

*Unions and the Persistence of Shocks to Employment**

Using both a parametric and a non-parametric measure of persistence, this paper examines the persistence of shocks to U.S. employment at the state-sector level. Shocks to employment are found to be more persistent in the less unionized labor markets. Shocks to employment are also observed to have become more and more persistent during the post-war period as unionization rates have fallen. The actual direction of causality was tested by an examination of employment in states with right-to-work laws. The paper rejects an implication of the insider-outsider theory.

1. Introduction

Blanchard and Summers (1986) attribute the persistence of high unemployment in Europe to the influence of unions.¹ Drawing on the insider-outsider hypothesis of Lindbeck and Snower (1986), they suggest that "insiders" negotiate a wage each period to maintain their level of employment with "outsiders" having little influence on the wage bargaining process. If unions seek to maintain current employment instead of wage stability, changes in employment will be more persistent in unionized labor markets.

This view differs from the traditional view of unions. Economists have long maintained that in the short run, union wages are more rigid than non-union wages (Dunlop 1950). Thus shocks to labor demand would result in employment adjustment rather than wage adjustment. This would make union employment more volatile, and changes in union employment less persistent than changes in nonunion employment.

These opposing views of the effect of unions are empirically

*This paper is based on a chapter of my Ph.D. dissertation. I am indebted to Joe Tracy and Bob Shiller for guidance and helpful discussions. Several anonymous referees provided helpful suggestions. All errors are my own.

¹Katz and Meyer (1990) suggest that some of the difference in the duration of unemployment spells between the U.K. and U.S. can be explained by the longer duration of unemployment benefits in the U.K.

tested here. U.S. employment data are examined at the state-sector level to permit for the control of sectoral and regional differences in employment patterns. Using both a parametric and nonparametric measure of persistence, shocks to employment are found to be more persistent in less unionized sectors. Furthermore, shocks to aggregate employment are found to have become more persistent over time as unionization rates have fallen. Thus the implications of the insider-outsider model are rejected in favor of the traditional wage rigidity model. The insider-outsider model may be relevant in Europe, but does not appear to be descriptive of U.S. labor markets.

The organization of the paper is as follows. The discussion begins by contrasting the different views of the effect of unions on persistence. The methodology used in measuring the degree of persistence is then discussed. Background information on unions is provided along with the data sources used in this study. The complete results for all sector-states showing that unions decrease the persistence of shocks are presented. The increasing persistence of shocks to employment during the past few decades is observed and attributed, in part, to the sharply declining unionization rates. The actual direction of causality is examined before the concluding remarks.

2. Persistence

Since the early 1970s Western Europe has suffered from persistently high unemployment rates. The U.S. has seen cyclical unemployment rates around an increasing average level. Even in Japan, unemployment rates have been persistently high by historical standards.² One explanation has focused on the asymmetry in the wage setting process between "insiders" and "outsiders" (Lindbeck and Snower 1986). In this model wages are set with a view to insuring the jobs of insiders while the outsiders are disenfranchised. The implications of the insider-outsider hypothesis for the persistence of employment changes depends on the assumptions about membership rules and the frequency of contract negotiations.

In Blanchard and Summers (1986) the insiders are the employed while the outsiders are the unemployed. If there is a high correlation between workers with jobs and workers with insider status, an adverse shock which reduces the level of employment will

²See Brunello (1990) for a discussion.

decrease the numbers of insiders. In the next period this new smaller group of insiders will set the wage to maintain this lower level of employment. Thus shocks to employment will be persistent. The insider-outsider model with a high correlation between insider status and employment status suggests that persistence may arise in non-union contexts, but that it is much more likely to arise the stronger and larger the union sector. This is because workers need to collectively negotiate a wage to maintain their employment level.

The Blanchard and Summers model is at odds with the traditional view of unions as seeking wage stability over employment stability. Since senior workers have greater influence on union policies than they would on the policies of a nonunion firm, labor adjustments in unionized firms have tended to take the form of temporary layoffs rather than reductions in wages or hours. Tracy (1986) shows that industrial union contracts tend to restrict the manner in which the firm can adjust the total labor input in a downturn. Layoffs and recalls are based on seniority. Work-sharing by hour restrictions, division of work and rotation of layoffs are either restricted or prohibited. Thus labor input adjustment in unionized firms occurs primarily through variations in employment rather than average hours.

