INFLATION AND WAGE INDEXATION IN THE POSTWAR U.S.

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ABSTRACT

This paper examines the relationship between inflation and wage indexation in the postwar U.S. using data on the prevalence of cost-of-living adjustments in major collective bargaining agreements. I find that increases in inflation precede increases in wage indexation but reductions in inflation do not precede reductions in wage indexation. There is virtually no evidence that wage indexation affects inflation.

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INFLATION AND WAGE INDEXATION IN THE POSTWAR U.S.

For the postwar U.S., the rate of inflation is positively related to a measure of the prevalence of wage indexation: the number of workers covered by cost-of-living adjustment clauses as a percentage of the number of workers subject to major collective bargaining agreements (those covering 1000 or more workers).[1] Figure 1 is a graph of this variable (INDEX) and the difference of the log of the annual average of the GNP deflator (INFL) scaled by a factor of 10. The two series are broadly similar in their movements over the period from 1957 to 1990. Both fell in the late 50s, though inflation began to rise in the early 60s while indexation did not begin to rise until the mid60s. Both series peaked once in the mid70s and again in the early 80s and both fell through much of the 80s. The correlation coefficient is .43.

It seems likely that increased inflation would cause the prevalence of wage indexation to increase, but greater indexation might also cause higher inflation. Unfortunately, currently available methods are not fully capable of identifying causal relationships. It may be possible, however, to discover whether one variable <u>precedes</u> -- i.e., "Granger causes" -- the other. In

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[1] The series is available on an annual basis since 1957. For 1957-84, the source is Hendricks and Kahn (1985), Table 2-7. For later years the sources are various issues of <u>Monthly Labor Review</u>. Holland (1988) demonstrates that this variable is positively related to the responsiveness of union, nonunion, and economy-wide wage aggregates to price-level shocks. His findings suggest that there is implicit indexation for nonunion workers and also that the indexation variable is a suitable proxy for the overall degree of wage indexation in the economy -- both explicit and implicit.

this paper I find that increases in inflation precede increases in wage indexation but reductions in inflation do not precede reductions in wage indexation. There is virtually no evidence that wage indexation affects inflation.

Theories Relating Inflation and Wage Indexation

Higher inflation may lead to greater use of wage indexation. Danziger (1984) presents a model in which an increase in inflation uncertainty creates greater uncertainty about real wages for workers with nonindexed contracts and leads to greater wage indexation. Ball's (1990) model implies that a higher rate of inflation produces greater uncertainty about the future direction of government policy and therefore greater inflation uncertainty.[2]

On the other hand, increased wage indexation may also lead to higher inflation. Fischer and Summers (1989) and Ball and Cecchetti (1991) show that increased indexation reduces the cost of inflation and thus may increase the time-consistent inflation rate.[3]

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[2] Holland (1986) finds that the prevalence of wage indexation is positively related to lagged values of a measure of inflation uncertainty. A number of authors have found evidence of a positive relationship between the inflation rate and inflation uncertainty, a recent one being Evans (1991). Cecchetti (1987) finds that the use of incomes policies (and not inflation itself) during the 1960s and early 1970s led to substantial increases in the degree of adjustment of wages to inflation in union contracts.

[3] Fischer (1983) presents evidence that indexation did not significantly affect the impact of the 1974 oil shock on the inflation rates of various countries.

Temporal Ordering

A finding that one variable precedes another does not necessarily imply causality. In the present case, however, causality implies precedence. If inflation causes wage indexation, inflation would change first because renegotiation of indexation clauses would be time-consuming. Likewise, if wage indexation causes inflation, indexation would change first because policymakers have to be aware of the greater incentive to inflate before they react to it.

The standard test for temporal ordering, or Granger causality, examines whether lagged values of a variable X help to explain the current value of another variable Y over and above the explanation provided by lagged values of Y, assuming that both X and Y are stationary. If X and Y are not stationary and not cointegrated but ΔX and ΔY are stationary, then the test requires replacing X with ΔX and Y with ΔY. Two nonstationary series are cointegrated if some linear combination of the two is stationary. They are then said to have a common stochastic trend: they tend to move together over long periods of time. If X and Y are cointegrated, then a more comprehensive test for temporal ordering described by Engle and Granger (1987) allows for a relationship between the two variables stemming from their common stochastic trend. Specifically, if two variables are cointegrated, then the lagged level of one may help to explain the current change in the other even if lagged changes do not. In other words, if X and Y have a common trend, the current change in X may be caused partly by X moving into alignment with Y. This is referred to as error correction. Engle and Granger show that if X and Y are cointegrated, Granger causality must exist between them in at least one direction, though two-way causality is also possible.

The error-correction model is

(1) $\Delta X_t = \alpha + \lambda\varepsilon_{t-1} + \Sigma_{i=1}\beta_i\Delta X_{t-i} + \Sigma_{i=1}\psi_i\Delta Y_{t-i} + u_t$,

where ε_{t-1} is the lagged value of the residual from the cointegrating equation:

(2) $X_t = \theta + \xi Y_t + \varepsilon_t$.

