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A CONSISTENT CHARACTERIZATION OF A NEAR-CENTURY OF PRICE BEHAVIOR

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ABSTRACT

This paper develops a single econometric equation that can explain most of the variation in the aggregate U.S. rate of inflation during the period between 1892 and 1978. Unlike previous studies that have omitted the Depression and World War II years, the present equation can explain the 1929-1945 period as well as other years. The equation is derived from a simple aggregate supply equation and makes the rate of price change depend on the rate of change of nominal GNP, the level of detrended real GNP, and on expected price change; the latter, in turn, depends on lagged values of price change and nominal GNP change. Four additional factors are identified that have had a significant impact on the price-setting process: the National Recovery Act (1933-1936), World War II price controls (1943-1947), the Nixon-era controls (1972-1975), and the relative prices of food and energy.

The most surprising result is that the contemporaneous elasticity of price change to nominal GNP change has been roughly one-third for almost a century, both in a single equation fitted to the whole period and in equations fitted to three sub-periods. The formation of price expectations changed completely after 1950 from regressive expectations appropriate under a gold standard to extrapolative inertia-dominated expectations appropriate under a fiat money standard and postwar long-period wage contracts. The results also imply that restrictive aggregate demand policy would have a much greater immediate impact in slowing inflation than implied by other econometric work on postwar data.

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A CONSISTENT CHARACTERIZATION OF A NEAR-CENTURY OF PRICE BEHAVIOR

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This paper demonstrates that the commonly used "Expectational Phillips Curve" (EPC) framework cannot explain the last 87 years of aggregate price behavior in the United States. The EPC explanation, which in its most general form relates price change to expected inflation and the *level* of detrended output, obscures the fact that price change has been much more closely related to the contemporaneous *rate of change* of detrended output. Over the near-century of annual data studied here, a change in output has shown a remarkably consistent tendency to be associated in annual data with a simultaneous change in the price level of about one-half as much. Stated another way, nominal GNP changes have been divided consistently, with two-thirds taking the form of output change and the remaining one-third the form of price change. This finding applies not only over the entire 1890-1978 sample period, but also over three sub-periods (1890-1929, 1929-1953, and 1953-1978).

The dominance of the output "rate-of-change" (ROC) explanation of price change over the "level" EPC explanation is not a new result but rather confirms previous findings by Allan Meltzer, myself, and others.[1] Nevertheless much recent literature on both postwar and historical price behavior has shown no awareness of the importance of the ROC phenomenon and has continued to specify equations based on the unadorned EPC.[2]

A second theme of this paper is that almost a century of price behavior can be explained with a single equation, in contrast to other historical studies that find it necessary to exclude years of depression, war, or both. While the single equation estimated here has a coefficient on the "ROC effect" that is extremely stable over the entire sample period, it verifies a marked shift after the Korean war in the formation of expectations regarding the price level and its rate of change, This shift reinforces the emphasis placed by Meltzer and Benjamin Klein on the contrast between the regressive expectations appropriate under a gold standard and the extrapolative expectations used to predict inflation under the postwar fiat money standard. And although this shift is consistent in overall timing with the research of Phillip Cagan and Jeffrey Sachs, its representation differs here, because while the formation of inflation expectations has shifted in the postwar years, the cyclical impact of detrended output changes has not.

I. SPECIFYING A REDUCED-FORM PRICE EQUATION

Because the length of this paper is so tightly restricted, we concentrate on results for annual price data[3]. Several recent papers take as their point of departure a standard EPC framework that makes the inflation rate (p_t) depend on the expected inflation rate (p_t^e) and the "gap" between actual and "natural" output (or unemployment). In the following discussion it is convenient to designate logs of levels of variables by upper-case letters; rates of change by lower-case letters; and the "gap" variable as the log of the ratio of actual real GNP to "natural" real GNP ($\hat{Q} = Q - Q^*$). Thus, the EPC hypothesis becomes:

$$(1) \qquad p_t = \alpha_0 + \alpha_1 \hat{Q}_t + \alpha_2 p_t^e + \eta_t, \qquad \alpha_1 > 0,$$

where η_t is an error term. We would expect $\alpha_2 = 1$ if the "natural rate hypothesis" holds and if expected inflation is measured accurately, and

$\alpha_0 = 0$ if the log of natural output (Q^*) is measured accurately.

