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THE INFLATION PROCESS IN THE UNITED STATES

A STUDY

PREPARED FOR THE USE OF THE

JOINT ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

BY

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AND

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FEBRUARY 22, 1972

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LETTERS OF TRANSMITTAL

FEBRUARY 18, 1972

To Members of the Joint Economic Committee:

Transmitted herewith is a study of the relation between employment and inflation entitled "The Inflation Process in the United States," by Otto Eckstein and Roger Brinner of Harvard University. This study, which endeavors to explain the economic processes which produced the unhappy combination of inflation and unemployment experienced recently in this country, forms part of the committee's continuing study of employment, income, and wealth in the United States.

The views expressed in the paper are exclusively those of the authors and do not necessarily represent the views of the Joint Economic Committee, individual members thereof, or its staff.

WILLIAM PROXMIRE,
Chairman, Joint Economic Committee.

FEBRUARY 17, 1972.

Hon. WILLIAM PROXMIRE,
Chairman, Joint Economic Committee,
U.S. Congress, Washington, D.C.

DEAR MR. CHAIRMAN: Transmitted herewith is a study entitled "The Inflation Process in the United States." This study was prepared for the Committee by Otto Eckstein, Professor of Economics at Harvard University, and Roger Brinner, Teaching Fellow at Harvard University, in association with Data Resources, Inc., of Lexington, Massachusetts. It forms part of the committee's continuing effort to analyze employment, income, and wealth in the United States.

This study examines the relationship between the level of employment and the rate of inflation and seeks to identify the processes which produced the combination of high unemployment and rapid inflation which has recently been experienced in the United States. The study concludes that the inflation process is cumulative, in that past wage and price changes are a major influence on current changes. It further concludes that, the higher the past rate of inflation, the more pronounced its impact on current price and wage changes. The wage-price guideposts of the early 1960s are found to have had a favorable effect in reducing inflation and the announced abandonment of income policies in 1969 an unfavorable effect. The changed structure of the labor market, which other recent studies have suggested as a partial explanation of recent inflation is found to be of only minor significance.

The views expressed in the paper are those of the authors and do not necessarily represent the views of the Committee, its individual members, or members of the Committee staff.

JOHN R. STARK,
Executive Director, Joint Economic Committee.

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Chapter I. SUMMARY OF CONCLUSIONS

The last few years have seen the worst combination of unemployment and inflation in modern United States experience. What produced so poor a result? Has the economic structure deteriorated so that the choices open to policy have worsened? Do we have to lower our sights for the 1970's? Or were the troubles due to peculiar factors of our recent history?

This study applies the methods of econometrics to these questions. The competing hypotheses are tested against the statistical record, and some new formulations are developed. Historical relationships for the behavior of prices and wages are combined into a small model which is used for simulation studies.

Our conclusions are, within limits, quite optimistic. The largest part of the poor price-unemployment performance is found to be due to particular historical circumstances: the period of excess demand, the abandonment of incomes policy, and the self-generating speed-up of the wage-price spiral once the fundamental conditions had gone sour. If normal conditions can be restored by the new wage-price program, the trade-off should be little changed from the earlier postwar years.

We find that the wage-price mechanism gradually becomes explosive once unemployment falls below a critical level, a level with the current structure of the economy in the range of 4 to 4.5 percent. The initially incomplete and delayed reflection in wage claims of deteriorating price behavior keeps the rate of inflation from moving up quickly. But as inflation persists and the wage claims increasingly respond to the price factor, the wage-price spiral accelerates until it reaches an explosive condition. This condition had been reached at the time of the wage-price freeze. Thus, our findings support an "accelerationist," "momentum" view of the inflationary process if the unemployment rate is kept below its critical level. But at higher levels of unemployment the traditional Phillips Curve analysis remains valid. Thus, there is a similarity in our findings with the monetarist position under conditions of full employment, but a rejection of this view under slack circumstances. We reject the terminology of the "natural" unemployment rate because the rate is not rooted solely in the technological conditions of production or markets. There is little that is "natural" about it.

The factors determining the level of the critical unemployment rate are not yet understood in a quantitative sense. The extent of market power applied to wage and price decisions is one fundamental factor: prices rise in the absence of excess demand, with costs passed forward fully even when there is ample idle productive capacity. Wages rise faster than productivity even when prices are stable and labor markets show an excess of supply. Great disparities in the training and opportunities of different segments of the labor force also make the critical unemployment rate high. It is one of the main tasks of future economic policy to lower the critical unemployment rate.

Our study does not support the recent findings that much of the severity of the inflation can be attributed to any deterioration of the structure of the labor force. While it is true that there is a secular decline in the experienced male worker unemployment rates for any given national rate, this has, at most, been a minor factor in accelerating the rate of wage increase.

Similarly, our study does not attribute the deterioration in the unemployment-price tradeoff to a worsened structure of product markets. While the introduction of import quotas on several major industry product lines has diminished competition, the overall increase of imports strengthened competition generally. We find no change in the response of the price level to cost and demand factors over the period.

The study also finds that the presence of the Viet Nam war, as opposed to other sources of excess demand of the same magnitude, had only a small impact on the development of the inflation. The surge of orders for military procurement in 1965–66 provided an extra impetus to price increases, but beyond that no independent "war effect" can be found in the statistics. Of course the unpopularity of the war was the main factor in the failure to raise taxes at the proper time which helped produce the excess demand. In that deeper sense, the war was a major factor.

Finally, the guidepost policies of the 1960's can be seen to have had at least a modest impact on the rate of wage increase, and a larger impact on the wage-price system as a whole. Until the last 18 months of experience, it was difficult to distinguish between the importance of guidepost effects and changes in the structure of the labor force in accounting for the modest wage increases from 1964 to 1967. But the most recent data discriminate strongly between these competing hypotheses, in favor of the guidepost effect and lagging inflationary expectations. The announced abandonment of incomes policies from January 1969 to August 1971 is therefore found to be an important contributing factor to the severity and acceleration of the wage-price spiral in this period.

Looking ahead, our analysis suggests that inflationary expectations are built on about two years of experience. Therefore, with an effective wage-price program, it should be possible to restore normal expectations in about a two-year span. Without the new economic policies of August 1971, it would have required an unemployment rate maintained at 6 percent until 1975 to clear the system of the adverse effects of the recent inflation: only in 1975 would inflation be reduced to the low level corresponding to such high unemployment in the long run.

The study also concludes that demand policies should not be determined by looking only one year ahead. The short run Phillips Curve always shows little tradeoff because it takes several years for inflation expectations to catch up with reality. Policy has to look at long term relationships between full employment and price stability if we are to reach our long term goals.

Chapter II. THE WAGE-PRICE MECHANISM: A SUMMARY

Before presenting the detailed account of the empirical work and the various alternative hypotheses tested, we report the central results: the equations finally employed in the simulation studies, and the main simulation. The equations contain the factors that appear to be most important and most statistically significant, and consequently seem to best represent the inflationary process.

A. Wage Determination

The basic wage equation of the model embodies the following concepts:

1. The rate of wage increase depends on excess demand in the labor market as measured by the rate of unemployment, with successive declines in the unemployment rate resulting in increasing increments in the rate of wage inflation. The inverse form of the unemployment rate follows the work of Phillips and numerous other studies.

2. The rate of increase of consumer prices influences wages, but with a coefficient of about one-half in normal times. This also confirms the results of numerous previous studies. Other factors serve to keep real wages in line with productivity.

3. A severe and persistent inflation results in greater wage sensitivity to prices. Hence there is a separate inflation severity factor. The criterion of severity used is the positive excess of the eight-quarter rate of inflation over 5 percent. That is, if the average of the annual rates of inflation for the previous two years exceeds 2.5 percent, then wage inflation responds more fully to price inflation. In the specification adopted in the paper, every percentage point increase in prices above 2.5 percent is approximately reflected in a full percentage point increase in wage inflation. As will be detailed later, the apparent response to a price change may be less than unitary during expansion and greater than unitary during concentration. The severity factor reflects the increased awareness and concern of workers with real wages as inflation persists, and the gradual spread of long-term labor settlements incorporating high wage increases.

4. The presence and intensity of guidepost policies measurably affects the rate of wage and price increases only through their impact on wages. This effect was estimated to be a reduction of approximately three quarters of one percent in wage inflation for given price inflation. The interdependence of wages and prices implied a total benefit on over-all behavior of 1¼ percent per year at peak effectiveness. The nature of the guidepost mechanism apparently resulted in a real income loss for labor at the initiation of the program. Other researchers have been divided in their evaluation of guidepost effectiveness.

5. Changes in the rate of personal taxation initially add pressure to wage inflation but the effect reverses itself. No comparable effect was found for social security taxes.

The basic wage equation and the necessary definitions are presented below:

FIGURE 1. Wage Equation

$$w_t = 1.257 + .496\ \overline{pc}_t + .248\ JP_t + 11.171\ (1/u_t) - .705\ GP_t + .022\ \overline{T}_t$$
$$(5.899)\ (7.307)\quad (4.021)\quad (10.067)\quad (6.911)\quad (3.215)$$

$\overline{R}^2 = .935$
$D.W. = .769$
$S.E. = .329$

Period: 1955:1—1970:4.

w_t : four-quarter rate of change in the wage index for the nonfarm private sector.

$\overline{pc}_t$: $.4\ pc_t + .3\ pc_{t-1} + .2\ pc_{t-2} + .1\ pc_{t-3}$.

pc_t : four-quarter rate of inflation in the consumption deflator.

JP_t : index of inflationary severity, equal to the positive excess over 5 percent of the eight-quarter rate of price inflation (2.5 percent per year).

u_t : aggregate unemployment rate of the noninstitutional population, age 16 and older.

GP_t : dummy variable reflecting the existence of the Federal wage guideposts from 1962–66.

$\overline{T}$: $10\ T_t - 4.5\ T_{t-1} - 3.0 T_{t-2} - 1.5\ T_{t-3}$.

T : four-quarter rate of change in the ratio of gross wages to wages net of personal tax payments.

NOTE.—The numbers enclosed in the parentheses are t-statistics.

B. PRICE DETERMINATION

The basic equation for the rate of increase of the price level embodies several well established concepts. The quarterly rate of increase of the price index for the non-farm private sector depends upon:

1. The rate of increase of *standard* unit labor costs, with a weight of 1, implying a complete forward cost pass through. Unit labor costs are used as a proxy for the full set of cost components.
2. The rate of increase of *actual* unit labor costs, with a much smaller coefficient, reflecting the partial impact of transitory changes in labor costs due to overtime and productivity swings.
3. Increases in the ratio of the real backlog of unfilled order to productive capacity in manufacturing. Decreases showed no such effect, confirming an asymmetric effect of demand on prices.

The basic equation used in the subsequent simulations and the definitions are shown as follows:

FIGURE 2. Price Equation

$$px_t = .007 + 1.000(\overline{w}_{t-1} - .65) + .351[(w_t - .65) - (\overline{w}_{t-1} - .65)] - .199(\overline{q}_{t-1} - .65) - .089(q_t - \overline{q}_{t-1}) - .517(\overline{w}_t - J\overline{W}_t) + .120[(UF/K)_t - (UF/K)_{t-1}]^*$$
$$(.038)\ (8.896)\quad (3.841)\quad (-2.397)\quad (-2.286)\quad (-3.414)\quad (2.298)$$

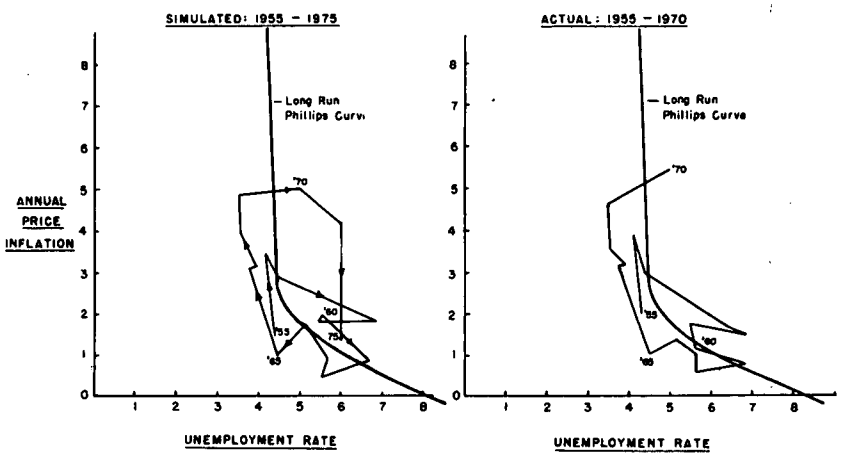
$\overline{R}^2 = .707$.

$D.W.=1.954$.
$S.E.=.223$
Period: 1955:1—1970:4.
px_t: one-quarter rate of change in the output deflator for the non-farm, private sector.
w_t: one-quarter rate of change in the sectoral wage index.
$(w_t-.65)$: one-quarter rate of change in standard unit labor cost.
$(\overline{w}_t-.65)$: $.4\ w_t+.3\ w_{t-1}+.2\ w_{t-2}+.1\ w_{t-3}-.65$.
q_t: one-quarter rate of change in the sectoral index of output per man-hour.
$\bar{q}_t$: $.4q_t+.3q_{t-1}+.2q_{t-2}+.1q_{t-3}$.
$\overline{JW}_t$: $.4\ JW_t+.3\ JW_{t-1}+.2\ JW_{t-2}+.1\ JW_{t-3}$.
JW_t: one-quarter rate of change in the Department of Commerce wage index for private, non-farm economy.
UF/K: ratio of real, unfilled orders to capacity in manufacturing.
*: indicates this variable is defined to be equal to zero if UF/K declines.

C. The Basic Simulation Results

The two main wage and price equations were combined with several subsidiary relations to simulate the actual unemployment-inflation experience of the 1955–70 period. The heavy line in figure 3 shows the long run Phillips Curve after the lags in wage and price responses are completely worked out. The light lines show the annual experiences and the path of the wage-price system. The right hand panel shows the actual path; the left hand panel shows the path as traced by the simulation model.

FIGURE 3
TIME PATHS OF THE ECONOMY



Because wages and output prices are set under the influence of the previous price experience, the combination of unemployment and inflation achieved in any year depends on the preceding history. This explains the clockwise loop of actual experience around the long

run curve. The inflation of the mid-1950's left a legacy of inflation expectations that made for a worse than normal tradeoff in 1958. By 1962 the economy was below the long run Phillips Curve. But after unemployment dropped below the critical 4 percent value in 1966, inflation accelerated. After unemployment rose in 1970, the actual experience remained far worse than the normal long run Phillips Curve. Without a freeze the path back to the normal trade-off would have been slow; with unemployment maintained at 6 percent, price stability would not have been restored until 1975.

