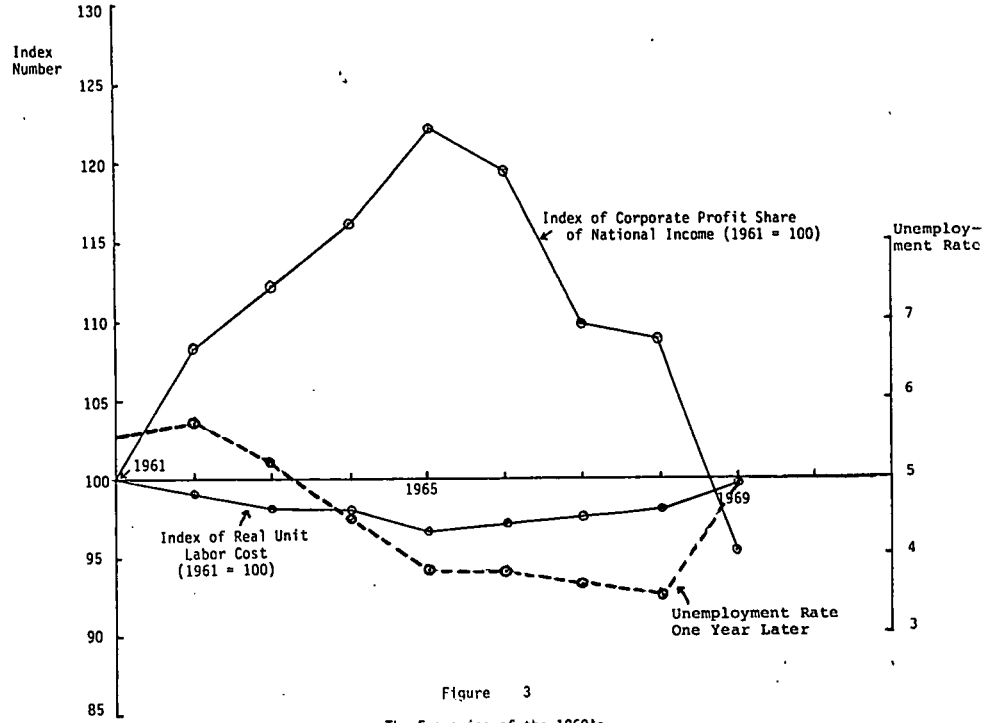

Figure 3

The Economics of the 1960's

Since 1979, the natural rate of unemployment may have increased even further. However, the 1980–1981 business cycle was too brief to warrant the application of the methodology described in Appendix I since it might be questioned whether sufficient time elapsed to complete the adjustment processes that are at the core of the unemployment model. But, other evidence is suggestive in this regard. A recent study covering the period January 1981 through September 1982 reveals that the unemployment rate reported by the Bureau of Labor Statistics, the standard one, has been drifting upward at the rate of .068 percentage points a month relative to the rate reeported by the Employment Training Administration, a rate that is based on unemployment among workers insured by the unemployment compensation system.[3] Since uninsured workers are more likely to be involved in marginal types of employment, this drift may reflect an increase in structural unemployment among those on the fringes of the labor market. At any rate, it would seem appropriate to regard the 6.62 percent estimate of the natural rate of unemployment as a *minimum* estimate for the current period.

[3] Paul B. Manchester, "A Short Run Model for Predicting the Monthly Unemployment Rate," Staff Study, Joint Economic Committee, November 1982.

V. THE SOURCES OF CHANGE IN THE NATURAL RATE OF UNEMPLOYMENT

The marked rise in the natural unemployment rate indicates an increase in the volume of structural unemployment since 1960. What are the sources of such change? An analysis of shifts in the structure of unemployment between 1960 and 1979, both business cycle peaks, is revealing. In Table 1, ratios of the unemployment rate by labor force sector to the unemployment rate for white males, aged 20 and over, regarded as the "prime" labor force sector, are shown. They indicate that the relative amount of unemployment among those aged 16–19 (both sexes) and females, aged 20 and over, has risen, in both cases very substantially. If the teen-age group had maintained its 1960 position relative to white males, 20 years of age and over, its unemployment rate in 1979 would have been 12.6 percent, instead of the actual rate of 16.1. Similar estimates for females, aged 20 and over, indicate that their unemployment rate in 1979 would have been 4.4 percent, rather than the actual rate of 5.7 percent. As to black males, 20 and older, the deterioration in relative status was minor. The same position in 1979 as in 1960 would have produced an unemployment rate of 8.2 percent, compared to the actual rate of 8.5 percent.

The shifts in the demographic structure of unemployment will account for 0.97 percentage points of the estimated 2.24 point rise in the natural unemployment rate in the 1960's and 1970's.[1] Of this, 0.14

TABLE 1.—RATIOS OF SECTOR UNEMPLOYMENT TO UNEMPLOYMENT, WHITE MALES, 20 YR. AND OLDER, 1960 AND 1979

Sector	Ratio of sector unemployment rate to unemployment rate, white male, 20 yr. and older		
	1960	1979	Change
Demographic:			
16–19 yr., both sexes	3.13	3.83	+0.70
Female, 20 yr. and older	1.09	1.36	+.27
Black male, 20 yr. and older	2.29	2.36	+.07
Occupational:			
Professional and technical	.40	.67	+.27
Managers	.33	.58	+.25
Clerical	.90	1.10	+.20
Sales	.90	1.08	+.18
All white collar	.64	.92	+.28
Operatives	1.90	2.14	+.24
Craftsmen	1.26	1.25	−.01
Nonfarm labor	3.00	3.00	0
All blue collar	1.86	1.92	+.06
Private household	1.26	1.33	+.07
Other service	1.43	2.03	+.60
All service	1.38	1.97	+.59
Farm	.64	1.06	+.42

Source: Bureau of Labor Statistics.

[1] The structural shifts specific to particular demographic groups are calculated by applying the ratios of sector to prime unemployment to the prime unemployment rate in 1979 and calculating the overall unemployment rate that this would produce. That "synthetic" unemployment rate is then subtracted from the actual rate to determine what portion of the actual rate is the result of structural changes specific to the demographic groups in question.

percentage points is the result of the non-prime demographic groups becoming more important in the labor force, while 0.83 points represent the impact of changes in the structure of unemployment that are specific to these groups.[2] This leaves 1.27 percentage points to be explained as non-demographically specific structural change. See Table 2 for a summary of the sources of change.

The concentration of demographically specific structural change among teen-agers and females suggests that it may reflect the relatively large increase in the proportion of these population sub-groups that are choosing to participate in the labor force. Among the 16–19 group (both sexes) the civilian labor force participation rate rose from 44.0 percent in 1960 to 58.0 percent in 1979.[3] Among females, aged 20 and over, the increase was from 37.6 percent in 1960 to 50.6 percent in 1979. Meanwhile, labor force participation among white males, aged 20 and over, fell from 86.0 to 80.1 percent in that interval. Among black males, aged 20 and over, the decline was from 86.2 to 77.1 percent. The relative increase in the number of females and teen-agers in the labor force may well mean that, among these groups, people with relatively less skill have been entering the labor force, driving up the amount of employment that should be regarded as structural in character.

