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ABSTRACT

Aggregate labor cost equations tended to overpredict labor-cost inflation in the United States in the 1980s. We consider the hypothesis that a change in the price-inflation-expectations mechanism can explain this apparent structural shift in the 1980s. We examine whether the sharp recession of the early 1980s and continued tight monetary policy throughout the decade may have led to changes in the relationship between past price inflation and expected price inflation such that distributed lags of price inflation persistently overestimated expected price inflation, and hence led to overprediction of labor-cost inflation by standard Phillips curves in this period. The evidence leads us to reject this hypothesis, and to conclude instead that there was a true structural shift in labor cost determination.

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I. Introduction and Overview

Aggregate labor cost equations, or Phillips curves, tended to overpredict labor-cost inflation in the United States in the 1980s, for the economy as a whole and in the union sector. This apparent structural shift generated numerous potential explanations, including: declines in union strength; the advent of flexible compensation systems in the union sector; changes in "wage norms"; the continuation of a longer-term decline in labor's share of output; increased international competition; and deregulation. Some of these explanations have received empirical support, while others have not, or do not offer a satisfactory explanation. Declines in union strength in the 1980s explain little or none of the deceleration of labor-cost inflation in this period (Neumark, forthcoming). The overprediction of labor-cost inflation in the union sector in the 1980s coincides with the advent of lump-sum payments and profit sharing in this sector, and micro-level evidence reveals a negative relationship between the advent of profit sharing and labor-cost growth (Bell and Neumark, 1991). But the deceleration of labor-cost inflation at the aggregate level continued even after the use of profit sharing tapered off. The deceleration in labor-cost inflation is consistent with the notion of shifting wage norms (Mitchell, 1986a; Bell, 1990), but establishing direct evidence on the wage norm hypothesis is problematic. Gordon (1988) interprets the deceleration of labor-cost inflation in the 1980s as a decline in labor's share of output, but does not explain the phenomenon. Vroman and Abowd (1988) provide some evidence suggesting that import competition partly explains the deceleration of labor-cost inflation, at both the aggregate level (where import prices are important), and the industry level (where import penetration matters). Kosters' (1984) assertion that deregulation explains the disinflation of the early 1980s seems difficult to reconcile with the widespread nature of decelerating labor costs, as opposed to the concentration of this deceleration in the deregulated industries (Mitchell, 1986b).

In this paper we consider an alternative hypothesis, that a change in the price-inflation-expectations mechanism can explain the apparent structural shift of the Phillips curve in the 1980s. A standard feature of Phillips curve specifications is a stable distributed lag of past price inflation to measure expected price inflation, often assuming an adaptive-expectations structure. We focus in particular on the period 1984-1990, following the 1982-1983 recession. We examine whether the sharp recession of the early 1980s and continued tight monetary policy throughout the decade may have led to changes in the relationship between past price inflation and expected price inflation such that this distributed lag persistently overestimated expected price inflation, and hence led to overprediction of labor-cost inflation by standard Phillips curves in this period.[1] If this hypothesis is correct, then the structural shift was a spurious result of model misspecification, rather than a real change in aggregate labor-cost determination.

Our statistical experiment consists of estimating standard Phillips curves, substituting survey forecasts of price inflation for distributed lag, adaptive-expectations forecasts, and asking whether using survey forecasts leads to the elimination or reduction of systematic overprediction of labor-cost inflation in the 1980s. The shift-in-expectations hypothesis suggests that substituting survey forecasts should eliminate or reduce the overprediction of labor-cost inflation in the 1980s, because the survey forecasts are based on all information, including the perceived strength of the government's anti-inflation stance, in contrast to the distributed-lag forecasts.[2]

The relationship between survey and distributed-lag forecasts of price inflation has received considerable attention in the rational expectations literature. The rational expectations revolution called into question naive expectations-generating mechanisms such as adaptive expectations that were used to explain macroeconomic variables including nominal wages and interest rates. An alternative approach was to use inflation forecasts from surveys of economists, forecasters, or households. This approach led to the question of whether such forecasts were indeed rational; research on this topic was also directed towards testing the rational expectations assumption. Numerous papers tested the rationality of forecasts of price inflation or other measures (e.g., Keane and Runkle, 1990; Mullineaux, 1978; Leonard, 1982; Pearce, 1979; Zarnowitz, 1985). The consensus from these papers appears to be that sample means or medians of forecasts from the various surveys (computed across the set of respondents) often do not satisfy statistical definitions of rationality.[3]

We are not directly concerned with the rationality of adaptive expectations or survey forecasts of price inflation, but rather with the question of whether we can explain recent behavior of aggregate labor costs. Nonetheless, the evidence against rationality of the aggregated survey forecasts raises the possibility that actual inflation expectations did change in a manner that led to overprediction of labor-cost inflation by standard Phillips curves, but that our statistical experiment will fail because the survey forecasts do not reflect the changes in actual expectations. We therefore attempt to validate the statistical experiment by also studying earlier periods of contractionary monetary policy, asking whether in these periods Phillips curves using survey forecasts of price inflation are less prone to overpredict labor-cost inflation than those using distributed-lag forecasts.

The empirical analysis of the Phillips curve in both the 1980s and the earlier contractionary periods can be interpreted as a test of the "credibility hypothesis" advanced by Fellner (1980). An empirical implication of this hypothesis is that an adaptive price-inflation-expectations mechanism in a Phillips curve fails periodically because it omits the unmeasured effects of the government's policy stance on the relationship between past inflation and expected inflation.[4] Fellner (1979) and Gramlich (1983) present limited evidence in favor of this hypothesis, finding relatively positive (negative) residuals from wage equations (Fellner) or price-inflation expectations equations (Gramlich) in periods in which the credibility of the government's anti-inflation stance was thought to be relatively weak (strong). The empirical analysis of this paper differs in a number of ways: we compare the behavior of aggregate labor-cost equations using distributed-lag and survey forecasts of price inflation, rather than just examining residuals; we use Romer and Romer's (1989) research to draw on the historical record of Federal Reserve policy to identify periods of explicit contractionary policy; and we provide a particular focus on the apparent structural shift in labor-cost determination in the 1980s.

We find that for the 1984-1990 period Phillips curves incorporating survey forecasts of price inflation are no less prone to overprediction of labor-cost inflation than are standard Phillips curves using an adaptive-expectations framework. This suggests that the apparent structural shift of the Phillips curve in the 1980s is not attributable to a change in the formation of price-inflation expectations. Furthermore, during earlier periods of explicit contractionary Federal Reserve policy, this finding is reversed; standard Phillips curves overpredict labor-cost inflation, while Phillips curves with survey forecasts do not.[5] This finding strengthens the validity of the experiment using survey forecasts of price inflation. Together, the findings lend credence to the hypothesis of a true structural shift in aggregate labor-cost determination in the 1980s.