This summary does not present the full results. The next two chapters contain the fuller account of the empirical framework and the statistical tests conducted in deriving the wage and price equations. Chapter V presents various other simulations, including studies of the possible impacts of the phase II wage-price program. The final chapter explores some very tentative policy conclusions.

Chapter III. THE WAGE EQUATION

After an extended period of remaining near the productivity trend, money wages accelerated sharply from 1965 to 1969. Even after the economy slid into recession, the rate of wage increase remained at its high level. Negotiated increases in major collective bargains rose somewhat later, but were at higher levels at the time the wage-price freeze was imposed.

TABLE 1.—INCREASES IN AVERAGE COMPENSATION PER MAN-HOUR IN THE PRIVATE NONFARM ECONOMY AND IN NEGOTIATED SETTLEMENTS 1965–1971

(Annual rate of percent change)

	Average compensation	Negotiated settlements
1965	3.7	N.A.
1966	6.1	4.7
1967	5.7	5.5
1968	7.3	6.5
1969	6.9	8.2
1970	7.0	9.1
1971 [1]	7.5	8.4

[1] 1st 9 months.

Source: Bureau of Labor Statistics.

There are several possible explanations for the behavior of wages in recent years. This chapter reports on empirical tests designed to assess the significance and importance of the competing hypotheses.

A. The Empirical Framework

This study analyzes the changes in the level of compensation in the entire private non-farm economy. Two steps were taken to minimize the random noise in the data. First, the data were expressed in terms of the percent change for successive four-quarter intervals. As figure 4 shows, the one-quarter changes (at annual rates) are highly erratic, probably due to rounding of already small numbers and incomplete seasonal correction. The large peaks following a large trough probably originate in too low an estimate of the trough value. The use of overlapping intervals as in four-quarter rates of change reduces this effect.

Second, the fixed-weight index for wages computed by Professor Gordon, which he generously provided to us, was used. An earlier study showed (Eckstein 1, 1968) that the changing mix of employment among high and low wage industries over the business cycle introduces a spurious variation into the data. The contrast between the uncorrected and the corrected series is shown in figure 5.

The method of analysis is the standard econometric multiple regression technique. Because of the simultaneous character of price

and wage equations, the two stage least squares method was employed to check major results. No significant changes in the sets of coefficients were discovered.

FIGURE 4

COMPARISON OF ONE-QUARTER (X4) AND FOUR-QUARTER RATES OF CHANGE IN THE FIXED-WEIGHT WAGE INDEX

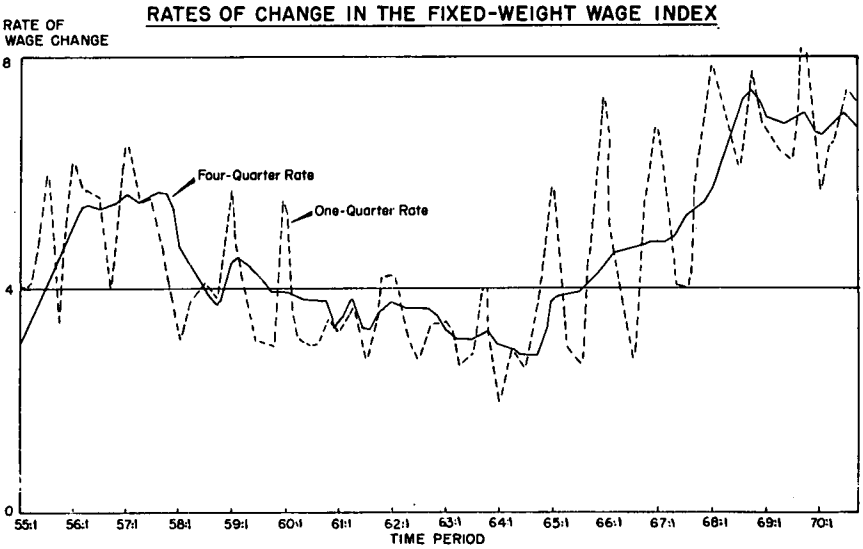
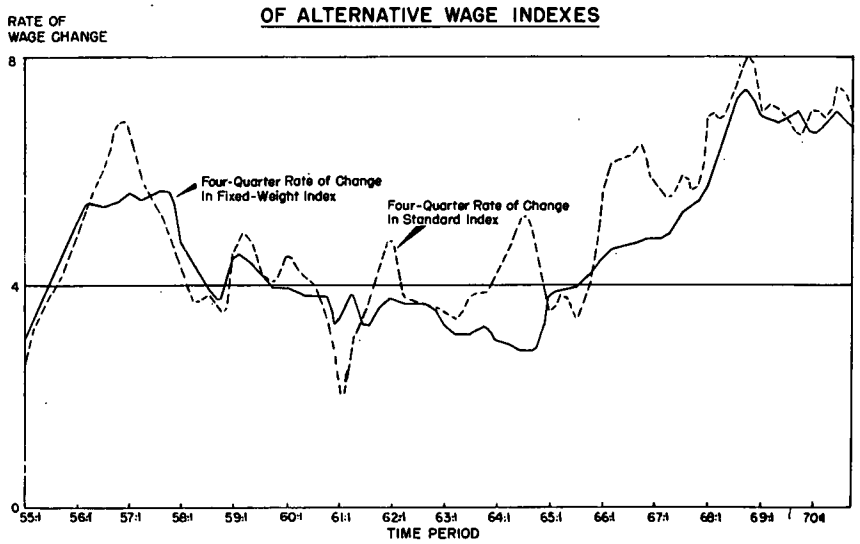


FIGURE 5

COMPARISON OF THE FOUR-QUARTER RATES OF CHANGE OF ALTERNATIVE WAGE INDEXES



B. The Impact of Labor Market Conditions

The national unemployment rate, usually in inverse form, has served most frequently as the indicator of the supply-demand balance in the labor market. From 1963 on, equations relying on this variable

ceased to track actual experience, and a search began for alternative measures. Simler and Tella (1968) recognized that there are changes in the composition of the labor force in terms of age, sex and experience. The fraction of the labor force represented by experienced workers or married male heads of households has fallen steadily because of the rising participation rates of women and the increasing percentage of young people in the working age population. These "secondary workers" are more likely to withdraw from the labor force when job opportunities are lacking; the reported national figure is insensitive to this differential participation behavior. It has also been conjectured that the increasing scarcity of the experienced male worker, who is particularly heavily represented in the highly skilled blue collar trades, has made the labor market tighter than the unemployment rate would indicate.

Behman (1964) suggested that the state of equilibrium in the labor market is measured more precisely by new hires rather than by the unemployment rate. When business is searching for new workers in large numbers it must be willing to offer a higher entry wage than in periods of stagnant employment.

To test these ideas, wage equations were estimated with various alternative measures of labor market conditions. The ideas tested include the following:

1. Equations were estimated using the traditional measure, *the inverse of the national unemployment rate.* This simple form survived the tests and was used in the simulations.

2. To measure the effect of the changing composition of the labor force, the *index of weighted unemployment rates* developed by Perry [1970] was introduced. This index weights labor force participants with an estimate of their average productivity as measured by their wages. To provide additional tests of the demographic factors, equations were tested using the *unemployment rates for males* and *married males,* and also the proportions of the labor force *age 16–19* or *male 25–64.*

3. As an alternative, the *ratio of actual to potential employed manhours* was also tested, using a half dozen measures similar to those developed by Robert Gordon (1971). These indices are developments of the original pioneering work of Simler and Tella (1968).

4. To measure the impact of changes in the demand for labor, equations using variables similar in spirit to Behman's new hires factor were run, using the *rate of accessions* in manufacturing, the Conference Board *index of help wanted advertising,* and the *number of unfilled job openings* reported by the Employment Service.

5. Finally, Perry's *index of the dispersion of unemployment rates* was also used.

When appropriate, these additional variables were detrended to remove the effects of population growth. These alternative or additional variables were tested in several contexts:

1. As simple substitutes for the inverse of the aggregate unemployment rate with all other variables from the basic equation retained.

2. As additional but independent factors through inclusion of both the new variable and the standard measure (1/u).

3. As products with the unemployment inverse to represent an interaction correction of the excess demand picture portrayed by the basic variable.

4. As each of the above in models without the index of inflation severity to determine if the correlation between these measures was the basis of stronger results for these measures in earlier studies.

None of the alternative variables was an adequate substitute: all yielded larger standard errors unless the equation tested also included at least the inverse unemployment rate and usually the inflation severity index as well.[1] Tests of the variables in the combined contexts led to improvements in standard error only for the teenage population proportion and the job vacancy statistic. But even in these cases, their coefficients remained insignificantly different from zero. The results are summarized in table 2.

This finding has significance for the interpretation given to the dispersion index by Perry. Simplified, his argument is that firms have not been able to completely adapt their production processes to the new skill composition of a labor force with increasing proportions of women and teenagers, and therefore the unemployment rates of secondary workers have increased relative to prime-age males. This implies that the dispersion of unemployment rates of age-sex groups from the mean will be greater for any given aggregate rate.[2] The evidence he presents for the hypothesized link between dispersion and age-sex composition indicates, for example, that from 1960 to 1969 the ratio of "prime-age" (25–64) females to males rose from 0.48 to 0.56, accompanied by an increase in the ratio of their unemployment rates from 1.3 to 1.9. Unfortunately, the same table indicates a reversal of this pattern between 1951 and 1960: the proportion rose from .41 to .48, but the ratio fell from 2.2 to 1.3. Other age-sex groups exhibit similar contrasting patterns, although not related to the decades in a systematic manner.

Since other scholars obtained successful results with these variants of labor market variables some further explanation on our part is required. In an earlier survey, one of us reported (Eckstein 1, 1968) that the Simler-Tella concept of a more comprehensive measure of unemployment, including the hidden unemployment of potential workers pushed out of the labor force, succeeded in explaining the low rate of wage increase of the wage round of 1964–66, where the previous equations failed. Similarly, the reformulations by Perry and Gordon succeed in the period up to 1969. As was pointed out in the earlier paper, there was the possible alternative explanation that the extraordinary wage stability in a tightening economy during this interval was attributable to the previous history of price stability, the timing of the wage rounds and guideposts.

Our results strongly support the argument that it was the good price history, not the hidden unemployment, which held down the

[1] Most of the substitutes were tested in their inverse and power forms as well, but still performed more poorly than the basic unemployment rate inverse.

[2] Archibald's (1969) discussion of the effect of aggregation makes it clear that increased dispersion will not automatically yield greater wage inflation for given mean unemployment. The result will depend on the available tradeoffs and relative sizes of the individual labor market subsectors.

TABLE 2.—TESTS OF LABOR MARKET EXCESS DEMAND VARIABLES

[All equations include the guidepost, tax, and normal price variable]

Labor market variables	Results						
	Inflation severity factor included				Inflation severity factor excluded		
	t-statistic[1]	Standard error of the regression	Coefficient of the normal price variable	Coefficient of the inflation severity factor	t-statistic[1]	Standard error of the regression	Coefficient of the normal price variable
PERIOD OF FIT: 1955–70							
1. Unemployment rate inverse (1/u)	10.067	0.329	0.50	0.25	8.531	0.372	0.70
2a. Accession rate	4.584	.469	.76	.13	4.660	.491	.86
2b. Accession rate, 1/u	−.528	.332	.49	.26	.393	.375	.71
3a. Vacancy rate	7.342	.393	.54	.34	5.430	.455	.83
3b. Vacancy rate, 1/u	1.034	.329	.49	.27	−.055	.375	.70
3c. Vacancy rate, u	1.792	.327	.54	.25	.307	.367	.73
4a. Help-wanted index	7.054	.401	.53	.08	7.257	.405	.68
4b. Help-wanted index, 1/u	−.320	.332	.50	.26	1.468	.369	.66
5a. Accession rate less lay-off rate	5.547	.441	.77	.12	5.580	.446	.83
5b. Accession rate less lay-off rate, 1/u	−.839	.330	.48	.27	.442	.375	.71
6a. 16 to 19-year-old workers as percent of labor force	6.815	.407	.50	.12	6.885	.415	.59
6b. 16 to 19-year-old workers as percent of labor force, 1/u	−1.735	.324	.53	.30	.304	.375	.69
7a. Married male unemployment rate inverse	7.848	.380	.51	.18	3.463	.399	.65
7b. Product of the inverses of the marred male and aggregate unemployment rates, 1/u	−1.354	.329	.53	.26	−.675	.371	.72
PERIOD OF FIT: 1955–69							
8. Unemployment rate inverse (1/u)	9.397	.335	.50	.21	9.466	.352	.60
9a. Perry's dispersion index, 1/u	−.592	.338	.50	.23	.465	.355	.58
9b. Product of 1/u and Perry's dispersion index, 1/u	1.641	.330	.42	.16	2.253	.337	.46
10a. Perry's weighted unemployment rate inverse	8.218	.363	.35	.16	8.723	.369	.42
10b. Perry's weighted unemployment rate inverse, 1/u	−.036	.338	.50	.20	1.536	.352	.56
10c. Perry's weighted unemployment rate inverse, Perry's dispersion index	5.135 1.642	.357	.30	.13	5.121 1.897	.364	.36

[1] The t-statistic for each equation is the ratio of the coefficient estimate to the standard error of the labor market variable other than the aggregate unemployment rate (1/u). If this statistic is less than approximately 1.67 in absolute value, the probability that the variable in question has a nonzero effect is less than 5 percent.

rate of wage increase. Equations which use the traditional formulation of the price factor in wage equations, excluding the severity index but using the various alternative labor market measures, were estimated and these results are also summarized in table 2. Such equations generally failed from 1969 on. The labor force factors permit the equations to track in the mid-1960's, but they would predict a reduction in the rate of wage inflation in the last year and a half when all labor market measures showed a very loose labor market, yet the rate of wage inflation continued unabated. Clearly the explanation must be found elsewhere.

Our results do not exclude the possibility of an impact on wages from the shifting composition of the working age population, or sudden changes in the mix of employment demands by industry. However, these factors appear to be minor compared to the role of the price factor including the inflation severity factor, which successfully explain both the remarkably low rate of wage increases of the mid-1960's and the remarkably high rate from 1969 to 1971.

C. The Role of Price Inflation in Wages: Expectations and the Inflation Severity Factor

It has long been recognized that the increase of consumer prices affects wage demands and the movements in money wages. According to classical theory, real conditions in the labor market should determine real wages, implying that money wages respond fully to consumer price changes. But the literature on money-wage econometrics has typically identified a coefficient of 0.4–0.6 on consumer prices. The further the coefficient is below unity, the greater is the inherent stability of the wage-price mechanism.