An examination of changes in the occupational structure of unemployment produces results that are quite consistent with the demographic changes. Unemployment appears to have become more concentrated among groups that have a heavy representation of females and young people among those who are employed. These are the white collar and service areas.[4] It is interesting to note that blue collar workers have maintained their relative position vis-a-vis the prime labor force sector. Even non-farm laborers show no decline in their relative unemployment status. This would seem to suggest that the increase in the amount of structural unemployment that has been identified is not rooted in technological changes that are rendering the relatively unskilled blue collar and laborer types less competitive in the labor market.[5]

TABLE 2.—SOURCES OF INCREASE IN NATURAL RATE OF UNEMPLOYMENT, 1961–69 TO 1973–79

Source of increase	Amount of increase (percent)
Demographic specific	0. 97
Due to change in demographic weights	. 14
Due to change in demographic structure of unemployment	. 83
Nondemographic specific	1. 27
Total	2. 24

Source: Calculated from Bureau of Labor Statistics data.

[2] The proportion of the demographic specific structural shifts that can be attributed to a pure change in demographic weights is calculated by applying the 1961 weights to the 1979 unemployment rates and observing how much of a change in unemployment this produces.

[3] The data cited in this paragrraph are from the *Employment and Training Report of the President*, various issues, *op cit.*

[4] For example, among females, in 1979, employment in the white collar and service areas accounted for 84.2 percent of all female employment. The similar percentage for males was 49.7. *Ibid.*

[5] The technological concept of structural change is a recurring theme. It was very popular in the early 1960's. However, the evidence then, as now, was not consistent with it. See "Higher Unemployment Rates, 1957–1960: Structural Transformation or Inadequate Demand," Staff Study, Subcommittee on Economic Statistics, Joint Economic Committee of the Congress (Washington, D.C.: 1961).

As to the demographically non-specific increase in the natural rate of unemployment, a number of likely explanations might be offered. There is the possibility that it represents a general widening of the gap between the skills of the labor force and the skill needs of industry. However, as just noted, the evidence on the shifts in the occupational structure of unemployment are not consistent with this.

A much more likely, and important, possibility is that workers labor supply responses have been altered in a fashion that affects the intensity of their job search effort, once they become unemployed, as well as their "reservation" wage, i.e., the wage rate below which they will not accept employment but will prolong the search process. A major factor in this regard is the existence of substantial unemployment compensation programs. The evidence is clear that the availability of unemployment compensation benefits is positively related to the level of unemployment.[6] And, that availability has been rising. Over the course of the 1961–1969 business cycle, about two-thirds of the civilian labor force was in employment covered by unemployment compensation systems. Contrast this with the almost 80 percent in covered employment in the years 1974–1979.[7]

In addition to unemployment compensation benefits, there are other social transfer payment systems to consider. The food stamp program did not exist in the 1960's. By the end of the 1970's, payments under this program amounted to over 6 billion dollars.[8] Vendor medical payments more than quadrupled during the 1970's. All told, social welfare expenditures in the United States rose from being about 13 percent of personal income in 1960 to almost one-fourth of personal income at the end of the 1970's.[9] Such a growth in the relative importance of "safety-net" expenditures alters people's attitudes with respect to what is an acceptable job, producing an upward drift in the natural unemployment rate.

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[6] Some of the representative studies of this subject are the early work of Gene Chapin, "Unemployment Insurance, Job Search, and the Demand for Leisure," *Western Economic Journal*, vol. 9, 1971, and, later, Martin Feldstein, "Unemployment Compensation: Adverse Incentives and Distributional Anomalies," *National Tax Journal*, vol. 27, 1974.

[7] U.S. Employment and Training Administration.

[8] Social Security Administration.

[9] Total social welfare expenditure data are from the Social Security Administration and the personal income data are from the Department of Commerce.

VI. THE NATURAL RATE AS A POLICY CONSTRAINT

The existence of a definable natural, or equilibrium, rate of unemployment implies the existence of a constraint that economic policy makers can violate only with serious consequences. For example, consider the interval 1966–1969, when the actual unemployment rate was forced below the natural rate, creating negative cyclical unemployment. This was accomplished through an escalation of the rate of price inflation to about five percent a year. However, even this could not hold the unemployment rate below the natural level indefinitely. Witness the surge in unemployment in 1970.

Unfortunately, there was a residual impact from the experience of the 1960's. By 1970, the persistent rise in price levels had engendered higher rates of increase in money wage rates as labor markets came to expect price inflation in the vicinity of five percent. This carried over into the early 1970's, when recovery from the 1970 recession was occurring. Whereas, in the recovery following the cyclical downturn of 1961 money wage rate increases averaged about 4.4 percent between 1962 and 1965, they averaged 8.4 percent between 1971 and 1974. In the period 1971–1972 this created only minor problems due to increases in productivity of 3.4 percent a year. In fact, the pattern of recovery from the downturn of 1970 seemed to be following the classic course (except for higher rates of price inflation) for post-World War II American business cycles. However, in 1973 and 1974, productivity increases were well below average (actually turning negative in 1974) while money wage rates continued to rise in response to the current and previous period's price inflation. Consequently, despite very substantial rates of price inflation, real unit labor cost rose and unemployment increased, particularly in 1975, producing what has come to be known as "stagflation."

The remainder of the decade of the 1970's represented more of the same, with the thrust of economic policy being in the direction of short term management of the system, the philosophy that had been so confidently extolled at the beginning of the 1960's. Looking back on this era from the perspective of the early 1980's, it is easy to question whether the optimism of the early 1960's was warranted. Compare 1980 to 1961. The unemployment rate in 1961 was 6.7 percent, to that time the highest rate for the post-World War II period. In 1980, it was 7.1 percent and rising. At that, it was lower than it had been in 1975 and 1976. As to inflation, in 1961, the rate of price inflation was 1.0 percent. In 1980, it was 11.1 percent and had been as high as 13.0 percent. Real economic growth was adequate, but not spectacular by historical standards—running at 3.55 percent per year, just slightly less than the long term historical average of about 3.6 percent a year. Even the interval of greatest economic growth in this period, 1961–1969, showed only a rate of growth of 4.7 percent, compared, for example, to the 6.0 percent that marked a similar period, 1921–1929. Or, take the period 1921–1941, embracing the Great Depression of the 1930's. The real growth rate in that interval was slightly greater (3.60 percent) than it was in the two decades under discussion here.[1]

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[1] The growth rates are calculated from the real Gross National Product statistics reported by the Department of Commerce, Bureau of Economic Analysis.

The rather mixed record of success in "managing" the American economy between 1961 and 1980 raises the issue of whether, *given the existence of a natural rate of unemployment*, short term manipulation and control of economic variables has much to offer from the standpoint of improving economic performance. Perhaps, it may be postulated, the economy would do just as well, or even better, if national economic policy focused more on providing conditions that are conducive to long term economic growth, rather than emphasizing the control of short term economic conditions. To explore that possibility, the actual performance of the American economy in the period 1961–1980 will be compared with the results of a simulation of the economy which assumes no attempt at managing it in the short run, except for a fixed rate of growth in the monetary base.[2] The model used to produce the simulation is the basic unemployment model of Appendix I plus relationships describing the determinants of real output growth and the level of price inflation. The detailed structure of the model is described in Appendix II.