II. Why Study the Phillips Curve?

The debate over the interpretation and existence of the Phillips curve is extensive and well-known to economists. (Begg, 1982, provides a thorough review.) We offer three arguments in support of the empirical analysis of the Phillips curve that we carry out in this paper. First, what is relevant for this paper is not whether the Phillips curve represents a policy tradeoff, but rather whether the Phillips curve specification is a reasonable description of the process by which aggregate labor-cost inflation is generated, if only in the short run. Even in the Sargent and Wallace (1975) model, there is a negative association between unemployment rates and price (or labor-cost) inflation, so a statistical relationship between labor-cost inflation and the unemployment rate is not problematic. A number of models have also been suggested that explain why current inflation may be associated with lagged inflation (e.g., Akerlof and Yellen, 1985; Fischer, 1977; Mankiw, 1985; Taylor, 1980), even when expectations are rational rather than adaptive; in these models, though, the interpretation of the lagged inflation terms as measuring expected inflation may be erroneous.

A second concern is that the natural rate may not be stable, which would make the Phillips curve specification unstable. The "New Microeconomic" foundations of unemployment theory elucidated in the Phelps volume (1970) modelled the equilibrium or natural rate of unemployment as an outcome of search behavior and intertemporal substitution. This suggests, however, that the natural rate can vary over time. Solow (1990) argues from a more "sociological" perspective that there may be multiple unemployment rates at which the market is in equilibrium. He constructs a loose "test" of the instability of the natural rate by comparing Phillips curve relationships based on a constant natural rate of unemployment to one in which the natural rate is modelled as the average rate of unemployment prevailing over the previous five years. For the U.S.--in contrast to many European countries--he concludes that a single stable equilibrium unemployment rate provides an acceptable characterization of the wage inflation process.

Third, we justify our interest in Phillips curve equations because policy makers in central banks and elsewhere use similar equations to predict aggregate labor-cost inflation. As Mankiw (1990) points out in his recent survey paper, "The IS-LM model, augmented by the Phillips curve, continues to provide the best way to interpret discussions of economic policy...among policy makers. Economists in business and government continue to use the large-scale macroeconometric models for forecasting and policy analysis," (pp. 1645-6). Attempting to explain the overprediction by these aggregate equations in the U.S. over this period necessarily involves adopting their formulation.

Finally, the overprediction of labor-cost inflation in the 1980s can be interpreted as in some sense a mirror image of the underprediction of labor-cost inflation in the 1970s, or stagflation. This phenomenon was surprising in light of earlier behavior of aggregate labor costs summarized in the Phillips-curve relationship, and whether or not the Phillips curve deserves a behavioral interpretation, we think it is undeniable that research on the coexistence of high labor-cost inflation and high unemployment led to important insights into how labor markets work. Research on the deceleration of labor costs in the 1980s can be expected to yield new insights, and to provide a means of testing some of the hypotheses advanced to explain aggregate labor-cost behavior in the 1970s.

III. Phillips Curve Results

In this section we document the overprediction of labor-cost inflation by standard Phillips curves in the 1980s, a phenomenon that has been interpreted as a structural shift. We contrast results using these standard Phillips curves with results using survey forecasts of price inflation instead of distributed lags of price inflation, and ask whether the overprediction errors are eliminated or reduced when the survey forecasts are substituted. The discussion in the text focuses on results using the Livingston survey, which elicits forecasts of the level of the CPI-U from a panel of economists, some of whom are forecasters. We also replicated our results using the ASA-NBER survey, which elicits forecasts of the GNP implicit price deflator from a panel of forecasters;[6] results using this survey are reported in appendix tables. In each case, we use the price measure corresponding to the forecasted series.

A feature of our data that requires explanation is the identification of the earlier periods of contractionary policy that we use to assess the validity of our statistical experiment. We began with dates of the inception of contractionary policies identified in Romer and Romer (1989) from Federal Reserve records; the halves corresponding to the inception of these policies that are within our sample period are 1955:H2, 1968:H2, 1974:H1, 1978:H2, and 1979:H2.[7] The use of dates from this source is advantageous for the present paper because the dates are not based on a retrospective look at periods of decelerating inflation. Romer and Romer rely entirely on Federal Reserve records--the "Record of Policy Actions" of the Board of Governors and the Federal Open Market Committee, and, up to 1976, the minutes of FOMC meetings. They identify these periods as "times when concern about the current level of inflation led the Federal Reserve to attempt to induce a recession (or at least a "growth recession")," (p. 134). Romer and Romer restrict attention to monetary contractions, and not expansions, because they are concerned with the effects of monetary shocks on real output; in their view, in the postwar period expansionary policies were always a response to declines in real activity, whereas contractionary policies were a response to nominal inflation. The same contractionary periods are appropriate for the analysis in this paper since the policy shifts were explicitly intended to lead to changes in the rate of inflation. With these dates in hand, we then calculated residuals from standard Phillips curves. We identified "contractionary periods" as the first run of one or more halves beginning on or after these dates, in which labor-cost inflation was overpredicted. The runs were allowed to encompass at most one intervening half with underprediction, and we restricted the window in which we looked for evidence of overprediction to three years after the shocks identified by Romer and Romer.[8,9]

A second point concerning the data is that we use currently available, and therefore revised data, rather than data available at the time the survey forecasts were made. For tests of unbiasedness of forecasts, the appropriate choice depends on whether forecasters were predicting initial or revised values of the variables, and whether there are any systematic patterns to the data revisions such that answers may differ depending on whether we use initial or revised data. According to research summarized in Keane and Runkle (1990), economic forecasts have tended to be closer to initial values than revised values, and they find similar results for the ASA-NBER forecasts of the GNP deflator. For tests of efficient use of available information in forecasting, it is obviously essential to use the initial data available to forecasters when their forecasts were made. For our purposes, though, the disadvantages of using revised data seem minimal, relative to the difficulty of assembling initial data. We are not testing the efficiency or unbiasedness of survey forecasts of price inflation, but rather trying to see whether they contain information--above and beyond that contained in a distributed-lag of price inflation--that is useful in modelling labor-cost inflation.

Table 1 reports results using a standard Phillips curve, for hourly compensation. The price inflation measure used is the CPI, corresponding to the price inflation series forecasted by the Livingston survey respondents. The data are aggregated to a semiannual frequency, corresponding to the frequency at which the Livingston data are available.[10] Column (1) reports estimates of a standard specification of the Phillips curve, including a post-1983 dummy variable.[11,12] The same overprediction documented by other researchers is evident. In column (2) we add dummy variables corresponding to the contractionary periods identified by the procedure described above. The dummy variable coefficients in column (2) show the magnitude of overprediction in each contractionary period and the post-1983 period. These coefficients should not in any way be interpreted as a "test" of the credibility or shift-in-expectations hypotheses, since the periods for which the dummy variables are defined were constructed by looking at the labor-cost equation residuals. The independent test comes when we look at results with the survey forecasts of price inflation; the estimates in column (2) only provide a benchmark with which to compare the overprediction that remains once we substitute survey forecasts of price inflation for the distributed-lag forecasts. In column (3) we parameterize the relationship more tightly by instead defining one dummy variable covering all four contractionary periods. Finally, in column (4) we report results paralleling those in column (3), imposing the natural rate restriction that the coefficient of the distributed lag of price inflation equals unity.[13]

We next turn to estimates of the Phillips curves using the survey forecasts of price inflation instead of distributed-lag forecasts. We are most interested in the estimate of the post-1983 dummy variable; if the apparent structural shift in this period reflects changes in the formation of price-inflation expectations, then the coefficient of this dummy variable should be considerably smaller than in the first four columns of Table 1. This statistical experiment assumes, of course, that the survey forecasts measure the price-inflation expectations that actually prevailed. The evidence for the earlier contractionary periods is used to assess the validity of the experiment. If the overprediction in these earlier contractionary periods is considerably reduced by using the survey forecasts of price inflation, then the experiment should be valid.