In other words, the value of ε in one period represents the error to be "corrected" (at least partially) in the next period. The null hypothesis that Y does not Granger cause X is rejected if either the ψ_i's are jointly significant or if λ is significant. If X and Y are positively related, then λ would be negative: an abnormally high value of X relative to Y results in a reduction in X.

Results of Tests for Temporal Ordering

The measure of wage indexation is the same as that used in Figure 1. The inflation rate is measured as the log difference of the annual average of either the GNP deflator (as in Figure 1), the GDP deflator, or the Consumer Price Index (CPI). For the most part, the results are similar for all three price indexes. For the sake of brevity, I will discuss only the results for the GNP deflator except when the results for one of the other price indexes differs substantially.

As is often the case with postwar data, one cannot say with confidence whether the series are stationary or nonstationary (or cointegrated if nonstationary). I perform the augmented Dickey-Fuller test for stationarity (see Dickey and Fuller 1979, 1981) on the inflation and wage indexation series. In general, the tests do not reject nonstationarity but they are known to have low power. Johansen's (1988) maximum-likelihood procedure indicates cointegration between the inflation rate and wage indexation. Engle and Granger's (1987) residual-based method, however, generally does not.[4]

I therefore perform the tests for temporal ordering based on three different assumptions: (1) inflation and indexation are stationary, (2) inflation and indexation are nonstationary but not cointegrated, and (3) inflation and indexation are cointegrated. In all cases, a search is conducted over three lagged values and the regression with the highest adjusted R^2 is presented. The results are not sensitive to the number of lags included. Because of searching over three lagged values and differencing, the regressions use the sample period 1961-1990.[5]

Table 1, columns 1 and 2 present the results for

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[4] The software program Microfit 3.0 by Pesaran and Pesaran (1991) is used for tests of stationarity, cointegration, and temporal ordering.

[5] In one regression an LM test detects serial correlation. Adding additional lagged values corrects the problem but does not alter the results. I do not present the results of the "corrected" regression because it has a lower adjusted R^2 than the one presented.

regressions in levels, which are based on Assumption 1. In Column 1, the dependent variable is wage indexation (INDEX) and in Column 2 it is the inflation rate (INFL). In Column 1, three lagged values of INFL have a significant positive effect on INDEX. The F-statistic is significant at less than the 1% level and the sum of the coefficients is positive and significant (t = 5.60). In Column 2, three lagged values of INDEX have no significant effect on INFL.

Table 1, columns 3 and 4 present the results for regressions in first differences that are based on Assumption 2. In column 3, lagged inflation affects wage indexation at a significance level of 6% for the F-statistic and the sum of the coefficients of lagged inflation is positive and significant at the 1% level (t = 2.72). In column 4, lagged wage indexation has no effect on inflation.

Table 1, columns 5 and 6 present the results of estimating the error-correction model from equation 1: regressions in first differences that are based on Assumption 3. The cointegrating equation is estimated using the Johansen method.[6] Normalized, that equation is

(3) $INDEX_t = 7.18 + 7.27 INFL_t$

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[6] The relationship between inflation and wage indexation is not likely to be linear, however, because indexation cannot exceed 100 percent. Nonetheless, I test for cointegration using what should properly be considered a linear approximation of a nonlinear model. Therefore, the results apply only to rates of inflation in the neighborhood of those experienced during the sample period. Using the log of indexation instead of the level does not improve the R^2 of the regressions.

or

(4) $INFL_t = -0.99 + 0.14INDEX_t$.

The row denoted EC contains the coefficients of the error-correction terms, the lagged residuals from the appropriate version of the cointegrating equation. Inflation precedes wage indexation and wage indexation does not precede inflation. The error-correction term in the indexation regression is negative as expected and strongly significant (t= -5.26). Three lagged values of inflation (first difference) have negative coefficients with an F-statistic that is significant at the 6% level and a t-statistic for the sum of the coefficients of -2.40 (significant at the 2% level). The negative coefficients appear only when the error-correction term is included, however, so the overall relationship between indexation and lagged inflation is clearly positive. In the inflation regression, the error correction term has a t-statistic of -1.16 and lagged indexation has no effect.

The results using the GDP deflator are virtually identical to those using the GNP deflator and to those using the CPI under Assumptions 1 and 2 (and are not reported). But the results using the CPI under Assumption 3 (cointegration) are different. As with the two deflators, inflation precedes wage indexation since the error-correction term in the indexation regression is negative and significant (t = -4.98). In contrast to the results using the two deflators, however, wage indexation also precedes inflation. In the inflation regression, the error-correction term is negative with a significant t-statistic of -3.46.

Therefore, any evidence that indexation precedes inflation is very weak. To investigate further, I examined the evidence on temporal ordering between wage indexation and the money growth rate using both M1 and M2 and also the rate of growth of monetary base (Federal Reserve Bank of St. Louis version). There is no evidence that indexation precedes either money growth or base growth, suggesting that increases in wage indexation have not affected the willingness to engage in inflationary monetary policy.