We shall find, however, that (1) is too restrictive a hypothesis to allow adequate characterization of secular changes in U. S. price behavior. Instead a more general approach can be developed if we start with a simple aggregate supply function that allows the difference between the actual and expected price *level* to respond positively to the output ratio $(\hat{Q})$:

$$(2) \qquad P_t = \beta\hat{Q}_t + P_t^e + \varepsilon_t, \qquad \beta > 0.$$

The positive slope of the aggregate supply curve can be explained in the traditional textbook fashion as resulting from the diminishing marginal productivity and increasing supply schedules of factor inputs, including both materials and labor. It is also consistent with the strong effect of output-ratio variables on the price of inelastically-supplied primary products and on oligopolistic price markups found in recent studies of postwar data.[4]

A general specification of the formation of expectations allows agents to distinguish between expected inflation (p_t^e) and shifts in the expected price level (P_t^e):

$$(3) \qquad P_t^e = p_t^e + \lambda P_{t-1} + (1-\lambda)P_{t-1}^e. \qquad 0 < \lambda < 1$$

The expected rate of inflation in turn can be specified to depend on past values of actual and expected inflation and any other relevant information, e.g., the past rates of change of nominal or real GNP, the money supply, wages, or unemployment.

An appealing feature of (3) is its applicability to price series with differing patterns of serial correlation. For instance, under a gold standard we might find the price level jumping up and down around a stable or slowly moving trend, and in this case the parameter λ might be small. But under the postwar fiat-money standard, few increases in the price level have been reversed. Thus rational agents might set $\lambda = 1$ and then apply this period's expected inflation rate (p_t^e) to last period's *actual* price level.

> "If, for example, an eight percent inflation rate occurred in a particular year [under the gold standard], an inflation rate of approximately minus eight percent would likely occur a short time later. . . . The gold standard can be considered to have been a period of *mean reversion* in the rate of price change while the current period is one of persistence or long-term *mean revision* in the rate of price change" (Benjamin Klein, pp. 193-4, emphasis in the original).

When (3) is substituted into (2), with a bit of manipulation we can derive an equation that relates the rate of inflation to the expected rate of inflation and to both the level and rate of change of the output ratio:

$$(4) \qquad p_t = \beta(\hat{q}_t + \lambda \hat{Q}_{t-1}) + p_t^e + \mu_t,$$

where we use the notational convenience that $p_t = P_t - P_{t-1}$, and where the new error term μ_t is serially independent if the original error term ε_t is serially independent. Note that (4) reduces to the traditional EPC equation (1) only if $\lambda = 1$.[5]

If the rate of change of nominal GNP relative to natural output growth ($\hat{y}_t = y_t - q^*_t$) is exogenous, then the $\hat{q}_t$ term in (4) will be negatively correlated with the error term, given the identity:

$$(5) \qquad \hat{q}_t \equiv \hat{y}_t - p_t.$$

This problem can be avoided if we substitute (5) into (4) and obtain the following expression that relates the inflation rate to "adjusted" nominal GNP growth, the level of the output ratio, and the rate of expected inflation:

$$(6) \qquad p_t = \frac{1}{1+\beta}[\beta(\hat{y}_t + \lambda\hat{Q}_{t-1}) + p^e_t + \mu_t].$$

II. DATA AND SPECIFICATION

Published annual data series exist for the 1890-1978 period for nominal and real GNP, the GNP deflator, consumer prices, average hourly earnings, the money supply, and the unemployment rate.[6] The "natural unemployment rate" is assumed to be constant before 1955 for an unemployment concept that excludes self-employed farmers and proprietors, since the latter experience little unemployment, and "natural real GNP" (Q^*) is an estimate of the real GNP that the economy can produce when operating at its natural rate of unemployment.[7]