The estimates in columns (5)-(8) of Table 1 substitute the Livingston forecast of the CPI for the distributed lag. The estimates in column (5) show that substituting the Livingston forecasts for the distributed lag does not reduce, but rather increases the overprediction in the post-1983 period; the dummy variable coefficient remains statistically significant, and the point estimate is larger than in the distributed-lag specifications.[14] On the other hand, the estimates in columns (6) and (7) show that for the contractionary periods the extent of overprediction is reduced relative to the estimates in columns (2) and (3). In column (6) none of the contractionary-period dummy variable coefficients is individually significant, nor is the set of coefficients jointly significant. The restricted estimates in column (7) tell the same story; the coefficient for the combined contractionary periods is close to zero (-.06), and insignificant. Finally, in column (8), where the natural rate hypothesis is imposed, the results are similar. Because the standard errors of the regressions with the Livingston forecasts are generally lower than those with the distributed-lag forecasts, and because the coefficients of the Livingston forecasts are closer to unity than those of the distributed-lag forecasts, it seems likely that these findings are attributable to information contained in the Livingston forecast, rather than to noise in the data. In particular, the absence of significant coefficients on the dummy variables for the contractionary periods, in columns (6)-(8), is not simply attributable to larger standard errors on these coefficients, relative to columns (2)-(4).[15,16]

Thus, the evidence does not support the hypothesis that a shift in the price-inflation-expectations mechanism can explain the overprediction of labor-cost inflation in the 1980s. At the same time, the credibility hypothesis, and its critique of the standard Phillips curve, appears to receive support for earlier periods following explicit shifts to contractionary policies; in contrast, the Livingston (and ASA-NBER) forecasters appear to have been aware of these policy shifts, and taken account of them in their forecasts. This strenghens the validity of our rejection of the shift-in-expectations hypothesis for the 1980s.

IV. Further Evidence

The preceding tables show that Phillips curves using survey forecasts of price inflation tended to outperform those using distributed lags for the contractionary periods we identified, but not for the post-1983 period. However, previous research has shown that through much of the 1970s Livingston and ASA-NBER forecasts of price inflation tended to be downward biased (e.g., Pearce, 1979; Zarnowitz, 1985).[17] This raises the possibility that the survey forecasts may have reduced the overprediction of labor-cost inflation in the earlier contractionary periods only because they predicted a lower value of price inflation, and not because they correctly predicted a deceleration in price inflation. This could have led us to incorrectly conclude that our statistical experiment is valid.

In Table 2 we present evidence for the Livingston forecasts that shows that this was not the case. Panel A reports results from regressing the *change* in the distributed-lag and survey forecasts of the inflation rate, as well as the change in the actual inflation rate, on the dummy variables for the contractionary periods and the post-1983 period. For the contractionary periods both the actual rates of inflation and the rates forecasted by the survey decelerate, as indicated by the negative coefficients on the corresponding dummy variables. The distributed lags, in contrast, forecast accelerating rates of price inflation in the contractionary periods. This evidence implies that at least part of the reason that overprediction of labor-cost inflation by the Phillips curve in these periods is reduced when the Livingston forecasts are substituted is that these forecasts better predict turning points in inflation. Panel B reports the mean forecast errors of the distributed-lag and Livingston survey forecasts. The first row of the panel documents the downward bias in the forecasts of the rate of inflation by the Livingston forecasters in the contractionary periods. This may be partly responsible for the results using the survey forecasts in the Phillips curve, but the results in panel A imply that it is not the full explanation; consequently, we continue to accept the validity of our statistical approach.

Turning to the post-1983 period, the estimates in column (3) of Panel A reveal that there was little deceleration in actual price inflation over this period. The Livingston forecasters, however, predicted somewhat more deceleration of price inflation than actually occurred, while the distributed lags erroneously predicted accelerating price inflation. This seems inconsistent with the findings in Table 1 that the overprediction of labor-cost inflation actually worsened somewhat when the survey forecasts were substituted for the distributed-lag forecasts. However, this can be explained by the upward bias of the survey forecasts of price inflation in the post-1983 period, documented in the second row of Panel B.[18]

Finally, we present evidence on survey forecasts of labor-cost inflation, to buttress the findings that survey forecasts accurately reflect behavior of actual prices and labor costs--even if they do not satisfy strict rationality--and to shed additional light on the shift-in-expectations hypothesis. The Livingston survey includes one labor-cost measure: average weekly earnings of production workers in manufacturing. In columns (1)-(3) of Table 3 we report Phillips curve estimates for this labor-cost measure. The same overprediction of labor-cost inflation in the earlier contractionary periods and the post-1983 period is apparent. In columns (4) and (5) we introduce the Livingston forecasts of inflation in average weekly earnings, first without and then with the other Phillips curve variables. For both the contractionary periods and the post-1983 period the Livingston forecast captures the lower rates of inflation of average weekly earnings, especially for the post-1983 period for which the overprediction is eliminated.[19] These results, combined with the results for price inflation, imply that the Livingston forecasters correctly predicted (or at least recognized) the deceleration of wages relative to prices in the post-1983 period. Thus, the same structural shift of standard Phillips curves in this period is reflected in data on expected price and labor-cost inflation. This makes it implausible that the structural shift of the Phillips curve in this period is attributable to deviations between actual and expected price inflation.

V. Conclusion

This paper asks whether the apparent structural shift in aggregate labor-cost determination in the 1980s is attributable to the standard Phillips curve's reliance on a distributed-lag model for price-inflation expectations. A stronger anti-inflation stance by the Federal Reserve may have led agents to expect lower price inflation than was predicted by the distributed-lag model. However, we find that using Livingston (or ASA-NBER) survey forecasts of price inflation instead of distributed lags of actual price inflation does not reduce the apparent structural shift in the 1980s. Furthermore, substituting these survey forecasts for distributed-lag forecasts *does* eliminate or reduce past episodes of overprediction of labor-cost inflation following contractionary policies, suggesting that the experiment for the 1980s is valid.

These results lead us to reject the hypothesis that a change in the formation of price-inflation expectations provides an explanation of the deceleration of labor-cost inflation in the 1980s. Price-inflation forecasts from distributed-lag models were relatively accurate in this period. What occurred in the 1980s, instead, was a deceleration of labor-cost inflation that was *not* accompanied by a deceleration of actual price inflation,[20] which we would term a structural shift in aggregate labor-cost determination.

