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Wage-Price Controls and the Shifting Phillips Curve

THE CONDITION OF THE U.S. ECONOMY improved in almost every respect after the initiation of the wage-price control program on August 15, 1971. Real gross national product grew rapidly, unemployment finally began to decline, and the rate of inflation moderated. But the coincidence of timing does not necessarily mean that controls are an essential condition for prosperity, or that the August 1971 message was the key that unlocked the floodgates behind which real aggregate demand had been restrained. The major task of this paper is to assess the effect of the controls by comparing the actual performance of the economy with its performance without controls as predicted by an econometric model fitted to the precontrol period. Since the reliability of econometric inflation equations is subject to doubt in light of their inaccurate predictions in the late 1960s, a substantial portion of the paper is devoted to an assessment of the stability of the coefficients in several recently published wage equations.

The determination of the four basic macroeconomic magnitudes—nominal (current dollar) income, real output, prices, and unemployment—is usefully separated into three subproblems: (1) the determination of nominal income, (2) the division of that nominal income between real output and prices, and (3) the relationship between real output and unemployment. This paper concentrates on the second problem and assumes that nominal income is determined independently of the control program by past and

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current monetary and fiscal policy. Once the paths of real output and inflation with and without the controls are determined, a simple "Okun's law" equation is used to compute the implied alternative paths of the unemployment rate.[1]

Before the achievement of the control program can be evaluated, a criterion for its "success" should be established. By my standard, controls can be judged "successful" if the value to society of the reduction in inflation they achieve relative to that which would have occurred without them is greater than the direct and indirect costs imposed by the control program. As I have argued previously, once inflation in the U.S. economy had, in 1968–71, settled down to a rate that was expected to continue at roughly 5 percent per annum, the attempt to reduce it did little good and caused positive harm by redistributing income from debtors to creditors.[2] The costs of the control program itself are impossible to measure but must be substantial, mainly in terms of the time lost by corporate executives, small businessmen, and landlords who must make reports, estimate productivity, and plan avoidance strategies, and in terms of the inequities imposed by an arbitrary decision process. Thus, when the small benefits and nonnegligible costs of the program are taken into account, it cannot be deemed a success even though the econometric simulations in this paper do demonstrate that it achieved a significant quantitative reduction in inflation.

Can the Data Distinguish among Alternative Models?

Inflation equations were an Achilles' heel in many econometric models during the late 1960s. The acceleration of inflation was underpredicted consistently and was explained only after it had occurred. The most important cause of weakness was the low variance of the rate of inflation in the pre-1966 period, which disguised the full impact on wages of a sustained period

1. The equation linking real output and unemployment, as well as those used to derive explanatory variables in forecasts, is contained in Appendix B of my "Inflation in Recession and Recovery," *Brookings Papers on Economic Activity* (1:1971), pp. 105–58. All Appendix B equations have been reestimated through 1972:2. Simulations and estimates of all equations are based on data revisions available on August 15, 1972. For Okun's law, see Arthur M. Okun, "Potential GNP: Its Measurement and Significance," in American Statistical Association, *Proceedings of the Business and Economic Statistics Section* (1962), pp. 98–104.

2. See my "Steady Anticipated Inflation: Mirage or Oasis?" *Brookings Papers on Economic Activity* (2:1971), pp. 499–510.

of substantial inflation. Since the feedback of inflation on wages did not begin to reveal itself until the late 1960s, any econometric model of U.S. wage-price relationships with coefficients estimated from a sample period ending before, say, 1968, should be considered obsolete, at least until re-estimated. Thus I limit my attention to three relatively recent studies, those of Eckstein-Brinner, Perry, and myself.[3]

The wage equations in these studies are viewed as alternative models to simulate the control period. There is no similar issue of comparing price equations. That equation is absent from Perry's work, and it contains the same explanatory variables in the Eckstein-Brinner approach as in my own.[4] While similar in explaining the rate of wage increase as a function primarily of labor market pressure and past inflation, the wage equations contain important differences in the variables used to represent labor market pressures and in the specification of the feedback of previous inflation. Both Perry and Gordon emphasize labor market variables that differ from the conventional aggregate unemployment rate. Perry introduces a weighted unemployment rate and unemployment dispersion index and supports a "guidepost dummy," while Gordon confirms his dispersion variable, supplements it with "disguised" unemployment and "the unemployment of hours" as dual proxies for excess labor demand, and rejects the guidepost dummy. Eckstein and Brinner, on the other hand, support the conventional unemployment rate in combination with a guidepost dummy, and deny any role in the inflation process to shifts in labor market structure. Perry introduces past inflation as last period's change in the consumer price index, whereas I use the consumption deflator of the national income accounts with lags estimated from an interest rate equation, and Eckstein and Brinner combine the recent change in the consumption deflator with an "inflation threshold" variable; these differences imply quite different responses of wage change to inflation in both the short and the long run. The papers also differ in their treatment of three supplementary factors: the social security tax, the personal income tax, and divergences between the price indexes for consumption goods and for aggregate output.

3. Otto Eckstein and Roger Brinner, *The Inflation Process in the United States*, A Study Prepared for the Use of the Joint Economic Committee, 92 Cong. 2 sess. (1972); George L. Perry, "Changing Labor Markets and Inflation," *Brookings Papers on Economic Activity* (3:1970), pp. 411–41; Gordon, "Inflation in Recession and Recovery."

4. Minor differences in the Eckstein-Brinner price equation concern the definition of "standard" productivity, the standardization of "standard" and actual unit labor cost, and the specification of lag distributions.

The selection among alternative wage equations for simulation of the wage-price control period can be approached in either or both of two ways. First, the goodness of fit and stability of coefficients of the alternative equations can be examined for several precontrol sample periods, and the "best" equation can be selected for the simulations. Or, second, several simulation tests might be conducted on the period of controls using *each* of several alternative wage equations. In this paper I have chosen the first approach, both because a time constraint has limited the number of equations that can be simulated and because it yields interesting conclusions in itself. Do the data provide any grounds for choosing among alternative hypotheses, or must we remain agnostic about the best method of specifying effects like those of labor market pressure and past inflation? Are there statistically significant differences in fit between otherwise similar equations using alternative unemployment rates? Is the rejection of the accelerationist hypothesis in most previous wage studies based on statistically significant differences between coefficients? How much do fitted coefficients vary across alternative sample periods? The first part of this paper is devoted to a detailed scrutiny of the Eckstein-Brinner, Gordon, and Perry wage equations to separate the questions that are answered conclusively from those that are not.

CRITERIA FOR COMPARING WAGE EQUATIONS

Although primary interest centers on comparing the statistical significance of alternative labor market and inflation variables, published wage equations differ along numerous other dimensions. Without some standardization of approach a vast number of equations can be estimated, differing in the source of the wage series, the number of quarters over which wage change is defined, the beginning and ending dates of the sample period, and the precise definition of independent variables. In order to focus the comparisons on alternative hypotheses and minimize the attention to trivial details, the following choices were imposed on all wage equations:

1. *Source of wage series.* As a measure of wages, Perry used compensation per manhour, whereas I developed a series on hourly earnings corrected for changes in overtime and interindustry employment shifts that was used both in my study and by Eckstein and Brinner. The index used here is identical with that in my earlier paper through 1963:4, and there-

after substitutes a more refined index that the Bureau of Labor Statistics has recently begun to publish regularly.[5]

2. *Form of wage change.* Both Perry and Eckstein-Brinner expressed the dependent variable in the form of four-quarter changes, and their results exhibit a substantial degree of first-order positive serial correlation. My 1971 estimates used two-quarter changes to reduce positive serial correlation and rejected one-quarter changes due to substantial negative serial correlation. I have subsequently discovered that the extent of negative serial correlation with one-quarter changes is approximately the same as the extent of positive serial correlation with two-quarter changes (Durbin-Watson statistics of about 2.5 and 1.5, respectively). Hence I now exhibit estimates for both forms of the dependent variable and assume that the two estimated coefficients for each independent variable bracket the "best" estimate.

3. *Sample period.* The three studies differ in the starting date of the sample period. While all excluded the Korean war period, Perry chose to begin in 1953:1, Eckstein-Brinner in 1955:1, and I in 1954:1. This study uses 1954:1 both because it represents a compromise and because most of 1953, a period of very low unemployment and only moderate inflation, appears to have been influenced by the Korean war controls. The terminal quarter, 1970:4, is that chosen previously by Eckstein-Brinner and myself and goes two years beyond the Perry sample period; while the sample period could be stretched by inclusion of the first two, precontrol, quarters of 1971, I prefer to "save" these for the simulations.

4. *Simultaneity.* Both the Eckstein-Brinner and Gordon studies (but not Perry's) are subject to criticism for inclusion of current-period price change in the wage equation. In this paper all inflation variables have been redefined to exclude current inflation.

5. *Form of independent variables.* All variables are constructed from an identical set of fully revised data.[6] Any variable expressed as a *level* (rather

5. As before, this wage index is adjusted for fringe benefits; the level of the wage index is multiplied by the ratio of compensation of employees to wages and salaries in the national income accounts (*Survey of Current Business*, Table 1.10). The replacement of my original series by the BLS series for the period starting in 1964:1 accounts for the substantial reduction in standard errors in my fitted wage equation as compared with that in the 1971 paper.

6. Sources are listed in my "Inflation in Recession and Recovery," pp. 155–58. The appendix below contains a list (alphabetically by symbol) of all variables used in this paper. The Eckstein-Brinner equation is specified exactly as in their paper (p. 4); Gordon's

than as a rate of change) is entered directly in the equations with the one-quarter wage change as dependent variable, and as a two-quarter average for the two-quarter wage-change equations. All level variables are multiplied by appropriate constants to make coefficients apply to annual rates of change (that is, 0.5 in the two-quarter case and 0.25 in the one-quarter case), and are thus comparable to the published results of Eckstein-Brinner and Perry.[7]

RESULTS OF SENSITIVITY TESTS

Sensitivity tests must allow for interactions among variables, or the results may be misleading. An important conclusion of this section is that Eckstein-Brinner prematurely discarded Perry's hypothesis that a changing labor market structure has shifted the Phillips curve, simply because alternative labor market variables were compared without consideration of possible interactions with Perry's other variables. To provide an "unbiased" appraisal of the effect of the three labor market and inflation hypotheses, each is introduced in *three* separate trials corresponding to the Eckstein-Brinner, Gordon, and Perry sets of "other" variables. This creates nine combinations for the labor market tests and nine more for the inflation tests.