A comparison of the results of the simulation, which assumes a two percent annual rate of growth in the monetary base, with the actual performance of the economy is shown in Table 3. The only substantial difference is in the rate of price inflation. Two decades of attempts at short term management of the American economy produced about four percent a year more price inflation with no appreciable effect on unemployment or the real growth rate, the latter two being determined by the underlying structural realities of the economy, that is, the forces that determine the natural rate of unemployment.

Interpreted within the framework of Arthur Okun's "misery index," the sum of the rate of price inflation and unemployment rate, the economy that was subject to detailed attempts at short term management produces an index of 9.95 while the unmanaged (simple monetary growth rule) economy yields an index of 6.16. The clear conclusion would seem to be that the existence of a natural rate of unemployment in an economy renders short term economic policy tools ineffective, at best.

TABLE 3.—COMPARISON OF ACTUAL PERFORMANCE OF ECONOMY WITH SIMULATION ASSUMING 2 PERCENT RATE OF GROWTH IN MONETARY BASE, UNITED STATES, 1961–80

[In percent]

Performance statistic	Actual performance 1961–80	Simulated performance 1961–80
Real growth rate	3. 55	3. 57
Average unemployment rate	5. 22	5. 38
Average rate of price inflation	4. 73	. 78
"Misery" index	9. 95	6. 16

Source: Authors' Calculations.

[2] The magnitude employed is the adjusted monetary base which consists of (1) reserve accounts of financial institutions at Federal Reserve Banks, (2) currency in circulation (currency held by the public and in the vaults of all depository institutions), and (3) an adjustment for reserve requirement ratio changes.

VII. CONCLUSIONS

The basic conclusions to be drawn from the analysis presented in this study are as follows:

(1) There is a natural rate of unemployment in the American economy.

(2) The natural rate of unemployment has trended upward in the past two decades, rising by about two-and-one-quarter percentage points since the period 1961–1969.

(3) The natural rate of unemployment stood at 6.62 percent over the interval 1973–1979 and there is evidence to suggest that it may have risen further since then. Thus, the 6.62 percent estimate is a minimal one. Actually, the rate is probably in excess of seven percent at this time.

(4) About one percentage point of the observed increase in the natural rate of unemployment can be attributed to structural changes in the labor force specific to certain demographic groups, largely teenagers and females, aged 20 years and older. About one-seventh of the demographic specific changes reflect the changing relative importance of the demographic groups in question. The remainder reflects structural changes that have altered the relative labor market status of these groups.

(5) About one-and-one-quarter percentage points of the increase in the natural rate of unemployment is the product of non-demographic specific structural changes. Technologically induced unemployment does not appear to be a likely explanation for this change. Rather, it seems more convincing to argue that the source of this rise in the natural unemployment rate may be found in the greater availability of benefits under various social programs, benefits that have produced modifications in people's attitudes with respect to what constitutes an acceptable job and/or an acceptable wage rate.

(6) The existence of a natural rate of unemployment limits the capacity of economic policy makers to manipulate the economic system. It appears that such important real magnitudes as the rate of economic growth and the unemployment rate cannot be altered in the long run by short term management of the economy.

A few final words. The estimates of the natural rate of unemployment that have been developed here suggest quite strongly that the legislatively defined goals of economic policy, as set forth in the Employment Act of 1946, as amended in 1978, are exceedingly optimistic. The stating of an intermediate term goal of four percent unemployment, a rate that is less than the natural rate in the 1960's, is a case in point. Certainly, this analysis argues that, using macroeconomic policy tools, such an unemployment rate could be attained, and then only temporarily, through the injection of a massive burst of unanticipated price inflation in the economy. Realistically, unemployment rates of the magnitude that have been defined by the Congress as "goals" can only be achieved through producing substantial changes in the structural facets of the American economy that have led to the existence of a natural unemployment rate in the vicinity of seven percent.

Appendix I. A MODEL OF LABOR MARKET ADJUSTMENT

Consider an economy in which the demand for labor (D_L) is determined according to the familiar marginal productivity conditions:

$$D_L = f(w_r) \tag{1}$$

where w_r denotes the real wage rate.

Let the supply of labor (S_L) be a fixed fraction of the population, i.e., perfectly inelastic:

$$S_L = S_o \tag{2}$$

This assumption is reasonably consistent with the facts of American society.[1] For purposes of simplifying the analysis, we will assume an invariant population over time.

Equating expressions (1) and (2) gives

$$S_o = D_L = f(w_r) \tag{3}$$

which produces an equilibrium real wage rate, designated hereafter as w_r^*, and an equilibrium level of employment, N^*. Let it be understood that at this equilibrium there will exist an equilibrium level of unemployment, U^*, consisting partly of the frictional variety and partly of a structural kind brought on by institutional constraints (such as minimum wage laws) that make it impossible to employ people with very low levels of marginal productivity. This is, of course, the "natural" level of unemployment.

Accompanying this real wage version of the labor market is a money wage version in which the demand schedule for labor is multiplied by the price level (P) so that at any point on the money wage demand schedule

$$w_m = w_r \, P \tag{4}$$

where w_m is the money wage rate.

Assume an initial equilibrium at which $w_r = w_r^*$. Now, introduce an exogenous change in the price level, induced by a change in money aggregate demand, which shifts the money wage demand schedule for labor, either to the left or to the right. In the absence of any adjustment in money wage rates, the real wage rate will deviate from equilibrium, a decrease in prices making it greater than w_r^* and an increase moving it below w_r^*. In either case, cyclical unemployment, defined as the difference between the actual and the "natural" level of unemployment ($U - U^*$), which may be either positive or negative, is created. If there is a fall in prices, real wage rates rise, employment falls, and the unemployment level rises above U^*. A rise in prices lowers real wage rates, enabling employers to hire workers whose marginal product previously was lower than the real wage they would have commanded. Thus, unemployment falls below U^* and ($U - U^*$) becomes negative.

In the real wage labor market we assume no change in the given technological conditions of production that underlie the demand schedule for labor. Consequently, the changes in the money wage labor market are reflected in movements along the real wage demand schedule for labor. Thus, the market is displaced from (or "shocked off") its equilibrium position.

For discussion purposes, let us assume that positive cyclical unemployment is the disequilibrium situation under consideration. A neoclassical adjustment mechanism suggests that money wage rates will fall until the equilibrium real wage rate, w_r^*, is reestablished. Symbolically, the pure neoclassical adjustment mechanism would be:

$$\dot{w}_m = \dot{p} \tag{5}$$

[1] The assumption on labor force participation in the aggregate is generally consistent with Clarence D. Long, *The Labor Force Under Changing Income and Employment* (Princeton, N.J.: 1958) who argues that the aggregate labor force participation rate tends to be stable in a developed industrial economy.