Four issues must be discussed before equation (6) can be estimated. The first and most important is the choice of a proxy for the expected rate of inflation (p^e_t). Edgar Feige and Douglas Pearce have emphasized that inflation expectations should be based on all available information making a marginal contribution to the prediction of inflation that is worth more than its marginal acquisition cost. Because of the shift in monetary standards over our sample period, it is important that we allow agents to shift the variables used to form expectations, and the coefficients applied to those variables.[8] We shall find, for instance, that the lagged inflation rate was very important in helping to predict the persistence of inflation observed in the post-1952 period but was of no use in predicting inflation during the gold-standard era. We also allow lagged values of the rate of change of nominal income and the money supply to influence the formation of expectations. The presence of the lagged output ratio ($\hat{Q}_{t-1}$) in equation (6) introduces an identification problem, since we do not know whether a positive coefficient indicates an important influence of that ratio on expected inflation, a high value of λ, or some mixture of the two.[9] A final difficulty is that agents observe economic data at shorter frequencies than a year, so that current variables may contain information used to form expectations. We assume here that expectations are based entirely on last year's data, but in future research quarterly versions of these equations will be estimated to assess the importance of this problem.

The second specification issue involves the treatment of episodes of government interference in the price-setting process. We introduce dummy variables for three such episodes, the NRA, and price controls in World War II and the Nixon era. Each dummy variable is constrained to sum to 1.0 over the years in which the program had its effect and to -1.0 over subsequent years when the program was dismantled. Thus each dummy variable sums to zero over its total period of impact, and its coefficient indicates the cumulative total effect of the program in question.[10] We also allow for supply shocks by treating the relative price of food and energy as exogenous during 1947-78.[11]

The third specification issue involves the treatment of World War I, for which no dummy variables are created because there were no price controls. After Britain departed from the gold standard in 1914, agents rightly expected the structure of price setting to change from the pre-1914 norm. The significance of this temporary change in structure is tested by allowing coefficients to shift during the 1915-22 interval.[12] The burst of money creation in World War I presented a much greater contrast to the preceding gold-standard era than did money creation in World War II (when the outbreak of war was preceded by four years of explosive growth in the monetary base during 1938-41). Another difference between the two wars was the widespread expectation in 1919-20 that the U. K. and U. S. would attempt to return to the prewar gold price, requiring the extinction of much of the fiat money created during the war, whereas the Fed's interest-rate pegging policy prevented the development of any such expectation in 1946-47. Thus it is perhaps not surprising that, although structural coefficients were allowed to shift during World War II, no significant shift could be found other than the direct impact of the price controls.

The final specification issue involves the interaction of inflation expectations and special factors. Agents were smart enough to know that the end of wars in 1918 and 1945 made lagged prices an invalid predictor of future price behavior, and they presumably were also aware of the dismantling of NRA, and the end of the Nixon-era price controls. To reflect the assumption of intelligent expectation formation, the lagged price-change term used as one of the expectations proxies is constructed "net" of the estimated contribution of the dummy variables and the food-energy contribution (thus requiring iterative estimation). In addition agents are assumed to have ignored the Great Depression and wars by setting the net lagged price-change term equal to zero in 1915-22 and 1929-49. While there is no important difference between the fit of the gross and net lagged inflation variables before 1953, the introduction of the net variable cuts in half the unexplained variance in the 1953-78 sub-period.

III. THE ESTIMATED EQUATION FOR 1892-1978 AND THREE SUB-PERIODS

Estimates of equation (6) are shown in Table 1. The first two lines exhibit the coefficients for the first two variables in (6). In the next two lines lagged net price change and nominal GNP change are proxies for expected inflation. Lagged changes in the money supply (M2) were also introduced but appear mainly to be collinear with lagged nominal GNP.[13] The "special factor" variables are listed last. The four columns of the table display the results of estimation for the entire sample period and three sub-periods.

The remarkable stability across sub-periods of the coefficients on $\hat{y}_t$ is evident, as is the significantly greater response of prices to $\hat{y}_t$ during World War I. The effect of the Phillips-curve variable, the lagged output ratio, is surprisingly small--real GNP slack of 5 percent (an output ratio of .95) slows inflation by only two-thirds of a percentage point per year in the postwar sub-period.