The main questions about the price effect in wage equations are these: first, what mechanism brings prices into wage claims—a retrospective search for equity to compensate for past inflation, or a prospective expectation of future inflation? Second, how long a period of price experience is pertinent to current wage claims? Third, is the price coefficient stable, or does it change for different intervals? Finally, is the price effect in the wage equation linear regardless of the magnitude of the price factor, or is there a non-linearity which magnifies the price coefficient as inflation becomes greater or lasts longer?

The present study does not test the retrospective or prospective character of the price effects. A recent study by Turnovsky and Wachter (1971) shows that price expectations move very similarly to recent price experience. They fitted wage equations using the projected rate of inflation of the Livingston forecasters' survey. Apparently, in the case of prices, the common assumption that future expectations are largely based on the recent past is roughly correct, hence empirical differentiation of the retrospective and prospective effects is difficult if not impossible.

The relevant price index is assumed to be the implicit deflator for consumer expenditures in the GNP accounts. The case for a consumption price index is admittedly stronger from the labor supply than the demand side. Traditional theory would prefer the inclusion of an output price index to reflect the value productivity of labor: but the parallel movements of the price series make it difficult to distinguish statistically.

Some recent work draws the mechanism for forming price expectations out of equations derived for long term interest rates (e.g., Yohe and Karnosky, 1969). These equations identify lengthy distributed lags, as long as six years. But the use of the same index of inflation expectations in the capital and labor markets requires the time horizons of the labor market participants, the institutional structures affecting their plans, and their perception of inflation to be the same as those of the capital market participants. It seems unlikely that these conditions would be met. Furthermore, the length of the lags seems unreasonable: the sensitivity of workers to prices is more continuous and wages are adjusted over shorter time spans. Also, the expected inflation rate for interest rates is totally forward looking: it is a projection of the rate which will occur in the future. Presumably, the role of price expectations in wage bargaining is partly backward-looking: the last wage increases were negotiated on the basis of a previous period's projection of current price inflation.

Because the historical record now includes a lengthy period of high inflation, it is possible to achieve more sensitive estimates of the nature of inflationary expectations in the wage process than in earlier studies. Our basic wage equation contains a non-linear form for the price variable. So long as the rate of inflation remains below 2.5 percent a year, as measured by the deflator for consumer expenditures, the coefficient on prices is 0.496, with a mean lag of one-quarter, and a distribution of the lag stretching back only three periods. However, when the rate of price inflation exceeds 2.5 percent, the price coefficient rises gradually to unity. This second factor, which we have called the *inflation severity factor*, contains the positive excess of average consumer price inflation above 2.5 percent for the preceding two years. Thus, as inflation passes this critical point, the average price coefficient increases to a potential maximum of 0.992.

During periods of price change below the critical 2.5 percent rise, the expectations process is stable and prices are only partially reflected in wage claims. The price indexes have some measurement error, particularly the small recognition of quality and product change. They also have an upward bias because of their Laspeyres form. Thus the loss of purchasing power when prices rise by less than 2.5 percent is small. A price coefficient of 0.5 in that range may reflect both the lack of a learning process and some overstatement of the real significance of the price changes as reported in the consumer price indexes.

The build up of the average effect of consumer prices is illustrated in figure 6. The marginal effect of increased average inflation is discontinuous: 0.496 at inflation below 2.5 percent, 0.992 above this level. The average effect is defined as the ratio of the estimated total price component in wage inflation to the given annual average inflation.[3]

This characteristic of the wage equation is critical to the working of the total inflationary mechanism. It is this severity factor which makes the mechanism explosive below a critical unemployment rate, and which creates much of the time lag of the rate of inflation behind economic conditions both in the upswing and in the deflationary phase of the business cycle.

Further tests.—It appears to be impossible to obtain a satisfactory wage equation which succeeds in explaining the historical record of the last year and a half without some form of inflation severity index. Table 3 shows that the traditional form for the price variable produces unstable results. As the period is lengthened in the 1960's, the price coefficient increases as more inflation is included in the period of fit. The equation as a whole would not pass the Chow Test for stability of structure.

On the other hand, once the inflation severity factor is included, the equation does pass the standard statistical tests for structural stability. The coefficients on the labor market variables in the equation do not show such a systematic change as the interval is varied, indicating that the changing structure of the equation is in the price factor.

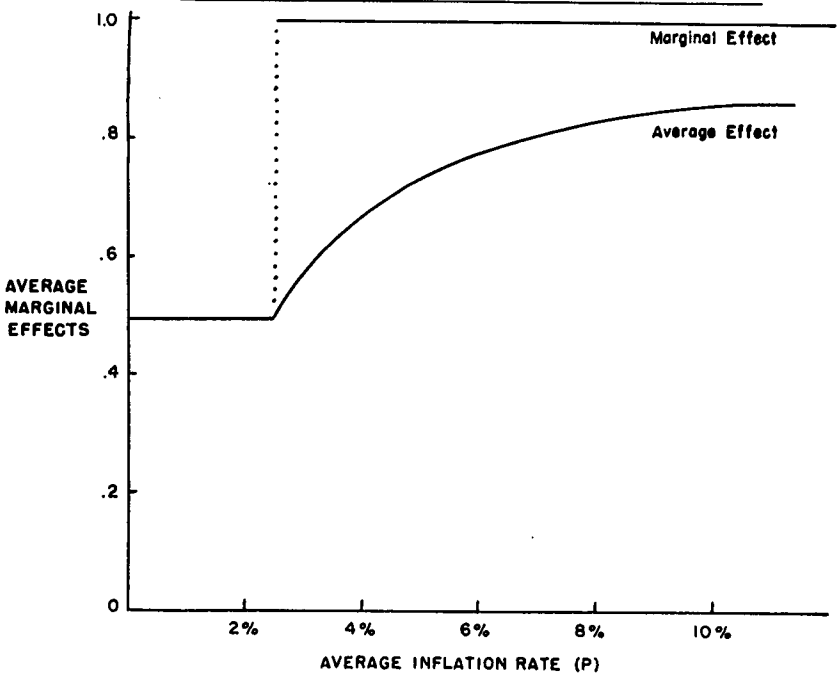
Additional tests were run to explore more precisely the time structure of the process by which the price element enters the wage equation.

[3] This assumes that the two successive annual inflation rates are equal. If the current rate exceeds the lagged rate the effect will be smaller and vice-versa.

FIGURE 6

STEADY-STATE CHARACTERIZATION:

THE EFFECT OF PRICE INFLATION ON WAGE INFLATION



$$\text{AVERAGE EFFECT} = \frac{.496 \times P + .248 \times (2P - 5)^*}{P}$$

(* signifies that the term enters only if positive)

MARGINAL EFFECT = .496 if P is less than 2.5

= .992 if P is greater than 2.5

TABLE 3.—COEFFICIENTS IN WAGE EQUATIONS, VARIOUS INTERVALS

Period	Estimated price coefficient	Coefficient on inverse unemployment rate
1955–60	0.24	12.57
1955–61	.36	13.65
1955–62	.35	13.62
1955–63	.39	13.10
1955–64	.39	12.30
1955–65	.44	12.29
1955–66	.40	12.15
1955–67	.38	11.80
1955–68	.50	12.97
1955–69	.51	12.98
1955–70	.62	11.74

Note.—The estimations included correction for first order serial correlation.

The four-quarter rate of wage inflation was estimated in equations including the guidepost, tax and unemployment variables and various

lag structures for the four-quarter rate of price inflation, but omitting the severity factor. The results obtained by restricting the pattern of weights to correspond to a third degree polynomial are representative and are displayed below in table 4.

TABLE 4.—RESULTS USING ALTERNATIVE PRICE STRUCTURES

Length of lag structure (quarters)	Mean lag		Coefficient sum		Standard error	
	I[1]	II[2]	I[1]	II[2]	I[1]	II[2]
4	0.343	0.416	0.712	0.715	0.350	0.364
8	.957	.948	.737	.737	.365	.352
16	.311	1.415	.643	.706	.364	.384
24	7.624	5.930	1.364	1.191	.269	.292

[1] The value of the coefficient after the most remote period is unrestricted.
[2] The value of the coefficient after the most remote period is restricted to equal 0.

Increasing the length of the lag structure does not substantially improve the standard error except for the six year lag, but in this case the coefficient sum and the lag weights pattern are unreasonable. Examination of the estimated lag weight reveals that they converge to zero after a maximum of five quarters in the 16 quarter structure and after nine quarters in the 24 quarter structure, then oscillate near zero for the remaining quarters. The coefficient of the guidepost dummy remains significant in all cases, and takes values in the range -0.72 to -0.82 when the coefficient sum is less than one. Adding the inflation severity factor to the longer lag structure reduces the standard error by approximately 10 to 15 percent, but leaves it no better than the basic wage equation of this study. Except for a few peculiar cases, its coefficient is estimated to be in the range 0.21 to 0.28 and the sum of the other price coefficients lies in the range 0.46 to 0.74.

It remains to examine the sensitivity of the equation to changes in the two critical parameters of the severity index, the rate of price rise at which the factor comes into play, and the nature of the non-linearity. Table 5 shows the sum of squared residual errors as the critical inflation rate for the severity index is varied. It can be seen that the 2.5 percent average annual rate in the linear context (constant=5, exponent=1) produces the best fit with ordinary least squares techniques, but—in line with a theory relating to a "critical level"—the fit does not deteriorate dramatically for larger exponents or higher critical values. In the later simulation studies we examine the impact of alternative severity indexes on the overall simulation results and the shape of the long term Phillips Curve.

D. The Impact of Incomes Policy: A Guidepost Variable

Earlier statistical studies reached varying conclusions on the effectiveness of the guidepost policies of the mid-1960s.[4] There is no doubt that the rate of wage increase remained amazingly low as the economy strengthened from 1964 on. The studies emphasizing the

[4] Perry (1967) estimated that a mean reduction of 2.1 percent in "visible" industries and 0.5 percent in "invisible" industries could be reasonably attributed to the effect of guideposts. His later work (1970) is based on a wage equation with a guidepost coefficient estimate of 0.78 and lagged price coefficient estimate of 0.345 for a total effect of 1.19 percent. This equation also contains his weighted unemployment rate and dispersion index. Simler and Tella (1968) recognized that "a dummy variable to represent the wage guideposts . . . would result in a highly significant negative regression coefficient for the dummy" but felt that the lack of observations past the guidepost period would make the interpretation subject to question. Although Gordon (1971) found no significant impact, equations similar to his which we estimated found a highly significant impact approximately equal to that which we have reported.

TABLE 5.—COMPARISON OF ALTERNATIVE SPECIFICATIONS FOR THE INFLATION SEVERITY FACTOR

	Exponent=1/2	Exponent=1	Exponent=3/2	Exponent=2	Exponent=3
	Sums of squared residuals				
Critical 2-year inflation rate:					
0	7.72	7.99	7.40	6.94	6.56
1	7.42	7.99	7.23	6.78	6.49
2	6.96	7.87	6.97	6.61	6.43
3	8.01	7.31	6.68	6.47	6.41
4	8.00	6.84	6.43	6.38	6.45
5	6.68	[1] 6.30	6.36	6.44	6.53
6	6.47	6.56	6.75	6.58	6.60
7	6.79	6.64	6.59	6.61	6.70
At best value of constant:					
pc coeff	.536	.496	.528	.526	.527
(t-statistic)	(8.436)	(7.307)	(8.326)	(7.835)	(8.196)
Index coeff	.480	.248	.112	.037	.004
(t-statistic)	(3.758)	(4.012)	(3.916)	(3.893)	(3.837)

[1] Basic.

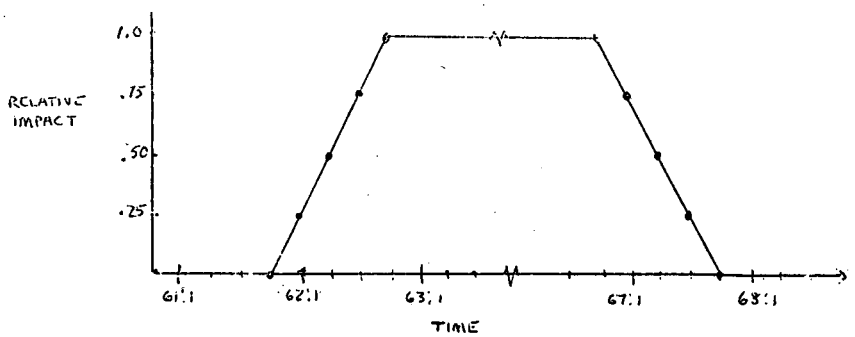
Note: Severity factor=(8-quarter inflation rate—constant) exponent. If the difference is negative, the index equals zero.

composition of the labor force account for this period by the higher proportion of women and youths. They therefore did not assert a significant role for guideposts (Simler-Tella, 1968). Alternatively, a guidepost dummy can be used to explain this period.

Once the inflation severity factor is recognized, these findings change. Much of the good wage record of the years after 1964 is due to the recognition lag on prices and the previous history of price stability. The demographic factors lose significance. But the guidepost variable, with modest magnitude, becomes highly significant statistically.

Because judgment and arbitrariness is inevitable in the definition of a guidepost dummy, we applied the exact form suggested by Perry and used by Gordon, a form that Gordon found insignificant. This guidepost dummy rises linearly from 0.25 in the first quarter of 1962 to unity in the last quarter, and is maintained at that value to the fourth quarter of 1966; it then declines linearly to return to zero by the end of 1967. Figure 7 pictures this dummy.

FIGURE 7. Characterization of Guidepost Effectiveness



In our new formulation, the guidepost dummy is significant with a t-statistic of over 6.9. It directly reduces the rate of wage inflation by 0.7 percent a year. In addition to the direct effect, the lower rate of

wage increase affects price movements, which in turn feed back into the wage equations both through the regular price term and the severity index. The total impact is estimated to be 1.4 percent per year for a period of stability and greater for periods of inflation.

E. The Impact of Personal Taxes on Wages

The level of personal taxation varied substantially during the 1960's, and may have affected the rate of wage increase. The period of tax reduction of 1964–65 saw exceptionally low wage claims, as these benefits to worker income may have substituted in part for higher wages. The surcharge of 1968 may have added to wage increases, and while it is not obvious in the data, the removal of the surcharge may have kept wage increases from being even larger than they would otherwise have been in 1969–70.