Labor market variables. The most complicated comparison is among the alternative labor market hypotheses. Table 1 has nine columns corresponding to the nine possible combinations of the three sets of labor market variables with the three sets of "other" variables. Each coefficient, t-statistic, standard error, and Durbin-Watson statistic is exhibited twice, with that estimated from the equation with the two-quarter wage change as dependent variable exhibited as the top member of each pair and the one-quarter version displayed underneath. The first column displays the Eckstein-Brinner basic equation, and columns (2) and (3) replace the Eckstein-Brinner labor market variables with those of Gordon and Perry, respectively, while retain-

exactly as in equation (19), p. 124 of the paper noted above (the freely estimated lag weights are used to avoid reestimating the interest rate equation to reflect revised data and to exclude current-period inflation); and Perry's as in equation (3), p. 425, of his paper cited above, with the insignificant secondary employment variable omitted for lack of data.

7. Level coefficients in my 1971 paper (on the disguised unemployment rate, U^D, the unemployment rate of hours, U^H, and the unemployment dispersion index, DU) must be multiplied by two to be comparable with the estimates presented here.

ing all other Eckstein-Brinner variables. A comparison of standard errors for the one-quarter changes (bottom member of each pair) supports the Eckstein-Brinner conclusion that the best-fitting equation is obtained with the conventional unemployment rate alone (hence the "best" standard error in column 1, line 7, is denoted *b*). This is true whether or not the guidepost dummy is included. However, the comparison for two-quarter changes (top member of each pair) is not so clear-cut. The Eckstein-Brinner approach fits best when the guidepost dummy is included (line 7) but significantly less well than the Gordon variables when the guidepost dummy is omitted (line 8).[8] A decision between the two approaches then depends on one's willingness to accept the conclusion that the guideposts conceivably could have reduced the rate of change of wages by as much as 0.7 percent at an annual rate.[9]

The next set of three columns introduces the alternative labor market variables into equations that otherwise are specified as in my paper. For the one-quarter equations the Gordon labor market variables fit best either with or without the guidepost dummy, with a statistically significant margin in the latter case. In the two-quarter variants the margin is more significant, and the conventional unemployment rate has the wrong sign when added to the equation (column 5, line 11).

Still a different outcome occurs in the final three columns. The Gordon variables fit best both with and without the guidepost dummy, but the Perry approach supplemented by the conventional unemployment rate is marginally better than Gordon-cum-guideposts (column 8, line 7, compared with column 9, line 9). However, either with or without the conventional unemployment rate ($1/U$), the Perry inverse of the weighted unemployment rate ($1/U^*$) does not come close to statistical significance.

Overall, Table 1 clearly demonstrates the interaction of the labor market variables with the others. The conventional unemployment rate combined with the guidepost dummy performs best by itself with other variables specified as in the Eckstein-Brinner approach, but must be supplemented by unemployment dispersion (not weighted unemployment) in the Perry

8. All comparisons of statistical significance refer to F tests at the 5 percent level carried out as suggested in Franklin M. Fisher, "Tests of Equality between Sets of Coefficients in Two Linear Regressions: An Expository Note," *Econometrica*, Vol. 38 (March 1970), p. 363.

9. The best-fitting two-quarter equation uses Perry's variables with the unemployment rate added (column 3, line 9) but must be rejected because the coefficient on the weighted unemployment rate ($1/U^*$) has the wrong sign (not shown).

Table 1. Estimated Wage Equations with Alternative Labor Market Variables[a]

Variable or summary statistic	*Eckstein-Brinner basic equation*			*Gordon*			*Perry*		
	Labor market variable			*Labor market variable*			*Labor market variable*		
	Eckstein-Brinner	*Gordon*	*Perry*	*Eckstein-Brinner*	*Gordon*	*Perry*	*Eckstein-Brinner*	*Gordon*	*Perry*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Variable									
1. Inverse of official	0.0016	...	...	0.0010	...	...	0.0015	...	...
unemployment rate	(8.33)	...	...	(4.43)	...	...	(6.26)	...	...
(1/*U*)	0.0018	...	...	0.0014	...	...	0.0016	...	...
	(6.29)	...	...	(4.39)	...	...	(5.54)	...	...
2. Inverse of weighted	...	...	0.0008	...	...	−0.0001	...	...	0.0001
unemployment rate	...	...	(2.94)	...	...	(−0.33)	...	...	(0.47)
(1/*U**)	...	...	0.0010	...	...	0.0001	...	...	0.0001
	...	...	(2.56)	...	...	(0.35)	...	...	(0.53)
3. Unemployment	...	0.0249	0.0224	...	0.0313	0.0774	...	0.0594	0.0983
dispersion index	...	(1.18)	(0.80)	...	(2.02)	(3.55)	...	(3.05)	(4.39)
(*DU*)	...	0.0384	0.0206	...	0.0410	0.0804	...	0.0745	0.1053
	...	(1.36)	(0.55)	...	(1.91)	(2.66)	...	(3.69)	(4.25)
4. Disguised unem-	...	−0.787	...	...	−0.622	...	...	−0.933	...
ployment rate	...	(−6.53)	...	...	(−5.18)	...	...	(−8.33)	...
(U^D)	...	−0.736	...	...	−0.602	...	...	−0.879	...
	...	(−4.04)	...	...	(−3.42)	...	...	(−5.99)	...

5. Unemployment	...	−0.474	...	...	−0.430	...	...	−0.173	...
rate of hours	...	(−2.21)	...	...	(−2.27)	...	...	(−0.91)	...
(U^H)	...	−0.387	...	...	−0.422	...	...	−0.051	...
	...	(−1.38)	...	...	(−1.65)	...	...	(−0.24)	...
6. Guidepost	−0.0069	...	−0.0103	−0.0043	...	−0.0105	−0.0102	...	−0.0169
dummy (D_G)	(−3.96)	...	(−3.85)	(−1.94)	...	(−4.15)	(−5.27)	...	(−8.10)
	−0.0076	...	−0.0111	−0.0040	...	−0.0115	−0.0110	...	−0.0178
	(−2.85)	...	(−2.95)	(−1.26)	...	(−2.96)	(−4.33)	...	(−6.90)
Summary statistic									
7. Standard error	0.00292[b]	0.00294	0.00302	0.00260	0.00219[b]	0.00232	0.00345	0.00284[b]	0.00302
with guidepost	0.00223[b]	0.00232	0.00225	0.00196	0.00181[b]	0.00185	0.00227	0.00197[b]	0.00200
dummy									
8. Standard error	0.00325	0.00306	0.00335	0.00265	0.00220	0.00263	0.00411	0.00313	0.00430
with D_G omitted	0.00235	0.00242	0.00239	0.00197	0.00183	0.00196	0.00256	0.00214	0.00263
9. Standard error	...	0.00295	0.00282	...	0.00216	0.00234	...	0.00315	0.00281
when $1/U$ is added	...	0.00232	0.00225	...	0.00185	0.00186	...	0.00216	0.00195
to basic equation									
10. t-statistic of D_G	...	−2.42	...	...	−1.23	...	...	−3.78	...
when added	...	−2.45	...	...	−1.53	...	...	−3.53	...
11. t-statistic of $1/U$	...	2.38	3.22	...	−1.69	0.76	...	−0.62	3.28
when added	...	2.50	1.09	...	−0.00	0.62	...	0.19	1.90
12. Durbin-Watson of	1.27	1.44	1.19	1.05	1.33	1.19	0.94	0.97	0.84
basic equation	2.24	2.29	2.17	2.21	2.50	2.40	1.65	1.83	1.80

Sources: Based on equations developed by (1) Otto Eckstein and Roger Brinner, *The Inflation Process in the United States*, A Study Prepared for the Use of the Joint Economic Committee, 92 Cong. 2 sess. (1972); (2) George L. Perry, "Changing Labor Markets and Inflation," *Brookings Papers on Economic Activity* (3:1970), pp. 411–41; and (3) Robert J. Gordon, "Inflation in Recession and Recovery," *Brookings Papers on Economic Activity* (1:1971), pp. 105–58. See appendix for sources of the basic data.

a. The dependent variables are two-quarter and one-quarter wage changes. The sample period is 1954:1–1970:4. A pair of coefficients, t-statistics (in parentheses), standard errors, and Durbin-Watson statistics are shown for each combination. The top member is estimated in a two-quarter equation and the bottom member in a one-quarter equation.

b. The best standard errors for the group.

approach, while in the Gordon equations conventional unemployment is completely insignificant. The unemployment dispersion index is strongly significant in the Gordon and Perry approaches, but not in that of Eckstein and Brinner. The disguised unemployment rate (U^D) is significant in every approach, but the unemployment rate of hours is less so and is completely insignificant when introduced into the Perry equations (column 8, line 5). The guidepost dummy is important for Eckstein-Brinner and Perry, particularly the latter (compare standard errors in column 9, lines 7 and 8), but not for Gordon. Finally, the best overall fit is obtained with the Gordon approach for both labor market and other variables (column 5); a determination of whether the margin of superiority is contributed by the inflation or tax variables awaits further comparisons.

Inflation variables. Fortunately the comparison for the alternative inflation variables is much simpler to digest. The first column in Table 2 exhibits coefficients fitted in the basic Eckstein-Brinner equation (the same equation as that displayed in Table 1, column 1). The influence of past inflation on wage change is represented by two variables.[10] The first (g_{d^*}) is the recent change in the personal consumption deflator (PCD) with a short distributed lag introduced with imposed weights. The second is the "inflation threshold" variable g_{dT}, which is equal to the average annual rate of change of PCD over the past two years *when that rate of change is above 2.5 percent*, but equal to zero otherwise. The next two columns replace the Eckstein-Brinner inflation variables with, respectively, the Gordon and Perry inflation variables in equations that are otherwise identical to column 1. The first Gordon inflation variable is a distributed lag on the rate of change of the same PCD series that Eckstein and Brinner use, but the weights are freely estimated rather than imposed. The second is a distributed lag on the difference between the rate of change of the price of nonfarm output and the price of consumption goods.[11] Perry's variable is simply the rate of change in the consumer price index (CPI), lagged one period.