The shift in the role of lagged price change from regressive to extrapolative expectations stands out, both in the shift from negative coefficients to a positive coefficient in the last sub-period, and to the significance

TABLE 1

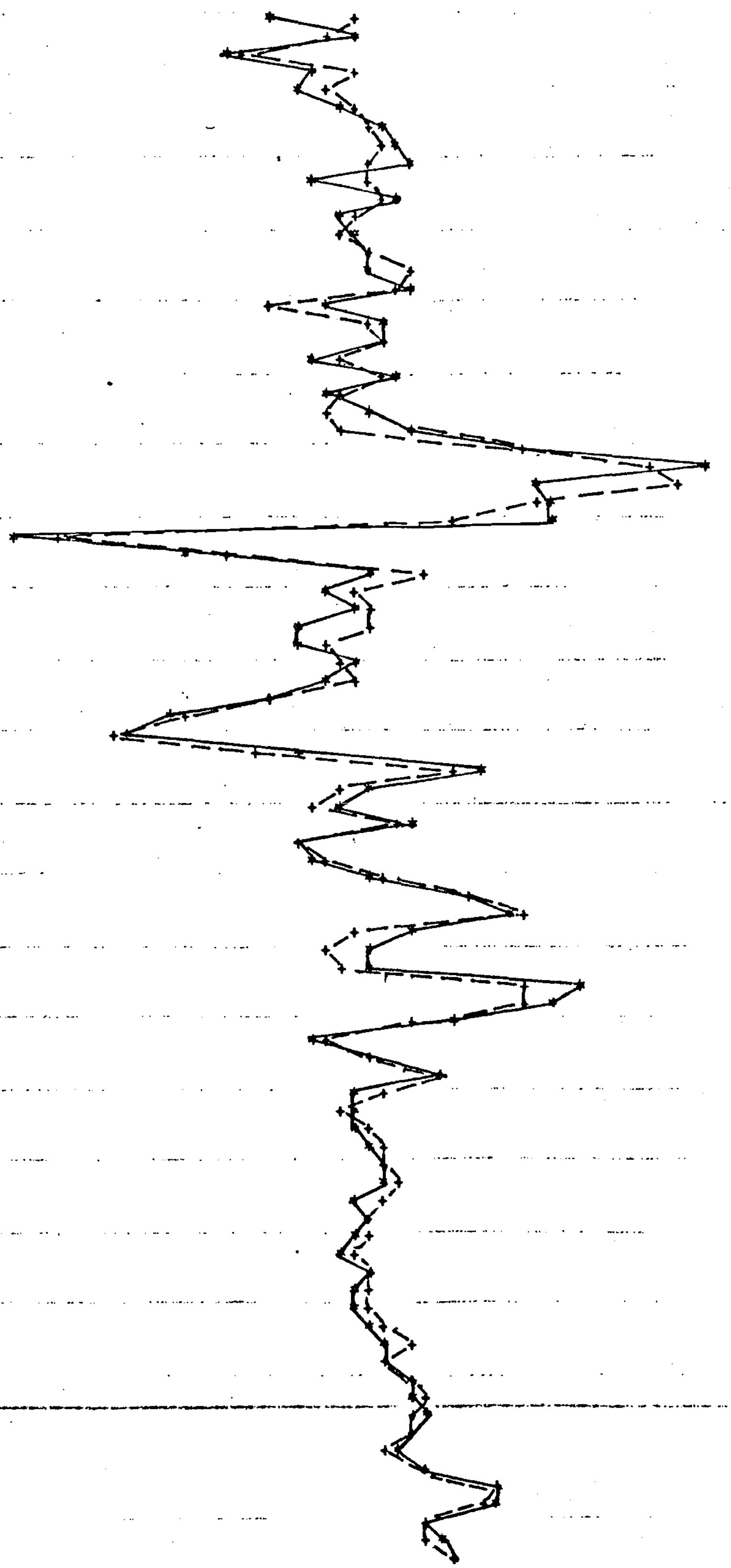
Estimated Equations for the Annual Percentage Change of the GNP Deflator

(t-ratios in [])