Thus, there would be, at worst, only a temporary disequilibrium in the market. In fact, in a world of instantaneous adjustments disequilibrium would never occur.

Contrast the neoclassical mechanism with a Keynesian adjustment response in which there would be either no change in money wage rates, i.e., absolute downward rigidity in wages, or, if there were some downward adjustment in money wage rates, there would be a corresponding fall in price levels which would further shift the money wage demand schedule for labor to the left, thus eliminating the employment effects of the wage adjustment mechanism. These two possible adjustment responses are:

$$\dot{w}_m = 0, \text{ or, if } \dot{w}_m < 0, \tag{6}$$

$$\dot{p}' = \dot{w}_m \tag{7}$$

where $\dot{p}'$ denotes the change in the price level induced by an adjustment in money wage rates. The end result is the same in both cases, no change in the real wage rate once it has been shocked out of equilibrium.

The neo-Keynesian view of a situation such as that under discussion would begin by treating the real wage rate, w_r, as being one of a range of possible equilibrium labor market situations which are the product of different levels of aggregate demand in the system. This implies that the real wage rate is determined by the level of aggregate demand. In the case of a rise in unemployment induced by a negative shift in aggregate demand, prices fall more rapidly than money wage rates, suggesting a wage adjustment mechanism of the following type:

$$\dot{w}_m = a + b\,\dot{p},\ 0 < d\dot{w}_m/d\dot{p} < 1 \tag{8}$$

Finally, there is the "new classical" economics adjustment response. Two versions may be postulated, a rational expectations approach and what Stein calls "asymptotically rational expectations."[2] In the former, labor market behavior is predicated on predictions of wage and price magnitudes where the errors in prediction are random (non-serially correlated) in character with a zero mean.[3] This implies

$$\tilde{w}_m + w_m + e_m \tag{9}$$

and

$$\tilde{p} = p + e_p \tag{10}$$

where the symbol $\sim$ indicates a predicted value and a represents an error term in the prediction (with appropriate subscripts). Combining (9) and (10) gives

$$w_r = (w_m + e_m)/(p + e_p) \tag{11}$$

Now, from equations (1) through (3) we may define

$$U = S_O - D_L = S_O - f(w_r) \tag{12}$$

where U denotes the actual level of unemployment. Keeping in mind our assumption of a fixed supply of labor, we may write

$$U - U^* = f(w_r^*) - f(w_r) = f(w_r^* - w_r) \tag{13}$$

where

$$d(U - U^*)/d(w_r^* - w_r) < 0 \tag{14}$$

For convenience purposes, we redefine (12) and (13) as follows:

$$U - U^* = \emptyset(w_r - w_r^*),\ d(U - U^*)/d(w_r - w_r^*) > 0 \tag{15}$$

If we assume that the system oscillates about equilibrium over time,

$$w_r^* = \overline{w}_r \tag{16}$$

where $\overline{w}_r$ represents the mean real wage rate over time.

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[2] For a description of some of the characteristics of the "new classical" economics, see Jerome L. Stein, "Monetarist, Keynesian, and New Classical Economics," *American Economic Review*, vol. LXXX, 1981.

[3] See Thomas Sargent, "A Classical Macroeconomic Model," *Journal of Political Economy*, vol. LXXXIV, 1976.

With behavior being in terms of predicted wage rates,

(17) $$(U-U^*)=f(\tilde{w}_r-\overline{w}_r)$$

and

(18) $$\tilde{w}_r-\overline{w}_r=(w_m+e_m)/(p+e_p)-\overline{w}_m/p$$

Over time, the mean value of (11) is $\overline{w}_m/p$ and, consequently,

(19) $$\overline{\tilde{w}_r-w_r}=0$$

and

(20) $$\overline{U-U^*}=0$$

i.e., the mean values for $(\tilde{w}_r-\overline{w}_r)$ and $(U-U^*)$ are zero. Of course, both of these magnitudes are still subject to a non-serially correlated error term with a zero mean.[4] What this produces is random variations around a stable level of unemployment. In reality, this result differs from an instantaneous neoclassical pattern of adjustment only by the random variation.

The asymptotically rational expectations version of the "new classical" economics differs from rational expectations only in the sense that the error term associated with the predictions that influence behavior may be systematic in character, i.e., serially correlated. This would be the case if the predicted values of labor market magnitudes are based on a partial response to current experience as well as a recognition of past events. However, if the end result is to restore equilibrium in the market, the final outcome will be a gradual approach to equilibrium and, over time, equations (19) and (20) will be satisfied, subject to an error term that may be serially correlated.

The existence of several possible wage adjustment mechanisms rather naturally leads one to wonder which best describes the American economy. To assist in answering that question, we write the following generalized short run wage adjustment function:

(21) $$\begin{aligned}(\dot{w}_m)_t=a-b(w_r-w_r^*)_{t-1}+c_t\dot{p}_t\\+c_{t-1}\,\dot{p}_{t-1}+\ldots.\,c_{t-n}\,\dot{p}_{t-n}+d_t\dot{\pi}_t+d_{t-1}\,\dot{\pi}_{t-1}\\+\ldots.+d_{t-n}\,\dot{\pi}_{t-n}\end{aligned}$$

where $\dot{\pi}_t$ denotes the rate of change in productivity per unit of labor. The productivity measure is included at this point to adjust for changes in the demand for labor that are the result of technological progress and changes in the relative availability of the supplies of other factors of production.

The logic of the adjustment mechanism described in expression (21) is rather straightforward. The negative relationship between the rate of change in money wage rates in the current period and the deviation of the real wage rate from its equilibrium value (if any) in the previous period reflects an equilibrating response to the existence of any disequilibrium in the real wage labor market. Thus, the further above equilibrium the real wage rate lies, the less the quantity demanded of labor and the greater the pressure for a decrease in money wage rates (or the less the pressure for increases). The other terms in (21) are designed to capture the pattern of adjustments, if any, to changes in prices and productivity in the current and past periods.

The generalized wage adjustment mechanism embodied in (21) is capable of yielding all the possible adjustment responses that have been enumerated. For example, in the extreme case of instantaneous adjustment of the neoclassical type, the parameters c_t and d_t equal unity, all other c's and d's equal zero, and $(w_r)_{t-1}$ is always equal to w_r^*. In such a case, (18) collapses into

(22) $$(\dot{w}_m)_t=\dot{p}_t+\dot{\pi}_t$$

which may be thought of as a long run wage adjustment function. Given that

(23) $$(w_r)_t=(w_m)_t/p_t$$

expression (22) implies that

(24) $$(\dot{w}_r)_t=(\dot{w}_m)_t-\dot{p}_t=\dot{\pi}_t$$

which is to say that an instantaneous neoclassical wage adjustment mechanism yields a world in which the rate of change in the real wage rate is equal to the rate of change in the productivity of labor.

[4] We assume that the respective error terms in the predictions of money wage rates are not correlated with the error terms in the predictions of prices.