In principle, any of the explanations mentioned in the Introduction could have led to this outcome. But in our view deregulation and increased international competition are less likely candidates as explanations of decelerating labor-cost inflation relative to price inflation; unless workers were appropriating all or most of any rents, the first-order effect of deregulation and international competition should be downward pressure on both wages and prices. Nonetheless, this leaves numerous possible explanations for the structural shift in the 1980s.

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Footnotes

1. Taylor (1988) made this argument for the latter part of the 1980s.

2. A few earlier papers (Lahiri, 1977; Turnovsky and Wachter, 1972; Gordon, 1971) estimated Phillips curves using Livingston forecasts of price inflation instead of distributed lags, but focused on testing the natural rate or accelerationist hypothesis, not on examining changes in the price-inflation-expectations mechanism as explanations of apparent structural shifts of the Phillips curve.

3. Keane and Runkle (1990) argue, however, that individual-level forecasts may nonetheless be rational, and provide evidence consistent with this for forecasts of the GNP deflator from the ASA-NBER survey of professional forecasters.

4. In contrast, Fellner (1980) argues that predictions of the hypothesis for changes in the relationship between labor-cost inflation and unemployment are ambiguous.

5. This is broadly consistent with findings in McNees (1986) and Granger (1986), that judgmental forecasts of the GNP implicit price deflator outperform Bayesian VAR forecasts.

6. The time series of the mean forecast of the Livingston respondents, and the median forecast of the ASA-NBER respondents, were supplied by the Federal Reserve Bank of Philadelphia.

Keane and Runkle (1990) argue that the ASA-NBER forecasts are likely to be superior because they are made by agents with an incentive to be correct. (The respondents are requested to provide the same forecasts that they provide to clients.) On the other hand, the Livingston forecasts are available for a longer period.

7. They exclude the consumer credit restraints announced by the Fed in March 1980.

8. As this suggests, the precise contractionary periods defined will vary as we look at different labor cost and price measures.

9. We verified that our conclusions were not sensitive to this definition of contractionary periods, by examining results defining these contractionary periods to include only the halves with overprediction (i.e., eliminating the possibility of one intervening half with underprediction); these results are discussed below.

10. For the price inflation, labor-cost inflation and productivity growth measures, we compute the annualized change in the quarterly average or value of the level of the appropriate variable, from Q2 to Q4 or Q4 to Q2. For the unemployment rate, we use the Q2 or Q4 quarterly average. In all cases, unless otherwise noted we use the officially-published seasonally-adjusted data.

11. The productivity measure is nonfarm business output per hour. The unemployment rate is for prime-age males, to control for demographic shifts.

12. We tested for first- and higher-order serial correlation in the errors. For some of the specifications and data series there was evidence of first-order, but not higher-order serial correlation, and we report the corrected estimates. This serial correlation can be distinguished empirically from the runs of negative residuals that are the focus of the empirical analysis, because the serial correlation pattern is assumed to persist throughout the sample period. This is borne out by the various replications of our results using alternative variables, sample periods, etc., which show that the key results are insensitive to correcting for serial correlation. Nonetheless, we interpret evidence of a structural shift in the Phillips curve, after accounting for serial correlation in the errors, as all the more compelling.

13. Columns (1)-(4) of Appendix Table 1A report similar specifications, with similar findings, using the GNP implicit price deflator instead of the CPI, corresponding to the ASA-NBER forecasts. We have aggregated the data to a semiannual frequency, to enhance comparability with the results based on the CPI and the Livingston forecasts. The results are the same using quarterly data; see footnote 16.

14. Consistent with earlier work (Lahiri, 1977; Turnovsky and Wachter, 1972; Gordon, 1971) we find coefficients on the Livingston forecasts significantly below unity in many specifications, although our estimates are considerably closer to unity.

15. Columns (5)-(8) of Appendix Table 1A repeat the analysis substituting the ASA-NBER forecast of inflation of the GNP deflator for the distributed lag of this variable. The qualitative results are the same as for the CPI and the Livingston forecast. As for the CPI/Livingston results, the coefficient for the rest of the 1980s becomes more negative, and remains statistically significant, when the survey forecast is substituted. On the other hand, the overprediction in the earlier contractionary periods is considerably reduced.

16. We verified the robustness of our estimates in a number of ways. We summarize the results here, and report the estimates in the appendix tables. First, we defined contractionary periods more narrowly to include only halves in which there was overprediction of labor-cost inflation, and examined results for both the Livingston and ASA-NBER data (Appendix Table 1B, columns (1)-(4)). Second, we used using average hourly earnings instead of hourly compensation, reverting to the original definition of contractionary periods, and again using both surveys (Appendix Table 1B, columns (5)-(8)); these estimates suggest a sharper deceleration of wages than compensation in the post-1983 period. Third, we looked at results for the Livingston survey, over the sample period for which the ASA-NBER equations could be estimated (Appendix Table 1B, columns (9)-(10)). Fourth, we examined our key results using the standard aggregate civilian unemployment rate, and a demographically-adjusted unemployment rate (Appendix Table 1C, columns (1)-(4)). Fifth, we also examined results under the perfect foresight assumption, using actual instead of forecasted price inflation (Appendix Table 1C, columns (5)-(8)); the persistence of the overprediction in the post-1983 period, in the perfect foresight experiment, makes the case for a true structural shift particularly compelling. Finally, we estimated our specifications for the ASA-NBER forecast of the GNP deflator, using the data at a quarterly frequency (Appendix Table 1C, columns (9)-(10)). In all of these cases the qualitative conclusions were unchanged.

We also used the Employment Cost Index for wages and salaries to obtain separate labor cost series for union and nonunion labor, although these data only extend back to 1976; see Appendix Table 1D. Estimates with these series show that the post-1983 structural shift occurred for both union and nonunion labor, although it was stronger for union labor. For both union and nonunion labor the Livingston forecasts of price inflation do not eliminate the post-1983 structural shift, paralleling the estimates reported in the tables.

As an alternative approach we simply added the survey forecasts to the specifications in columns (2) and (3) of Table 1, an "encompassing" approach to comparing the survey and distributed-lag forecasts of price inflation. The coefficient of the survey forecast was always significant and larger than the coefficient of the distributed-lag forecast. The qualitative results were similar. The reduction in the coefficients of the dummy variables for the contractionary periods was somewhat smaller than in columns (6) and (7) because the distributed-lag forecasts included in these specifications--as Table 2 below shows--overpredict price inflation in the contractionary periods. Furthermore, the deceleration of labor cost inflation after 1983 persisted. For example, in the estimates corresponding to Table 1, when the Livingston forecast was added to the specifications in columns (2) and (3), the coefficients (standard errors) of the post-1983 dummy variable were -1.89 (.48) and -1.79 (.48).

17. Caskey (1985) argues that for the period covered by these data this underprediction is consistent with forecasts based on Bayesian learning with a reasonable set of priors regarding the inflation process.