Bils (1991) and Ragan (1990) observe that if union contracts result in wage rigidity, employment should adjust after recontracting to offset excessive movements in employment during the previous contract period. They both conclude that employment in many U.S. and Canadian industries shifts at the beginning of each contract period to undo some of the disturbances which occurred during the prior contract.

Graphically these results can be seen as follows. Consider the effects of a recession-induced decline in production and labor demand on Figure 1. As labor demand is reduced from D to D' , the traditional auction market would have a flexible real wage driven toward a new equilibrium. The real wage would move without hindrance to equate the demand for labor with the supply at all times. The wage would fall from W_0 to W_1 as employment fell from L_0 to L_1 . But if real wages are slow to adjust, the labor market will not clear instantaneously. If the wage remains rigid at W_0 , say, because of union contracts, employment will fall to L_2 creating unemployment equal to $L_0 - L_2$. Only after recontracting will the real wage fall, causing employment to then rise from L_2 to L_1 if the shock is completely permanent. This is demonstrated on Figure 2.

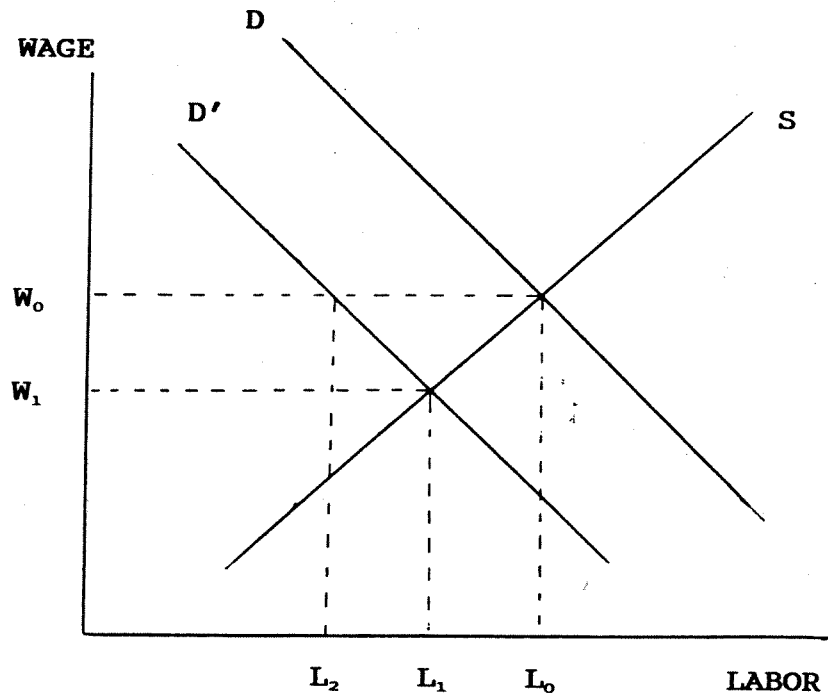


Figure 1.
Labor Market Demand Shocks

Two observations are worth noting here. First, shocks to employment demand will lead to larger employment changes with some wage rigidity³ (since the wage is not allowed to adjust). And second, changes in the level of employment will be less persistent under some real wage rigidity. With short-run wage rigidity, employment initially falls from L_0 to L_2 . But when wages adjust, employment will gradually adjust with a lag back up to L_1 . In an auction market employment will fall from L_0 to L_1 and stay there. The main contribution of this paper is to examine the relation of employment persistence to unionization, thus testing the insider-outsider and wage rigidity theories of unions.

A similar examination of real wages would not provide much insight into labor markets. If implicit contracts are typically of shorter

³There is some evidence for this in the literature. See Pearce (1983) and Bils (1991).