We follow the analysis of Gordon to test this hypothesis. If workers were to pass personal tax changes forward to employers through corresponding increase in gross wages, then the following relationships would hold: let N=net wages, G=gross wages, and t=the effective tax rate. Then,

$$N=G\ (1-t) \text{ and } \%\triangle G=\%\triangle N+\%\triangle\ (1/1-t)$$

For example, if the tax rate is 10 percent, and a 1 percent surcharge is imposed, gross wages should rise an extra 1.1 percent.

Ignoring the dynamics of the process for a moment, if the net wage after tax were maintained at a level consistent with the nontax determinants, the coefficient of $\%\triangle(1/1-t)$ would be one. Conversely, if labor supply were completely inelastic with respect to net wages, the estimated coefficient would be zero.

The likelihood of different short- and long-run responses suggests the inclusion of both current and lagged values of the tax variable: on *a priori* grounds one can argue that the immediate response will be significant but the subsequent movements will reduce the gross wage toward the previous level. The initial equilibrium is disturbed by the imposition of a tax. The short-run response is a reduction in supply, resulting in some forward shifting of the tax. But after some delay, the pressures of past living standards, and the diminished consciousness of the tax increase restore the old gross wage equilibrium.

Our results generally confirm Gordon's findings. Initially, higher personal taxes do seem to result in an increase in gross wages, albeit only to the extent that one-fourth of the tax may have been shifted forward. However, subsequent adjustments over the next year reduce this effect so that the original equilibrium is almost restored, and the workers do indeed bear the burden of the personal tax.

A similar analysis of changes in the level of payroll taxes, i.e., mainly social security contributions, does not yield such results. There is no significant increase in wages in response to the higher social security taxes. Apparently the insurance rationale of social security is accepted, and workers feel that the extra withholding purchases benefits in a manner analogous to consumer spending on private insurance.

The impact of tax changes on the rate of wage increase in the 1960's was very minor. If there had been no tax changes over the entire

period, the average rate of wage increase would differ by only 0.05 percent.

F. Impact of Unionization on Wages

While there have been numerous studies of the overall impact of unionization on wage structure,[5] our interest is more narrowly focused on the more immediate and identifiable effects on wage changes of recent years.

On the whole, the degree of unionization in American industry has not changed significantly in the last 15 years. The percentage of the labor force that is organized has been roughly stable. The relative bargaining power of business and labor, at given economic conditions, does not seem to have changed measurably, judging by the stability of our wage equation.

There are three important phenomena that we did not attempt to incorporate in the present study, but which deserve some comment. First, the prevalence of three year contracts in the major industries slowed down the inflationary process quite considerably. As the inflation accelerated, the participants in collective bargaining underestimated the extent to which the bargained results would be eroded by inflation. By the end of the period the long term contract may have served to prolong the period of disinflation because of the desire for a catch-up on the lost purchasing power. These phenomena are illustrated in table 1 of this chapter. In the critical period of accelerating inflation the negotiated wage increases lagged substantially behind the less organized sectors. From 1969 on, the negotiated wages continued to accelerate while the remainder were already showing the impact of a weaker labor market.

Second, our period of study saw the increasing unionization of public employees. As Bok and Dunlop observed (1970, p. 288), the initial impact of unionization is frequently a one-time rise in compensation. Earnings in the public sector rose faster than in the private economy, probably reflecting this process. By the end of the period, state and local governments found themselves in financial difficulty and the supply of school teachers was suddenly found to be excessive due to the falling birth rate. Such phenomena led to a recent diminution of the wage trends of public employees. Federal employees also went through a catch-up period as the principle of parity with private compensation was enacted into law and the initial period of correction was completed.

Third, the particular role of the construction trades must be acknowledged. Construction wages rose much more rapidly than private wages generally for a variety of reasons. The supply of skills is limited by the entry and training system for new workers. The economy itself created a very high demand for construction labor both as part of the capital goods boom and the high level of military spending. The rapid increase of construction wages disturbed the industrial wage structure as members of industrial unions saw the large increases and high levels of the construction trades. The extent of spill-over probably was not large until 1969–1970, at which time it may help to explain the large industrial settlements in a weakening economy.

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[5] See H. G. Lewis, *Unionism and Relative Wages in the United States, an Empirical Inquiry* (Chicago: University of Chicago Press, 1963) and Derek C. Bok and John T. Dunlop, *Labor and the American Community* (New York: Simon and Schuster, 1970), Chapter 11.

G. Econometric Decomposition of the Historical Record

The basic wage equation can be used to decompose the historical record of wage inflation into the separate contributions of price inflation, the demand for labor, guideposts and personal taxes. While this mechanical decomposition ignores the interaction of the several factors as well as the simultaneous properties of the complete wage-price system, it does convey, on an objective basis, some sense of the relative importance of the separate factors in different phases of the recent history. The decomposition of effects consists of multiplying the actual historical values of the separate factors in the equation by their coefficients. The sum of the effects plus a 2.7 percent productivity-related constant is equal to the total estimated wage change, still leaving the unexplained error to be accounted for. The decomposition is summarized in table 6. The "adjusted labor market demand" component is defined such that it equals zero at an unemployment rate of 8 percent.

TABLE 6.—DECOMPOSITION OF THE HISTORICAL WAGE RECORD

Year	Wage change	Components					
		Normal price factor	Inflation severity factor	Total price inflation	Adjusted labor market demand	Personal tax	Guidepost
1955	4.47	0.23	0	0.23	1.25	0.08	0
1956	5.49	1.22	0	1.22	1.31	−.01	0
1957	5.63	1.48	.23	1.71	.87	−.06	0
1958	3.78	1.09	0	1.09	.36	.02	0
1959	4.01	.70	0	.70	.60	.08	0
1960	3.84	.78	0	.78	.38	−.01	0
1961	3.55	.43	0	.43	.41	−.07	0
1962	3.43	.48	0	.48	.62	.12	−.71
1963	3.27	.61	0	.61	.61	−.10	−.71
1964	2.82	.56	0	.56	.86	.03	−.71
1965	4.12	.70	0	.70	1.31	−.09	−.71
1966	4.85	1.35	0	1.35	1.63	.17	−.71
1967	5.32	1.26	.21	1.47	1.47	−.01	0
1968	7.37	1.81	.37	2.18	1.86	.22	0
1969	7.02	2.17	.90	3.07	1.71	−.28	0
1970	6.67	2.32	1.16	3.47	.51	−.04	0

Chapter IV. THE PRICE EQUATION

Previous studies have established that changes in the rate of increase of the price indexes are affected mainly by changes in unit labor and material costs, with secondary influences coming from demand conditions and perhaps such other factors as guideposts, war and profit targets. This study supports the earlier findings on price equations.[1] The basic equation contains actual and standard unit labor cost variables. The effect of demand is measured by the ratio of the level of real unfilled orders to capacity, a measure corresponding quite closely to the relationship between effective demand and supply. The asymmetry between price increases and decreases first noted by Schultze is found again, with the demand variable having positive effect when the ratio of orders to capacity is increasing, no effect when decreasing. No independent effect in the price equation was found for guideposts, and only slight evidence for an independent effect of the presence of war.

From the point of view of economic stability and the long run distribution of income between profits and wages, the coefficient of the labor cost term in the price equation is particularly critical. A coefficient of one would imply a complete forward pass through of higher costs, and would also be consistent with a stable long term distribution of income. The study finds this coefficient to be unity.

A. The Empirical Framework

The output price variable.—To be consistent with the wage analysis, the variable analyzed is the rate of change of the price of gross product originating in the non-farm, private sector as computed by the U.S. Department of Commerce, Office of Business Economics. The one-quarter rate is the dependent variable. It was not necessary to use a fixed-weight index or the four-quarter rate of change; unlike our experience on the wage side, switching from the smooth, four-quarter rate did not decrease the signal-to-noise ratio to a point where the coefficients became unstable.

Input prices.—At the level of aggregation of the non-agricultural private economy, the larger part of material purchases is internalized to the sector. The remaining input costs are agricultural prices, import prices and taxes. Whether unit capital costs should also enter into the price equation depends upon the pricing hypothesis.

The final equation does not include any of these input costs.[2] It was found that variations in these factors did not add to the statistical explanation of price changes. Of course, this result is only pertinent at this level of aggregation: previous studies of industry prices showed ample independent effects of input prices and capital costs.

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[1] See Schultze and Tryon, 1962; Eckstein and Fromm, 1968; and Eckstein and Wyss, 1971.

[2] To the extent that price increases for other cost elements parallel unit labor cost inflation, the coefficient of the latter will be biased upward. If all costs change at equal proportional rates, a straightforward model such as that developed by Nordhaus (1971) makes it clear that "the coefficient on the wage rate in the price equation should be 1/m, where m is the degree of homogeneity of the production function."

B. The Effect of Labor Costs

Unit labor cost is determined by dividing the hourly wage by the output per worker per hour. The rate of change of unit labor cost thus approximately equals the rate of change of wages minus the rate of change of output per man-hour. Standard unit labor costs are calculated by using trend values of productivity increase rather than the actual values. On a quarterly basis this trend was estimated to be 0.65 percent.

Cost determinants enter the price equation through four terms reflecting the differences in the rates of increase between current and lagged values of standard and actual unit labor costs:

1. A weighted average (0.4, 0.3, 0.2, 0.1) of the rates of change of standard unit labor cost in the previous four quarters.
2. The difference between the current rate and this average.
3. A weighted average (0.4, 0.3, 0.2, 0.1) of the lagged deviations of productivity growth from its quarterly trend rate of 0.65 percent.
4. The difference between the current deviation and this weighted sum.

This framework permits evaluation of changes in the magnitude and timing of the impacts of standard and actual unit labor cost. The ratio of the second coefficient to the first (0.35), is the relative weight of the current effect to the total impact of increases in standard labor cost. Similarly, the ratio of the fourth coefficient to third (0.40) indicates the relative weight of current productivity deviations. The third and fourth terms are equivalent to the deviations of standard from actual labor costs due to productivity swings. The ratio of the third coefficient to the first (0.20) indicates the relative importance of actual vis-a-vis standard unit labor cost inflation.

Estimation.—The same techniques used with wages were applied to prices. Two-stage least squares estimates were calculated and did not differ substantially from those obtained by ordinary least squares. The period of fit was 1955:1 to 1970:4. Serial correlation was not present in the first context tested.

Productivity swings and actual labor costs.—The measure of productivity used in this study was the U.S. Department of Commerce, Bureau of Labor Statistics index of output per man-hour in the private, non-farm sector. Simple regressions revealed a basic secular rate of increase of slightly over 2.5 percent per year with significant cyclical deviations. Productivity typically increases as capacity utilization increases in an economic expansion, then declines as the rate of increase of output decelerates. The conventional explanation is that the costs of hiring and firing plus the uncertainty about the timing of the cycle lead to lags in employment adjustment.

While business evidently prices according to some concept of "standard" or "permanent" cost rather than the highly volatile short run labor costs, there is an independent effect of the short-run productivity swings. In the equation this factor is represented by the deviation of short run productivity changes from their trend value. The estimated time structure of the effect over five quarters implies diminishing weights of 0.089, 0.044, 0.033, 0.022, 0.011; the total effect of short run productivity swings is about 20 percent of the effect of long run productivity growth. Thus, there is some benefit to

prices in a period of economic recovery, albeit small, and conversely, there is a particular deterioration of prices when the economy slows down due to the productivity lag.

Various tests were made of nonlinearities in the response to cyclical fluctuations in output per manhour to determine if extreme experiences produced unusual effects. However, no significant nonlinearity was detected.

Asymmetric responses to productivity swings were also investigated. *A priori*, it was suspected that downward price flexibility would be limited but that upward movements due to below average performance would be substantial. The typical result given below demonstrates that the data would not support this hypothesis:

$$
\begin{aligned}
px_t = {} & .009 + .996\ (\overline{w}_t - .65) + .352\ [(w_t - .65) - (\overline{w}_{t-1} - .65)] \\
& (.117) \quad (8.814) \qquad\qquad (3.812) \\
& + \begin{cases} -.223\ (\overline{q}_{t-1} - .65) & \text{if } \overline{q}_{t-1} > .65 \\ (-1.409) & \\ -.184\ (\overline{q}_{t-1} - .65) & \text{if } \overline{q}_{t-1} < .65 \\ (-1.547) & \end{cases} \\
& - .088(q_t - \overline{q}_{t-1}) \\
& \quad (-2.248) \\
& - .517\ (\overline{w}_t - \overline{JW}_t) \\
& \quad (-3.389) \\
& + .123\ [(UF/K)_t - (UF/K)_{t-1}]^* \\
& \quad (2.227)
\end{aligned}
$$

$R^2 = .702.$
$D.W. = 1.951.$
$S.E. = .225.$
Period: 1955:1–1970:4.

The coefficients (−0.223, −0.184) are insignificantly different from each other.

Adjustment for the fixed-weight wage index.—The index which Professor Gordon provided is a composite of average hourly earnings (excluding overtime) of production and non-supervisory workers. A correction is made for fringe benefits by multiplying this index by the ratio of wages, salaries and supplements to wages and salaries, but no adjustment is made for the exclusion of supervisory worker salaries. Therefore, Professor Gordon's index differs from the Department of Commerce index of compensation per manhour in two basic ways: (1) Gordon's use of fixed weights for combining the individual industry wage series into the national composite; and (2) his omission of the supervisory worker component in unit labor cost. To correct for this omission, Gordon simply included the difference between the rates of change of the two wage indexes; we used the simple (0.4, 0.3, 0.2, 0.1) declining weight lag structure on current and past values of this difference. This new variable, represented in the equation as $(\overline{w}_t - \overline{JW}_t)$, enters quite significantly with a coefficient of −0.52 confirming Gordon's conclusion that the supervisory labor cost component should not be ignored.

C. Demand Factors

Previous empirical studies have recognized that the larger part of the effect of changes in demand makes itself felt in price behavior through the cost channel: the response of input prices to demand yields their contribution to increased output price, their importance depending upon their weight in the total value of the output. Under perfect competition, prices move directly with cost changes, supply and demand are kept equal as markets are cleared, and physical capacity remains fully utilized. Under a strongly oligopolistic, target-return or full-cost pricing situation, price movements are again stimulated by cost changes as efforts are made to eliminate deviations of realized from desired profits.

It is primarily in the intermediate case, between perfect competition and strong oligopoly, that measurable demand conditions are seen to affect prices directly in studies of individual industries. Such measures as variations in industrial utilization rates, the ratios of inventories to sales, and changes in orders appear to have significant independent influences on prices.