A comparison of the first three columns indicates that the Eckstein-Brinner inflation variables work marginally better in their equation than the Gordon variables (the difference is not statistically significant), but

10. For variables used in this paper, g indicates the rate of growth.

11. This variable reflects the analytic presumption that, with the price of consumption goods unchanged, an increase in the price of nonconsumption goods raises the marginal revenue product of labor and hence tends to pull up wages if labor is paid the value of its marginal product.

much better than the Perry CPI variable. On the other hand, the Gordon inflation variables fit significantly better in both the Gordon and Perry equations (columns 4–6 and 7–9, respectively). The most interesting feature of Table 2 is the clear evidence of interaction among variables. The coefficients on all of the inflation variables are substantially higher when introduced into the Eckstein-Brinner equation (first three columns) than in the Gordon or Perry equation. The Eckstein-Brinner approach, which uses the conventional unemployment rate as its only labor market variable, cannot explain the marked wage change in the late 1960s without heavy emphasis on the influence of recent inflation, whereas the Gordon and Perry equations emphasize structural shifts in labor market variables and leave less to be explained by inflation. This is especially true of the Perry approach, in which the high coefficient on unemployment dispersion (Table 1, column 9) is offset by low inflation coefficients, and which thus is furthest from supporting the accelerationist hypothesis that the sum of the inflation coefficients is equal to unity.

Another interesting feature of Table 2 is the sensitivity of the coefficients on the first Eckstein-Brinner inflation variable (g_{d*}) to the form in which the equation is fitted. The variable is statistically insignificant in the one-quarter equations, but in the two-quarter equations the coefficient doubles and the t-ratio becomes significant; and in the Eckstein-Brinner published equation based on four-quarter changes, the coefficient doubles again to 0.496 and the t-ratio climbs to 7.3. Yet the two-quarter and four-quarter versions exhibit a substantial degree of positive serial correlation, indicating that both the t-ratios and the size of the coefficient itself are seriously biased.[12] In the more reliable one-quarter versions, which display no significantly autocorrelated disturbances, the entire contribution of past inflation works through the threshold variable, which has particularly unstable coefficients in Table 2 and even more so in Table 3 below.

Finally, Table 2, line 6, exhibits the mean lag of the past influence of consumer prices on wage change. Perry appears to have substantially underestimated the mean lag by restricting past inflation to the simple form of a one-quarter lag. The relatively short Eckstein-Brinner lag on g_{d*} is offset by the relatively long lag attached to their threshold variable (5.0 quarters).

12. The Durbin-Watson statistics in the two- and four-quarter versions are 1.27 and 0.77, respectively (the latter is displayed in the Eckstein-Brinner paper, *Inflation Process*, p. 4), and both are sufficiently low to cause rejection of the hypothesis of nonautocorrelated disturbances in favor of the hypothesis of positive autocorrelation.

Table 2. Estimated Wage Equation with Alternative Inflation Variables[a]

Variable or summary statistic	*Eckstein-Brinner basic equation*			*Gordon*			*Perry*		
	Inflation variable			*Inflation variable*			*Inflation variable*		
	Eckstein-Brinner	*Gordon*	*Perry*	*Eckstein-Brinner*	*Gordon*	*Perry*	*Eckstein-Brinner*	*Gordon*	*Perry*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Variable									
1. Recent change in	0.244	...	...	0.277	...	...	0.179	...	...
personal consump-	(2.25)	...	...	(2.28)	...	...	(1.64)	...	...
tion deflator with	0.113	...	...	0.183	...	...	0.105	...	...
imposed weights (g_d*)	(0.72)	...	...	(1.12)	...	...	(0.76)	...	...
2. Recent change in	...	0.902[b]	...	...	0.705[b]	...	...	0.449[b]	...
personal consump-	...	(6.94)	...	...	(5.86)	...	...	(2.90)	...
tion deflator with	...	0.852[b]	...	...	0.660[b]	...	...	0.402[b]	...
estimated weights	...	(4.54)	...	...	(3.71)	...	...	(7.88)	...
(g_{d^e})									
3. Inflation threshold	0.821[c]	...	...	0.552[c]	...	...	0.428[c]	...	...
(g_{dT})	(3.95)	...	...	(3.04)	...	...	(1.66)	...	...
	0.966[c]	...	...	0.563[c]	...	...	0.546[c]	...	...
	(316)	...	...	(2.08)	...	...	(1.60)	...	...

4. Product price	...	0.542[b]	...	...	0.590[b]	...	...	0.663[b]	...
($g_p - g_d$)	...	(2.24)	...	...	(3.41)	...	...	(3.29)	...
	...	0.650[b]	...	...	0.684[b]	...	...	0.692[b]	...
	...	(1.86)	...	...	(2.51)	...	...	(2.45)	...
5. Consumer price	...	...	0.342	...	...	0.180	...	...	0.137
index, $t-1$ ($g_{c_{t-1}}$)	...	...	(6.00)	...	...	(2.62)	...	...	(2.17)
	...	...	0.252	...	...	0.117	...	...	0.092
	...	...	(3.54)	...	...	(1.57)	...	...	(1.35)
6. Mean lag on g_d^*, g_d^e,	2.0 5.0 [4.3]	4.0	1.0	2.0 5.0 [4.0]	4.0	1.0	2.0 5.0 [4.1]	2.6	1.0
g_{dT}, or $g_{c_{t-1}}$[d]	2.0 5.0 [4.7]	5.2	1.0	2.0 5.0 [4.3]	4.5	...	2.0 5.0 [4.5]	3.4	1.0
Summary statistic									
7. Standard error	0.00292	0.00295	0.00347	0.00242	0.00220	0.00274	0.00289	0.00256	0.00302
	0.00223	0.00228	0.00249	0.00193	0.00183	0.00202	0.00193	0.00186	0.00199
8. Durbin-Watson	1.27	1.26	1.20	1.21	1.33	1.09	0.87	1.06	0.84
	2.24	2.22	1.96	2.35	2.50	2.15	1.89	2.19	1.80

Sources: Same as Table 1.
a. See Table 1, note *a*.
b. Estimate is the sum of a series of distributed lag coefficients.
c. Coefficient refers to annual rate of change. The Eckstein-Brinner published coefficients refer to a rate of change over two years.
d. The numbers in brackets are weighted average mean lags calculated by multiplying the mean lag on each variable g_d^* and g_{dT} by its coefficient.

Table 3. Wage Equations Estimated for Alternative Sample Periods Beginning with 1954:1[a]

Variable or summary statistic	Eckstein-Brinner basic equation			Gordon			Perry		
	Last observation			Last observation			Last observation		
	1966:4	*1968:4*	*1970:4*	*1966:4*	*1968:4*	*1970:4*	*1966:4*	*1968:4*	*1970:4*
	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*	*(7)*	*(8)*	*(9)*
Variable									
1. Inverse of official or	0.0017	0.0018	0.0016	...	...	...	0.0006	0.0007	0.0001
weighted unemploy-	(6.96)	(8.21)	(8.33)	...	...	...	(1.77)	(2.24)	(0.48)
ment rate	0.0019	0.0020	0.0018	...	...	...	0.0006	0.0007	0.0001
($1/U$ or $1/U^*$)	(4.84)	(6.23)	(6.29)	...	...	...	(1.58)	(2.12)	(0.53)
2. Unemployment	...	...	...	0.00215	0.0362	0.0313	0.0634	0.0579	0.0983
dispersion	...	...	...	(1.11)	(2.12)	(2.02)	(1.40)	(2.10)	(4.39)
index (DU)	...	...	...	0.0353	0.0465	0.0410	0.0775	0.0596	0.1053
	...	..	...	(1.28)	(2.08)	(1.91)	(1.51)	(1.88)	(4.25)
3. Disguised unem-	...	...	...	−0.640	−0.662	−0.622	...	...	...
ployment rate	...	...	...	(−5.37)	(−5.24)	(−5.18)	...	...	...
(U^D)	...	...	...	−0.728	−0.667	−0.602	...	...	...
	...	...	...	(−3.96)	(−3.69)	(−3.42)	...	...	...
4. Unemployment	...	...	...	−0.421	−0.394	−0.430	...	...	...
rate of hours	...	...	...	(−2.18)	(−1.81)	(−2.27)	...	...	...
(U^H)	...	...	...	−0.472	−0.385	−0.422	...	...	...
	...	...	...	(−1.72)	(−1.39)	(−1.65)	...	...	...
5. Guidepost dummy	−0.0077	−0.0078	−0.0069	...	...	...	−0.0153	−0.0148	−0.0169
(D_G)	(−4.20)	(−4.26)	(−3.97)	...	...	...	(−3.78)	(−6.37)	(−8.10)
	−0.0083	−0.0083	−0.0076	...	...	...	−0.0170	−0.0154	−0.0178
	(−2.85)	(−2.99)	(−2.86)	...	...	...	(−3.60)	(−5.41)	(−6.90)

