The U.S.Inflation Process: Does Nominal Wage Inflation cause Price Inflation, Vica-versa, or Neither?

Abstract

Low unemployment has revived concerns about accelerated inflation. This paper examines the relationship between price and nominal wage inflation. It finds that it varies by business cycle. Prior to the great oil shock of 1973, price and nominal wage inflation were unconnected in a Granger-causal sense. In the 1970s, wage inflation caused price inflation. In the 1980s, the relationship reversed and price inflation caused nominal wage inflation. In the 1990s, the pattern has changed again, and there is some weak evidence of bidirectional causality between wages and PPI inflation. However, wages continue to have no impact on CPI inflation, which is widely viewed as one of the Fed's target variables. This suggests that wage inflation should be de-emphasized as a monetary policy information variable.

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Issues

The last twelve months have been an interesting period for monetary policy. On one hand, with the unemployment rate falling to a twenty three year low of 4.3%, there have been renewed concerns about inflation accelerating. On the other hand, actual inflation has continued to fall, and there is the possibility of deflation owing to east Asia's economic collapse and the ensuing global commodity price deflation. In this mixed economic environment, the outlook for U.S. inflation has become hard to ascertain.

Given the finely balanced situation it is important that policy makers avoid any missteps, and for this reason an understanding of the inflation process remains as important as ever. In particular, the relationship between nominal wage inflation and price inflation remains a crucial matter. Those who believe that the low rate of unemployment risks sparking renewed inflation presumably have in mind a model whereby inflation originates in labor markets and is wage driven.

Over and above immediate policy concerns, there are important theoretical issues at stake. Thus, the pattern of price - wage inflation causality has implications for the relative validity of the NAIRU and conflict approaches to inflation. NAIRU theory, as articulated by Friedman (1968), Phelps (1967), and Lucas (1973), is a monetary theory of inflation. Inflation results from excessive money supply growth, and it first shows up in the goods market through higher prices. A price - wage spiral may then ensue, but the initiating event is a monetary shock that should first be observed in goods markets. Conflict theory maintains that inflation is the result of conflict over income distribution, and predicts that it first shows up in labor markets through higher nominal wages. Once again, a price wage spiral may ensue, but this time the initiating event should be a nominal wage shock.

The current paper examines the empirical relationship between price and nominal wage inflation using Granger-causality analysis. The study builds on earlier work by Gordon (1988), Mehra (1991), and Emery and Chang (1996). The principal innovations are the use of monthly data and the use of nominal wage data. All of the above mentioned studies used quarterly data which gives rise to a problem of time-aggregation. That is, the temporal sequence of impulses to prices and nominal wages gets lost owing to aggregation of data into quarterly form, thereby making it appear as if impulses hit both variables simultaneously.

A second difference from the studies by Mehra (1991) and Emery and Chang (1996) concerns the wage variable. Those studies used unit labor costs as the wage measure, and such a measure depends on both nominal wages and labor productivity. The current study uses gross average hourly nominal wages of production and non-supervisory workers, a group that constitutes approximately 80% of workers. Productivity growth still impacts inflation, but in this set-up it does so through prices with faster productivity growth causing competitive firms to lower prices faster.

The principal finding of the paper is that there is no unique relationship between price and nominal wage inflation. Instead, the relationship has varied by business cycle. In the "Golden Age" era prior to the great oil shock of 1973, price and nominal wage inflation were unconnected in a Granger-causal sense, and each had an independent life. In the 1970s, wage inflation Granger-caused price inflation. In the 1980s, the relationship reversed and price inflation Granger-caused nominal wage. Finally, in the 1990s the economy has again changed and there is weak evidence of bi-directional causality. However, wages do not cause CPI inflation which is the Fed's price target variable. This suggests de-emphasizing the employment cost index (ECI) as an information variable for guiding monetary policy.

Empirical evidence on the relation between wage and price inflation

Identifying causality is a particularly difficult problem. One method for doing so is Granger-causality analysis, which involves running regressions of the form

$$(1)\quad Yt = a0 + \sum_{i=1}^{n} bt\text{-}iYt\text{-}i + \sum_{i=1}^{n} ct\text{-}iXt\text{-}i + ut$$

Formally, a variable X is defined to Granger cause a variable Y if lagged values of X contain information, over above the information already contained in lagged values of Y, that is statistically significant for predicting current values of Y. This is the case if the F-statistic associated with the ct-i coefficients is statistically significant.

Though useful, there are also limitations to Granger causality analysis. First, Granger-causality analysis represents a statistician's notion of causality that identifies "temporal" causality rather than theoretical causality. As a result, there is always a danger of the rooster and the sunrise problem: the rooster crows before the sunrise, and the rooster's crow therefore contains information about the coming sunrise, but it would be hard to argue that the rooster's crow causes the sunrise. Second, Granger-causality analysis involves looking for a statistical relation between variables X and Y, but it is possible that a third variable Z may be what matters. In this case, one could mistakenly conclude that X causes Y when X is in fact proxying for the effect of Z. Third, Granger-causality analysis focuses on the relationship between lagged values of X and current values of Y. However, many economic relationships involve simultaneous interaction of variables, and this simultaneous causal dimension is not picked up at all.