From the previous discussion, it should be apparent that the same parametric conditions apply in the case of expression (21) if the adjustment process is of the rational expectations type. All that is different is that rather than the relationship between changes in money wage rates and changes in prices and productivity being one of wages adjusting to price and productivity movements, all these magnitudes are being predicted accurately except for the random error term. Thus, the causality is different but the empirical relationship is basically the same. Therefore, hereafter we shall regard the two processes as one, delineating them as an instantaneous neoclassical (RATEX) adjustment process.[5]

A modified version of the neoclasical adjustment mechanism can be constructed which incorporates some imperfections in the adjustment process. These might occur, for example, due to lags in the adjustments that must take place. Under such conditions, w_r may deviate from w_r^* and c_t and d_t may be less than unity. Specifically, postulate that

$$(25) \qquad \begin{aligned} &0<b<1 \\ &0<c_t<1, \text{ and} \\ &0<d_t<1 \end{aligned}$$

This modified neoclassical adjustment mechanism can become identical in the long run with the instantaneous adjustment paradigm if (1) the variations of w_r around w_r^* have a mean of zero and (2) the sum of the various c's (and d's) are each equal to unity. Consequently, it is possible to have complete long run adjustment of the neoclassical type even though there is imperfect adjustment in the short run.

The deviations of w_r about w_r^* in the modified neoclassical adjustment regimen do not tend to be random in character since they are the result of systematic lags in the adjustment process. Therefore, the end product is similar in nature to that generated by an asymptotically rational expectations adjustment mechanism. In fact, again, exactly the same parametric expectations with respect to expression (21) emerge, albeit because predictions of present magnitudes based on past and current experience is systematically imperfect. Therefore, hereafter we will treat the modified neoclassical and asymptotically rational expectations approaches as similar, invoking the designation modified neoclassical (ARE).

Turning to the Keynesian adjustment mechanisms, we first consider the strict wage rigidity formulation. In it, w_r becomes unequal to w_r^* as the result of an exogenous shock to aggregate demand and money wages do not adjust at all. Thus, b must be equal to zero as well as all the c's and d's in expression (21). The alternative Keynesian adjustment paradigm, which emphasizes the interdependence between money wages and prices, also begins with a real wage labor market disequilibrium, $w_r \neq w_r^*$. Now, though, flexible money wages are assumed, represented by the parameter b being greater than zero and less than or equal to unity. However, there is an induced price level change which will be equal to $-b\,(w_r - w_r^*)$ and all the c's are equal to zero. Under these conditions the real wage rate remains unchanged and $(w_r - w_r^*)$ is a constant.

Finally, there is the neo-Keynesian adjustment model. Within it, w_r is viewed as the equilibrium real wage and, thus, the term $(w_r - w_r^*)$ becomes $(w_r - w_r)$, i. e., it is equal to zero and disappears from expression (21). The critical parameters are the c's, with both c_t and the sum of the c's assumed to be less than one. What this yields is a variable real wage rate that reflects only a partial adjustment of money wage rates. In a sense this may be thought of as a partial money illusion.

These various formulations of the money wage rate adjustment mechanism are summarized in Table 1. The parametric conditions associated with each of these paradigms will be the basis for the conducting of empirical tests of the validity of the several alternatives.

Our empirical exploration of the money wage adjustment mechanism in the United States will employ the standard Department of Labor data series describing hourly compensation and productivity, as well as the price deflator series that accompanies the wage data, to estimate expression (21) for the period 1949–1978.[6] It is a simple estimate in that only current values of $\dot{p}_t$ and $\dot{\pi}_t$ are

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[5] We realize that "purists" might object to such a grouping. However, since we cannot discriminate between the two possibilities empirically, we feel justified in grouping them in this fashion.

[6] *Employment and Training Report of the President* (Washington, D.C.: various issues), Tables G–1 and G–2.

Table 1

Summary of Characteristics of Various Money Wage Adjustment Mechanisms

Adjustment Mechanism	Expected Value of Parameter							Other Remarks
	$w_r - w_r^*$	a	b	c_t	d_t	Other c's	Other d's	
Neoclassical								
Instantaneous (RATEX)	0	0	0	1	1	0	0	none
Modified (ARE)	$w_r \neq w_r^*$ (temporarily)	0	$0<b<1$	$0<c<1$	$0<d<1$	>0 with c_t sum to 1	>0 with d_t sum to 1	none
Keynesian								
Wage Rigidity	$w_r \neq w_r^*$	0	0	0	0	0	0	none
Interdependence	$w_r \neq w_r^*$	0	$0<b\leq 1$	0	$0\leq d\leq 1$	0	$0\leq d\leq 1$	$\dot{p}_t = -b(w_r - w_r^*)$
Neo-Keynesian	$w_r = w_r^*$	?	irrelevant	$0<c<1$	$0<d<1$	may be >0: with c_t sum to <1	may be >0; with d_t sum to <1	none

used as independent variables.[7] In order to obtain a value for the term $(w_r - w_r^*)$ we begin by expressing all wage rate measures in index number form. Thus,

$$(26) \qquad (w'_r)_t = (w_r)_t / (w_r)_o$$

and

$$(27) \qquad (w_r^{*\prime})_t = (w_r^*)_t / (w_r^*)_o$$

where the symbols $(w'_r)_t$ and $(w_r^{*\prime})_t$ indicate the index number form of the variables.

Now, we define

$$(28) \qquad (w_r^*)_t = (w_r^*)_o (1 + \dot{\pi}_t)$$

which is to say that the equilibrium wage changes as productivity levels change between times 0 and t (measured by $\dot{\pi}_t$). Combining (26)–(28) gives

$$(29) \qquad (w_r - w_r^*) = (w_r')_t - (w_r^{*\prime})_t = (w'_r)_t - (1 + \dot{\pi}_t) = [(w'_r)_t - \dot{\pi}_t] - 1$$

But, the term in brackets is simply the real wage rate in time t (in index number form) adjusted for any change in productivity that occurs between times o and t. This translates into the real unit labor cost of producing output and we may employ this statistic (designated) as $(w''_r)_t$) as a measure of $(w_r - w_r^*)_t$. Of course, the negative one simply transfers into the constant term of expression (21), altering, in the process, any parametric expectations with respect to that constant. Actually, to preserve the sense of the equilibrating mechanism, we go further and define $(w_r - w_r^*)$ as $[(w''_r)_t - \overline{w}''_r]$, thus expressing it as the deviation of real unit labor cost from its mean value for the period under consideration.

The results of the estimation process are

$$(30) \qquad (\dot{w}_m)_t = \underset{}{2.49} - \underset{(0.11)}{0.39}[(w_r'')_{t-1} - \overline{w}_r''] + \underset{(0.07)}{0.83}\dot{p}_t + \underset{(0.10)}{0.31}\dot{\pi}_t, \; R^2 = .85, \; \overline{R}^2 = .83, \; D\text{-}W = 1.74$$

where the values in parentheses beneath the regression coefficients are standard errors.