	1892–1978	1892–1929	1929–1953	1953–1978
	(1)	(2)	(3)	(4)
1. Adjusted Nominal GNP Change ($\hat{y}_t$)				
a. Entire Period	.316 [8.83]	.287 [3.34]	.348 [9.65]	.341 [8.47]
b. Extra effect, 1915-22	.306 [5.13]	.358 [3.48]	----	----
2. Lagged Output Ratio ($\hat{Q}_{t-1}$)				
a. Entire Period	.044 [1.86]	.176 [1.63]	.073 [3.61]	.130 [3.57]
b. Extra effect, 1953-78	.090 [0.60]	----	----	----
3. Lagged "Net" Price Change (p^N_{t-1})				
a. Entire Period	-.225 [-1.49]	-.041 [-0.17]	-.731 [-2.96]	.722 [10.09]
b. Extra effect, 1953-78	.836 [2.80]	----	----	----
4. Lagged Adj. Nom. GNP Change ($\hat{y}_{t-1}$)				
a. Entire Period	.179 [3.99]	.059 [0.57]	.147 [3.21]	----
b. Extra effect, 1915-22	.120 [1.86]	.209 [1.82]	----	----
c. Extra effect, 1953-78	-.305 [-1.31]	----	----	----
5. Special Factors				
a. NRA dummy, 1933-36	8.94 [3.90]	----	8.45 [5.00]	----
b. World War II dummy, 1943-47	-17.85 [-7.62]	----	-17.39 [-10.54]	----
c. Nixon-era dummy, 1972-75	-4.77 [-2.35]	----	----	-4.70 [-9.88]
d. Relative Price of Food and Energy	.985 [2.17]	----	1.222 [2.58]	.493 [3.56]
6. R^2/Standard Error	.877/2.10	.852/2.74	.961/1.41	.964/0.49
Durbin-Watson statistic	1.89	2.10	1.50	1.72

PLOT OF ACTUAL(*) AND FITTED(+) VALUES

ID	ACTUAL	FITTED
1892	-.3480E-01	.1619E-01
1893	.1467E-01	-.1468E-02
1694	-.6310E-01	-.5107E-01
1895	-.1368E-01	.1316E-01
1896	-.2337E-01	-.6111E-02
1697	.2356E-02	.1149E-01
1898	.3150E-01	.1947E-01
1899	.3389E-01	.2657E-01
1900	.4379E-01	.2452E-01
1901	-.1147E-01	.2159E-01
1902	.3650E-01	.2782E-01
1903	.7389E-02	.1085E-01
1904	.1280E-01	.2337E-02
1905	.2453E-01	.1937E-01
1906	.2337E-01	.4700E-01
1907	.4239E-01	.3360E-01
1908	-.6663E-02	-.3242E-01
1909	.3288E-01	.2221E-01
1910	.2765E-01	.3071E-01
1911	-.1107E-01	.1965E-02
1912	.4002E-01	.2867E-01
1913	-.4064E-02	.8196E-02
1914	.1975E-01	-.5994E-02
1915	.4463E-01	.3786E-02
1916	.1128	.1144
1917	.2168	.1853
1918	.1192	.2015
1919	.1310	.1219
1920	.1303	.7208E-01
1921	-.1824	-.1575
1922	-.8408E-01	-.6074E-01
1923	.2402E-01	.5180E-01
1924	-.2106E-02	.1434E-01
1925	.1405E-01	.2193E-01
1926	-.1646E-01	.2099E-01
1927	-.2074E-01	-.7458E-03
1928	.1590E-01	.1055E-02
1929	-.3342E-02	.1165E-01
1930	-.3279E-01	-.3438E-01
1931	-.9562E-01	-.8679E-01
1932	-.1170	-.1282
1933	-.2322E-01	-.4609E-01
1934	.8249E-01	.7326E-01
1935	.1888E-01	.5363E-02
1936	.4665E-02	-.1080E-01
1937	.4720E-01	.3964E-01
1938	-.2315E-01	-.1640E-01
1939	-.7367E-02	-.6210E-02
1940	.2435E-01	.2894E-01
1941	.7893E-01	.7621E-01
1942	.1005	.1085
1943	.4465E-01	.1278E-01
1944	.1958E-01	-.3940E-02
1945	.2263E-01	.7006E-02
1946	.1458	.1085
1947	.1232	.1118
1948	.6674E-01	.4711E-01
1949	-.1022E-01	-.4243E-02
1950	.1977E-01	.1761E-01
1951	.6548E-01	.6359E-01
1952	.1267E-01	.2563E-01
1953	.1506E-01	.8459E-02
1954	.1366E-01	.2142E-01
1955	.2138E-01	.2689E-01
1956	.3100E-01	.2764E-01
1957	.3315E-01	.3720E-01
1958	.1587E-01	.2549E-01
1959	.2186E-01	.1880E-01
1960	.1689E-01	.2038E-01
1961	.8844E-02	.1598E-01
1962	.1817E-01	.2119E-01
1963	.1463E-01	.1744E-01
1964	.1552E-01	.2490E-01
1965	.2190E-01	.3296E-01
1966	.3230E-01	.4174E-01
1967	.2902E-01	.2673E-01
1968	.4395E-01	.4476E-01
1969	.4904E-01	.5061E-01
1970	.5212E-01	.4571E-01
1971	.4975E-01	.4703E-01
1972	.4061E-01	.3306E-01
1973	.5638E-01	.5688E-01
1974	.9204E-01	.9521E-01
1975	.9138E-01	.8498E-01
1976	.5062E-01	.5087E-01
1977	.5811E-01	.5216E-01
1978	.7017E-01	.6653E-01