18. Appendix Table 2A repeats this analysis using the GNP deflator and the ASA-NBER forecasts, with the same results. We also examined results using the more narrow definition of contractionary periods based only on halves with overprediction of labor-cost inflation, using the restricted specification in which one

dummy variable captures all of the contractionary periods (Appendix Table 2B), and using the Livingston data over the shorter period for which the ASA-NBER forecasts are available (Appendix Table 2C). The qualitative conclusions were unaffected.

19. Our results are broadly consistent with those of Levine (1990), who studies the PIMS survey of executives' expectations of price and wage inflation. Levine finds that, conditional on the unemployment rate, survey respondents did not revise their price inflation forecasts in response to the Volcker/Reagan policy change in 1980 and 1981, but they did revise downward their expectations of real wage inflation.

As for the earlier findings, these results were qualitatively unchanged using the more narrow definition of contractionary periods based only on halves with negative residuals (Appendix Table 3A).

20. This is part and parcel of the decline in real wages over this period, which began after 1973, and accelerated slightly in the 1980s. For a review of evidence on this point see the papers in Burtless (1990). While the decline in real wages in the 1970s was partly related to stagnant productivity growth, the decline in the 1980s is probably more strongly reflected in Phillips curve estimates because it occurred despite a pick-up in productivity growth.

Table 1. Hourly Compensation Phillips Curves, with Distributed-Lag and Livingston Forecasts of CPI Price Inflation[1]

	Distributed-Lag Forecast				Livingston Forecast			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	5.76 (.54)	5.86 (.56)	5.78 (.49)	5.01 (.67)	5.80 (.53)	5.90 (.56)	5.81 (.54)	5.28 (.65)
Six-half geometric lag of CPI inflation	.52 (.06)	.59 (.07)	.60 (.06)	1.00	...	...	...	...
Livingston forecast of CPI inflation	...	...	...	...	.71 (.08)	.77 (.09)	.71 (.08)	1.00
Unemployment rate, prime-age males	-.48 (.13)	-.51 (.12)	-.50 (.12)	-.71 (.16)	-.54 (.13)	-.58 (.13)	-.54 (.13)	-.66 (.15)
Productivity growth	.02 (.08)	.02 (.08)	.03 (.07)	.13 (.09)	.09 (.08)	.05 (.08)	.09 (.08)	.18 (.08)
Dummy variables for contractionary periods:[2]								
1957:H1-1958:H2	...	-1.23 (.77)	...	...	...	.68 (.78)	...	...
1968:H2-1970:H2	...	-1.24 (.74)	...	...	...	-.58 (.74)	...	...
1975:H1	...	-.84 (1.45)	...	...	...	1.82 (1.34)	...	...
1979:H2-1981:H2	...	-.95 (.87)	...	...	...	-1.06 (.86)	...	...
Joint significance[3]	...	.18	...	...	...	.29	...	...
All contractionary periods combined	...	...	-1.15 (.47)	-2.54 (.56)	...	...	-.06 (.45)	-.43 (.51)
Post-1983 dummy variable	-1.29 (.52)	-1.49 (.50)	-1.50 (.48)	-1.32 (.68)	-2.06 (.51)	-2.17 (.51)	-2.07 (.53)	-2.09 (.67)
$\bar{R}^2$	.69	.70	.71	...	.71	.71	.70	...
Standard error	1.33	1.31	1.28	1.62	1.29	1.28	1.30	1.39
ρ[4]	.20 (.12)	.15 (.12)	.14 (.12)	.25 (.12)	.21 (.12)	.17 (.13)	.21 (.12)	.36 (.12)

Table 1 (continued)

1. Standard errors of estimates are reported in parentheses. Sample period is 1952:H2-1990:H1. Data are at semiannual frequency. The coefficients of the distributed lag forecast were constrained to sum to unity. The Livingston forecast is the percentage change from the prevailing level of the index in the fourth month of the half to the forecasted level for the end of the next half, at an annualized rate.
2. These periods were chosen via the following procedure. Residuals were calculated from the model estimated in column (1). Dates of the beginning of contractionary policies by the Federal Reserve Board were taken from Romer and Romer (1989); the halves corresponding to the contractions identified are 1955:H2, 1968:H2, 1974:H1, 1978:H2, and 1979:H2. The periods for which the dummy variables are defined cover the first run of consecutive halves with a negative residual beginning during or following the contraction identified by the Romers. The runs encompass at most one intervening half with a positive residual, and are limited to a period up to three years after the contraction identified by Romer and Romer. It was assumed that the negative residual in 1979:H2 corresponded to the 1978:H2 contraction identified by Romer and Romer, and therefore that the runs corresponding to the 1978:H2 and 1979:H2 contractions overlapped.
3. p-value from likelihood-ratio test.
4. In all tables, for each specification an AR1 correction was calculated using the Cochrane-Orcutt procedure in TSP 6.0, using one lagged value outside of the indicated sample period. The AR1 correction was maintained throughout each set of specifications including the contractionary period dummy variables if the specification without these variables indicated at least marginally significant evidence of first-order serial correlation (t-statistic > 1.5); otherwise OLS estimates are reported. In no cases was statistically significant evidence of higher-order serial correlation. In all cases, to avoid ambiguities we retained the sample period over which the serial-correlation-corrected estimates were computed.

Table 2. Forecasted and Actual Changes in CPI Inflation[1]

A. Regression Results

	Change in Distributed Lag Forecast (1)	Change in Livingston Forecast (2)	Change in Actual Inflation (3)
Constant	-.17	.26	.21
	(.26)	(.15)	(.23)
Dummy variable for all contractionary periods combined[2]	.65	-.62	-.72
	(.53)	(.27)	(.50)
Post-1983 dummy variable	.30	-.44	-.08
	(.56)	(.32)	(.50)
$\bar{R}^2$	-.01	.15	.03
Standard error	1.79	.69	1.90
ρ	...	.37	-.21
		(.12)	(.12)

B. Forecast Errors[3]

	Distributed Lag Forecast (1)	Livingston Forecast (2)
All contractionary periods combined	-.58	2.13
	(2.36)	(1.45)
Post-1983	.12	-.27
	(1.56)	(1.09)
Entire sample period	.02	.84
	(1.91)	(1.58)

1. Standard errors of estimates are reported in parentheses. Sample period is 1953:H1-1990:H1. For these specifications, the serial-correlation correction was retained when there was at least marginally significant evidence of first-order serial correlation (t-statistics > 1.5); otherwise OLS estimates are reported. There was never evidence of higher-order serial correlation. In all cases, we retained the sample period over which the serial-correlation-corrected estimates were computed. See footnotes to Table 1 for further details.
2. Contractionary periods are based on estimates in Table 1, column (1); details are provided in footnotes to Table 1.
3. Mean forecast errors are reported, with root mean square errors in parentheses.