Despite these limitations, Granger-causality analysis remains a useful diagnostic tool. In economics, no single piece of evidence is conclusive. Instead, an array of evidence is needed, and Granger-causality methods can contribute to assembling such an array. Given this, the paper reports results from Granger causality regressions between wage inflation and several measures of price inflation. The definition of variables was as follows:

WAGEINF = annualized percentage rate of change in gross average hourly earnings

CPIINF = annualized percentage rate of change in the consumer price index (CPI)

CPIXINF = annualized percentage rate of change in the consumer price index excluding food and energy (CPI-X)

PPIINF = annualized percentage rate of change in the producer price index (PPI)

Data was in monthly form. The full sample period was 1964.01 - 1997.12. Rates of inflation were computed as the first difference of the natural log, and then converted to an annualized percentage rate.

In addition to reporting results for the full sample, results are also reported for the sub-sample periods 1964.02 - 1973.11, 1973.11 - 1981.07, 1981.07 - 1990.07, and 1990.07 - 1997.12. Recent U.S. economic history is widely viewed as consisting of three periods: a post-World War II Golden Age, a period of breakdown in the 1970s, and a new age of diminished expectations that began in the early 1980s. These sub-samples are intended to capture these sub-divisions, but they are also conditioned on NBER dating of business cycle peaks. 1973.11 corresponds to the beginning of the

recession associated with the first OPEC oil shock, while 1981.07 corresponds to the beginning of the great Volcker - Reagan recession. 1990.07 corresponds to the beginning of the Bush recession.

Granger causality analysis involves estimating autoregressive equations using ordinary least squares (OLS). To be statistically valid, the variables in the regressions must satisfy the assumptions of OLS, which means that they should be stationary (i.e. constant mean and finite variance). To test for stationarity, all variables were therefore subjected to an augmented Dickey - Fuller test. The results are reported in table 1, and show that all the measures of wage and price inflation both within the full and sub-sample periods are stationary at the 5% significance level.

Table 2 reports the results of the Granger causality regressions testing for causality between wage inflation and CPI inflation. These regressions were run using 3, 6, 12 and 18 month lag structures. Subject to the caveats regarding interpretation of Granger causality regressions, the principle findings are as follows.

(1) Over the full sample period there appears to be bi-directional causality between all measures of inflation (CPI, CPI-X, and PPI) and hourly wage inflation. This pattern holds for all lag structures.

(2) However, when the full sample period is broken down into sub-sample periods a richer and more complex story emerges. In the Golden Age period (1964.01 - 1973.11) there appears to be no causal relation between wage inflation and price inflation. This holds for all measures of price inflation, and all lag lengths.

(3) In the breakdown period (1973.11 - 1981.07) the relationship changes, and the inflation begins to resemble a conflict inflation. Thus, lagged wage inflation explains (Granger causes) both CPI and PPI inflation, but CPI and PPI inflation do not cause wage inflation. Paradoxically, this pattern is inconsistent with natural rate dynamics, yet this is actually the period when natural rate theory started to dominate the American economics profession.

(4) In the 1980s (1981.07 - 1990.07), the dynamics of the inflation process completely reverse and price inflation now drives wage inflation. Now CPI, CPI-X, and PPI inflation, all cause wage inflation. There is some evidence that wage inflation causes CPI inflation using a 3 month lag, but it has no causal impact when the lag is longer.

(5) Finally, in the most recent period (1990.07 - 1997.12) there is a mixed pattern. There is no Granger-causal relationship between wage and CPI inflation, which resembles the pattern that prevailed in the 1960s. CPI-X inflation does appear to Granger-cause wage inflation, but not vica-versa. Meanwhile wage inflation does appear to cause PPI inflation, but the reverse does not hold.

In sum, the Granger - causality evidence on the relationship between wage and price inflation reveals a complex picture that varies by business cycle and according to the measure of price inflation. Such evidence suggests that a single mono-causal approach to explaining inflation is inadequate and that a multi-causal approach is needed. The 1970s display a pattern of price - wage inflation causality that is consistent with conflict inflation. However, the 1960s were characterized by an absence of a causal relation between wage and CPI inflation, a pattern which has somewhat reasserted itself in the 1990s. When it comes to the relation between wage and PPI inflation, the pattern is broadly similar though there is some evidence that wages are still causing PPI inflation.

The results also have important policy implications. In recent years the Federal Reserve has increasingly committed itself to watching wages as an indicator of coming inflation, a stance which is evidenced by Chairman Greenspan's interest in the employment cost index (ECI). Such a position is consistent with a belief in conflict inflation, and might have been appropriate in the 1970s when wage inflation did Granger-cause price inflation. However, it is not justified today when there appears to be no relation between CPI inflation and wage inflation.