Plot of Actual and Fitted Values

[for Atlanta session; not for publication

due to space limitations]

of the "extra 1953-78 effect" in the full sample period. This shift in structure was introduced in two alternative ways to compare Cagan's hypothesis that the recession flexibility of prices has gradually diminished during postwar recessions between 1949 and 1970, and an alternative hypothesis that the new mode of expectation formation suddenly began in 1953. The Cagan hypothesis is tested in both columns (1) and (4) by multiplying the applicable lagged price-change variable by the time trend that moves smoothly from zero to unity between 1953 and 1970 and remains at unity thereafter. The Cagan variable does significantly worse in the postwar sub-period and cannot explain why inflation was so low during 1961-65 in the face of rapid nominal GNP growth.

How well do the equations in Table 1 fit as compared to the simple EPC alternative? The following is a comparison using our data of standard errors of the equations in Table 1 with an EPC specification of Sachs which includes only the current output ratio and four lagged values of the dependent variable:[14]

	1892-1978	1892-1929	1929-1953	1953-1978
Standard Errors from:				
Table 1	2.10	2.74	1.41	0.49
Phillips Curve Alternative	3.83	4.70	4.48	0.79
Standard Deviation of Price Change	5.52	6.52	6.02	2.33

Results similar to those in Table 1 have been obtained for the same specification applied to wage-change data. The similarity of the price and wage results suggests that the increased inertia observed in the postwar period characterizes wages and prices together rather than any shift in the cyclical behavior of the real wage. The annual change in the real wage responds negatively to the lagged output ratio, and positively to $\hat{y}_{t-1}$ (before 1953), to the NRA, and to both the World War II and Nixon-era dummy variables.

IV. *IMPLICATIONS*

The results in Table 1 establish that the elasticity of price change to nominal GNP change has been approximately one-third for almost a century, and that the serial correlation in the price-change variable has shifted from negative to positive at some point in the early 1950s. The inertia in the price-change process in the postwar period tends to dissuade policymakers from halting inflation, because a sluggish response of price change to restrictive demand policy creates high unemployment and political pressure to abandon the tight policy. But the extremely simple equation displayed in column (4) of Table 1 for the postwar years suggests a much greater payoff to restrictive demand policy than has recently been believed. An artificial (and implausible) experiment which drops adjusted nominal GNP growth from 6 to 0 percent causes inflation to slow down 1.8 percentage points in the first year, another 1.8 points in the second year, and 1.7 points in the third year, for a total response of 5.3 points after only three years.[15]

The change in the structure of expectation formation in the postwar period also reminds us that the conclusions of many econometric studies may be sensitive to extensions of sample period.[16] And it seems quite consistent with a change in attitude in the first postwar decade toward recognition of a fundamental change in the stabilizing role of government policy (initiatives based more on the automatic stabilizers and new institutions like F.D.I.C. than on countercyclical policy). The shift also emphasizes the crucial role of three-year staggered wage contracts, a unique American institution that dates back to the first postwar decade and that introduces positive serial correlation in the wage-change data which in turn leads rational economic agents to expect positive serial correlation in the price-change data.