6. Consumer price	0.299	0.287	0.244	0.416[b]	0.574[b]	0.705[b]	0.076	0.089	0.137
(g_{d*}, g_{de}, $g_{c_{t-1}}$)	(2.41)	(2.44)	(2.24)	(2.84)	(3.59)	(5.86)	(1.09)	(1.36)	(2.17)
	0.181	0.143	0.113	0.402[b]	0.553[b]	0.660[b]	0.059	0.057	0.092
	(0.97)	(0.84)	(0.71)	(1.65)	(2.46)	(3.71)	(0.79)	(0.81)	(1.36)
7. Inflation threshold	−0.071	0.118	0.821	...	...	...	...	...	...
(g_{dT})	(−0.20)	(0.22)	(3.95)	...	...	...	...	...	...
	0.126	0.554	0.965	...	...	...	...	...	...
	(0.11)	(0.70)	(3.16)	...	...	...	...	...	...
8. Product price	...	...	...	0.517[b]	0.533[b]	0.590[b]	...	...	...
($g_p - g_d$)	...	...	...	(3.12)	(2.90)	(3.41)	...	...	...
	...	...	...	0.495[b]	0.590[b]	0.684[b]	...	...	...
	...	...	...	(1.77)	(2.10)	(2.51)	...	...	...
9. Social security tax	...	...	...	1.0[c]	1.0[c]	1.0[c]	0.903	0.929	0.995
($g_{(1/1-T_s)}$)	...	...	...	...	...	...	(3.60)	(3.83)	(4.19)
	...	...	...	1.0[c]	1.0[c]	1.0[c]	0.976	0.995	0.999
	...	...	...	...	...	...	(4.82)	(5.12)	(5.17)
10. Employee or	0.029	0.026	0.027	0.244	0.238	0.171	...	...	...
personal tax	(3.22)	(3.21)	(3.67)	(4.76)	(4.25)	(4.00)	...	...	...
($g_{(1/1-T_e)}$)	0.020	0.015	0.015	0.213	0.189	0.115	...	...	...
	(1.197)	(1.73)	(1.93)	(3.03)	(2.76)	(2.04)	...	...	...
Summary statistic									
11. Standard error	0.00296	0.00296	0.00292	0.00192	0.00221	0.00220	0.00300	0.00291	0.00302
	0.00232	0.00226	0.00223	0.00173	0.00180	0.00182	0.00197	0.00190	0.00199
12. Durbin-Watson	1.19	1.30	1.27	1.60	1.37	1.33	0.77	0.90	0.84
	2.30	2.25	2.24	2.62	2.40	2.49	1.83	1.84	1.80

Sources: Same as Table 1.
a. See applicable parts of note *a* to Table 1.
b. Coefficient is the sum of a series of distributed lag coefficients.
c. Coefficient shown is for first period only, to be comparable to Perry's. Variable was introduced for additional periods, and all coefficients were constrained rather than estimated. The procedure is exactly as explained in Gordon, "Inflation in Recession and Recovery," p. 122.

Thus a "weighted average" mean lag calculated for this approach, displayed in brackets on line 6, is very similar to the lags estimated directly for the Gordon inflation variable.

Tax variables. Changes in both the social security tax and personal income tax enter into the basic Gordon equation, while Perry uses only the former and Eckstein-Brinner only the latter. The sensitivity tests strongly support the inclusion of both, since both enter with significant t-ratios in all of the equations estimated in Tables 1 and 2.[13] The tax variables are the factor explaining the better overall fit of the Gordon equations in columns 4, 5, and 6 of Tables 1 and 2, compared with those of Eckstein-Brinner and Perry, whatever labor market or inflation variables are introduced.[14]

Changes in sample period. How dependent are the results of the previous comparison on the sample period chosen? Although equations could be fitted for many sample subperiods, the most interesting comparison is between the period ending in 1970:4 and subperiods that exclude some or all of the high inflation period of the late 1960s. Equations for three alternative sample periods are displayed in Table 3, ending respectively in 1966:4, 1968:4, and 1970:4. The coefficients are most stable on $1/U$ (in the Eckstein-Brinner equation), U^D, U^H, g_{d*}, and the social security tax variables. The least stable coefficients are on the Perry weighted unemployment rate, which becomes insignificant in the period ending 1970:4; on the unemployment dispersion index, which has a low significance level in the Gordon and Perry equations ending in 1966:4; and on the Gordon inflation (g_{d^e}) and the Eckstein-Brinner threshold inflation (g_{d^T}) variables. In addition, the size of the Gordon employee tax variable drops substantially in the period ending 1970:4.

13. To maintain conformity with my 1971 paper, the distributed lag weights and sum of coefficients on the employers' social security tax variable are constrained. As a cross-check, the weight on the constrained series of coefficients was estimated freely; it fell consistently into the range 0.8 to 1.0, as compared with the constraint of 1.0. Also the social security coefficient in Perry's equation consistently falls in the range 0.9 to 1.0 (see Table 3).

14. The only exception to this statement is the one-quarter comparison in Table 2, which indicates that for a given inflation variable Perry's approach for the other variables fits as well as Gordon's. The superiority of the two-quarter Gordon versions suggests that the effect of the personal tax rate, which is included in the Gordon approach but not in Perry's, may be represented more accurately by a two-quarter average than by a simple one-quarter change. This conjecture is supported by a substantial improvement in fit when the two-quarter personal tax change is introduced into the one-quarter equation (not shown).

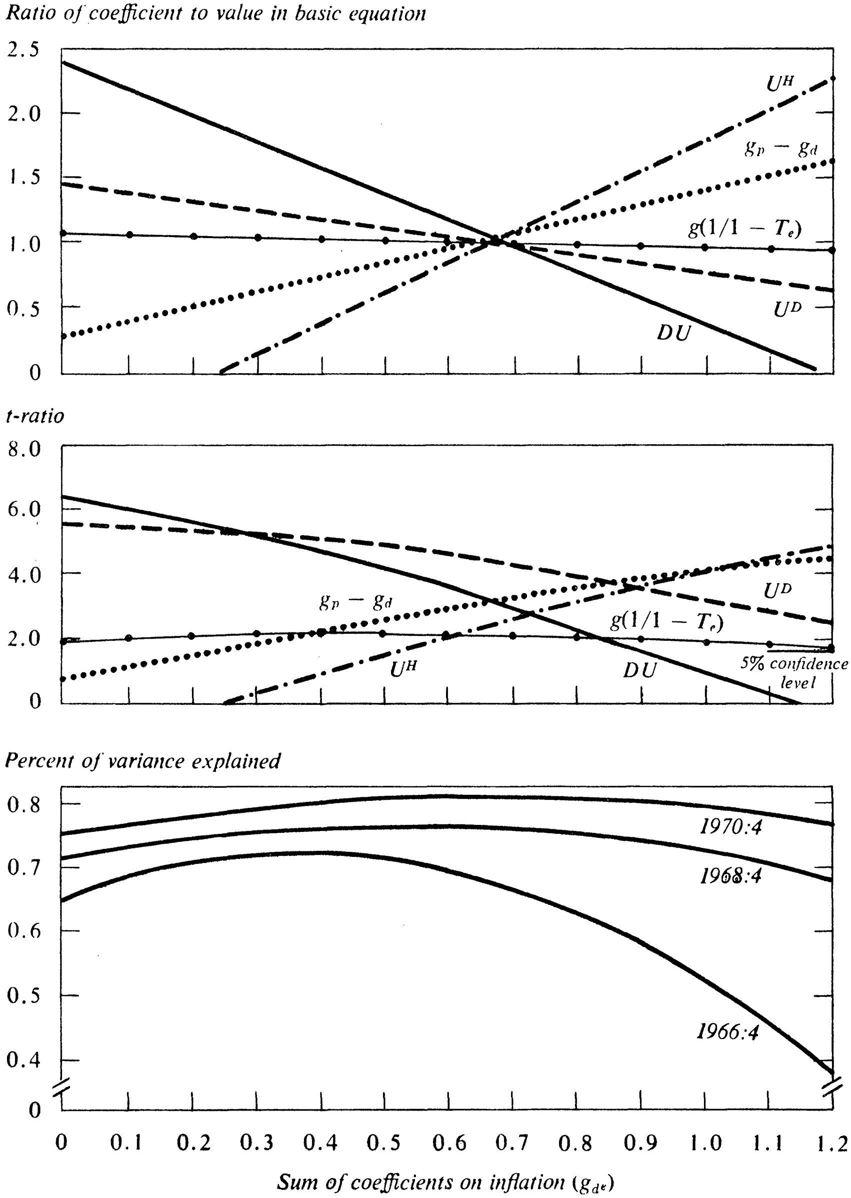
Each equation taken as a whole exhibits a shift in the size of at least one coefficient between 1966:4 and 1970:4 as it attempts to explain the extent of the 1967–70 inflation. The Eckstein-Brinner equation calls upon the threshold inflation variable, which is insignificant in the first two sample periods but suddenly leaps into significance to explain the 1969–70 period. In the one-quarter version for the first two sample periods, in fact, *neither* Eckstein-Brinner inflation variable is significant, and the pace of wage change is explained *entirely* by unemployment, the guidepost dummy, and personal tax changes. Because its statistical significance relies entirely on the addition of the eight 1969–70 observations to the sample period, the threshold inflation variable is equivalent to a dummy variable invoked to explain a particular set of eight observations.

The Gordon equation also explains the acceleration of inflation in 1967–70 by a steady increase in the coefficient on past inflation. The size of the increase is, however, less dramatic than in the case of the Eckstein-Brinner threshold variable, because the Gordon equation explains at least part of the 1967–70 episode as due to factors other than inflation—an increase in unemployment dispersion, a drop in disguised unemployment, and an increase in personal and social security tax rates. The Perry equation explains the 1969–70 period *completely* without reliance on an inflation variable through (1) the increase between 1968:4 and 1970:4 in the coefficient on unemployment dispersion, and (2) the drop in the coefficient on weighted unemployment, which prevents the increase in unemployment in the 1970 recession from influencing the prediction of wage change.

THE TRADEOFF BETWEEN ALTERNATIVE HYPOTHESES

Further evidence on the choice between past inflation and changing labor market structure as the major explanation of the acceleration in wage increases in the late 1960s is supplied by constraining the sum of the coefficients on past inflation at various values rather than estimating it freely. The basic Gordon one-quarter wage equation has been estimated with the coefficient sum constrained at intervals of 0.1 between 0.0 and 1.2, and this experiment has been repeated for the three sample periods examined in Table 3 above. The bottom frame in Figure 1 exhibits the percentage of variance explained for three sample periods and for each alternative constraint on the sum of inflation coefficients. For instance, the line for the 1966:4 sample period indicates that the percentage of variance explained

Figure 1. The Wage Acceleration-Unemployment Dispersion Tradeoff[a]



Source: Derived from basic Gordon equation described in text.
a. Symbols are the same as those identified in Table 3 above.

ranges from 0.65 for a 0.0 constraint to a maximum of 0.72 for the best-fitting 0.4 constraint, back to a minimum of 0.38 for the 1.2 constraint.[15]

The bottom frame in Figure 1 reveals two consistent patterns as the sample period is extended from 1966:4 to 1970:4. First, the percentage of variance explained rises; second, the best-fitting coefficient sum rises from 0.4 in the early period to almost 0.8 in the last period.