Asymmetric Effects of Inflation on Wage Indexation

Tests for asymmetry indicate that increases in the inflation rate precede increases in wage indexation but decreases in the inflation rate do not precede decreases in wage indexation. It may be that it is more difficult to remove indexation clauses from contracts than it is to add them.

The tests are based on constructing two series, POS and NEG, where POS = max(0,ΔINFL) and NEG = min(0,ΔINFL). I regress lagged values of POS, NEG, and ΔINDEX on ΔINDEX. Three lagged values of POS are highly significant: the F-statistic of 4.07 is significant at the 2% level and the sum of the coefficients has a t-statistic of 3.31. Lagged values of NEG have essentially no effect since maximizing adjusted R^2 implies a lag length of zero.[7]

[7] I added up to six lagged values of NEG without altering the results.

The finding of asymmetric effects suggests that inflation and wage indexation are not cointegrated despite the findings of the Johansen test. If the two variables were cointegrated, they would move both up and down together over long periods of time. The asymmetry also appears in tests using the CPI, which suggests that we should discount the anomalous result that wage indexation precedes CPI inflation when cointegration is assumed.

Indexation and the Dynamics of Inflation

It is possible that an increase in indexation affects the dynamics of inflation without causing higher inflation. Indexation may reduce the likelihood that policymakers will choose to disinflate, in which case one would expect greater persistence of inflation during times of greater indexation.

Within the sample period, there is a period of eleven years duration (1961-71) in which the prevalence of wage indexation is clearly lower than in other periods. During that period, indexation averages 25.7% and never exceeds 33%. There also is an eleven-year period (1975-85) during which indexation is clearly greater than in other periods. The average is 57.8% and the minimum is 51%. I examined quarterly data for inflation of the GNP deflator in each of the time periods. I first estimated AR(1) processes for inflation in both periods. The estimate of the autoregressive parameter (ρ) for the low-indexation period is .53 ($t = 4.08$) and for the high-indexation period is .77 (t =

8.56).[8]

The finding raises the possibility that inflation is more persistent during high-indexation periods. On further examination, however, this does not appear to be the case. For AR(1) models of inflation, I estimate "rolling regressions" over samples of 40 quarters -- i.e., the starting and ending periods change with each new observation. There is only one major change in the dynamics of the inflation process, and it occurs between 1968:1 and 1970:2 when the estimate of ρ increases from .13 to .54. The prevalence of wage indexation, on the other hand, is essentially constant from 1961 through 1972 (see Figure 1). It does not begin to increase until 1972. Therefore, greater prevalence of wage indexation is not the cause of the major change in inflation dynamics that occurred during the period.

A minor change in inflation dynamics occurrred as the persistence of inflation increased again in the late 1980s. Between 1985:1 and 1990:3, the estimates of ρ range from .74 to .86. The prevalence of wage indexation, however, fell during this time from 55 to 39 percent.[9]

Conclusion

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[8] Alogoskoufis and Smith (1991) and Evans find that the inflation process in the U.S. can be characterized as an AR(1) process with time-varying parameters.

[9] Between 1961:1 and 1967:4, the estimates of ρ are essentially zero, ranging from -.10 to .12. Through the 1970s until 1984:4, the estimates fluctuate between .43 and .67.

In the postwar U.S., increases in inflation have preceded increases in the prevalence of wage indexation. Decreases in inflation, however, have not preceded decreases in wage indexation. There is virtually no evidence that wage indexation has affected inflation.

The results should not be extended to other types of indexation. It is not clear that inflation has led to greater use of indexed financial instruments. Furthermore, wage indexation may reduce the <u>benefits</u> of inflation as well as the costs. For example, if inflation reduces real wages (because of fixed nominal wages), then labor demand and employment increase. Increased indexation would reduce the positive effect on employment. Therefore, the impact of wage indexation on the incentive for policymakers to inflate may be weaker than the impact of other types of indexation.

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Table 1

Tests for temporal ordering between the inflation rate (INFL) and the prevalence of wage indexation (INDEX), 1961-1990.

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	INDEX	INFL	ΔINDEX	ΔINFL	ΔINDEX	ΔINFL
F-statistic	12.7	1.39	2.75	0.86	2.80	----
sum of coefficients	2.45 (.44)	-.004 (.02)	3.32 (1.22)	-.001 (.06)	-3.87 (1.61)	----
EC	----	----	----	----	-.396 (.08)	-.116 (.10)
number of lags (independent variable)	3	3	3	2	3	0
number of lags (dependent variable)	1	2	0	0	0	0
R^2	.94	.78	.24	-.01	.64	.01

Standard errors are in parentheses. The F-statistic tests the joint significance of the lagged independent variables. The sum of coefficients is for the lagged independent variables. EC represents the error-correction term (if applicable).