References

Emory, K.M., and Chang, C., "Do Wages Help Predict Inflation?" Economic Review, Federal Reserve Bank of Dallas, First Quarter 1996, 2 - 9.

Friedman, M., "The Role of Monetary Policy," American Economic Review, 58 (May 1968), 1-17.

Gordon, R.J., "The Role of Wages in the Inflation Process," American Economic Review, 78 (May 1988), 276-83.

Lucas, R.E., Jr., "Some International Evidence on Output-Inflation Tradeoffs," American Economic Review, 63 (1973), 326-34.

Mehra, Y.P., "Wage Growth and the Inflationary Process: An Empirical Note," American Economic Review, 81 (September 1991), 931-37.

Palley, T.I., Post Keynesian Economics: Debt, Distribution and the Macro Economy, St.Martin's Press, New York, 1996.

Phelps, E., "Money Wage Dynamics and Labor market Equilibrium," Journal of Political Economy, 75 (July - August 1967), 678-711.

	Sample Period				
	1964.02-1997.12	1964.02-1973.11	1973.11-1981.07	1981.07-1990.07	1990.07-1997.12
WAGEINF	-5.96	-5.49	-4.97	-4.59	-4.45
CPIINF	-5.00	-3.15	-2.91	-4.90	-3.70
CPIXINF	-4.63	-3.37	-2.94	-4.13	-3.32
PPIINF	-6.71	-4.37	-3.71	-5.91	-4.71
Mackinnon critical values:					
1%	-3.45	-3.49	-3.50	-3.49	-3.50
5%	-2.87	-2.89	-2.89	-2.89	-2.89
10%	-2.57	-2.58	-2.58	-2.58	-2.58

Table 1 Results from augmented Dickey-Fuller stationarity tests based on: D(Y) = a0 + a1D(Y(-1)) + a2D(Y(-2)) + residual
where D is the first-difference operator.

Null Hypothesis	p-values lag=3	lag=6	lag=12	lag=18
1964.01 - 1997.12				
CPIINF is not Granger Caused by WAGEINF	0.00	0.00	0.00	0.00
WAGEINF is not Granger Caused by CPIINF	0.00	0.05	0.30	0.06
CPIXINF is not Granger Caused by WAGEINF	0.01	0.06	0.03	0.01
WAGEINF is not Granger Caused by CPIXINF	0.00	0.16	0.01	0.04
PPIINF is not Granger Caused by WAGEINF	0.00	0.00	0.02	0.02
WAGEINF is not Granger Caused by PPIINF	0.00	0.02	0.02	0.04
1964.01 - 1973.11				
CPIINF is not Granger Caused by WAGEINF	0.16	0.32	0.59	0.56
WAGEINF is not Granger Caused by CPIINF	0.06	0.17	0.87	0.59
CPIXINF is not Granger Caused by WAGEINF	0.82	0.95	0.88	0.55
WAGEINF is not Granger Caused by CPIXINF	0.09	0.50	0.34	0.76
PPIINF is not Granger Caused by WAGEINF	0.60	0.92	0.98	0.44
WAGEINF is not Granger Caused by PPIINF	0.26	0.56	0.63	0.06
1973.11 - 1981.07				
CPIINF is not Granger Caused by WAGEINF	0.05	0.04	0.03	0.02
WAGEINF is not Granger Caused by CPIINF	0.56	0.83	0.22	0.67
CPIXINF is not Granger Caused by WAGEINF	0.39	0.15	0.25	0.21
WAGEINF is not Granger Caused by CPIXINF	0.36	0.68	0.62	0.87
PPIINF is not Granger Caused by WAGEINF	0.01	0.02	0.03	0.06
WAGEINF is not Granger Caused by PPIINF	0.88	0.51	0.82	0.92
1981.07 - 1990.07				
CPIINF is not Granger Caused by WAGEINF	0.01	0.09	0.47	0.48
WAGEINF is not Granger Caused by CPIINF	0.03	0.14	0.26	0.04
CPIXINF is not Granger Caused by WAGEINF	0.41	0.06	0.16	0.08
WAGEINF is not Granger Caused by CPIXINF	0.00	0.03	0.04	0.01
PPIINF is not Granger Caused by WAGEINF	0.27	0.58	0.93	0.97
WAGEINF is not Granger Caused by PPIINF	0.07	0.04	0.00	0.01

Table 2 CPI - wage rate Granger causality results.

	p-values			
Null Hypothesis	lag=3	lag=6	lag=12	lag=18
1990.07 - 1997.12				
CPIINF is not Granger Caused by WAGEINF	0.09	0.08	0.17	0.28
WAGEINF is not Granger Caused by CPIINF	0.49	0.72	0.22	0.44
CPIXINF is not Granger Caused by WAGEINF	0.31	0.24	0.26	0.36
WAGEINF is not Granger Caused by CPIXINF	0.04	0.05	0.04	0.01
PPIINF is not Granger Caused by WAGEINF	0.30	0.02	0.03	0.10
WAGEINF is not Granger Caused by PPIINF	0.97	0.54	0.37	0.36

Table 2 Continued