Since the true coefficient on past inflation is higher than has been estimated in past published studies with relatively "early" sample periods, other conclusions of those studies may require reexamination if there are important interactions between the effects of inflation and other explanatory variables. The top frame in Figure 1 illustrates the interaction of the alternative constraints on past inflation with the estimated coefficients on the other variables in the basic Gordon wage equation for the 1970:4 sample period. The solid line shows the steady decline in the freely estimated coefficient on the unemployment dispersion index as the constraint on past inflation is raised from 0.0 to 1.2. The parallel decline in the t-ratio on unemployment dispersion is illustrated by the solid line in the middle frame of Figure 1. This pronounced inflation-dispersion tradeoff explains the divergent conclusions of Eckstein-Brinner and Perry on the primary cause of the wage-change acceleration of the late 1960s. Perry used an inflation variable that yielded a low coefficient and thus concluded that unemployment dispersion is important; Eckstein-Brinner used other inflation variables, which yielded high coefficients, and thus concluded that dispersion is not important. I occupied an intermediate position in my previous, 1971 paper and argued that *both* factors are important. The confidence band on the inflation coefficient stretches from 0.4 to 1.0 for the latest sample period, and since this encompasses t-ratios on unemployment dispersion between 4.7 and 0.4, no conclusion can be reached by this approach on the relative importance of either variable.

Coefficients on the other variables in the equation appear to be more stable. All have t-ratios greater than the 5 percent confidence level for values of the inflation coefficient above 0.6.[16] The hours unemployment and product price variables interact positively with inflation and have coefficients that increase as the inflation constraint is raised, whereas the coeffi-

15. The best-fitting equation is displayed in column 4 of Table 3.

16. The t-ratios in Figure 1 for the constrained version of the equation do not correspond to those in Tables 1 to 3 since the dependent variable is constrained and hence its variance is different from what it would be without constraint.

cient on disguised unemployment declines somewhat. While most of the variance of the dispersion variable takes the form of a rising time trend in the 1960s as inflation accelerates, the disguised unemployment coefficient is less collinear with inflation. The most stable coefficient is that on the employee tax variable, which does not appear to interact with inflation at all.

To summarize this rather exhaustive set of comparisons of wage equations, a few conclusions do seem to hold up:

- Perry's emphasis on a shift in labor market structure through the unemployment dispersion variable is confirmed even when the coefficient on past inflation is allowed to vary.
- Disguised unemployment and variations in personal tax rates can explain slow wage increases in the 1962–65 period without reliance on a guidepost dummy, and imply that the moderation in wages previously attributed to the guidepost program would have occurred anyway.
- The product price, personal tax, and social security tax variables are consistently significant for all sample periods.
- Multicollinearity clouds the verdict on the relative roles of hours unemployment, Perry's weighted unemployment rate, and the conventional unemployment rate.
- While there is no evidence that the elasticity of wage change to expected inflation was as large as unity during the sample period, the results raise the possibility of a variable elasticity, as discussed below.

A VARIABLE INFLATION COEFFICIENT

The steady and regular increase during the late 1960s on the coefficient of past inflation in wage equations suggests the possibility of a disequilibrium adjustment process that had not been completed by the end of 1970. The bottom frame of Figure 1 is consistent with the idea, which Eckstein and Brinner introduced in their threshold variable, that the degree of consciousness of and adaptation to inflation depends on its expected future behavior. Many wage agreements and other contracts, which are stated in nominal terms when the expected rate of inflation is low, gradually are converted to real terms through inflation escalators when the expected rate of inflation increases.

Simulations of alternative future economic policies may be too "optimistic" if they assume that the partial adjustment of wage change to inflation evident in most published estimates will persist indefinitely. An alternative hypothesis is that the elasticity of wage change to the expected rate of inflation is a positive function of the expected rate of inflation itself:

(1) $$g_{w_t} = aX_t + b(g_{d_t^e})g_{d_t^e},$$

where aX_t represents the other variables multiplied by their respective coefficients. The hypothesis states that, starting from an initial position of low inflation and high unemployment, the elasticity of wage change (b) will be low, but an increase in labor market pressure will raise the rate of wage change not only directly, but also indirectly as higher wage change causes inflation, which increases the expected rate of inflation (g_{d^e}) and, in turn, raises the elasticity of wage change to expected inflation. The process produces an accelerating inflation whenever the net contribution of the other variables (aX) exceeds a critical level.

While numerous specifications of the variable coefficient hypothesis are possible, the data cannot distinguish among several plausible alternatives, and the following simple form was chosen for estimation and simulation pending further research:

(2) $$\begin{aligned} b_t &= cg_{d_t^e};\ 0 \leqslant g_{d^e} < 1/c \\ &= 1.0;\ g_{d^e} \geq 1/c. \end{aligned}$$

Equation (2) states that the variable response coefficient b varies linearly between 0.0 and 1.0 but is constrained not to move outside that range.[17] The estimates and simulations of this particular version of the variable coefficient hypothesis should be viewed as extremely tentative, both because more complex curvilinear relationships seem preferable in principle to (2), and because the distributed lag weights used to estimate $g_{d_t^e}$ from past rates of inflation in (1) and (2) are *assumed* to be identical to those estimated in the fixed coefficients equation above (Table 3, column 6). Further research is in progress to allow the distributed lag weights and the variable b coefficient to be estimated simultaneously.

When (2) is substituted into (1), the wage equation is identical to those discussed above, with the value of g_{d^e} replaced by its square. For the "standard" sample period the results of the two-quarter and one-quarter versions of my basic equation are as follows:[18]

17. In principle, the constraint refers to the absolute value of $g_{d_t^e}$, in order to handle deflation, but none of the experimental simulations below results in a decline of the price level.

18. The equation is identical in all details to that in Table 3, column 6, except that g_{d^e} is replaced by $(g_{d^e})^2$. The numbers in parentheses are t-statistics.

Version	*DU*	U^D	U^H	$g_p - g_d$	$g_{(1/1-T_e)}$	$(g_{d^e})^2$	*Standard error of the estimate*
Two-quarter	0.0400	−0.577	−0.289	0.578	0.219	28.5	0.00212
	(3.19)	(−5.55)	(−1.85)	(3.73)	(5.36)	(6.95)	
One-quarter	0.0474	−0.579	−0.323	0.603	0.139	52.1	0.00181
	(2.60)	(−3.65)	(−1.44)	(2.44)	(2.53)	(4.22)	

In comparison with the same equation fitted with a fixed b coefficient, displayed in Table 3, column 6, the fit of the variable coefficient version is slightly but not significantly better. Coefficients on other variables are very similar. An interesting feature of the variable coefficient version is the increased coefficient and t-ratio of unemployment dispersion, indicating that *both* an increased reaction to past inflation *and* changing labor market structure contributed to the inflation of the late 1960s. The coefficient c on the squared inflation term can be interpreted from (2). The elasticity of wage change to expected inflation becomes unity when the expected inflation rate equals $1/c$, estimated in the two-quarter equation as $1/28.5$ (a two-quarter percentage rate of 3.51 and annual rate of 7.02), and in the one-quarter equation as $1/52.1$ (a one-quarter rate of 1.92 and annual rate of 7.67).

While these results must be viewed as tentative and might be sensitive to alternative specifications of the variable coefficient hypothesis, their implications are extremely important. The variable coefficient approach has the advantage that it reconciles (1) the partial adjustment observed in most postwar econometric studies of wage behavior; (2) the steady increase in the size of the partial adjustment coefficient as the sample period is extended into the late 1960s; (3) the accelerationist hypothesis that the rate of inflation will steadily accelerate if the unemployment rate is permanently maintained below a certain "natural" rate; and (4) the relative flatness of the Phillips curve to the right of the natural rate evident in the absence of any apparent tendency to accelerating *deflation* during the last half of the Great Depression. If this hypothesis is correct, policy makers may have to dampen the pace of the current economic recovery or maintain controls permanently to prevent inflation from accelerating, as illustrated below in the simulations of hypothetical future growth paths.

STABILITY OF COEFFICIENTS IN PRICE EQUATION

In comparison with the complexity and controversy surrounding the choice of the best explanation of wage change, the equation that relates prices to wages is a tranquil oasis. As illustrated in Table 4, the equation developed in my 1971 paper retains relatively stable coefficients for several alternative sample periods. The sum of the coefficients on the recent change in standard unit labor cost remains insignificantly different from unity for each sample period, and the equation thus predicts a constant distribution of income in long-run simulations. The equation indirectly explains variations in the share of profits in income by directly explaining changes in the ratio of price to unit labor cost, a ratio that is highly correlated by definition with the share of profits in total income.

Simulation Experiments

The simulation experiments are based on a two-equation price-wage model, fitted to the period ending in 1970:4, with the price and wage equations specified exactly as in my 1971 paper (see Table 4, column 3, above, for price equation; Table 3, column 6, for wage equation). Since the speci-

Table 4. Estimated Price Equations for Alternative Sample Periods Beginning with 1954:2[a]

	Ending date of sample period		
Variable or summary statistic	*1966:4*	*1968:4*	*1970:4*
Variable			
Standard unit labor cost ($g_{w/q'}$)	1.110[b]	0.889[b]	0.964[b]
	(4.73)	(4.68)	(6.42)
Change in ratio of actual to potential productivity ($g_{q/q'}$)	−0.182[b]	−0.221[b]	−0.238[b]
	(−1.41)	(−1.74)	(−1.92)
Change in ratio of compensation to wage rate index ($g_{CMH/w}$)	0.671	0.533	0.537
	(3.50)	(2.86)	(2.88)
Change in ratio of unfilled orders to capacity ($g_{UF/K}$)	0.021	0.024	0.023
	(2.83)	(3.17)	(2.96)
Summary statistic			
Standard error	0.00197	0.00203	0.00212
Durbin-Watson	2.31	2.40	2.47

Source: Derived from equation developed in "Inflation in Recession and Recovery." See appendix for sources of the basic data.

a. The dependent variable is the one-quarter change in the fixed-weight nonfarm private deflator.

b. Coefficient is sum of a series of distributed lag coefficients.

fication of my previous paper is reproduced, simulations can test the performance of the model on data available after its construction. Simulations were also run with both the basic fixed coefficient version and the variable coefficient version of the wage equation.