Some proponents of the classical equilibrium approach to macroeconomics, particularly Robert Barro, protest that because these wage-setting institutions impose a high cost on some workers who experience employment fluctuations, they must not exist, a position which ignores the fact that rational firms and unions have chosen this bargaining pattern to minimize the real private costs of negotiations and strikes. The alternative classical equilibrium explanation of business cycles, that output responds positively to price "surprises," seems an implausible description of the last two decades in terms of the price equation developed in this paper, since the prolonged output boom of 1965-69 followed five straight years (1963-67) when price change was lower than the postwar equation can explain, while the "great recession" of 1974-75 occurred after six straight years (1970-75) when price change was *higher* than the fitted value.[17]

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FOOTNOTES

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1. Meltzer provides a convincing demonstration of the importance of ROC phenomena, and the unimportance of Phillips Curve variables, for a sample period that includes 61 of the 87 years studied here. R. A. Gordon shows the importance of the change of the unemployment rate in wage equations and reviews the 1958-72 literature, including several earlier articles that included the change in unemployment. My own previous research on postwar structural price equations has always found strong effects of the rate of change of detrended output or a similar demand variable. For examples of such equations, and for evidence that the ROC explanation is also important for postwar wage behavior, see the author (1977, esp. pp. 269-70). I discovered the importance of the ROC explanation of interwar price behavior in writing a textbook case study (1978, pp. 162-5) and with James Wilcox provided subsequent econometric support. Although they do not comment on the fact, the unemployment equation estimated for 1930-65 by Robert Lucas and Leonard Rapping has such a large coefficient on lagged unemployment that it amounts to a relation linking the rates of change of unemployment, prices, and wages.

2. The recent study of historical price behavior by Jeffrey Sachs neither cites any of the papers listed in the previous footnote nor makes any mention of ROC variables. Edward Gramlich utilizes a so-called "mainline" model for the explanation of postwar inflation in which neither the wage nor

price equations contain any ROC variables. Many other similar econometric models of the postwar inflation process could be cited.

3. Results for annual wage data are briefly discussed below. Quarterly data extending back to 1900 have also been prepared for most of the variables and will be studied in a future paper.

4. In addition to my evidence (1977) supporting a relation between the price mark-up and detrended output, Richard Cooper and Robert Lawrence find a significant relation between the prices of nonferrous metals, primary fibers, and raw agricultural products, on the one hand, and detrended world industrial output, on the other.

5. Sachs rules out any relation between the inflation rate and the change in the output ratio by assumption. If the price-markup in his equation (8) is allowed to be a function of the level of the output ratio, then his model becomes underidentified.

6. The starting date of 1890 is chosen because it marks the beginning of the annual Kendrick GNP series, Rees cost-of-living and average hourly earnings series, and the Lebergott unemployment series. A data appendix is available for interested readers [included for Atlanta discussants]. Equations have been run with consumer prices as an alternative dependent variable and with the unemployment gap replacing the output ratio, and there was no important difference from the results presented in Table 1.

7. The methodology is described in Gordon, 1978, Appendix C. R. A. Gordon, p. 275, stresses the importance of an adjustment for the declining secular importance of the self-employed.

8. Thus this paper recognizes Thomas Sargent's criticism that earlier

Phillips Curve work did not take account of the actual process by which inflation is generated.

9. If a short-frequency business cycle were expected, the effect of $\hat{Q}_{t-1}$ on expectations might be negative, raising the possibility that our estimates of the coefficient on $\hat{Q}_{t-1}$ might be biased toward zero. This is unlikely to occur in the postwar years, given the well-known positive serial correlation of $\hat{Q}_t$.

10. The precise values of the dummy variables are chosen to provide a measure of the timing impact of each program in annual data:

NRA Dummy		World War II Dummy		Nixon-era Dummy	
1933	0.4	1943	0.5	1972	0.5
1934	0.6	1944	0.4	1973	0.5
1935	-0.4	1945	0.1	1974	-0.3
1936	-0.6	1946	-0.6	1975	-0.7
		1947	-0.4		

11. The "food-energy" variable in Table 1 is the difference for 1947-78 between the annual rates of change of the personal consumption deflator and the deflator net of expenditures on food and energy.

12. The importance for expectation formation of special events, like wars and postwar adjustment periods, is stressed in Gordon (1973).