Table 3. Phillips Curves for Average Weekly Earnings in Manufacturing, with Distributed Lag and Livingston Forecast of Price Inflation, and Livingston Forecast of Labor Cost Inflation[1]

	(1)	(2)	(3)	(4)	(5)
Constant	5.08	5.84	5.56	-.55	.02
	(1.18)	(1.16)	(1.03)	(.56)	(.69)
Six-half geometric lag of CPI inflation	.47	.58	...	...	...
	(.13)	(.13)			
Livingston forecast of CPI inflation	...	...	.93	...	-.06
			(.14)		(.08)
Livingston forecast of AWE inflation[2]	...	...	...	.92	.97
				(.06)	(.07)
Unemployment rate, prime-age males	-.20	-.31	-.45	...	-.27
	(.27)	(.26)	(.23)		(.13)
Productivity growth	.48	.39	.55	...	.14
	(.20)	(.20)	(.18)		(.10)
Dummy variable for all contractionary periods combined[3]	...	-2.84	-2.48	-1.12	-.80
		(1.03)	(.89)	(.48)	(.52)
Post-1983 dummy variable	-1.76	-2.36	-3.15	.17	.82
	(1.11)	(1.08)	(.96)	(.55)	(.57)
$\bar{R}^2$	.29	.35	.48	.83	.85
Standard error	3.37	3.22	2.87	1.63	1.57

1. Standard errors of estimates are reported in parentheses. Sample period is 1952:H2-1990:H1. All specifications include a dummy variable for the first half, which was negative and statistically significant, but considerably larger in columns (1)-(3). (The raw data used to construct average weekly earnings are released in not-seasonally-adjusted form.) See footnotes to Table 1 for further details.

2. This is the percentage change from the prevailing level in the fourth month of the half to the forecasted level for the end of the next half, at an annualized rate.

3. Contractionary periods are based on specification estimated in column (1), and include: 1956:H1-1958:H1, 1969:H2-1971:H2, 1974:H1-1975:H1, and 1979:H1-1980:H1; details regarding the definition of contractionary periods are provided in footnotes to Table 1.

Appendix Table 1A. Hourly Compensation Phillips Curves, with Distributed-Lag and ASA-NBER Forecasts of GNP Deflator Inflation[1]

	Distributed-Lag Forecast				ASA-NBER Forecast			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Constant	5.44 (1.16)	5.38 (1.63)	5.12 (1.08)	3.39 (.71)	5.46 (.88)	5.99 (1.27)	5.52 (.94)	4.49 (.65)
Six-half geometric lag of GNP deflator inflation	.57 (.14)	.68 (.19)	.71 (.14)	1.00	...	...	...	...
ASA-NBER forecast of GNP deflator inflation	...	...	...	...	.82 (.14)	.78 (.18)	.82 (.15)	1.00
Unemployment rate, prime-age males	-.37 (.15)	-.43 (.17)	-.40 (.14)	-.45 (.15)	-.58 (.14)	-.62 (.16)	-.58 (.15)	-.65 (.13)
Productivity growth	-.01 (.12)	-.00 (.12)	-.02 (.11)	.02 (.11)	.15 (.11)	.10 (.12)	.14 (.11)	.20 (.10)
Dummy variables for contractionary periods:[2]								
1969:H1-1970:H2	...	-1.84 (.92)	...	...	...	-.60 (.97)	...	...
1975:H1-1975:H2	...	-1.79 (1.44)	...	...	...	.87 (1.08)	...	...
1979:H2	...	-.97 (1.63)	...	...	...	-.71 (1.51)	...	...
1981:H1-1982:H1	...	-1.25 (1.14)	...	...	...	-.09 (.96)	...	...
Joint significance	...	.09	...	...	...	.82	...	...
All contractionary periods combined	...	...	-1.62 (.61)	-2.07 (.59)	...	...	-.11 (.54)	-.02 (.54)
Post-1983 dummy variable	-1.48 (.75)	-1.53 (.80)	-1.48 (.70)	-.53 (.54)	-1.94 (.54)	-2.05 (.63)	-1.98 (.59)	-1.59 (.50)
$\bar{R}^2$	.63	.65	.68	...	.72	.69	.71	...
Standard error	1.55	1.49	1.44	1.50	1.35	1.40	1.37	1.38

1. Standard errors of estimates are reported in parentheses. Sample period is 1969:H1-1990:H1. The ASA-NBER forecast is the percentage change from the forecasted level of the index for the current quarter to the forecasted level two quarters ahead, at an annualized rate. See footnotes to Table 1 for further details.

2. See footnotes to Table 1 for details regarding definition of contractionary periods. It was assumed that the negative residual in 1979:H2 corresponded to the 1978:H2 contraction identified by Romer and Romer.

Appendix Table 1B. Alternative Estimates and Specifications of Phillips Curves[1]

	Hourly Compensation, Runs of Consecutive Negative Residuals Only				Average Hourly Earnings				Hourly Compensation 1969:H1-1990:H1	
	CPI		GNP Deflator		CPI		GNP Deflator		CPI	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	5.78 (.54)	5.81 (.54)	4.23 (1.22)	5.44 (.89)	5.81 (.53)	5.12 (.47)	7.57 (.83)	6.24 (.66)	6.55 (.76)	5.99 (.90)
Six-half geometric lag of price inflation	.56 (.06)	...	.76 (.16)	...	.34 (.07)	...	.23 (.10)	...	.51 (.08)	...
Livingston forecast of CPI inflation	...	.71 (.08)	...	...	...	.60 (.08)	...	...	...	.69 (.13)
ASA-NBER forecast of GNP deflator inflation	...	...	...	.83 (.15)	...	...	...	.55 (.10)	...	...
Unemployment rate, prime-age males	-.50 (.12)	-.54 (.13)	-.31 (.15)	-.57 (.15)	-.27 (.11)	-.38 (.10)	-.38 (.11)	-.52 (.09)	-.42 (.13)	-.48 (.14)
Productivity growth	.05 (.07)	.10 (.08)	-.03 (.11)	.14 (.11)	-.06 (.08)	.05 (.08)	-.04 (.08)	.11 (.07)	.05 (.10)	.12 (.11)
Dummy variable for all contractionary periods[2]	-1.27 (.53)	-.16 (.51)	-1.80 (.78)	-.22 (.62)	-.75 (.47)	-.49 (.38)	-1.32 (.41)	-.57 (.35)	-1.46 (.52)	-.48 (.51)
Post-1983 dummy variable	-1.42 (.52)	-2.07 (.53)	-1.20 (.72)	-1.99 (.56)	-2.50 (.45)	-2.59 (.37)	-3.26 (.54)	-2.75 (.40)	-2.41 (.53)	-2.55 (.57)
$\bar{R}^2$	.71	.70	.67	.71	.69	.78	.77	.85	.74	.70
Standard error	1.28	1.30	1.47	1.37	1.17	.99	1.07	.84	1.30	1.39
ρ	.23 (.12)	.22 (.12)	...	...	...	...	...	...	...	...

1. Standard errors of estimates are reported in parentheses. Sample period is 1952:H2-1990:H1 for columns (1) and (2), 1969:H1-1990:H1 for columns (3), (4), (7), and (8), and 1965:H1-1990:H1 for columns (5) and (6). Columns (9) and (10) replicate the CPI-Livingston results reported in Table 1 for the same subperiod for which the GNP Deflator-ASA-NBER estimates can be computed. See footnotes to Tables 1 and 1A for further details.