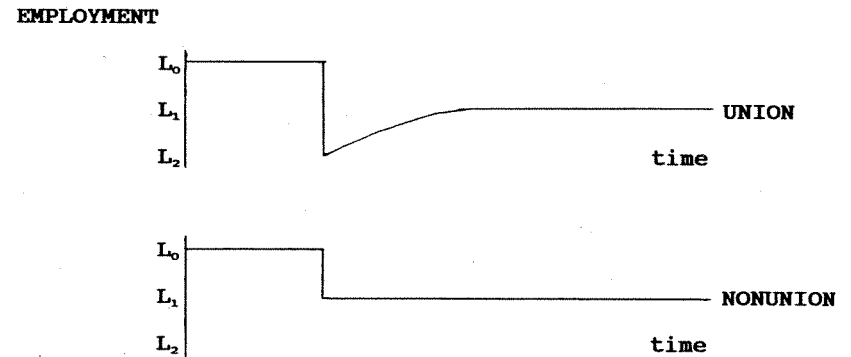


Figure 2.
Employment Dynamics

duration than explicit union contracts, then real wages might be expected to change more frequently in non-unionized labor markets. But those changes would be just as persistent as in the unionized labor markets. The best univariate forecast of the future wage would be the current contract wage in both markets. These models, however, have implications for the bivariate dynamics of employment and real wages which are worth examining in future research.

3. Methodology

Both a non-parametric and a parametric approach to measuring the level of this persistence is considered. The non-parametric approach was suggested by Cochrane (1988). His measure is a ratio of variances, the variance of the $(k + 1)^{th}$ difference in employment over the variance of the first difference of employment:

$$V = \frac{1}{k + 1} \frac{\text{Var} [E_{t+k+1} - E_t]}{\text{Var} [E_{t+1} - E_t]} \quad (1)$$

If E_t follows a random walk, then the variance of the $(k + 1)^{th}$ difference is $(k + 1)$ times the variance of the first difference. Hence, for a random walk, the variance ratio is unity. For any stationary series, the variance of the $(k + 1)^{th}$ difference approaches twice

the variance of the series as k goes to infinity. Thus for any stationary series, the above ratio approaches zero for large k . Cochrane proposes using the limit of the variance ratio as a measure of persistence. Let us call this limiting variance ratio V .

For the parametric measure, the change in log of employment is modeled as a stationary ARMA (p,q) process following Campbell and Mankiw (1987b). That is,

$$\Phi(L) \Delta E_t = \Theta(L) \epsilon_t, \quad (2)$$

where

$$\Phi(L) = 1 - \Phi_1 L - \Phi_2 L^2 - \dots - \Phi_p L^p$$

and

$$\Theta(L) = 1 + \Theta_1 L + \Theta_2 L^2 + \dots + \Theta_q L^q.$$

Here L is the lag operator, and ϵ_t is assumed to follow a zero-mean white noise process.

This equation can be rewritten to determine the moving average representation or the impulse response function for ΔE_t :

$$\begin{aligned} \Delta E_t &= \Phi(L)^{-1} \Theta(L) \epsilon_t \\ &= A(L) \epsilon_t. \end{aligned} \quad (3)$$

The moving average representation for the level of E_t is derived by inverting the difference operator $1 - L$:

$$\begin{aligned} E_t &= (1 - L)^{-1} A(L) \epsilon_t \\ &= B(L) \epsilon_t, \end{aligned} \quad (4)$$

where

$$B_i = \sum_{j=0}^i A_j.$$

Since B_1 measures the response of E_{t+1} to an innovation at time t ,

one can take the value of B_i as i approaches infinity as a measure of persistence. Let us call that limit M . If E_t is stationary, B_i will approach zero as i approaches infinity.⁴

To measure the volatility of employment, both a non-parametric and parametric measure are again considered. The non-parametric measure is the standard deviation of the growth rate of seasonally adjusted monthly employment data. For a parametric measure, the log of employment is modeled as an AR(p) process,

$$E_t = \beta_0 + \beta_1 E_{t-1} + \dots + \beta_p E_{t-p} + \epsilon_t, \quad (5)$$

and the standard deviation of ϵ_t is used as a measure of volatility.

Persistence and volatility of employment may depend not only on unionization, but on the nature of shocks to the labor market. *Ceteris paribus*, an economy with a large construction sector would be more volatile than one with a small one. While the durables manufacturing sector is highly unionized, they might be expected to show more volatile and less persistent employment changes for accelerator reasons. And while the northern states are more highly unionized, employment might be more volatile because of a series of severe winter weather shocks. Thus it is necessary to control for aggregate, sectoral and regional shocks. This is done by examining U.S. employment data at the state-sector level. This paper measures the persistence and volatility of shocks to employment in each state-sector and examines if they are explained by unionization rates in that state-sector after having controlled for aggregate, sectoral and regional shocks.