Figure 2 displays a full dynamic simulation of the interaction of the fixed coefficient wage and price equations in the 1954–71 period. All simulations are calculated for one-quarter changes, but for the sake of clarity, four-quarter overlapping changes are exhibited, except for the two post-sample quarters of 1971, where one-quarter changes are displayed.[19] Employing information on the history of wages and prices only through 1953:4, and the values of all exogenous variables in the wage and price equations, but generating its own estimates of wages and expected prices, the model is able to track the inflation rate very closely; the only exceptions are a moderate overprediction for the 1954 recession, for the 1959–60 interval, and for the period of accelerating inflation during 1968 and 1969. The standard error of the predicted price series in the full dynamic simulation (0.002113) is actually *lower* than the standard error in the fitted price equation based on the true exogenous wage (0.002116). Errors in the wage and price equations therefore appear to be offsetting and do not cumulate during the sample period. In the two post-sample quarters of 1971, the model's prediction of an average annual rate of inflation of 3.91 percent is considerably lower than the actual average rate of 4.65 percent, although a similar simulation based on the variable coefficient wage equation comes somewhat closer to the mark with a prediction of 4.25 percent.[20]

An interesting feature of the simulation is its ability to track the ratio of price to unit labor cost (PULC), which is a good proxy for the ratio of profits to sales. The close tracking of this aspect of the profits squeeze of the 1968–70 period lends credibility to the estimates of the effects on profits of the controls program discussed below.

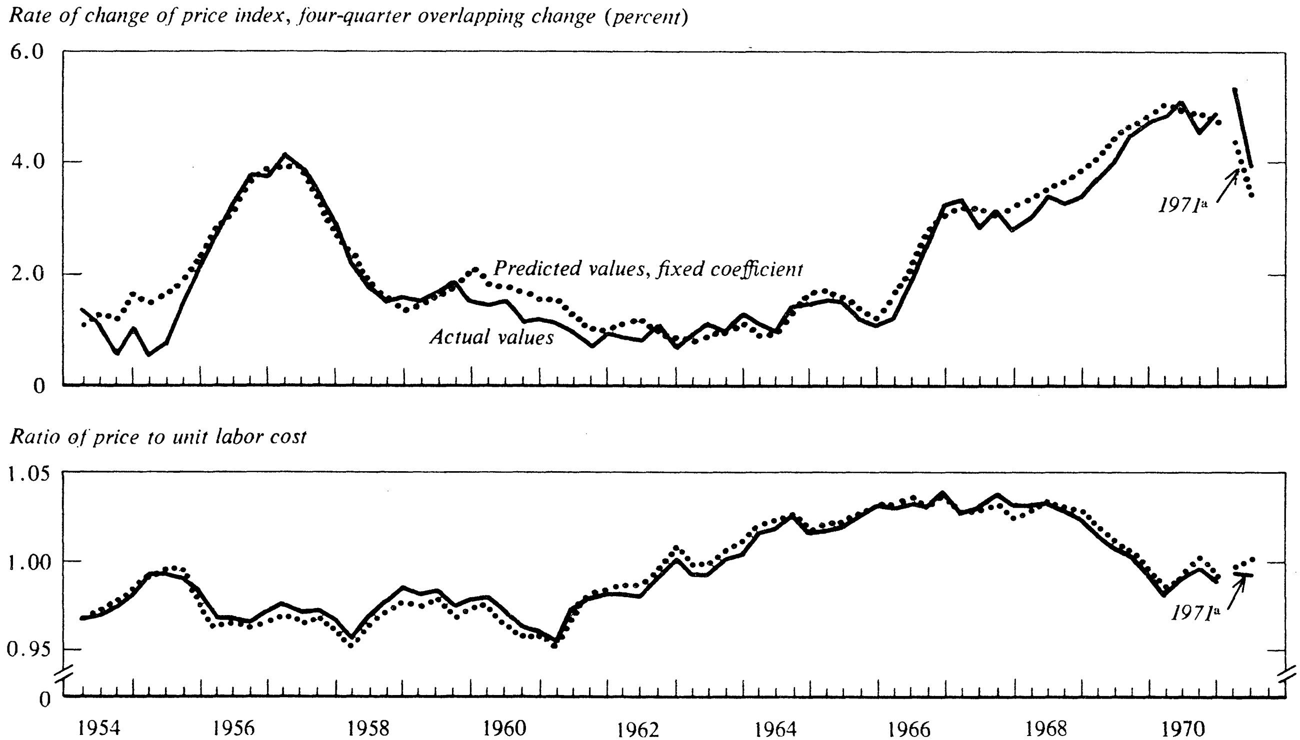
THE WAGE-PRICE CONTROL PROGRAM

The basic purpose of this paper is a comparison of the actual performance of wages and prices during the control period with the performance

19. For the wage equation the coefficients in the simulations are an *average* of the coefficients for the one-quarter and two-quarter versions displayed in Table 3, column 6.

20. For the final quarter (1971:2) before the freeze "turned out the lights," the actual rate was 3.95 percent, as compared with a variable coefficient prediction of 3.85 and fixed coefficient prediction of 3.50 based on the full 1954–71 simulations.

Figure 2. Results of Full Dynamic Simulation of Wage-Price Model, 1954:1–1971:2



Source: Derived from price equation in Table 4, column 3, and wage equation in Table 3, column 6.
a. One-quarter change.

predicted by the model in simulations for 1971:3 through 1972:2 for "similar economic conditions." This similarity can be specified in terms of either real or nominal variables, but the former are more natural because they drive the model. Since price and wage changes have been erratic during the first year of controls, with an initial freeze and then a partial rebound, Table 5 contains comparisons only of the average performance over the control period, with a three-quarter interval chosen to maintain comparability with the Bosworth paper in this volume. All variables other than prices, expected prices, and wages are set at their actual values in the simulation, which begins in 1971:3 and "inherits" the actual rates of price change before that quarter.

The first line of Table 5 compares the actual rate of wage change with the rate the model says would have obtained given actual (controlled) prices. The difference between the actual and simulated value (−0.48 percent) represents the "partial derivative" of wage change with respect to actions of the Pay Board. This comparison understates the effect of the Pay Board on newly negotiated agreements, since the actual change in wages exceeded the board guidelines due to deferred increases from previously negotiated contracts. A similar calculation made next year for a longer control interval should show a greater effect on wage rates.

The second line of Table 5 makes a similar comparison of the actual rate of price change with the prediction of the model given actual (controlled) wages. The impact of the Price Commission (−1.47 percent) has been substantially greater than that of the Pay Board, perhaps partly because deferred increases are less important for prices than wages. Line 3b calculates the total effect of the control program by comparing actual price change with the prediction for a no-controls economy generated by a full dynamic simulation of the model with wages and prices both endogenous. The estimated difference of −1.85 percent is slightly less than the sum of the separate effects of the Pay Board and Price Commission (−1.95 percent) due to their interaction.[21]

As George Perry has previously argued, "cost absorption" does not operate symmetrically for business and labor; a control program leaves the distribution of income unaffected if it moderates the response of wages to past price change while allowing prices *fully* to reflect current wage change.[22]

21. The equivalent figure with the variable coefficient wage equation is −2.01 percent rather than −1.85 percent.

22. George L. Perry, "Controls and Income Shares," *Brookings Papers on Economic Activity* (1:1972), pp. 191–94.

Table 5. Comparison of Actual and Predicted Performance of Selected Indicators during the Wage-Price Control Program, through Second Quarter 1972

Indicator	*Actual*	*Predicted by model*	*Difference*
	Annual percentage rates of change		
1. Control by Pay Board: Wages, with prices exogenous	6.18	6.66	−0.48
2. Control by Price Commission: Prices, with wages exogenous	2.14	3.61	−1.47
3. Total control program, wages and prices interacting			
a. Wages	6.18	6.86	−0.68
b. Prices	2.14	3.99	−1.85
	Billions of dollars or percent		
4. Nonfarm private business			
a. Change in ratio of price to unit labor cost	0.56[b]	2.10[b]	−1.54
b. Gross product originating	$927.8	$942.1[c]	$−14.3
5. Nonfinancial corporations			
a. Gross product originating	$600.7	$610.0[c]	$−9.3
b. Less: indirect business taxes	−57.4	−58.3[c]	−0.9
c. Less: all other costs and interest	−479.0	−479.0	0.0
d. Equals: profits before tax[d]	64.2	72.7	−8.5
e. Ratio of profits before tax to gross product originating	0.107	0.119	−0.012

Sources: Actual figures for gross product originating in nonfarm private business and for nonfinancial corporations are from *Survey of Current Business*, Vol. 52 (August 1972), Tables 3, 9, pp. 11, 13. Predicted figures from simulation of wage-price model for the four-quarter interval 1971:3–1972:2. Wage and price changes are from the sources shown in the appendix.

a. Total of three quarterly rates of change (1971:4, 1972:1, and 1972:2), converted to annual rate.

b. For consistency both the actual price deflator and productivity index are based on actual 1972:2 weights, whereas fixed weights were used in calculating lines 2 and 3b (see appendix, explanation for symbol p); cumulated over four quarters from 1971:2 to 1972:2.

c. Actual figure is multiplied by 1.0154, the estimated increase in the ratio of price to unit labor cost if controls had not been in effect.

d. Includes inventory valuation adjustment.