In the present study, these and other measures were explored. The one measure of demand disequilibrium that was found to be strongly significant throughout the tests was the ratio of real, unfilled orders to physical capacity.[3] If shifts in factor costs, government spending or private tastes result in a market price below equilibrium, unfilled orders will increase and equality of demand and supply will only be achieved through inflation. This effect is felt most strongly in the early phases of an economic espansion before production adjusts to the more vigorous demand. On the other hand, later in the cycle when this ratio falls, there appears to be no significant deflationary effect because of the downward rigidity of prices. Similar asymmetries were found when the change in the ratio of real inventories to capacity was used as the sensor of excess demand in the output market.

Lengthening the response lags with respect to excess demand variables did not noticeably improve the explanatory power of the equations. The only possible difference noted was that, *ceteris paribus*, equations estimated with longer lags tended to have smaller residuals during the late fifties and early sixties, but generally larger residuals in the late sixties.

The variations in the composition of demands were important during some of the periods, but their impact is primarily felt through the factor prices and unfilled orders. Sectoral demand shifts lead to higher aggregate wage and material costs due to asymmetries and rigidities of the type described by Schultze (1959). Our empirical studies indicated that the largest additional effect on prices in any given quarter was less than one-quarter of one percent.

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[3] As capacity expands, the volume of unfilled orders can expand correspondingly without an inflationary impact. The Federal Reserve Board index of manufacturing capacity was used as the capacity measure. The orders variable was deflated by a fixed weight index of durable and non-durable manufacturing output prices. The weighted index was necessary because durable manufacturing has a disproportionate share of unfilled orders.

Other authors, beginning with George deMenil, further alter such variables by division by a trend connecting cyclical peaks, in an attempt to remove changes in the desired order-sales relation (which they assert to be failing). This correction was also made by us but excluded in the final version because it appeared also to remove information that should be retained.

The potential effects of shifts from a "war" to "peace" economy were tested using various rates of change of the share of defense spending in the budget or GNP. None of these was found to be significant. The effects of the Viet Nam war buildup and the withdrawal are captured by their effects on input prices and on unfilled orders.

D. Stability of the Coefficients

Chow tests were performed to test the stability of the sets of coefficients in two formats: first, the standard unit labor cost weights were constrained to those just derived [(0.351, 0.260, 0.195, 0.130, 0.065), (−0.089, −0.044, −0.033, −0.022, −0.011)], and second, new relative weights of current and lagged values were permitted. Also, the pattern of change in the unit labor cost coefficients was analyzed by utilizing regressions over expanding intervals. Table 7 presents the results of these studies. The sets of coefficients are not statistically different in any of the paired periods tested regardless of whether the relative labor costs weights are constrained or not. However, examination of the cost coefficients as the interval is expanded does indicate some movement.

TABLE 7.—STABILITY OF COEFFICIENTS

F STATISTICS FOR CHOW TESTS

Period pairs	Fully constrained relative weights	Current relative weight free to adjust
1955–1960} 1961–1970}	0.90	0.56
1955–1961} 1962–1970}	.42	.37
1955–1962} 1963–1970}	.40	.35
1955–1963} 1964–1970}	.36	.35
1955–1964} 1965–1970}	.57	.47
1955–1965} 1966–1970}	.88	.74

COST COEFFICIENTS—DIFFERENT PERIODS OF FIT

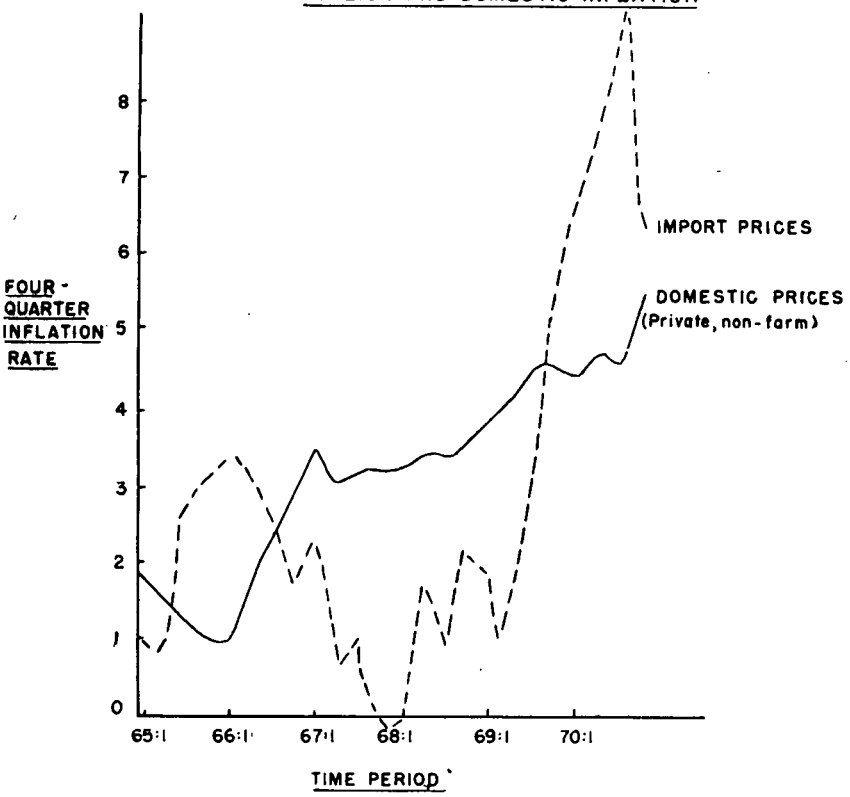
Period	Current standard unit labor cost (w_t=.65)	Weighted average of past standard unit labor costs (w_{t-1}=.65)	Sum	Ratio of current to sum
1955:4–1960:4	0.378	0.665	1.043	0.362
1955:4–1961:4	.459	.534	.993	.462
1955:4–1962:4	.446	.529	.975	.457
1955:4–1963:4	.449	.504	.953	.471
1955:4–1964:4	.444	.529	.973	.456
1955:4–1965:4	.477	.475	.952	.501
1955:4–1966:4	.413	.527	.940	.439
1955:4–1967:4	.397	.576	.973	.408
1955:4–1968:4	.330	.512	.842	.391
1955:4–1969:4	.314	.551	.865	.363
1955:4–1970:3	.329	.586	.915	.359
1955:4–1970:4	.351	.649	1.000	.351

The acceleration of wages occurring in 1967 and 1968 was evidently not matched by an immediate, comparable price inflation. This is indicated by the reduction in the sum of the coefficients in this period

and by the declining relative weight for current increases in standard unit labor cost. This phenomenon as well as the price resurgence in 1970 are possibly best explained by variations in the pressure of foreign competition. Figure 8 below indicates the four-quarter inflation rates of import prices and non-farm, private domestic output prices. Beginning in late 1966, import prices rose very little, implying that further domestic inflation would have significantly reduced the competitive position of American firms. By 1970, the relative inflation rates were reversed as import prices rose sharply. American prices then responded fully to wage inflation.

FIGURE 8

FOREIGN AND DOMESTIC INFLATION



E. Econometric Decomposition of the Historical Price Record

The basic price equation derived here can be used to analyze the separate factors that explain the increase of prices as seen through the equation. It is important not to impute causality in a static framework to separate factors, because of the simultaneity of prices and wages. Nonetheless, some additional understanding is gained by this form of historical review.

Table 8 presents the historical decomposition for the period as a whole, 1955–1970, and for the major sub-periods. Taking the entire period, prices can be seen to have responded mainly to changes in standard unit costs. Of the average annual rate of increase of prices of 2.36 percent, 1.96 percent is the cost factor. The temporary productivity deviations average out close to zero, since one period's extra gain is the next period's loss. The increases in the ratio of unfilled orders to capacity do add independently to the total price increases because only the pluses are significant; when the ratio returned to normal it did not serve to retard price increases. Finally, the changes in the mix of compensation add another 0.16 percent.

TABLE 8.—PRICE INFLATION: AVERAGE ANNUAL COMPONENTS

	1955–58	1959–62	1963–66	1967–70	1955–70
Standard unit labor cost (current and lagged)	2.06	1.11	1.02	3.63	1.96
Productivity:					
Deviations from trend (current and lagged)	.08	−.08	−.11	.27	.04
Increases in ratio of real unfilled orders to capacity	.31	.14	.34	.01	.20
Other compensation and mix	0	−.07	.45	.13	.16
Average quarterly inflation at annual rates	2.44	1.11	1.70	4.05	2.36

Note: These figures are slightly less than the actual average, due to the omission of the constant term, 0.0026.

Looking at shorter periods, the predominance of the labor cost factor can be seen throughout. But there are some interesting variations in the other factors. The short run productivity swings added substantially to the inflation of 1967–1970, an extra 0.27 percent a year, as the economy switched from an extended period of high growth to four years of growth substantially below the long run trends. During the early phases of the recent upswing, from 1963–66, the productivity factor cut the inflation rate somewhat.

The buildup in the ratio of unfilled orders to capacity had a large effect on prices in the business cycle upswings of 1955–58 and 1963–66. In interpreting these coefficients it should be kept in mind that the impact of these factors on the wage-price system as a whole is considerably more important than on the price equation alone. The extra price increases soon become reflected in increases in wages, which in turn raise prices through higher standard unit labor costs. The impacts of these factors on the entire wage-price system are analyzed in the next chapter.

Chapter V. THE WAGE-PRICE SYSTEM AS A WHOLE: SIMULATION STUDIES

Because wages and prices are linked together in a simultaneous process, the overall wage-price behavior of the economy can only be ascertained by analyzing the system as a whole, either by explicit mathematical solution of the equations, or by simulation studies. While the equations used here are small in number and of sufficiently simple structure to allow explicit mathematical solution, the simulation method allows retention of the empirically derived lag structure, exploration of the sensitivity of the system to minor variations in specification, and derivation of empirical estimates under alternative economic conditions. This chapter mainly uses the simulation technique. A brief analytical treatment is also presented.

The plan of the chapter is as follows:

First, the model is fleshed out with some supplementary relationships which are necessary to consider it a closed wage-price system.

Second, a historical simulation is run to see if the model can reproduce the actual record. This simulation is used to analyze the two most recent inflations—the episode of the mid-1950's, and the current experience—and also to account for the intervening periods of price stability.

Third, the simulation model is used for a series of exercises to assess our present prospects for achievable combinations of unemployment and prices. The model is run forward from mid-1971 assuming that there would have been no wage-price freeze, to estimate how long unemployment would have had to remain high to bring the economy back to reasonable price stability.

Fourth, the model is run assuming alternative phase II policies on permissible wage increases. Estimates are also made of the path that wages would pursue given the price result; the difference between the assumed wage increase and the increase that would be produced without constraint for the given price performance is a measure of the additional contribution that policy would have to make to the disinflation process. This exercise is repeated on the price side.

Fifth, the long-run Phillips Curve is traced by simulations which assume that various given unemployment rates persist without change over a sufficient number of years to allow the initial conditions to wear off. Next, a condensed, analytical version of the model is presented.

Sixth, some further sensitivity studies are presented.

A. Completing the Model

Additional links must be provided for the model to complete it. While the model uses the deflator for the non-agricultural, private

sector as its measure of the price level in the output price equation, consumer prices enter the wage equation. The equation on the following page derives movements of the consumer price index from the private output deflator.

In the long run, output and consumption prices cannot differ greatly since one is the largest part of the other. The greater trend increase of capital goods and government purchases can introduce some divergence of the coefficient from unity. Also the series are apt to have significant differences reflecting the lags and the volatility of farm prices which have a greater impact on the consumption deflator. The simple bridge equation used in the simulations relates the current rates of increase in the consumption deflator (pc) to current and past rates of increase in the output deflator (px):

$$pc_t = .029 + .938\overline{px}_t$$
$$(\overline{px}_t = .306px_t + .251px_{t-1} + .195px_{t-2} + .139px_{t-3} + .083px_{t-4} + .027px_{t-5})$$

The mean lag in the impact is found to be one and one-half quarters; the total effect, 0.938, is insignificantly different from 1.0.[1] That is, in the long run the rate of consumption price inflation fully reflects output price inflation.

Actual values of productivity growth, increases in the effective personal tax rate and changes in unfilled orders are used for the historical simulations. For future periods the simulations are based on five year forecasts of these variables projected by the Data Resources quarterly econometric model of the United States. Adjustments were made to reflect differences in assumptions underlying the control solutions for the larger model and the wage-price simulations.

The analyses of the long run or steady state Phillips Curves are based on the following assumptions:

1. A constant effective rate of personal taxation.
2. No wage-price guidelines or jawboning.
3. Productivity advancing at its long run trend value (0.65% per quarter).
4. A constant level of real unfilled orders in relation to capacity implying a smooth growth of demand.
5. All forms of compensation increasing at the same rate.

Hence, demand in the labor market (as measured by the unemployment rate) and the severity of inflation were the critical variables in this form of analysis.

B. The Historical Simulation

Figure 9 shows the historical simulation of wages and prices in comparison to the actual development. Since the equations were fitted to this period, it was likely that the model would reproduce the historical record closely. Nonetheless there was some risk that the interactions of the equations could produce cumulative errors. The bar graphs (figs. 10a and 10b) indicate the simulated components of the wage and price inflation in annual terms.

[1] The standard error of the mean lag is 0.416 and that of the sum of the coefficients is 0.039.

Simulating the model from 1955 through 1970 yields occasional three or four quarter departures from the historical trend. The source of the problem is in the link between the consumption and output prices. These errors are largely due to unpredictable swings in agricultural prices. This factor can affect the timing of high levels of inflation because the severity factor is based on consumption price inflation. Thus in the late 1960's the wage-price mechanism was somewhat worsened by the timing of agricultural price swings.

1. The Inflation of the Mid-1950's

Previous analyses of the inflation of the mid-1950's have emphasized the critical role of the strength of the early upswing led by the 1955 automobile boom. The large build-up of orders, first in autos and then in capital goods, as well as the high profits early in the boom led to large wage settlements which then introduced a cost-push element as the boom itself weakened. The sharp changes in the composition of demand also worsened the record.