4. Data and Specification

Estimates of unionization rates at the state-sector level are from the Current Population Survey (CPS).⁵ In May of each year from 1973 to 1981 the CPS collected data on workers identified by their membership in unions or by their representation at work by a union,

⁴From the state space literature any ARMA process can be written as a Markov process. It is then straightforward to obtain the impulse response function of the ΔE_t process. See Campbell and Mankiw (1987b) for details.

⁵The data utilized in this section were made available in part by the Inter-university Consortium for Political and Social Research. The data for Current Population Survey, May 1980 were originally collected by the U.S. Dept. of Labor, Bureau of Labor Statistics. Neither the collectors of the original data nor the Consortium bear any responsibility for the analyses or interpretations presented here.

TABLE 1. *Union Membership as a Percentage of Employed Wage and Salary Workers, by Industry, May 1980*

All industries	23.0
Private sector	20.1
Goods—producing	30.5
Mining	32.0
Construction	30.9
Manufacturing	32.3
Durable Goods	34.8
Nondurable Goods	28.5
Service—producing	13.5
Transportation, communication, and public utilities	48.4
Wholesale and retail trade	10.1
Finance, insurance, and real estate	3.2
Service	8.9
Government	35.9

Source: Adams (1985)

whether or not they were members. Union here is defined to include traditional labor unions and employee associations that represent employees in collective bargaining. The unionization rate estimates are not reported here but are available from the author by request. Data on employment by sector at the state level was obtained from the Current Employment Statistics program. All employment series are classified according to the 1972 standard industrial classification (SIC), and are generally available monthly from 1939. The data were seasonally adjusted by the moving average method.

This paper will take advantage of the differences in unionization across sectors and regions. Across sectors, unionization rates in 1980 varied from 3.2% in finance, insurance and real estate to 48.4% in transportation, communication and public utilities. Across regions, unionization rates in 1978 varied from 14.5% in the Southwest to 36.4% in the Mideast region. The differences are even greater between states with 41% of New York unionized and only 8.9% of South Carolina unionized. Table 1 presents unionization rates by sector, while Table 2 presents unionization rates by state.

Unionization rates have also changed over time, generally falling since the mid 1950s. The proportion of wage and salary workers

TABLE 2. *Total Union and Employee Association Membership as a Percentage of Employees in Nonagricultural Establishments Ranking by State, 1978*

1. South Carolina	8.9	26. Alabama	24.6
2. North Carolina	10.7	27. Maine	24.7
3. Florida	13.2	28. Maryland, D.C.	25.0
4. Texas	13.3	29. Kentucky	25.4
5. South Dakota	14.7	30. Connecticut	26.4
6. New Mexico	14.8	31. Nevada	27.1
7. Mississippi	15.0	32. New Jersey	27.3
8. Virginia	15.3	33. Minnesota	27.6
9. Kansas	15.8	34. Massachusetts	27.7
10. Georgia	15.8	35. California	28.8
11. New Hampshire	16.9	36. Oregon	29.5
12. Louisiana	16.9	37. Montana	29.9
13. Oklahoma	17.3	38. Rhode Island	29.9
14. Arkansas	17.6	39. Wisconsin	30.5
15. Arizona	18.0	40. Missouri	31.0
16. Colorado	18.1	41. Indiana	31.9
17. Idaho	19.1	42. Alaska	32.3
18. Nebraska	19.3	43. Illinois	33.4
19. North Dakota	19.4	44. Ohio	33.6
20. Utah	19.6	45. Hawaii	35.8
21. Wyoming	19.7	46. Washington	36.5
22. Tennessee	21.0	47. Pennsylvania	37.3
23. Iowa	22.6	48. Michigan	38.5
24. Vermont	22.8	49. West Virginia	40.4
25. Delaware	23.9	50. New York	41.0
All States	26.9		

Source: U.S. Department of Labor (1980)

in unions (excluding employee associations) fell from 35.5% in 1945 to 21.9% in 1980. When employee associations are combined with traditional labor unions, the decline is 30.5% in 1968 to 24.7% in 1980. By 1990 the percent of employed wage and salary workers belonging to unions and employee associations was down to 16.1%. The number of union members has remained near 17 million since 1985 while employment has been rising. This decline in unionization is generally attributed to employment shifts away from centers

of union strength, from manufacturing industries to less organized sectors such as the service industries.