All of the coefficients have the expected signs and are significantly different from zero at normal levels of significance. In addition, all coefficients are significantly different from unity. A comparison of the values of the parameters with the conditions established in Table 1 yields some interesting conclusions. First, there is no support for the instantaneous neoclassical (RATEX) adjustment mechanism. Not only is $b<0$, but c_t and d_t are less than unity. Consequently, we may reject this form of the adjustment mechanism. Similarly, there is nothing in regression (30) to suggest consistency with the Keynesian wage rigidity formulation. It, too, may be disregarded. As to the Keynesian "interdependence" adjustment mechanism, two of the three coefficients, b and d, might be interpreted as being consistent with it.[8] Therefore, even though the value of the estimate of the coefficient c_t is inconsistent, we will temporarily reserve judgment. The same can be said for the neo-Keynesian formulation. The values of the parameters c_t and d_t are consistent but the significance of b mitigates against it.

Finally, there is the modified neoclassical (ARE) adjustment model. All three of the coefficients are exactly consistent with this hypothesis. However, there are other dimensions to the model that have not been explored. Some further tests are required, not only of the modified neoclassical (ARE) but of the Keynesian interdependence and neo-Keynesian possibilities.

We begin with the Keynesian interdependence model. Remembering that it implies an unchanging value for $(w_r'' - \overline{w}_r'')$, we may establish as a condition

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[7] Inclusion of a succession of lagged price and productivity terms in the estimating equation introduces severe problems of multicollinearity.

[8] Almost any value for the estimate of the parameter d_t may be interpreted as being consistent with the Keynesian "interdependence" adjustment process.

that lends it support the proposition that there should be no systematic relationship between the variable $(w_r'' - \bar{w}_r'')$ and changes in money wage rates. We test this by estimating the regression

$$(31) \qquad (w_r'' - \bar{w}_r'') = -0.82 + \underset{(0.09)}{0.25}(\dot{w}_m)_t, \; R^2 = .22, \; D\text{-}W = 0.80$$

In this regression both $(w_r'' - w_r'')$ and $(\dot{w}_m)_t$ are adjusted to eliminate any possible distortion introduced by changes in the level of productivity per unit of labor. The significance of this relationship reflects adversely on the Keynesian interdependence model in that it suggests that, holding productivity constant, changes in money wage rates will affect the real wage rate in the expected direction.[9] On the basis of the combination of this and the earlier evidence we feel that the second of the Keynesian alternatives should be rejected.

This leaves only the modified neoclassical (ARE) and the neo-Keynesian possibilities. The key element in these is the degree of permanence of the partial adjustment of money wage rates to price and productivity changes. In the neoclassical (ARE) it is temporary while in the neo-Keynesian it is permanent. The most straightforward way to evaluate the permanence of the partial adjustment is to invoke expression (22) which argues that the temporary partial adjustment will disappear over time. By simply calculating the means of the rates of change in money wage rates, prices, and productivity over the period under consideration, we can determine whether the rate of change in money wage rates is equal to the sum of the rates of change in prices and productivity. The actual data are summarized in Table 2 for different periods in the post-World War II era. They show that from 1947 through 1969, the sum of the mean rates of change in prices and productivity is almost exactly equal to the mean rate of change in money wage rates. From 1947 to 1960, productivity rose by 3.0 percent a year, prices by 2.5 percent, and money wages by 5.5 percent. Between 1960 and 1969, there was a 3.1 percent a year increase in productivity, prices advanced at an annual average rate of 2.2 percent, and money wages moved upwards at 5.3 percent a year. After 1969, though, there is evidence of a divergence between the rate of change in money wage rates and the sum of the rates of change in prices and productivity, with wages advancing more rapidly. Between 1969 and 1973, comparable points in the business cycle, money wages drifted upward by about 0.2 percent a year more than prices and productivity combined and, between 1973 and 1979, again comparable points in the business cycle, the drift was about 0.4 percent a year. These data are totally inconsistent with the neo-Keynesian money wage adjustment mechanism. Instead, they support the modified neoclassical (ARE) response, accompanied by a secular drift upward in the equilibrium real wage rate in the decade of the 1970's.

Acceptance of the modified neoclassical (ARE) money wage adjustment mechanism has implications with respect to explaining the behavior of the level of

TABLE 2.—RATES OF CHANGE IN MONEY WAGE RATES, PRICES, AND PRODUCTIVITY, UNITED STATES, 1948–79

[In percent]

Time period	Mean annual rate of change in—			
	Money wage rates (w)	Productivity (π)	Prices (p)	$w-(\pi+p)$
1948–60	5. 5	3. 0	2. 5	0.
1960–69	5. 3	3. 1	2. 2	0.
1969–73	7. 1	2. 3	4. 6	. 2
1973–79	9. 0	. 7	7. 9	. 4

[9] Interestingly, this relationship was observed much earlier (for the period 1932–1938) by Lorie Tarshis, "Changes in Real and Money Wage Rates," *Economic Journal*, vol. XLIX, 1939. Tarshis' findings prompted Lawrence R. Klein, *The Keynesian Revolution* (New York: 1947), to wonder whether "Keynes was backing the wrong horse." (p. 107) However, he resolved his dilemma by stating in the very next sentence that, "Our main concern, however, is not with the empirical problem but with the theoretical relation of wage cuts to unemployment." Our concern in this study is with the empirical problem.

unemployment in the American economy. Specifically, in line with our earlier discussion, deviations of real unit labor cost from its equilibrium level should produce deviations in the same direction away from the equilibrium level of unemployment, U*. At this point, to simplify the notation, let (U—U*) be indicated by the symbol $\hat{U}$ and $(w_r'' - \overline{w}_r'')$ by $\hat{w}_r$.

Within the context of a modified neoclassical (ARE) view of the world, the critical magnitude in explaining variations in unemployment is the portion of any change in the money wage rate which may be considered to be exogenous to, i.e., not determined by, the other variables that affect the real wage rate. Thus, we may write

(32) $$\hat{U} = f(\hat{w}_r)$$

and

(33) $$\hat{w}_r = f([\dot{w}_m]_x)$$

where the subscript x denotes exogenous.

Now, we may define

(34) $$(\dot{w}_m)_x = (\dot{w}_m)_a - (\dot{w}_m)_n$$

where the subscripts a and n represent, respectively, actual and endogenous.

Clearly, the endogenous changes in money wage rates are defined by (21). Let us state (32), (33), and (21) in linear form as follows:

(35) $$\hat{U}_t = a_1 + b_1(\hat{w}_r)_t$$

(36) $$(\hat{w}_r)_t = a_2 + b_2(\dot{w}_m)_{xt}$$

and

(37) $$(\dot{w}_m)_{nt} = a_3 - b_3(\hat{w}_r)_{t-1} + c_3\dot{p}_t + d_3\dot{\pi}_t$$

Combining (35), 36) and (37) with (34) yields

(38) $$\hat{U}_t = a_1 + a_2b_1 - b_1b_2a_3 + b_1b_2(\dot{w}_m)_{at} + b_1b_2b_3(\hat{w}_r)_{t-1} - b_1b_2c_3\dot{p}_t - b_1b_2d_3\dot{\pi}_t$$

which may be simplified to

(39) $$\hat{U}_t = \alpha + \beta(\hat{w}_r)_{t-1} + \gamma(\dot{w}_m)_{at} - \delta\dot{p}_t - \lambda\dot{\pi}_t$$

The signs assigned to the parameters of expression (39) follow from the attribution of signs in equations (35) through (37). Interestingly, from (38) we infer that unless b_3, c_3, and d_3 equal unity, $\beta \neq \gamma$, $\beta \neq \delta$, $\beta \neq \lambda$, $\gamma \neq \delta$, and $\gamma \neq \lambda$. Also, if $c_3 \neq d_3$, $\delta \neq \lambda$.