Since the Price Commission has pushed prices below the level they would have attained under normal price behavior (Table 5, line 2), the major distributional effect of the control program has been to benefit labor at the expense of business. As indicated on line 4a of Table 5, the ratio of price to unit labor cost in 1972:2 was 1.54 percent below the level that would have been expected on the basis of actual productivity behavior and past price-setting relationships. The cyclical recovery of the ratio of price to unit labor cost has been only one-quarter the "normal" (that is, predicted) rate during the four quarters ending 1972:2, and this implies that the controls program has shifted the distribution of income from nonlabor to labor income. Line 4b of Table 5 indicates that with wage rates fixed at their actual value, gross nonfarm private business product would have been $14.3 billion higher without the controls. Section 5 of the table estimates that about 60 percent of this difference, $8.5 billion, directly reduced nonfinancial corporate profits before tax. The remainder consisted of a sizable reduction in nonfarm private nonlabor income outside of nonfinancial corporations and a small reduction in indirect business taxes. Since simulations of the wage-price model into the future (as described below) predict a further increase in the uncontrolled PULC ratio during the current economic expansion, the controls are likely to have a redistributional effect beyond that which has already occurred.[23]

Effect of controls on real output and unemployment. The simulations with which the performance of controls is compared in Table 5 implicitly assume a monetary and fiscal policy sufficiently accommodating to have allowed nominal GNP to grow faster in the absence of controls by the estimated effect of the controls (1.85 percent, from Table 5, line 3b), in order to "pay for" both exogenous real output growth and faster inflation. If, on the other hand, nominal income growth had been held at its actual level, a simulation indicates that inflation would have been virtually the same as reported in Table 5 above, but real output would have been lower by roughly the effect of the controls. In the case of the fixed coefficients version of the model, exogenous nominal GNP growth causes a 3.93 average annual rate of inflation over the three quarters in place of 3.99 with exogenous real output; 7.15 percent real output growth in place of 8.94; and an unemployment rate in 1972:2 of 6.19 in place of 5.77. Thus the controls have provided a boost to real output growth that I and several other economists had argued earlier could have been provided by more expansive monetary policy in 1970 and 1971.[24]

23. For instance in Path A in Figure 3 below, the uncontrolled PULC ratio rises by 1.85 percent from 1972:2 to 1973:4. If the controls were to prevent any increase in PULC beyond the actual 1972:2 level, nonfarm private nonlabor income would be reduced by a further $12.5 billion, or $26.8 billion when combined with the reduction that has already occurred.

24. The closeness of the inflation rates predicted with nominal income and real output exogenous reflects the short-run horizontal flatness of the Phillips curve in the wage-price model. See the discussion of the short-run tradeoff in my "Inflation in Recession and Recovery," pp. 136–40.

THE LONG-RUN UNEMPLOYMENT-INFLATION TRADEOFF

The wage-price model cannot predict the future of the control program but only the future of an uncontrolled economy, with which actual developments can be compared as they occur. At the present time policy makers must make crucial decisions about the degree of restraint, if any, that must be applied to prevent the present economic recovery from proceeding too far or too fast. If the eventual elimination of controls is planned, econometric forecasts of the behavior of a no-controls economy are of extreme interest.

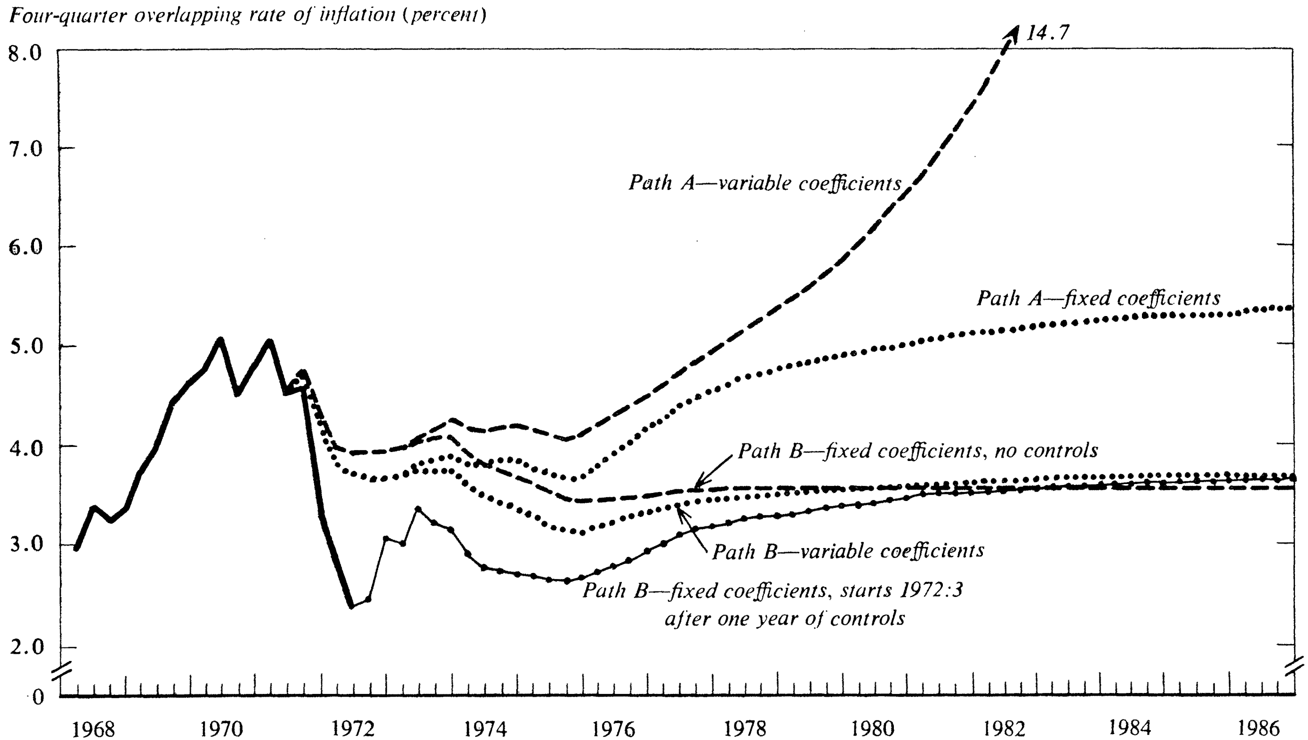
Both the fixed coefficient and variable coefficient versions of the model have been simulated for the period 1971:3 through 1986:4 on the assumption of actual growth in real output between 1971:3 and 1972:2; alternative rates of real growth between 1972:3 and 1973:4; and steady growth thereafter that maintains whatever "gap" between real actual and potential output is reached in 1973:4.[25] Figure 3 compares the no-controls forecasts of the two versions of the model for two paths of economic recovery. Path A assumes an annual rate of output growth of 6.7 percent for the six quarters between 1972:2 and 1973:4, whereas Path B assumes a slower 5.4 percent rate for that period. Beginning in 1974:1 real output grows permanently at its potential rate. The unemployment rate falls along both paths and reaches a permanent level of 4.2 percent along Path A and 4.8 percent along Path B.[26] Under the fixed coefficient version of the model, inflation

25. The procedures that translate the exogenous rate of output growth into the explanatory variables in the wage and price equations are exactly the same as those outlined in Appendix B of "Inflation in Recession and Recovery" with equations reestimated on revised data through 1972:2. All tax rates are held constant in the future (that is, beginning in 1972:3), except for the social security tax increase scheduled for 1973:1, and the personal tax rate is constrained to be unchanged in the first half of 1972 to eliminate the temporary effect of overwithholding on the effective tax rate (an assumption also made in Table 5).

26. If the growth of potential output is faster than the assumed annual rate of 4.3 percent in the 1971–73 period, real output growth can be greater by a corresponding amount and still lead to the stated unemployment rates.

The only differences between these simulations and those in my 1971 paper are slight changes in the coefficients resulting from the reestimation on revised data, as reported above in Tables 3 and 4, and the reestimation of the price equation (for the purpose of the future simulations only) with the sum of coefficients on standard unit labor cost constrained to equal 1.0 (rather than the estimated value of 0.964), so that the distribution of income remains absolutely fixed in the long run. The latter change makes the long-run Phillips curve slightly steeper than that in the 1971 paper.

Figure 3. Alternative Future Paths of Inflation Using Equations with Variable and Fixed Coefficients, 1972–86, and Actual, 1968–72[a]



Source: Wage-price model described in the text.

a. For 1972:2–1973:4, Path A assumes an annual rate of output growth of 6.7 percent and Path B assumes a rate of 5.4 percent; beyond that, real output grows at its potential rate. Inflation is measured by the fixed-weight nonfarm private deflator.

eventually stabilizes at a 5.3 percent annual rate on Path A and 3.6 percent rate on Path B, both rates above the administration target of 2.5 percent inflation.[27]

While this set of predictions may seem gloomy to administration policy makers, it takes on a rosily optimistic glow when set alongside the simulations of the model using the variable coefficient wage equation. In this version any attempt to reduce the rate of unemployment below its natural rate causes inflation to increase, which in turn raises the variable inflation coefficient in the wage equation and causes inflation to accelerate further. Along Path A the unemployment rate is pushed far below the natural rate and by 1986 the annual inflation rate has reached the Brazilian range (14.7 percent) and is still accelerating. Since the natural rate of unemployment in the model is 4.8 percent, Path B is sufficiently conservative to maintain a steady inflation of 3.5 percent. If policy makers attempt to aim for the natural rate and miss slightly, the consequences will not be disastrous. A slightly faster rate of output growth that achieves a permanent 4.55 percent unemployment rate causes an inflation rate that accelerates very slowly, reaching 4.0 percent in 1978 and "only" 5.0 percent in 1985.[28]

These simulations all make the counterfactual assumption that controls have not been in effect in 1971–72. If it was assumed alternatively that controls had been in effect but had been eliminated on July 1, 1972, and if workers were to base their inflationary expectations of the future on a weighted average of past price change, then the low rate of inflation during the control period would moderate postcontrol wage demands. The lowest dotted line in Figure 3 assumes the Path B pattern of output growth and the fixed coefficient version of the model but differs from the dotted line directly above it in a starting date of 1972:3 instead of 1971:3. The intervening year of controls dampens the inflation rate for a long period, with a maximum difference of about 0.7 percent during 1972–73 and a difference of 0.1 percent even in 1986. This result may tempt policy makers to experiment with an "on-off" policy that combines short periods of controls with long uncontrolled intervals in between. The premise of this approach, however, requires that workers continue to base their postcontrol inflation predictions

27. All statements about the rate of inflation refer to the fixed-weight nonfarm private deflator and imply somewhat higher numerical values for the rate of inflation of the GNP deflator.