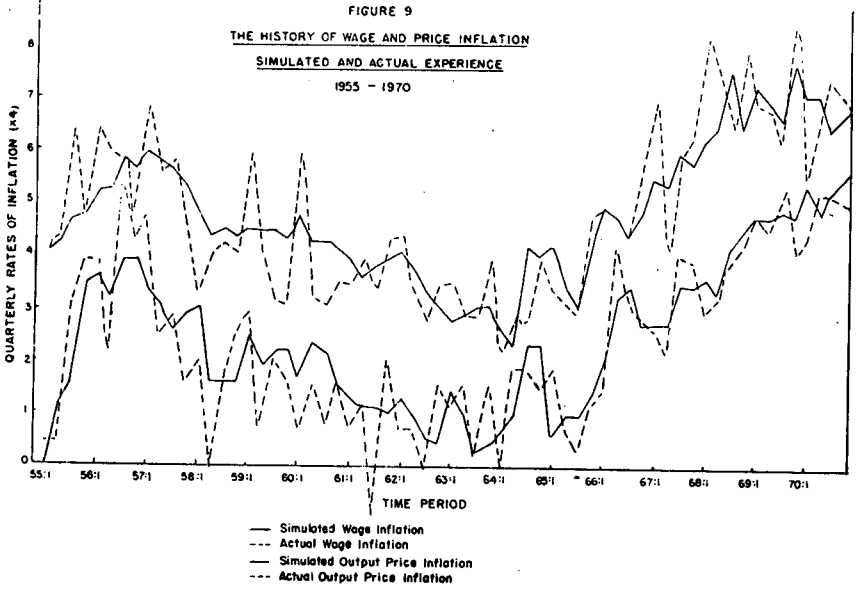
The buildup of unfilled orders raised the inflation rate by 0.85 points in 1955, while the productivity surge reduced it by 0.24 points. By 1956 unit labor cost was raising prices by 2.62 points as wages accelerated due to the strength of the price rise and the impact of low unemployment: the productivity slowdown also added 0.5 to price inflation. In 1957 wages and unit labor costs rose slightly faster as the inflation severity factor began to come into play and unemployment rose only slightly. But the inflation rate was reduced by a second rise of productivity. The severe recession of 1958 reduced the inflation rate as unemployment cut wage increases and other factors were neutral. The lags of the process produced some worrisome quarters after unemployment rose and before prices stabilized.

FIGURE 9

THE HISTORY OF WAGE AND PRICE INFLATION

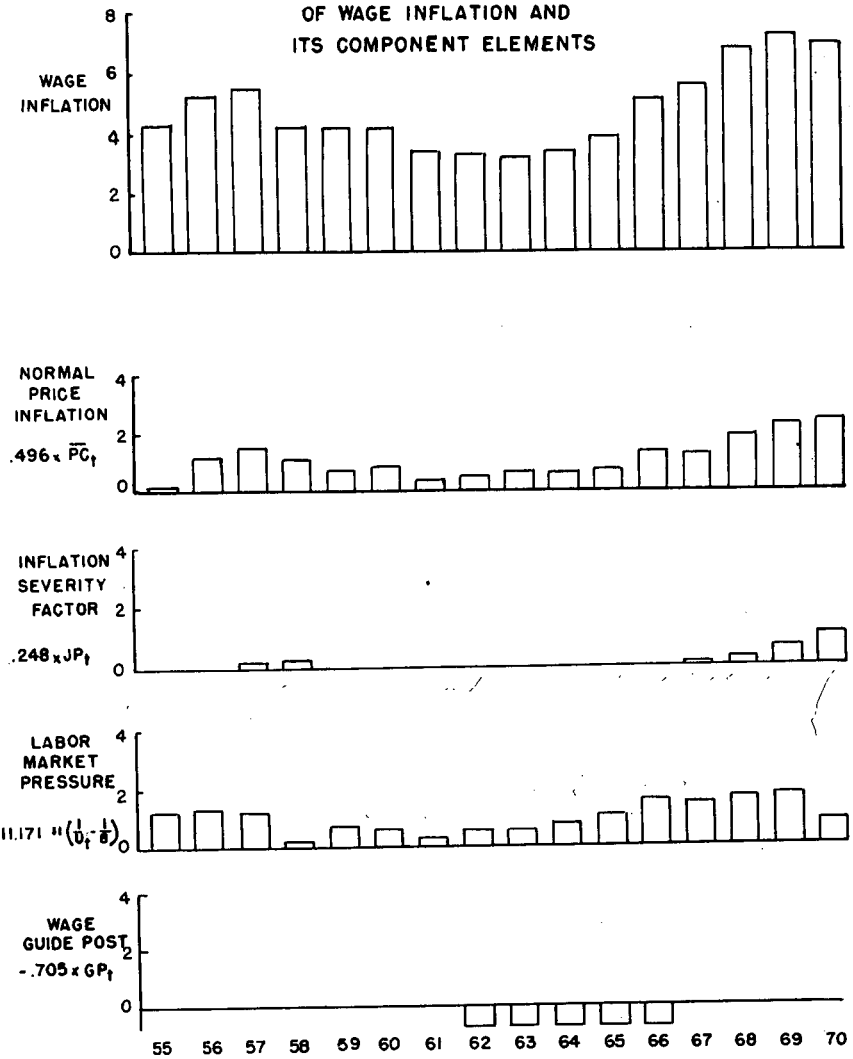
SIMULATED AND ACTUAL EXPERIENCE

1955 – 1970



NOTE.—Top lines are wages; lower lines are prices.

FIGURE 10a
SIMULATED HISTORY
OF WAGE INFLATION AND
ITS COMPONENT ELEMENTS



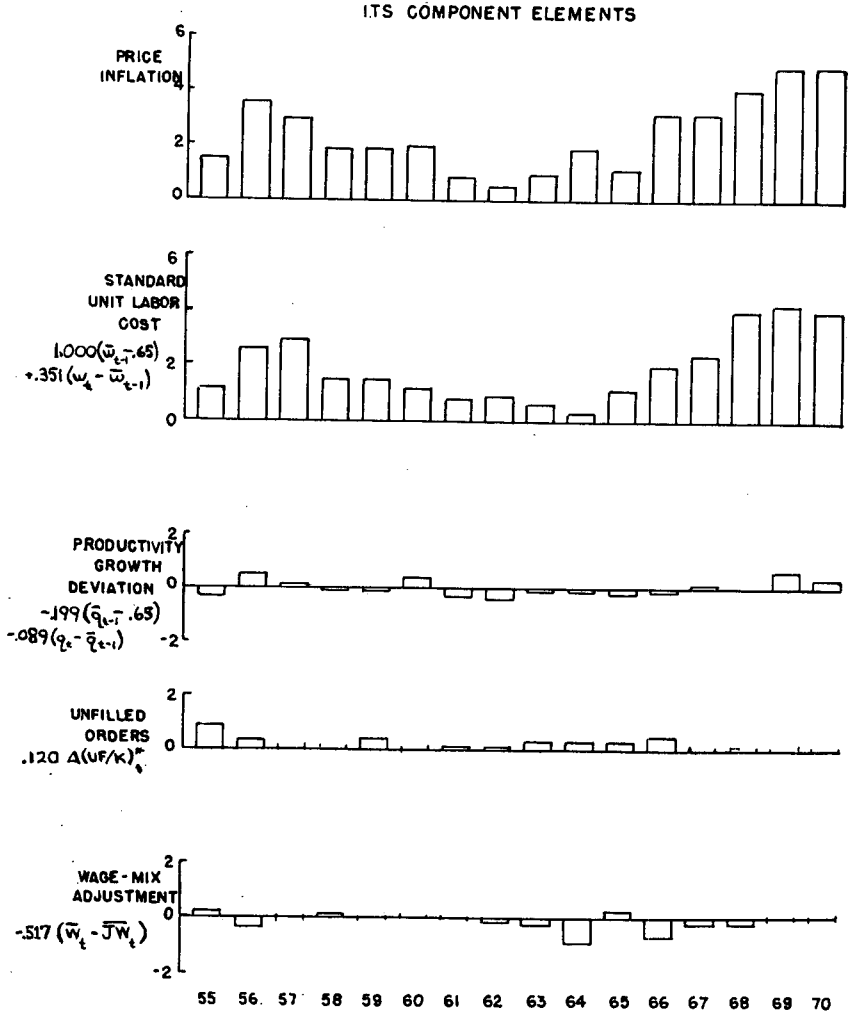
A CONSTANT TERM OF 2.65 REFLECTING PRODUCTIVITY GROWTH IS THE FINAL MAJOR COMPONENT

2. The Period of Price Stability: 1958–65

The eight years of price stability, 1958–65, saw unit labor costs rising less than 1 percent yearly. Prices rose somewhat more, about 1.5 percent, with the difference due to the asymmetrical effects of a rise in unfilled orders.

Within the period, there were variations in the importance of different factors. In the earlier years, 1958–60, unit labor costs rose more but a fall of agricultural prices held down consumer prices. By 1963–65 the economy was stronger and orders began to rise, but guideposts, aided by productivity gains and personal tax reductions, held back wages.

FIGURE 10b
SIMULATED HISTORY
OF PRICE INFLATION AND
ITS COMPONENT ELEMENTS



The period shows that price stability can be maintained over some range of real conditions. Unemployment was above 5 percent for most of the period, but even after some recovery, the price-cost structure remained in stable balance. There appears to be some tendency for the economy to stay in the area where the broad price indexes rise 1 to 1.5 percent.

3. The Inflation Begins: 1965–68

Under the stimulus of the Vietnam war buildup and the rising investment boom, the real economy became very strong between 1964 and 1966, but inflation did not appear for quite some time. In 1965, the price index rose only 1 percent, as productivity and mix effects offset the impact of rising unfilled orders. Unit labor costs

rose 1.2 percent, as guideposts, personal tax cuts, a modest consumer price change and the stable price history kept the wage increase down to 3.8 percent despite the sharp drop in unemployment.

By 1966, wages rose 5.0 percent in a tighter labor market with consumer prices now raising wages by 1.3 percent. Prices accelerated to 3.1 percent as the war caused a buildup of unfilled orders and unit labor costs rose 2 percent. The 1967 slowdown saw materials prices softening, but labor costs accelerated as guideposts seemed to lose their effectiveness and the consumer price element began to show the first signs of the inflation severity factor. The renewed expansion of 1968 saw wages accelerate to a 7 percent gain as the inflation severity factor got slightly worse, unemployment was very low and consumer prices stayed in motion.

In retrospect, the amount of inflation was astonishingly low in these years, considering the state of excess demand, very low unemployment and gradually accelerating consumer prices.

4. The Wage-Price System Explodes: 1969–71

By 1969, the inflation severity factor was adding .7 percent to wages, and the total effect of prices on wages equallied 3.1 percent. Unemployment was still low, bringing the total wage rise to 7 percent. With productivity poor in a slowing economy, unit labor costs rose 4.2 percent and prices by 4.8 percent. A year later unemployment rose very sharply, but the inflation severity factor was at its peak. Wages therefore, still rose by 6.8 percent. Prices suffered from wage changes and below normal productivity. In 1971 the inflation factor in wages was barely beginning to weaken and prices remained at close to their peak increase.

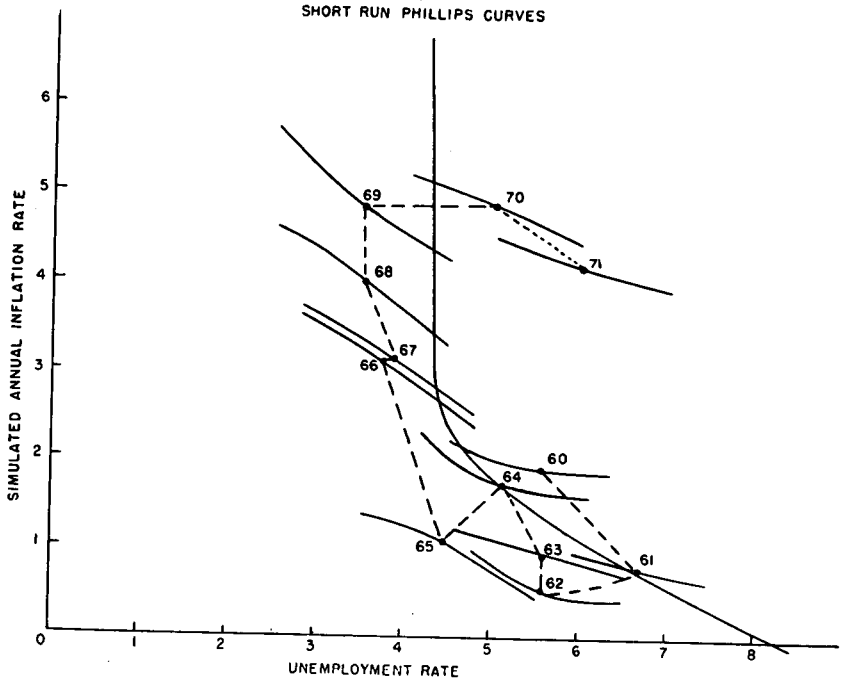
C. If There Had Been No Freeze

At the time the President announced the new economic program, there were two conflicting tendencies in the wage-price process. On the one hand, high unemployment had moved the economy a considerable distance away from the explosive portions of the long run Phillips Curve. On the other hand, the continued poor price history and absence of incomes policies largely defeated the price and wage stabilizing effects of this weak economy.

These tendencies and the prospects that we would have been facing without the new policies can be understood most clearly in terms of the movements of the short run Phillips Curves. Figure 11 shows the Phillips Curve possessed by the economy during each of the years of the 1960's. Each curve shows the combination of unemployment and price change which could be reached for that particular year, given the actual history that had preceded it. Thus, following a period of price stability, the short term Phillips Curves are near the origin in the unemployment-inflation space. But as inflation worsens, the Phillips Curve shifts up, year by year, reaching its worst position in the first half of 1970.

Starting from the contemporary conditions, the government had the short term choices indicated by the 1971 Phillips Curve. For 1972 the choices would have been affected, at least in a small way, by the experience of 1971: for the years thereafter, the Phillips Curves would have depended upon the intervening history.