Expression (39) can furnish the basis for an empirical explanation of the level of unemployment once a minor problem is resolved, viz., the fact that the unemployment measure is defined as a deviation from the equilibrium level of unemployment, a magnitude that we do not know with precision. To now, our assumption of an invariant population has implied, within the framework of a modified neoclassical (ARE) adjustment mechanism, a constant equilibrium level of unemployment. Under such conditions, that constant equilibrium would be captured in the constant term of any empirical relationship of a linear kind. Realistically, though, some adjustment must be made to take into account changes in population and labor force that occur over time, changes which alter the equilibrium level of unemployment. This can be accomplished within the context of our basic assumption of a constant labor force participation rate, which implies that

(40) $$S_t = S_0(1+\dot{q})^t$$

where $\dot{q}$ is the rate of growth in population. If we assume further that the equilibrium level of unemployment expands proportionately to the growth in population, i. e.,

(41) $$U_t^* = U^*_0(1+\dot{q})^t,$$

expressions (40) and (41) may be rearranged as

$$(42) \qquad (U_t - U_t^*) = U_t = \hat{U}_t - U_0^*(1+\dot{q})^t$$

Dividing both sides of (42) by S_t gives

$$(43) \qquad (U_t - U_t^*)/S_t = [U_t - U_0^*(1+\dot{q})^t]/S_t$$
$$= U_t/S_t - U_0^*/S_0$$

Since U_0^*/S_0 is a constant, the ratio U_t/S_t, which is simply the observed unemployment rate in time t, can be employed, *for statistical purposes*, in estimating expression (39), as a measure of $\hat{U}_t$.

Using as a measure of unemployment the standard unemployment rate data reported by the Department of Labor[10], we have estimated expression (39) in two forms, one employing current values for all variables and one lagging the independent variables one year. Again, the time period 1949–1980 is considered. The results are summarized in Table 3. In both cases they are generally consistent with the modified neoclassical (ARE) adjustment mechanism although the lagged version produces more robust estimates. In that formulation all variables have the expected signs and are significantly different from zero at normal levels of statistical significance. Approximately seventy percent of the variation in unemployment rates is explained. This lends additional support to our previous findings.

Some additional tests of the unemployment model have been conducted, using data from the pre-World War II era. These data, in some cases, differ from series that are available currently. For example, money wage rate data are either available in the form of estimates of annual compensation or as hourly wage rates for the unskilled. Neither of these exactly match the wage data for the 1949–1980 interval. However, by using both sets of data, as well as appropriate productivity series for each set, the basic unemployment model can be tested for the period 1901–1941. For this analysis, we have used the standard data series for unemployment rates presented in *Historical Statistics* of the United States.[11] Price change data are also taken from *Historical Statistics*, with the choice being series E–135 for the consumer price index. The two wage series are Stanley Lebergott's annual earnings of workers while employed[12] and the David-Solar index of unskilled hourly wage rates.[13] For productivity measures, we use John Kendrick's estimates, as reported in *Historical Statistics*, employing an annual output series (D–688) with Lebergott's earnings series and an hourly series (D–683) with the David-Solar wage measure.[14]

Table 4 presents the empirical estimate of the unemployment equation for 1901–1941. It differs from the results reported in Table 3 only in that two wage and productivity series are used and the lag structure differs. Experimentation revealed that the one year lag observed after World War II was not present prior to the War. Instead, unemployment and real unit labor cost vary concurrently. Overall, the model does an excellent job of explaining unemployment in the period 1901–1941, accounting for over ninety percent of the variation in the unemployment rate. Both real unit labor cost variables are highly significant statistically with the expected positive sign. All of the other variables have the expected sign and one wage (hourly unskilled), one productivity (output per man-hour), and the rate of change in prices are significant at the five percent level or beyond. Perhaps the most remarkable dimension of the model is its capacity to explain the phenomenon of The Great Depression. Table 5 shows the estimated and actual values for unemployment for the years 1929–1941. The correspondence is obvious. Added to the empirical material pertaining to the post-World War II period, the evidence supporting the theoretical model of unemployment is quite substantial.

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[10] The unemployment rate data are from Table A–1, *Employment and Training Report of the President*, *op. cit.*

[11] *Historical Statistics of the United States*, part 1 (Washington, D.C.: 1975), Series D–86.

[12] *Ibid.*, Series D–724.

[13] Paul A. David and Peter Solar, "A Bicentenary Contribution to the History of the Cost of Living in America," in Paul Uselding, ed., *Research in Economic History*, vol. 2 (Greenwich, Conn.: 1977), pp. 59–60.

[14] *Historical Statistics*, *op. cit.*

Table 3

Unemployment Regression Results, United States, 1949-1969

Regression Format	Regression Parameters*							
	Constant	Real Unit Labor Cost ($\hat{w}_r$)	Rate of Change in Money Wages	Rate of Change in Productivity	Rate of Change in Prices	R^2	$\bar{R}^2$	D-W
Adjusted Real Wage Lagged One Period - Other Variables Current	4.77	0.72 (0.16)	0.20 (0.23)	- 0.13 (0.14)	- 0.25 (0.21)	.52	.44	1.57
Adjusted Real Wage Lagged Two Periods - Other Variables Lagged One Period	4.79	0.72 (0.12)	0.39 (0.18)	- 0.46 (0.11)	- 0.32 (0.16)	.72	.68	1.57

* Values in parentheses are standard errors of regression coefficients.

TABLE 4.—SUMMARY OF REGRESSION RESULTS, 1901–41

Independent variable or regression statistic	Regression parameters [1]
Real unit labor cost (L) [1]	0. 73
	(0. 08)
Real unit labor cost (DS) [1]	0. 33
	(0. 04)
Percent change money wage (L)	0. 07
	(0. 17)
Percent change money wage (DS)	0. 28
	(0. 10)
Percent change output/man-hour	−0. 62
	(0. 18)
Percent change output/year	−0. 03
	(0. 10)
Percent change prices	−0. 88
	(0. 17)
Constant	4. 03
R^2	. 92
R^2 (adjusted)	. 91
D–W	1. 25

[1] Values in parentheses beneath regression coefficients are standard errors. L denotes Lebergott series and DS denotes David-Solar series.
[2] Real unit labor cost is expressed as deviation from 1929 value (=100) and is lagged one year.