This paper seeks to compare the nature of shocks to employment in heavily unionized sector-regions with those in less unionized sector-regions. The measures of persistence characterize the data over a period of time. Since unionization rates change over time, it will be important that the more unionized sector-region at one point in time remain the more unionized sector-region throughout the sample period. Of course, this will not be true for all pairs of sector-regions. In particular, consider the public sector. While unionization in the U.S. has generally been on the decline, public sector unionization has risen from 13% in 1956 to 23% in 1980. Thus the public sector is excluded from the analysis.⁶

Relative rates of unionization across regions also change over time. Rankings of states by unionization rate were examined for various years from 1939 to 1987. Hawaii has gone from being the least unionized state in the nation to one of the 5 most unionized states during this period. But on the whole, the state rankings have not changed tremendously. The correlation coefficient of the rankings in 1939 and in 1982 was 0.68, while the correlation coefficient for the rankings in 1975 and 1982 is 0.96.

Unionization rates at the state-sector level were examined, disaggregating to 50 states and 7 sectors. At this level of disaggregation, relative unionization rankings in 1977 and 1980 had a correlation coefficient of 0.92. Over longer periods of time the data are difficult to find. Table 3 shows the percent of production workers in unionized establishments in metropolitan areas by region-sector in 1961 and 1984.⁷ The data does suggest some shifts in relative unionization over time. For example, Midwest nonmanufacturing was more unionized than West nonmanufacturing in 1961, but this was reversed by 1984. On the whole though, particularly when unionization rates differ significantly, there are no ordinal shifts. Thus there may be some noise in the regressions, but hopefully the signal comes through.

⁶Another difficulty with including the public sector is that public sector unions are not generally allowed to bargain over wages, the main concern of private sector unions.

⁷This is not exactly analogous to our previous definition of unionization for two reasons. First, this is employment in unionized establishments, establishments in which a majority of the production or office workers are covered by labor-management agreements. And second, this is employment in metropolitan areas only. These data are considered for lack of a better alternative.

TABLE 3. *Percent of Production Workers in Unionized Establishments All Metropolitan Areas, by Region and Sector*

	1961	1984
<i>Northeast</i>	77	57
Manufacturing	81	60
Nonmanufacturing	69	54
Transportation and public utilities	97	90
Wholesale trade	63	52
Retail trade	47	35
Selected services	68	43
<i>South</i>	48	32
Manufacturing	60	42
Nonmanufacturing	34	22
Transportation and public utilities	86	72
Wholesale trade	22	19
Retail trade	13	10
Selected services	18	9
<i>Midwest</i>	80	69
Manufacturing	86	80
Nonmanufacturing	66	52
Transportation and public utilities	98	93
Wholesale trade	65	57
Retail trade	42	31
Selected services	69	44
<i>West</i>	80	48
Manufacturing	83	48
Nonmanufacturing	78	47
Transportation and public utilities	98	89
Wholesale trade	75	44
Retail trade	68	35
Selected services	66	35

Source: Doyle (1985)

There is a clear trade-off to be made in the specification of this study. Measurements of persistence become more accurate as the time span of the employment data is increased. On the other hand, as the time span increases, unionization rates are more likely to change significantly. In practice, the specification was defined by the availability of the data. For the main results, the data were disaggregated to seven sectors; durables manufacturing, nondura-

bles manufacturing, transportation and public utilities, wholesale trade, retail trade, finance, insurance and real estate, and services.⁸ At this level of disaggregation, many of the employment series only begin in 1972. Thus persistence was estimated over the period of 1973 to 1987, and unionization rate estimates from the May 1980 CPS, the midpoint of the period, were used.⁹

5. Results for All Sector-States

The volatility and persistence was estimated for shocks to employment in 314 state-sector employment series encompassing 50 states and 7 sectors with monthly data from 1973 to 1987. The remaining 36 employment series were missing or began after 1973. Regressions on these volatility and persistence measures were run with the unionization rate for the specific state-sector as an independent variable, along with dummy variables for each sector and state (or region). The sector dummies are relative to durables manufacturing. The state dummies are relative to California, and the region dummies are relative to the Far West.