FIGURE II
SHORT RUN PHILLIPS CURVES

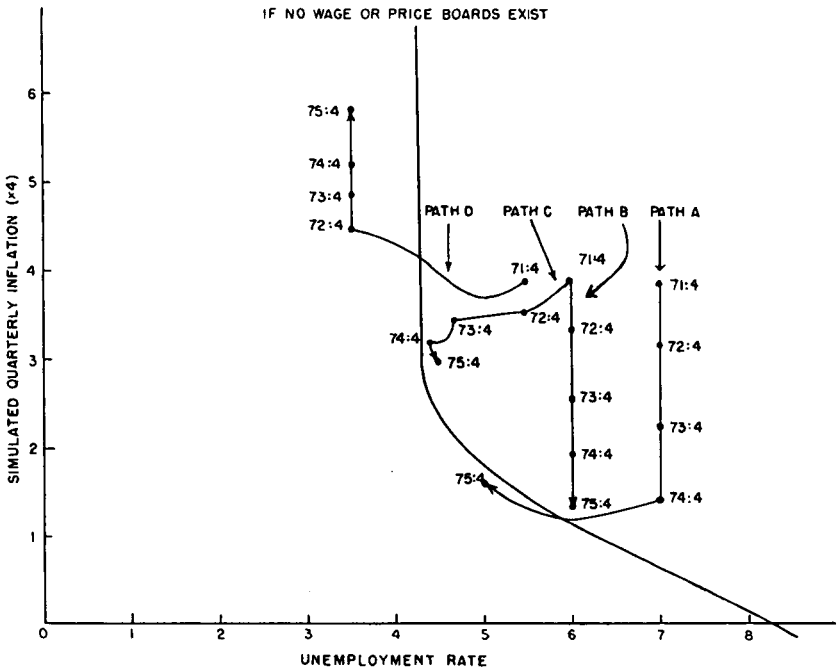


To show the actual choices, figure 12 shows the path of inflation and unemployment under these assumptions: path A illustrates the most conservative policies, with unemployment allowed to rise to 7 percent, and to be maintained at that deep recession level until near price stability has been restored in 1974. Path B shows maintenance of the 6 percent unemployment rate until price stability is achieved in 1975. Path C assumes the unemployment path of a standard economic forecast showing unemployment falling to 5.2 percent by the end of 1972 and falling to 4.7 percent by the end of 1973, and staying at that level thereafter. Price stability is never restored and the curve returns to the neighborhood of the explosive area by 1974. Path D shows a quick return to 4.5 percent unemployment by the summer of 1972 and a drop to 3.5 percent thereafter. The wage-price explosion would quickly resume.

It can be seen that a continuation of the previous policies, relying exclusively on unemployment to bring the wage-price system back to stability, would have been a very costly and drawn out process. Indeed, the unemployment cost of the classical route to price stability would obviously have been prohibitive.

If the goals had been more moderate, looking only to an ultimate target of a 3 percent inflation rate, the path would still have been difficult. The trouble is that the three percent price goal leaves the economy in a condition where inflationary expectations remain lively. The expectational inflation severity factor stays in force, and only a sufficiently high rate of unemployment could neutralize the inherently explosive character of the system under that circumstance. The fact is that once the inflationary expectations have become fully aroused,

FIGURE 12
ALTERNATIVE PATHS (1971 – 1975)
IF NO WAGE OR PRICE BOARDS EXIST



intermediate policies aiming only to bring the inflationary rate down to "acceptable" levels require so sensitive a management of demand to keep the economy from relapsing into an explosive wage-price pattern that it is probably impractical.

D. Studies of Phase II and Beyond

The projected Administration monetary and fiscal policies combined with probable consumer and investor responses produce the gradual recovery depicted earlier as Path C. To analyze the potential of Phase II, an additional series of simulations were run. Table 9 presents the baseline results and the potential benefits and problems of policies intended to achieve the wage and price targets of 5.5 percent and 2.5 percent respectively. Phase II controls are assumed to be in effect through the third quarter of 1973.

In all three studies, the average annual unemployment rates for 1971 to 1975 are projected to follow the pattern: 6.0 percent, 5.7 percent, 5.0 percent, 4.5 percent, 4.5 percent. Without wage-price controls inflation would not drop below 3 percent in this interval.

Part II of the table analyzes the economy if only wage controls are successfully pursued. Such a program would reduce the first-year wage inflation by 0.8 percent. If labor accepted this reduction of income, the system would settle down on its own to price and wage behavior only a few tenths above the Phase II goals. By 1975 price and wage levels could be 3 percent lower as a result of the better path.

TABLE 9.—PHASE II STUDIES

	1971	1972	1973	1974	1975
I. Basic forecast (path C):					
Unemployment rate	6.0	5.7	5.0	4.5	4.5
Wage change	6.45	5.89	5.76	5.74	5.63
Price change	4.38	3.55	3.48	3.25	3.15
II. Controlled wage level:					
Wage change	5.62	5.50	5.45	5.32	5.25
Price change	4.08	2.78	2.84	2.84	2.76
Free wage path given the price results	6.43	5.63	5.42	5.32	5.25
Difference between controlled and free wage paths	.81	.13	−.03	0	0
Accumulated wage stress	.81	.94	.91	.91	.91
III. Controlled price level:					
Wage change	6.41	5.48	5.14	4.92	4.92
Price change	3.76	2.50	2.57	2.45	2.40
Free price path given the wage results	4.36	3.40	3.00	2.85	2.74
Difference between controlled and free price paths	.60	.90	.43	.40	.34
Accumulated price stress	.60	1.50	1.93	2.33	2.67

The difference between the controlled wage path and the free path measures the current stress on the wage controls created by the uncontrolled price path. The accumulated stress shows how this pressure builds up over time from current and past differences. It is certainly doubtful whether the one-sided program would be accepted by labor.

If only prices can be successfully controlled, the stress on the controls will be greater. Large wage increases in 1971 and 1972 will create strong cost pressures in addition to the problems created by the expanding unfilled orders of a recovering economy. With prices limited to a 2.5 percent rate, wages decelerate gradually to a 5 percent rate but the process will be slow, too slow for business to be expected to comply. The accumulated price stress will reach almost 2 percent by the assumed end of the two-year price control program.

In summary, one-sided programs will create great strains. On the other hand, if both elements of Phase II succeed, the system settles down near the Phase II targets and would be near its long-run Phillips Curve by the second half of 1973.

E. The Long-Run Phillips Curve

Since the economy, in fact, faces a relatively horizontal Phillips Curve in the short run whose location in the unemployment-inflation space is largely predetermined by the price history, the definition of a long run Phillips Curve has to be a somewhat synthetic construct. Further, demand policy in the U.S. is largely oriented towards short run goals, so the short run Phillips Curve considerations dominate. Nonetheless, policy should also consider the longer run choices, the implications of any particular short run policy on the subsequent path of the system. The long run Phillips Curve also can show the true structural characteristics of the economy with regard to unemployment and inflation. What does the Phillips Curve look like when the present is neither punished by a poor past history of inflation, nor rewarded by an exceptionally good price history bought with high unemployment?

We define the long run Phillips Curve as follows: assume that a given unemployment rate is maintained so long that the initial conditions and the lag structures of the equations no longer have an effect.

Figures 11 and 12 (see above) indicate this curve as the heavy line in the center of the short run curves. It consists of two parts: a nearly vertical element which defines the critical unemployment rate—the lower bound of sustainable long run performance, and a second segment which is a conventional Phillips Curve. Even if a good past history allows the economy to temporarily reach a combination of unemployment and prices to the left of the critical rate of unemployment, the subsequent path of the system is essentially vertical and explosive. Thus the critical rate of unemployment is defined to be that rate which produces a rate of wage increase sufficiently above productivity to push price inflation above the critical 2.5 percent rate which brings the expectational inflation severity factor into play.

If unemployment is higher than the critical rate, the system will ultimately show declining inflation until it settles down on the appropriate point on the long run Phillips Curve. This segment of the curve is stable: if unemployment were constant, wages and prices would settle to steady and mutually consistent rates of increase.

The long run Phillips Curve is a measure of the structural element in the inflation problem. That the natural rate of unemployment is as high as 4 percent is disappointing from the social point of view. In the 1960's the Council of Economic Advisers defined an interim unemployment goal of 4 percent. Despite the manpower and equal opportunity programs designed to improve the functioning of the labor market plus whatever small steps may have been taken to improve the performance of product markets, the interim goal of 1962 continues to escape our grasp. The few years of unemployment below the interim target produced a wage-price explosion. In the absence of major efforts to improve the structure of the economy, future governments would be well advised not to exceed the old interim targets, and perhaps not even to reach them.

This seems to be a very high rate of unemployment to be necessary to hold the aggregate wage rate within 2 to 3 percent of productivity growth. Apparently, product markets permit full transmission of cost increases over a wide range of demand conditions. Labor markets produce wage increases above productivity even when there is considerable unemployment. It is the totality of our product and labor market structures—asymmetries, barriers to entry, other monopolistic elements, information imperfections, protection from foreign competition, discrimination in employment and other factors—which limits our economic performance to the inadequate possibilities sketched by the long run Phillips Curve.

1. Present Results and the Accelerationist Position

As the preceding analysis has demonstrated, the weights which wage and price inflation receive as determinants of each other have important implications for the stability of the economy and hence for the options available to policy makers. If prices and wages fully respond to each other, no permanent tradeoff between unemployment and inflation exists. This is the position of the "accelerationist" school. Expectations are assumed to be consistent and to derive primarily from past experience, recognizing the average as well as the trend of the recent past. Wage inflation is asserted to fully respond to anticipated price inflation to maintain an expected real wage level.

Prices increase proportionately with unit labor costs. In the long run anticipated price inflation is identical to actual price inflation and equals wage inflation adjusted for productivity gains. The "natural" rate of unemployment is determined by the structure of the labor market. The mobility and flexibility of the work force, the job-search behavior of participants, the adaptability of productive processes and the efficiency of information collection and dissemination procedures are prime determinants. According to the monetarist version of the theory, the price levels are determined solely by the increase in money demand, which in turn is determined by the rise in the money supply.

The key difference between this view and that which emerges from the present study is the existence of a permanent tradeoff in periods of unemployment above the "natural" rate. The price equations of the two theories are nearly the same: both indicate that, aside from deviations due to productivity and unfilled order irregularities, prices will rise with unit labor cost. However, we place greater emphasis on the role of monopoly elements in the determination of the critical rate of unemployment. In our view, complete transmission of cost increases should not occur when capacity significantly exceeds demand. A major difference comes on the wage side, where our equation implies that the system has a considerable range of stability.

If the accelerationist's view is accurate, it is only the destabilizing actions of government, and perhaps capital purchasers, which preclude a world of no inflation and 4 percent unemployment. The only roles for policy are to stabilize demand to eliminate this stimulus to cycles and to make the labor market more efficient in order to reduce the "natural" rate of unemployment. No tradeoff exists because only one problem need exist: unemployment.

F. An Analytical View of the Model of This Study

Various analytical versions of the wage-price mechanism can be utilized to demonstrate the logic of the long and short run relationships. To simplify the analysis, unfilled orders and tax rates are assumed constant and output prices are set equal to consumer prices. Let:

(1) $$p_t = \alpha_1 w_t + \alpha_2 w_{t-1} - \alpha_3 q_t$$

(2) $$w_t = \beta_o + \beta_1 p_t + \beta_2 \left(\frac{p_t + p_{t-1}}{2} - \beta_3 \right)^* + \beta_4 (1/u_t)$$

where
p: price inflation
w: wage inflation
q: trend rate of productivity growth
u: unemployment rate
* only effective if the term is positive

The price response to current wage increases is not complete due to rigidities of price-setting and to an adjustment mechanism. If previous unit labor costs did not equal their anticipated values, current prices would be adjusted to take this discrepancy as well as expected future unit labor cost inflation into account. This is analogous

to the retrospective-prospective entry of living costs into wage inflation. The separate processes by which these elements enter have not and probably cannot be identified. Therefore, for example, the equation for wage inflation (2) is derived from several elementary but unspecified relations designating:

1. The wage response to unanticipated inflation (i.e., unexpected real income losses) in the past.
2. The wage response to expected current inflation.
3. The mechanism by which expectations are generated.

The inflation severity factor, represented here by $\left(\frac{p_t+p_{t-1}}{2}-\beta_3\right)$, attempts to capture the changes in these substructures which occur when a severe, persistent inflation is generated.

The empirical analysis yields several significant facts about these coefficients:

1. $\alpha_1+\alpha_2=\alpha_3$. This reflects the equivalent price response to cost inflation induced by changes in input price and in productivity.
2. $\alpha_1+\alpha_2=\alpha_3=1$. This indicates the complete (unitary) transmission of cost changes into price changes or a stable distribution of output among factors.
3. $\beta_1<1$. This denotes the incomplete sensitivity of money wages to moderate inflation.
4. $\beta_4=0$. Together with $\beta_1<1$, the response of money wage change to excess demand or supply in the labor market yields the unemployment-inflation tradeoffs available at high unemployment rates. The value of β^1 creates the potential for explosive inflation if demand policy puts pressure on labor resources.
5. $\beta_1+\beta_2=1$. This precludes a stationary equilibrium value for inflation at unemployment rates below 4%. It represents the complete marginal transmission of high level price inflation into wage inflation.
6. β_3, the critical value for average annual inflation, is approximately 2.5.

A two-track model.—The structure of the inflation severity factor captures the change in wage sensitivity to prices. $\left(\frac{p_t+p_{t-1}}{2}-\beta_3\right)$ is the difference between average annual inflation and the estimated critical value. Given that this difference is included only if positive, i.e., if inflation is designated "severe," equation (2) will yield a markedly different tradeoff in periods of persistent inflation than in periods of relative price stability. The wage equations are the following:

(2a) if inflation is non-severe:

$$w_t=\beta_0+\beta_1 p_t+\beta_4(1/u_t).$$

(2b) if inflation is severe:

$$w_t=(\beta_0-\beta_2\beta_3)+\left(\beta_1+\frac{\beta_2}{2}\right)p_t+\left(\frac{\beta_2}{2}\right)p_{t-1}+\beta_4\,(1/u_t)$$

We first solve the model for p_t in terms of u_t ignoring the lags. The corresponding Phillips Curves are:

(3a) non-severe inflation:

$$p_t=\left[\frac{1}{1-(\alpha_1+\alpha_2)\ \beta_1}\right]\ [(\alpha_1+\alpha_2)\ \beta_0+(\alpha_1+\alpha_2)\ \beta_4\ (1/u)-\alpha_3 q)]$$

The empirical result that $(\alpha_1+\alpha_2)\beta_1$ is less than one but greater than zero assures us of the existence of a stable set of unemployment-inflation possibilities.

(3*b*) severe inflation:

$$[1-(\alpha_1+\alpha_2)\ (\beta_1+\beta_2)]\ p_t=(\alpha_1+\alpha_2)\ (\beta_0-\beta_2\beta_3)+(\alpha_1+\alpha_2)\ \beta_4(1/u)-\alpha_3 q$$

According to the statistical estimates, division by the bracketed term on the left is now impossible in that this term is insignificantly different from zero.[2] $(\alpha_1+\alpha_2)$ equals one, as noted above, to reflect the full transmission of cost increases to prices. If inflation is severe, $(\beta_1+\beta_2)=1$ and the marginal effect of living cost inflation on wage demands is unitary. The inflation term therefore drops out of the formula and the rate of unemployment is determined by the trend rate of productivity increase and the structure of the labor market:

$$u=\frac{(\alpha_1+\alpha_2)\ \beta_4}{\alpha_3 q-(\alpha_1+\alpha_2)\ (\beta_0-\beta_2\beta_3)}.$$

Given the historically estimated values of the parameters and trend productivity, the minimum stationary value for u is approximately 4.2 percent.