28. The social security tax increase of 1973:1 explains the short-run increase in inflation in all simulations during 1973.

on the controlled rather than the uncontrolled period. Just as plausible is a post-controls rebound of inflation as business tries to recover its *actual* profit loss and as labor tries to recover its *imaginary* wage shortfall.[29]

Summary and Conclusions

This paper takes a detailed second look at the wage-price model that I published in the first part of 1971 and confirms most of its conclusions. The Phillips tradeoff curve shifted in an unfavorable direction in the 1960s: A given aggregate unemployment rate is now accompanied by a greater divergence than in the 1950s between the unemployment rates of prime-age male workers and those of women and teenagers, and thus signifies a greater excess demand for labor. Perry's unemployment dispersion index measures the shifting *structure* of the labor market, and the divergence between "total" and official unemployment seems to represent the *level* of labor demand better than the official unemployment rate by itself. In the long run the rate of inflation is determined primarily by excess labor demand, but the slow adjustment process in the price and wage equations makes the inheritance of recent inflation an important factor during the "short run" of one to three years. The other major factors contributing to the short-run pattern of inflation are (1) a deviation of productivity from its trend value, which tends to occur whenever the rate of output growth varies, and (2) changes in personal and social security tax rates. The response to tax changes has received insufficient attention in previous studies; the average annual rate of inflation was 0.45 percent faster in 1966–69 than it would have been if 1965 tax rates had remained in effect.[30]

The only major conclusion of the 1971 paper that appears questionable is the assumption of a fixed coefficient on expected inflation in the wage equation. An alternative equation is specified in which this coefficient is estimated to be a linear function of expected inflation and eventually to reach unity when the inflation rate reaches 7 percent. The variable coefficient on expected inflation is similar in spirit to the "threshold inflation"

29. The post-controls wage explosion hypothesis is supported by the current trend to shorter contracts noted by Bosworth.

30. In the four years 1966–69 tax rate changes raised the rate of inflation by the following annual rates, respectively: 0.60, 0.30, 0.36, and 0.53. This calculation is based on a comparison of two dynamic simulations of the model beginning in 1966:1, assuming (1) actual tax rate changes and (2) no tax rate changes.

variable of Eckstein and Brinner, but their other major conclusion—that the structure of labor markets has remained unchanged since 1955—is not supported.

Several methodological points emerge from the sensitivity tests. First, the positive serial correlation that has plagued previous wage studies is not present when the dependent variable is expressed as a one-quarter change, instead of a two- or four-quarter change. In most cases coefficients are quite stable when otherwise similar one-quarter and two-quarter versions of wage equations are fitted, but *t*-ratios are quite different and, as expected in the presence of positive serial correlation, exaggerate the statistical significance of variables in the two- and four-quarter versions. Another important finding is that correlations among independent variables are sufficiently high to require considerable care in comparisons of alternative models; one set of labor market variables may perform better with a particular set of inflation or tax variables but not with some other set.

Since the final version of the wage-price model is the same as that in my 1971 paper, the policy conclusions are the same. A recovery of real output sufficient to bring the unemployment rate down to the 4 percent region (the actual 1956 average rate) will cause the rate of inflation to rise to a pace faster than that in 1969–70. Achievement of the administration's 2.5 percent inflation target without controls requires that the unemployment rate be maintained forever at about 5.2 percent. If, however, the variable coefficients version of the model is closer to the "truth," then the policy implications are considerably more gloomy: Inflation eventually will accelerate at any unemployment rate below 4.8 percent.

The model indicates that the wage-price control program has had a very marked effect in moderating the rate of inflation during its first year, by an amount estimated to be 1.85 percent. A corollary of this achievement is that the controls program is largely responsible for the rapid pace of the economic recovery in 1971–72; the wage-price control program has provided the boost to real demand that the Federal Reserve Board was unwilling to provide in the six-quarter interval between the end of restrictive monetary policy in February 1970 and the imposition of the freeze in August 1971. Without the controls program, unemployment would have *risen* to 6.2 percent by 1972:2. Most of this achievement should be credited to the Price Commission, which has caused a substantial redistribution of income from business to labor and *already* has been responsible for a reduction in before-tax profits by $8 billion below the no-controls level in 1972:2, with more to come in the next few quarters as the profit guidelines are breached by a growing number of firms. The achievement of a reduction in inflation is strictly temporary if the controls are lifted soon and if they have no lasting heritage of damping wage demands. Thus it is hard to see that any "success" has been achieved by the temporary control program, since a passing reduction in inflation hardly seems worth the effort that businessmen, lawyers, and government officials have invested in the program. Once again society must face the dilemma that it cannot have full employment and even a 4 percent rate of inflation, much less a 2.5 percent rate, unless (1) controls are maintained permanently, or (2) manpower and social programs succeed in reversing the unfavorable shift in the structure of labor markets by equipping women, teenagers, and disadvantaged workers to fill job vacancies.

I strongly favor the second course of action.

APPENDIX

Symbols and Sources of Data Used in Regressions

THIS APPENDIX PROVIDES a complete list of the symbols used in the regressions; the definition of the variables used; and a key to the abbreviations used to identify the sources.

Symbols and Sources

Symbol	*Name of variable*	*Source*
c	Consumer price index, all items	BS/SCB
CMH	Compensation per manhour, nonfarm private economy	PWP
d	Personal consumption deflator	BS/SCB

Symbol	*Name of variable*	*Source*
d^*	Eckstein-Brinner expected inflation variable with imposed weights: $g_{d_t^*} = 0.4\, g_{d_{t-1}} + 0.3\, g_{d_{t-2}} + 0.2\, g_{d_{t-3}} + 0.1\, g_{d_{t-4}}$	
d^e	Expected inflation variable with weights estimated by polynomial distributed lag technique, with individual coefficients constrained to lie along a fourth-degree polynomial with both a level and a first derivative equal to zero in the most distant (twelfth) period	. . .
d^T	Eckstein-Brinner threshold inflation variable: $= 0.0$ if $[(d_{t-1} - d_{t-9})/d_{t-5}] < 0.05$; otherwise $= \frac{1}{2}\left[\frac{d_{t-1} - d_{t-9}}{d_{t-5}} - 0.05\right]$	
DU	Unemployment dispersion index	GLP
D_G	Guidepost dummy	RJG
g	Rate of growth of indicated variable	. . .
J_F	Share of civilian labor force composed of females and males under age 20	MLR
L	Subscript denoting sum of a series of distributed lag coefficients	. . .
p	Nonfarm private deflator:	
	before 1971:3 (1963 weights)	RJG
	1971:3 through 1972:2 (1967 weights)	SCB-2
q	Nonfarm private output per manhour (productivity)	PWP
q'	Potential (standard) value of q	RJG
T_e	T_s plus T_p; form used in Gordon regressions: $g_{(1/(1-T_e))}$	. . .
T_p	Federal plus state and local personal tax and nontax payments divided by personal income; form used in Eckstein-Brinner regressions: $10\, g_{Z_t} - 4.5\, g_{Z_{t-1}} - 3.0\, g_{Z_{t-2}} - 1.5\, g_{Z_{t-3}}$, where $Z = 1/1 - T_p$	SCB-1

Symbol	*Name of variable*	*Source*
T_s	One-half of federal plus state and local social security tax revenue divided by total wage and salary payments; form used in Gordon regressions: $gz_t - 0.35\, gz_{t-1} - 0.25\, gz_{t-2} - 0.15\, gz_{t-3} - 0.05\, gz_{t-4}$, where $Z = 1/1 - T_s$; form used in Perry regressions: gz_t alone.	SCB-1
U	Official unemployment rate	BS/SCB
U^*	Weighted unemployment rate	GLP
U^D	Disguised unemployment rate	RJG
UF/K	Ratio of unfilled orders to shipments in durable manufacturing multiplied by Federal Reserve manufacturing utilization index, detrended	BCD, series 850 and 852
U^H	Unemployment rate of hours	RJG
w	Hourly earnings index for production workers in the nonfarm private economy, adjusted for overtime and changes in interindustry output mix:	
	1954–63	RJG
	1964–72	MLR
	The published index is adjusted for fringe benefits as explained in RJG.	
aX	Other variables in the equation multiplied by their respective coefficients	. . .

Key to Sources

BCD	*Business Conditions Digest*, various issues.
BS/SCB	U.S. Office of Business Economics, *Business Statistics, 1971*, for data to 1970:4, and various issues of the *Survey of Current Business* for subsequent data.
GLP	Data provided by George L. Perry, as used in his paper, "Changing Labor Markets and Inflation," *Brookings Papers on Economic Activity* (3:1970), pp. 411–41.
MLR	*Monthly Labor Review*, various issues.
PWP	Bureau of Labor Statistics quarterly news release, "Productivity, Wages, and Prices."
RJG	Appendix C of Robert J. Gordon, "Inflation in Recession and Recovery," *Brookings Papers on Economic Activity* (1:1971), pp. 153–58.

SCB-1 *The National Income and Product Accounts of the United States, 1929–1965: Statistical Tables*, A Supplement to the *Survey of Current Business* (1966), for data to 1963:4, and various issues of the *Survey of Current Business* for subsequent data.

SCB-2 Fixed-weight private deflator from "Alternative Measures of Price Change for GNP, 1969–72," *Survey of Current Business*, Vol. 52 (August 1972), pp. 33–35. Fixed-weight nonfarm private deflator derived by adding to the quarterly rate of growth of the fixed-weight private deflator the difference between the quarterly rates of growth of the nonfarm private and private implicit deflators from the same issue, Table 18, p. 14.