TABLE 5.—ACTUAL AND ESTIMATED UNEMPLOYMENT RATES, UNITED STATES, 1929–41

[In percent]

Year	Unemployment rate	
	Actual	Estimated
1929	3. 2	3. 0
1930	8. 7	8. 2
1931	15. 9	16. 4
1932	23. 6	22. 4
1933	24. 9	26. 5
1934	21. 7	19. 1
1935	20. 1	18. 8
1936	16. 9	13. 6
1937	14. 3	11. 7
1938	19. 0	17. 3
1939	17. 2	16. 8
1940	14. 6	15. 1
1941	9. 9	11. 2

There are additional implications of the model. For example, consider the impact of attempting to hold the unemployment rate below the equilibrium level. In order to do this, the sum of the rates of growth in prices and productivity must be kept greater than the rate of growth in money wages. Given the long term pattern of money wage adjustment in labor markets, this can be done only by resorting to an ever increasing rate of price inflation. Thus, if $\dot{p}_t > \dot{p}_{t-1} > \ldots > \dot{p}_{t-n}$ in perpetuity, a permanent disparity, or money illusion, can be created, provided that labor markets do not begin to anticipate the increases in the rate of price inflation. If, at any point, you choose to halt the process of escalating the rate of price inflation, say, merely to stabilize it, the unemployment rate will begin to return to the equilibrium level. Furthermore, any attempt to slow the rate of price inflation implies that $\dot{p}_t < \dot{p}_{t-1} < \ldots < \dot{p}_{t-n}$, which means that money wage rates will rise faster than warranted by productivity and price level changes, real unit labor cost will rise, and employment (unemployment) will fall (rise). In short, once committed to a policy of using price inflation in an attempt to reduce unemployment below the equilibrium level, any attempt to reduce the rate of price inflation will cause the unemployment rate to temporarily rise above the equilibrium level. Finally, there is the clear implication that attempts to reduce the level of unemployment through expansionary macroeconomic policy that reduces real unit labor cost by inflating the price level will not permanently reduce the unemployment rate below the natural rate associated with a zero rate of price inflation. Thus, *any stable rate of price inflation produces the equilibrium (or natural) rate of unemployment.*

The fact that any stable rate of price inflation produces the natural unemployment rate provides a means of empirically estimating that rate. Assume the following long run money wage adjustment mechanism:

$$(\dot{w}_m) = \alpha + \dot{p} + \dot{\pi} \tag{44}$$

The constant term, α, in (44) is designed to capture any time drift in the equilibrium real wage rate in the economy, such as that already noted in the 1969–1973 and 1973–1979 business cycles. Substituting (44) into expression (39) and solving yields:

$$U^* = 4.79 + 0.39\alpha + 0.72(\overline{w}_r)_{t-2} - 0.07\overline{\dot{\pi}}_{t-1} + 0.07\overline{\dot{p}}_{t-1} \tag{45}$$

where the symbol, —, over the variables denotes their mean value for the period under consideration. Using expression (45), the natural rate of unemployment has been estimated for the business cycles that transpired in the interval 1961 through 1979. The 1980–1981 cycle is not considered on the grounds that it was such a brief cycle that the adjustment processes that enable us to estimate the natural unemployment rate from (45) may not have been able to be completed. The results are reported in Table 6. For the 1961–1969 cycle, the natural unemployment rate was 4.38 percent. Over the interval 1969–1973, it was 5.72 percent and, for the 1973–1979 cycle, it was 6.62 percent, indicating that it rose by about two-and-one-quarter percentage points between 1961 and 1979.

TABLE 6.—THE NATURAL RATE OF UNEMPLOYMENT, 1961–79

Time period	Natural rate of unemployment (percent)
1961–69	4. 38
1969–73	5. 72
1973–79	6. 62

Source: Calculations from model of unemployment.

Appendix II. AN EXTENDED MODEL

For purposes of simulating how the American economy would have performed under a regime of a constant monetary growth rule, the model of unemployment presented in Appendix I has been modified to translate unemployment into employment and real output and to provide an explanation for the determination of the rate of price inflation that enters into the labor market adjustment mechanisms.[1] Certain variables are treated as exogenously given, the labor force (L), the rate of growth in productivity ($\dot{\pi}$), and the rate of growth in the monetary base ($\dot{B}$). All other variables are determined endogenously by the operation of the model. Below is a full statement of the extended model.

The Extended Model

Variables:

Exogenous:

- Labor Force (L)
- Rate of Growth in Productivity ($\dot{\pi}$)
- Rate of Growth in Monetary Base ($\dot{B}$)

Endogenous:

- Rate of Growth in Money Wages ($\dot{W}$)
- Rate of Growth in Prices ($\dot{P}$)
- Employment (N)
- Unemployment Rate (U)
- Real Output (Y)
- Real Unit Labor Cost (w_r^*) (expressed as deviation from equilibrium value)

Relationships:

(1) $\dot{P}_t = f(\dot{B}_t, \dot{Y}_t)$
(2) $\dot{w}_t = f(w_r^*{}_t, \dot{p}_t, \dot{\pi}_t)$
(3) $U_t = f(w_r^*{}_{t-})$
(4) $w_r^*{}_t = f(w_r^*{}_{t-1}, \dot{p}_t, \dot{\pi}_t, \dot{w}_t)$
(5) $N_t = f(L_t, U_t)$
(6) $Y_t = f(N_t, \pi_t)$

Specific Equations:

(1) $\dot{p}_t = a_0 + a_1\dot{B}_t - a_2\dot{Y}_t$
(2) $\dot{w}_t = b_0 - b_1(w_r^*{}_{t-1}) + b_2\dot{p}_t + b_3\dot{\pi}_t$
(3) $w_r^*{}_t = w_r^*{}_{t-1} - \dot{p}_t - \dot{\pi}_t + \dot{w}_t$
(4) $U_t = c_0 + c_1 w_r^*{}_{t-2} - c_2\dot{p}_{t-1} - c_3\dot{\pi}_{t-1} + c_4\dot{w}_{t-1}$
(5) $N_t = (1 - U_t)L_t$
(6) $Y_t = \alpha(1 + \dot{Y}_t)Y_{t-1}$
(7) $\alpha = Y_{1961}(1 + \overline{\dot{\pi}}_{61-80} + \overline{\dot{N}}_{61-80})/Y_{1980}$
(8) $\dot{Y}_t = \dot{N}_t + \dot{\pi}_t$

Parametric Values:

$a_0 = .989$
$a_1 = .943$
$a_2 = -.588$
$b_0 = 2.49$
$b_1 = -0.39$
$b_2 = 0.83$
$b_3 = 0.31$
$c_0 = 4.79$
$c_1 = 0.72$
$c_2 = -0.32$
$c_3 = -0.46$
$c_4 = 0.39$
$\alpha = 0.99446$

The lag structure of this model is such that by assuming a particular rate of growth in the monetary base, values for all the endogenous variables can be generated sequentially in a fashion that moves from year to year producing estimates of the various measures of performance for the economy. Table 3 of the text reports a summary of the results obtained under an assumption of a two percent annual growth rate in the monetary base.

[1] The mechanism for explaining the rate of price inflation is from David Klingaman and Rajindar Koshal, "A Model of United States Inflation, 1959–1980," *Atlantic Economic Journal*, vol. 10, no. 4 (December, 1982).

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