13. Versions with lagged money perform better in the first subperiod but substantially worse in 1929-53, reflecting the looseness of the money-GNP relationship during the Great Depression emphasized by Gordon and Wilcox.

14. To emphasize the contribution of the $\hat{y}$ variables in Table 1, the four "special factor" variables are introduced into the Sachs specification in addition to his dummy variable for World War I. Sachs in Table 4 fits a

second EPC model, with only a constant term and the current and lagged output ratio as right-hand variables, having respective sub-period standard errors with our data of 5.25, 3.22, and 1.88.

15. Of course the output ratio falls rapidly as well from 1.00 to .929 at the end of the third year. Then a subsequent policy in the fourth through sixth years of 3.0 percent adjusted nominal GNP will leave the economy with an inflation rate of only 1.3 percent and an output ratio of .993.

16. The finding of Feige and Pearce that money contributes nothing to the explanation of prices, when the influence of lagged prices is held constant, is likely to be highly dependent on their 1953-71 sample period.

17. The cumulative price error of -2.01 percentage points in 1963-67 can be contrasted with a swing in the output ratio ($\hat{Q}$) of +8.8 percentage points in 1961-66; the cumulative price error of +2.6 percentage points in 1970-75 can be contrasted with a swing in the output ratio of -7.8 percentage points in 1973-75.

DATA APPENDIX

Consumption Price Index.

1890-1928: Consumer Price Index, series B69 in LREG, linked to:

1929-1978: Personal Consumption Deflator, Table 7.1 in NIPA.

GNP Deflator.

Nominal GNP divided by Real GNP.

Money Supply (M2).

1890-1946: Series B111 in LREG, linked to:

1947-1978: Federal Reserve Bulletin, various issues

Nominal GNP.

1890-1908: Series A7 in LREG, linked to:

1909-1928: Series A8 in LREG, linked to:

1929-1978: Table 1.2 in NIPA.

Real GNP, Actual.

1890-1908: Series A1 in LREG, linked to:

1909-1928: Series A2 in LREG, linked to:

1929-1978: Table 1.2 in NIPA.

Real GNP, Natural.

1890-1955: A trend is extended between selected benchmark years when the actual unemployment rate was close to the "natural" unemployment rate, 1890, 1901, 1912, 1923, 1929, and 1950. In each benchmark year the level of natural real GNP differs from actual real GNP by a multiple of the difference between actual and natural unemployment, with the exact method described in Gordon (1978, Appendix C, p. xxiii). The choice of some benchmark years has been changed since the publication of that reference.

1955-1977: The "$QPOT_1$" series from Perloff and Wachter (1979) was supplied by Michael Wachter and was extrapolated to 1977-78 by extending the 1976-77 rate of growth.

Real GNP, Natural.

See Gordon (1978, Appendix C, p. xxiii). The series has been changed for 1890-1929 by adopting the following benchmark years for application of the procedure described there: 1890, 1901, 1912, 1923, 1929.

Wage Index.

1890-1957: Series B70 in LREG multiplied by Series B69, rebased to 1957,

linked to:

1957-1978: ERP, Table B-35, "Average gross hourly earnings in current dollars in manufacturing."

Unemployment Rate, Actual.

1890-1929: Series B1 in LREG.

1930-1970: Series B2 in LREG.

1971-1978: Table B-27 in ERP.

Unemployment Rate, Natural.

1890-1955: It was assumed that the natural rate of unemployment for "UA", the unemployment rate calculated with the self-employed excluded from the labor force, was equal to 5.0 percent, the value of UA observed in late 1950. The natural rate for the official concept of unemployment steadily drifts up during 1890-1955, reflecting the falling share of the self-employed in the labor force.

1955-1978: The series developed in Perloff and Wachter (1978) was supplied by Michael Wachter. Its 1977 value was extrapolated to 1978.

Key to Sources:

LREG: Long Term Economic Growth, 1860-1970. Washington: Department of Commerce, 1973.

ERP: Economic Report of the President, 1979. Washington: Council of Economic Advisers, 1979.

NIPA: 1929-1972: The National Income and Product Accounts of the United States, 1929-74: Statistical Tables. A Supplement to the Survey of Current Business. Washington: Department of Commerce, 1975.

1973-1978: Survey of Current Business, various July issues.