2. Contractionary periods for each of the columns are as follows:

columns (1) and (2)—1957:H1-1958:H2, 1968:H2-1969:H1, 1975:1, 1979:H2, and 1980:H2;
columns (3) and (4)—1969:H1, 1975:H1-1975:H2, 1979:H2, 1981:H1-1982:H1;
columns (5) and (6)—1969:H1-1971:H2, 1974:H1-1975:H1, 1979:H1-1980:H1;
columns (7) and (8)—1969:H1-1971:H2, 1974:H1-1975:H1, 1979:H1, 1982:H1-1982:H2;
columns (9) and (10)—1969:H1-1971:H2, 1975:H1-1975:H2, 1979:H2-1982:H1.

Contractionary periods for columns (1)-(4) are defined as in Table 1, except the runs of negative residuals are not allowed to encompass one positive residual. Contractionary periods for columns (5)-(10) are defined in the same way as in Table 1. It was assumed that the negative residual in 1979:H2 corresponded to the 1978:H2 contraction identified by Romer and Romer, and therefore that for columns (5), (6), (9), and (10) the runs corresponding to the 1978:H2 and 1979:H2 contractions overlapped.

Appendix Table 1C. Alternative Estimates and Specifications of Phillips Curves[1]

	Aggregate Unempl. Rate CPI		Demographically-Adj. Unempl. Rate[2] CPI		Perfect Foresight CPI		Inflation Forecasts GNP Deflator		Quarterly Data GNP Deflator	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)
Constant	6.29 (.68)	6.44 (.73)	6.74 (.77)	7.04 (.81)	5.78 (.49)	4.45 (.53)	5.12 (1.08)	4.20 (1.25)	6.62 (1.24)	6.25 (.91)
Six-half geometric lag of price inflation[3]	.64 (.07)	...	.64 (.07)	...	.60 (.06)	...	.71 (.14)	...	.53 (.12)	...
Livingston forecast of CPI inflation	...	.78 (.09)	...	.79 (.09)	...	...	...	...	...	...
ASA-NBER forecast of GNP deflator inflation	...	...	...	...	...	...	...	...	...	.82 (.13)
Actual inflation rate	...	...	...	...	...	.61 (.06)	...	.66 (.13)	...	...
Unemployment rate	-.45 (.13)	-.52 (.14)	...	...	...	...	...	...	...	...
Perry-weighted unemployment rate	...	...	-.23 (.06)	-.28 (.07)	...	...	...	...	...	...
Unemployment rate, prime-age males	...	...	...	...	-.50 (.12)	-.30 (.11)	-.40 (.14)	-.20 (.14)	-.49 (.17)	-.72 (.14)
Productivity growth	.03 (.08)	.11 (.08)	.03 (.08)	.12 (.08)	.03 (.07)	.23 (.09)	-.02 (.11)	.09 (.12)	.10 (.06)	.17 (.06)
Dummy variable for all contractionary periods[4]	-1.28 (.50)	-.14 (.47)	-1.29 (.50)	-.16 (.46)	-1.15 (.47)	-.55 (.45)	-1.62 (.61)	-.26 (.57)	-2.18 (.69)	-1.17 (.59)
Post-1983 dummy variable	-1.79 (.51)	-2.40 (.54)	-1.70 (.51)	-2.31 (.53)	-1.50 (.48)	-1.53 (.47)	-1.48 (.70)	-1.47 (.71)	-1.99 (.70)	-1.80 (.57)
$\bar{R}^2$	.69	.69	.69	.70	.71	.66	.68	.68	.63	.66
Standard error	1.32	1.32	1.32	1.30	1.28	1.38	1.44	1.45	1.71	1.63
ρ	.19 (.12)	.24 (.12)	.19 (.12)	.22 (.12)	.14 (.12)	.03 (.12)	...	...	.32 (.12)	.19 (.11)

1. Standard errors of estimates are reported in parentheses. Sample period is 1952:H2-1990:H1 for columns (1)-(6), 1969:H1-1990:H1 for columns (7)-(8), and 1969:Q1-1990:Q2 for columns (9) and (10). Data are at semi-annual frequency in columns (1)-(8), and quarterly frequency in columns (9) and (10). Quarterly dummy variables were insignificant when included in specifications estimated in columns (9) and (10), and were omitted. See footnotes to earlier tables for further details.

2. Unemployment rates of teens, men aged 20 and over, and women aged 20 and over, weighted by 1965 labor force participation rates.

3. Twelve-quarter geometric distributed lag for columns (9) and (10).

4. Contractionary periods for each of the columns are as follows:
   columns (1)-(6)—same as Table 1;
   columns (7) and (8)—same as Table 1A;
   columns (9) and (10)—1969:Q1-1970:Q2, 1974:Q4-1975:Q2, 1979:Q2-1979:Q3, and 1981:Q2-1981:Q4.

Contractionary periods are defined as in Table 1, except that for columns (9) and (10) the analysis was based on quarterly residuals, using the quarters identified as the beginnings of contractionary periods in Romer and Romer (1989) (1955:Q3, 1968:Q4, 1974:Q2, 1978:Q3, and 1979:Q4).

Appendix Table 1D. Estimates of Phillips Curves for Union and Nonunion Workers (Employment Cost Index: Wages and Salaries)[1]

	Private Industry Workers		Union Workers		Nonunion Workers	
	(1)	(2)	(3)	(4)	(5)	(6)
Constant	7.06	4.92	7.38	5.17	7.00	4.84
	(.77)	(.97)	(1.07)	(1.56)	(.97)	(1.19)
Six-half geometric lag of price inflation	.27	...	.38	...	.21	...
	(.06)		(.07)		(.07)	
Livingston forecast of CPI inflation	...	.48	...	.63	...	.43
		(.09)		(.13)		(.10)
Unemployment rate, prime-age males	-.32	-.19	-.35	-.22	-.34	-.22
	(.09)	(.09)	(.13)	(.15)	(.12)	(.11)
Dummy variable for all contractionary periods[2]	-.42	.08	-1.08	-.78	-.78	-.40
	(.39)	(.33)	(.55)	(.59)	(.49)	(.40)
Post-1983 dummy variable	-2.59	-2.07	-3.88	-3.54	-2.43	-1.86
	(.36)	(.38)	(.48)	(.59)	(.45)	(.46)
$\bar{R}^2$	.90	.91	.91	.90	.80	.84
Standard error	.67	.61	.89	.97	.84	.75

1. Standard errors of estimates are reported in parentheses. Sample period is 1976:H2-1990:H1. Sspecifications in columns (3)-(6) include a dummy variable for the first half; the dummy variable was not statistically significant in columns (1) and (2). (The ECI data are not seasonally adjusted.) The productivity growth variable always entered with a negative coefficient, and was therefore excluded from the equations. See footnotes to Table 1 for further details.