Since relative unionization rates do change over time, two measures of unionization were used. The first was just the estimated unionization rate from the May 1980 CPS. The second measure grouped sector-states into different categories of unionization. Sector-states with unionization rates between 0–9% were grouped together, 10–19% were grouped together, 20–29%, etc. With this measure there were eight categories of unionization because the highest unionization rate was transport and public utilities in Rhode Island with 76.6%. By grouping sector-states into eight levels of unionization, this measure of unionization explicitly recognizes the

⁸In addition to the public sector, the construction sector, where the concept of a firm is ambiguous, was also excluded.

⁹The employment data were also examined disaggregated to just five sectors; manufacturing, transportation and public utilities, wholesale and retail trade, finance, insurance and real estate, and services. At this level of aggregation most of the employment series begin back in 1939 permitting a measure of persistence over a longer period of time. Unfortunately here limitations result from the unionization rate data. Before 1977 one can not determine unionization rates by state for all 50 states from the CPS. The smaller states were aggregated into state-regions. And prior to 1973 the CPS did not include information on union status. Unionization rates in 1973 may be a poor measure of relative unionization over the entire 1939–87 period.

TABLE 4. *Volatility and Unionization: Regression on the Standard Deviation of the Monthly Employment Growth Rate*

	A	B
Constant	1.1099 (0.2358)*	1.2952 (0.2123)*
Union	2.3003 (0.4904)*	2.1097 (0.4709)*
Sector		
<i>Nondurable</i>	-0.4606 (0.1554)*	-0.4783 (0.1557)*
<i>Transport</i>	-0.7296 (0.1678)*	-0.6980 (0.1666)*
<i>Wholesale</i>	-0.3272 (0.1856)	-0.3794 (0.1822)*
<i>Retail</i>	-0.4045 (0.1902)*	-0.4648 (0.1858)*
<i>Finance</i>	-0.4054 (0.2043)*	-0.5266 (0.1911)*
<i>Service</i>	-0.3876 (0.1884)*	-0.4450 (0.1844)*
Region		
<i>Northeast</i>	0.1409 (0.2015)	0.1157 (0.2015)
<i>Mideast</i>	-0.1895 (0.1732)	-0.2127 (0.1740)
<i>Great Lakes</i>	-0.5639 (0.1645)*	-0.5586 (0.1650)*
<i>Plains</i>	-0.1872 (0.1557)	-0.2158 (0.1553)
<i>Southeast</i>	-0.2194 (0.1465)	-0.2590 (0.1448)
<i>Southwest</i>	-0.2186 (0.1823)	-0.2408 (0.1821)
<i>Rocky Mountain</i>	0.1571 (0.1715)	0.1294 (0.1711)
<i>R²</i>	0.297	0.293
<i>SER</i>	0.701	0.704
<i>mdv</i>	0.982	0.982
<i>NOB</i>	314	314

NOTE: Standard errors are in parentheses.

*indicates significance at 5% level.

Dummy variables are defined in the appendix.

regression A: actual unionization rate estimate.

regression B: 10% point unionization rate cell.

lack of knowledge about the exact rankings of unionization rates over this time period.

The results for volatility are presented on Table 4. Both the parametric and the non-parametric measure of volatility generated similar results, so only the results with the non-parametric measure are reported to save space. Unionization is found to have a significant effect on volatility. This was confirmed using both the actual unionization rate estimate and the category measure of unionization. When volatility is measured as the standard deviation of monthly employment growth, a 1 percentage point increase in unionization is estimated to increase volatility by over 2.3%. This volatility mea-

TABLE 5. Persistence and Unionization: Regression on the Variance Ratio V with Window Size $k = 40$