The notion of two tracks, and only two, is undoubtedly subject to question. A better formulation, if the data had permitted, might have been a multiple track version recognizing several ranges of severity. But even as estimated, the model is not as dichotomous as these condensed versions might suggest. The lag structures in wage and price equations extend four to eight periods and lend flexibility to the transition. Furthermore, the condensed versions may give a false first impression: that if price inflation is greater than 2.5 percent, the price component of wage inflation is the full value of current and past increases in the cost of living whereas if price inflation is less than 2.5 percent, only β_2 percent (approximately 50 percent in the context of this model) is represented in higher wage costs. But only the marginal effect of *sustained* inflation above 2.5 percent is unitary, not the average effect, and the marginal effect of the *current* single year inflation is only approximately 0.75.

The role of lags.—Recognizing that $\alpha_2=(1-\alpha_1)$, equation (1) can be easily rewritten to clarify the source of relatively flat short run curves:

$$p_t=w_t+\alpha_2(w_{t-1}-w_t)-\alpha_3 q_t$$

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[2] The tradeoff becomes progressively steeper in models of this type as the product $(\alpha_1+\alpha_2)\ (\beta_1+\beta_2)$ approaches unity. This is the reason the long run Phillips Curve sketched in the previous section is not strictly vertical. The estimated sum of the unit labor cost coefficients in the output price equation (corresponding to X_1+X_2) is 1.000. The sum of the living cost coefficients in the wage equation corresponding to $(\beta_1+\beta_2)$ is 0.992. The price bridge equation transmits only 94% of output price inflation into consumption price inflation. Therefore the product equivalent to $(\alpha_1+\alpha_2)\ (\beta_1+\beta_2)$ is only 0.94 rather than unity.

In an expansion, current wage inflation will exceed past wage inflation, hence $(w_{t-1}-w_t)$ will be negative and price change will be less than the long run value corresponding to the current cost change. The larger the relative weight of lagged cost increases (α_2), the flatter the short run Phillips Curve will be relative to the long run curve. This effect is augmented in the labor market by the presence of lagged price elements representing the incomplete adaptation of expectations to accelerating prices.

A contraction presents the opposite problem: the delayed responses retard the cooling-off process initiated by restrictive demand policies. The best way to visualize the result is to think of a cycle beginning at high unemployment. As unemployment is reduced, a path below the steady-state curve is pursued. Assume unemployment below the critical rate has been achieved with little inflation. If policy makers fail to perceive the source of their good luck—the lagged responses—and seek to maintain the low unemployment rate, inflation will accelerate.

G. Further Exploration of the Severity Factor

The sensitivity of the severity index format actually adopted to the choice of the critical value of inflation and to the exponent to which the positive excess of inflation over this value is raised was indicated earlier in the table presenting the sums of squared residuals (ch. III, table 5). Figure 13 below indicates that the implicit steady-state Phillips Curves are not significantly shifted or altered by such changes. The left hand panel presents the options for critical values of 3 percent, 5 percent, and 7 percent (corresponding to average annual inflation rates of 1.5 percent, 2.5 percent, and 3.5 percent) combined with a unit exponent, while the right hand panel indicates similar curves when an exponent of 2 is used. The left hand integer within the parentheses indicates the exponent and the right hand number designates the critical value. It can be seen that the range of results is disappointingly narrow. Any of the equations which had comparably good statistical qualities historically show the critical rate of unemployment to fall between 3.8 percent and 4.2 percent.

While these results indicate a robustness to the estimates of the critical unemployment rate, the results should not be over-interpreted, of course. The historical period on which the model is based runs only from 1955 to 1971. The inflation severity factor took on small values in the later years of the inflation of the mid-1950's, but showed large values only in the three year episode at the end of the 1960's. Thus, in some crude sense, it can be considered to be only one observation of the critical process of forming inflationary expectations. We have now begun studies to test the same ideas in earlier historical episodes.

H. The Long-Run Phillips Curve in a Fluctuating Economy

The long run Phillips Curve estimated above assumes that the economy has a constant unemployment rate; in other words, that the level of real demand grows at the same rate as the rate of potential output. The actual economy contains lots of fluctuations. At least three characteristics of the model produce a somewhat worse long run Phillips Curve if the unemployment rate fluctuates:

First, the effect of the demand variable in the price equation, the ratio of the real volume of orders to capacity, is asymmetrical. When orders build up there is an extra increase in prices; when orders decline there is no offsetting reduction. In a fluctuating economy there will be periods when orders do build up and add to prices.

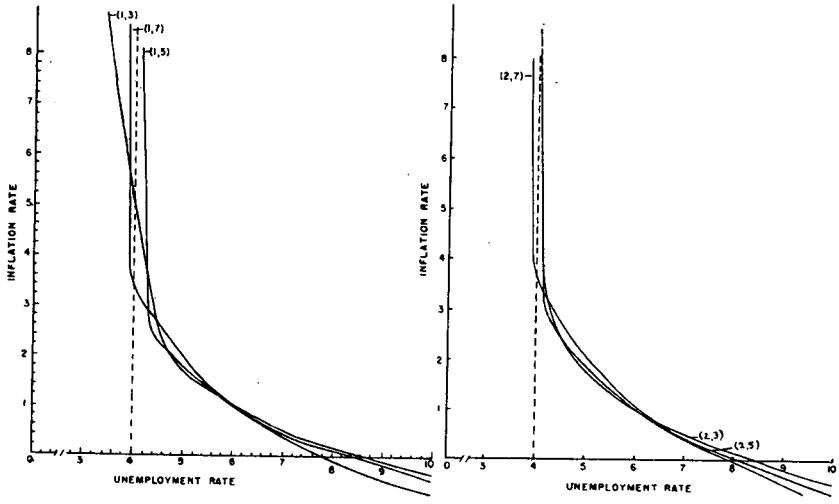
Second, the unemployment variable appears in the nonlinear inverse form used in most studies, a form which is superior statistically. If unemployment varies around an average value, the impact on wages will be greater than if it remained at the average. The nonlinearity introduces an asymmetry, such that the positive wage deviation when the unemployment rate is below average is greater than the negative deviation caused by an equal variation in the unemployment rate above its mean. Third, in a fluctuating economy, with an average unemployment rate not too far removed from the critical rate, there will be periods when the actual unemployment falls below the critical value bringing the severity factor into play.

If the labor market pressure is sustained long enough to generate a persistent inflation, the larger wage response will shift the short run Phillips Curve to an inferior position. The wage increases which push behavior into the critical area will be followed by further wage and price increases. However, when unemployment is above average, there is no offsetting intensified effect.

We have not attempted at this stage to develop long run Phillips Curves reflecting these cyclical characteristics. We will pursue this work at a later stage.

FIGURE 10

FLEXING THE ELBOW: THE STEADY STATE OPTIONS UNDER ALTERNATIVE SEVERITY INDEX SPECIFICATIONS



Chapter VI. THE CHOICES BEFORE US

The preceding analysis raises difficult questions for policy without offering answers. The basic conclusion, that the Phillips Curve becomes nearly vertical at an unemployment rate near 4 percent is highly pessimistic and would imply no improvement of our potential national goals from the interim goals set eleven years ago.

A. The Limits of Demand Policies

Demand management in the United States through fiscal and monetary policies has mainly been a short-term endeavor. Each fall the Administration analyzes the economic outlook for the succeeding year and devises a fiscal program designed to achieve an attainable combination of employment and price goals over a 12 to 18 month period. After a long period of slack, when the price-wage system is in relative stability and the short run Phillips Curve favorable, the government can aim at a low unemployment rate with little fear of a quick inflation. But after the wage-price system is in rapid motion, the short run choices open to demand policy become atrocious. While Administrations may live from day to day, the nation does not. Therefore, demand policy should be based on longer term considerations as identified by the long term Phillips Curve, not the short-term trade-off.

With the existing structure of the economy, the maximum sustainable employment goal appears to be an unemployment rate of approximately 4 percent. This is not an adequate long term employment goal. The structure of unemployment by race, sex and age has improved little in the last ten years, except for an improvement for Negro women. A national goal of 4 percent implies teenager rates of 13 percent for whites and twice that for Negroes. The social costs of unemployment are high. Other countries do better than the United States.

B. The Importance of Stable, Balanced Growth

While the long run Phillips Curve is inadequate under conditions of stable growth, it becomes even worse when growth comes in spurts. The asymmetric effect of backlogs of unfilled orders in product markets on price behavior adds to the wage-price spiral in strong periods without corresponding subtraction in weak periods. Sharp changes in the final demand mix, such as capital goods booms or surges of military spending, create sudden changes in the mix of the desired work force which accentuate the rate of wage increase for any given national unemployment rate. Such variations can deteriorate the long run attainable minimum rate of unemployment by several tenths of a point, resulting in a further worsening of the unemployment targets to about 4.5 percent.

It is impossible for policy to avert significant fluctuations in the economy. There are variations in the fundamental factors determining demand: population changes affect housing; the abundance or scarcity of fixed capital and major new technological innovations make plant and equipment spending unstable; sales expectations will occasionally be exceeded or disappointed, creating fluctuations of inventories. Psychological and other ill-understood factors lead to variations in consumer spending attitudes.

It has been the ideal of stabilization policy to neutralize these variations in the private economy to achieve stable growth and reasonably full utilization of potential. In actual practice, public policies have, at times, added to the instability of the economy. The two wars of the post-war period, Korea and Viet Nam, were the biggest single shocks to the economic system. Imperfections of diagnosis or inability of the political process to produce rational policies have added to instability.

The analysis presented here does not reduce the need for economic management, and indeed in some respects increases it. If it really is dangerous to have the unemployment rate drop below 4 percent or to have major variations of demand near full employment, the needs for stabilizing policy become greater. Further, once unemployment is high, the case for demand management to hasten recovery is unimpaired. But the analysis does argue that the cost of "stop-go" policies is high if they add to the variability of the economy: the long run Phillips Curve is worsened.

C. The Potential of Incomes Policies and Controls

The analysis of the preceding chapter showed that the wage guideposts of the mid-1960's lowered the rate of inflation, and particularly delayed the moment when the inflation severity factor came into play to make the wage-price system unstable. Given the significance of this factor and of price expectations in general, our analysis seems to point toward the use of such incomes policy measures.

The operational question is not whether such policies should be used at all, but whether their use should be episodic or permanent. Many countries have suffered the gradual deterioration of the short run Phillips Curves until the point was reached where all the choices open to government were unacceptable. As drastic disinflation and deliberate creation of massive unemployment became less acceptable, governments turned to various kinds of incomes policies and controls. The half-life of these programs has been rather short, but perhaps sufficient to lower the short run Phillips Curves by changing inflationary expectations, thereby setting the stage for another cycle of gradual deterioration.

The current wage-price program is the strongest effort of this type that the United States has attempted in normal times, and probably would rate high in the international scale of such programs as well. It is too early to tell how effective the program will be and how quickly it will become unacceptably unpopular. Our work suggests that such a program should probably be maintained at least two years and with sufficient rigor to bring the price record outside of the severity region,

i.e., to lower the annual inflation rate to 2.5 percent or less and to keep it in that range. Once inflationary expectations have been brought to their normal, more moderate pattern, there would be no need to continue to maintain these policies if the society is willing to limit its unemployment goals to the 4 to 4.5 percent area. If we want to set more ambitious goals, we will need a better economic structure and more permanent incomes policies.

D. Improving the Structure of the Economy

It is at this point that it is conventional to recommend expanded manpower policies and stronger anti-trust actions to shift the long run Phillips Curve. Since the United States has kept its manpower policies of rather limited scope compared to the fraction of the population that is inadequately prepared for the modern job world, and since we have not attempted a qualitative leap in anti-trust policy in many years, one cannot assess whether such policies could succeed in significantly shifting the Phillips Curve.

During the 1960's manpower policies had three strategies: there was a regional emphasis with particular attention to depressed areas, particularly Appalachia. As the economy tightened and some shortages appeared, there was an effort to add to the supply of the bottleneck skills. Later, the manpower programs increasingly focused on training the disadvantaged segment of the population.

Holt, MacRae, Schweitzer and Smith (1971) have related manpower policies to the Phillips Curve problem. Their theory of the Phillips Curve emphasizes the frictional elements in unemployment: the turnover rate, the efficiency of job search, the responses of wages and prices to job vacancies and unemployment, and the dispersion of unemployment rates among separate labor market compartments. These authors see great potential in measures designed to improve the efficiency of the market. Recently Robert E. Hall (1971) has prepared a detailed analysis of these proposals and reached more pessimistic conclusions. Hall questions the relative importance of the cited job market factors in explaining the prevalence of unemployment and doubts the practical potential of such measures as a centralized computerized federal employment service. He argues that the solutions to the manpower problem lie in much broader measures which will provide incentives to employers to change their hiring practices. This conclusion is consistent with the companion study to the present paper by Thurow (1971) who, with others, [Galbraith, Kuh, Thurow, 1971] has advanced a broad plan which sets employment quotas for women and racial minorities.

As for anti-trust policy, continuous vigilance is needed to avoid expansion of the degree of monopoly in the American economy. Whether the present type of anti-trust policy can be strengthened to the point where it would seriously affect the ability of business to fully pass on cost increases in periods of weak demand is questionable. Perhaps a stronger anti-trust policy would reduce the average profit rate which in earlier studies was seen to be one of the determinants of industry wages. Foreign competition remains the major factor in limiting market power.

E. Concluding Comments

We are not attempting to offer basic solutions to the structural problems which so deeply embed an inadequate Phillips Curve in the American economic system. In terms of priorities, the initial task is to return the economy to that portion of the long run Phillips Curve which contains the normal tradeoff between unemployment and inflation. That task is likely to absorb the energies of policy for the next year or two.

When we are again ready to turn to the structural questions, a solution which would not attempt to change the fundamental economic system may well have these ingredients:

1. A major tax incentive to stimulate on-the-job training and employment of the disadvantaged.
2. The beginnings of a quota approach for minorities in the hiring practices of large companies.
3. More direct government concern with the meeting of the skill requirements of a high employment economy, particularly of those skills where entry is controlled by the private parties at interest.
4. New government policies designed to make product markets more competitive and to reduce the protection of industry through tariffs, quotas and internal regulations.
5. A permanent incomes policy which reconciles wage and profit claims with the economy's ability to meet them.

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