2. Contractionary periods for each of the columns are as follows:
   - columns (1) and (2)--1977:H1, 1978:H2-1979:H1, and 1981:H2-1982:H1;
   - columns (3) and (4)--1979:H1-1979:H2, and 1981:H2;
   - columns (5) and (6)--1977:H1, 1978:H2-1979:H1, and 1980:H2-1982:H1.

   Contractionary periods are defined as in Table 1.

Appendix Table 2A. Forecasted and Actual Changes in GNP Deflator Inflation[1]

A. Regression Results

	Change in Distributed Lag Forecast (1)	Change in ASA-NBER Forecast (2)	Change in Actual Inflation (3)
Constant	-.14	.32	.39
	(.27)	(.25)	(.24)
Dummy variables for contractionary periods combined[2]	.22	-.58	-1.36
	(.51)	(.35)	(.46)
Post-1983 dummy variable	.13	-.48	-.35
	(.42)	(.40)	(.38)
$\bar{R}^2$	.05	.15	.28
Standard error	1.52	.83	1.50
ρ	-.33	.32	-.47
	(.15)	(.15)	(.14)

B. Forecast Errors[3]

	Distributed Lag Forecast (1)	ASA-NBER Forecast (2)
All contractionary periods combined	-1.36	1.24
	(1.63)	(1.46)
Post-1983	-.00	-.56
	(.85)	(.72)
Entire sample period	-.14	.60
	(1.72)	(1.51)

1. Standard errors of estimates are reported in parentheses. Sample period is 1969:H1-1990:H1. See footnotes to Tables 1 and 2 for further details.
2. Contractionary periods are based on estimates in Appendix Table 1A, column (1); details regarding the definition of contractionary periods are provided in footnotes to Table 1.
3. Mean forecast errors are reported, with root mean square errors in parentheses.

Appendix Table 2B. Forecasted and Actual Changes in CPI and GNP Implicit Price Deflator Inflation, for Contractionary Periods Based on Runs of Negative Residuals Only[1]

A. Regression Results

	Change in Distributed Lag Forecast		Change in Survey Forecast		Change in Actual Inflation	
	CPI (1)	GNP Defl. (2)	CPI (3)	GNP Defl. (4)	CPI (5)	GNP Defl. (6)
Constant	-.17	-.10	.16	.28	.24	.36
	(.24)	(.25)	(.14)	(.22)	(.26)	(.21)
Dummy variable for all contractionary periods[2]	1.12	.15	-.34	-.69	-1.32	-1.81
	(.63)	(.59)	(.28)	(.38)	(.69)	(.50)
Post-1983 dummy variable	.31	.09	-.34	-.43	-.10	-.32
	(.54)	(.41)	(.32)	(.37)	(.59)	(.34)
$\bar{R}^2$	.02	.05	.10	.16	.02	.34
Standard error	1.75	1.52	.71	.83	1.90	1.44
ρ	...	-.34	.34	.27	...	-.52
		(.15)	(.11)	(.16)		(.14)

B. Forecast Errors[3]

	Distributed Lag Forecast		Survey Forecast	
	CPI (1)	GNP Defl. (2)	CPI (3)	GNP Defl. (4)
All contractionary periods combined	-1.08	-1.71	1.91	.89
	(2.84)	(1.45)	(1.65)	(1.27)

1. Standard errors of estimates are reported in parentheses. Sample period is 1953:H1-1990:H1 for columns (1), (3) and (5), and 1969:H1-1990:H1 for columns (2), (4), and (6). See footnotes to Tables 1, 2, and 1A for further details.
2. Contractionary periods for columns (1), (3), and (5) are defined as in Appendix Table 1B, columns (1) and (2), and for columns (2), (4), and (6), as in Appendix Table 1B, columns (3) and (4); details regarding the definition of contractionary periods are provided in footnotes to Table 1.
3. Mean forecast errors are reported, with root mean square errors in parentheses. Estimates for the post-1983 sample period and the entire sample period are given in Tables 2 and 2A.

Appendix Table 2C. Forecasted and Actual Changes in CPI Inflation: 1969:H1-1990:H1[1]

A. Regression Results

	Change in Distributed Lag Forecast (1)	Change in Livingston Forecast (2)	Change in Actual Inflation (3)
Constant	.09	.46	.75
	(.53)	(.28)	(.44)
Dummy variables for contractionary periods combined[2]	-.34	-.72	-1.67
	(.78)	(.36)	(.67)
Post-1983 dummy variable	.05	-.61	-.63
	(.79)	(.42)	(.65)
$\bar{R}^2$	-.04	.18	.09
Standard error	2.12	.82	2.11
ρ	...	.32	-.24
		(.15)	(.16)

B. Forecast Errors[3]

	Distributed Lag Forecast (1)	ASA-NBER Forecast (2)
All contractionary periods combined	-.95	1.54
	(2.61)	(1.62)
Post-1983	.13	-.27
	(1.56)	(1.09)
Entire sample period	-.00	.85
	(2.20)	(1.80)

1. Standard errors of estimates are reported in parentheses. Columns (9) and (10) replicate the CPI-Livingston results reported in Table 1 for the same subperiod for which the GNP Deflator-ASA-NBER estimates can be computed. See footnotes to Tables 1 and 2 for further details.
2. Contractionary periods are based on specification estimated in Appendix Table 1B, columns (9) and (10).
3. Mean forecast errors are reported, with root mean square errors in parentheses.

Table 3A. Phillips Curves for Average Weekly Earnings in Manufacturing, with Distributed Lag and Livingston Forecast of Price Inflation, and Livingston Forecast of Labor Cost Inflation, for Contractionary Periods Based on Runs of Negative Residuals Only[1]

	(1)	(2)	(3)	(4)
Constant	5.70	5.49	-.67	.01
	(1.17)	(1.01)	(.55)	(.71)
Six-half geometric lag of CPI inflation	.54	...	...	...
	(.13)			
Livingston forecast of CPI inflation	...	.94	...	-.04
		(.14)		(.11)
Livingston forecast of AWE inflation	...	...	.91	.96
			(.06)	(.08)
Unemployment rate, prime-age males	-.31	-.51	...	-.30
	(.27)	(.23)		(.13)
Productivity growth	.35	.50	...	.13
	(.21)	(.18)		(.10)
Dummy variable for all contractionary periods combined[2]	-3.54	-3.87	-1.61	-1.37
	(1.47)	(1.28)	(.66)	(.73)
Post-1983 dummy variable	-2.09	-2.94	.27	.94
	(1.08)	(.93)	(.54)	(.60)
$\bar{R}^2$	.33	.49	.83	.85
Standard error	3.26	2.85	1.63	1.57

1. Standard errors of estimates are reported in parentheses. Sample period is 1952:H2-1990:H1. See footnotes to Tables 1 and 3 for further details.
2. Contractionary periods are based on specification estimated in Table 3, column (1), and include: 1956:H1, 1969:H2-1970:H2, 1974:H1, 1979:H1, and 1980:H1. Contractionary periods are defined as in Table 3, expect the runs of negative residuals are not allowed to encompass one positive residual; further details regarding the definition of contractionary periods are provided in footnotes to Table 1.