	A	B
Constant	1.0803 (0.2307)*	1.0280 (0.2223)*
Union	-1.0781 (0.2812)*	-1.0824 (0.2884)*
Sector		
Nondurable	-0.3982 (0.1182)*	-0.3958 (0.1185)*
Transport	-0.0159 (0.0800)	-0.0308 (0.0816)
Wholesale	0.2346 (0.2364)	0.2400 (0.2376)
Retail	0.7668 (0.2658)*	0.7719 (0.2670)*
Finance	0.5617 (0.2730)*	0.5934 (0.2702)*
Service	-0.4449 (0.1833)*	-0.4358 (0.1841)*
Region		
Northeast	-0.2731 (0.1018)*	-0.2696 (0.1018)*
Midwest	-0.2798 (0.1043)*	-0.2744 (0.1042)*
Great Lakes	0.5294 (0.1800)*	0.5527 (0.1796)*
Plains	-0.1300 (0.0883)	-0.1151 (0.0867)
Southeast	0.2786 (0.1278)*	0.2820 (0.1281)*
Southwest	0.2184 (0.2058)	0.2036 (0.2085)
Rocky Mountain	0.2024 (0.1325)	0.2073 (0.1325)
R^2	0.471	0.470
SER	0.373	0.373
mdv	0.290	0.290
NOB	314	314

NOTE: Standard errors are in parentheses.
 Estimated by weighted regression.
 *indicates significance at 5% level.
 regression A: actual unionization rate estimate.
 regression B: 10% point unionization rate cell.

sure had a mean value of 0.98% over this period in the data set. The implied elasticity of volatility with respect to the unionization rate is 0.54.

Regressions with the variance ratio V for window sizes $k = 40$ and $k = 60$ are presented on Tables 5 and 6.¹⁰ Since persis-

¹⁰It should be noted that the persistence measure V is strongly biased toward zero as k approaches T . It is identically equal to zero for $k = T - 1$ since there is only one observation for the k^{th} difference. Campbell and Mankiw (1987a) present some Monte Carlo results and recommend window sizes around 50 for this approximate sample size.

TABLE 6. Persistence and Unionization: Regression on the Variance Ratio V with Window Size $k = 60$

	A	B
Constant	0.6598 (0.1584)*	0.6074 (0.1485)*
Union	-0.6429 (0.1834)*	-0.6191 (0.1812)*
Sector		
Nondurable	-0.2154 (0.0864)*	-0.2064 (0.0857)*
Transport	-0.0141 (0.0541)	-0.0214 (0.0548)
Wholesale	0.3714 (0.1720)*	0.3916 (0.1702)*
Retail	0.6215 (0.1934)*	0.6395 (0.1922)*
Finance	0.2868 (0.1783)	0.3235 (0.1740)
Service	-0.2321 (0.1215)	-0.2126 (0.1190)
Region		
Northeast	-0.2055 (0.0761)*	-0.1970 (0.0758)*
Midwest	-0.1748 (0.0796)*	-0.1663 (0.0792)*
Great Lakes	0.2302 (0.1195)	0.2566 (0.1188)*
Plains	-0.0941 (0.0679)	-0.0788 (0.0662)
Southeast	0.0994 (0.0988)	0.1108 (0.0979)
Southwest	0.0245 (0.1466)	0.0261 (0.1473)
Rocky Mountain	0.2752 (0.1249)*	0.2848 (0.1245)*
R^2	0.404	0.402
SER	0.249	0.249
mdv	0.164	0.164
NOB	314	314

NOTE: Standard errors are in parentheses.
 Estimated by weighted regression.
 *indicates significance at 5% level.
 regression A: actual unionization rate estimate.
 regression B: 10% point unionization rate cell.

tence is measured with error, the equations were estimated by weighted least squares. The observations were weighted by the inverse of the standard error of the estimate of V . Unionization rates are shown to have a significant negative effect on persistence. A decrease in unionization by 1 percentage point would increase persistence by approximately 0.6–1%. That is to say, if a shock was truly transitory before, then approximately 0.8% of the shock would be permanent if unionization declined by 1 percentage point. The implied elasticity of persistence with respect to unionization rate is around 0.86–0.91.

Then ARMA models were estimated for all the state-sector

employment series,¹¹ and the implied impulse response function limits, M , were evaluated. The regressions on the log of M for the ARMA (2,2) model¹² are presented on Table 7. Unionization is again shown to have a significant negative effect on persistence. The estimated effect of unionization on persistence is slightly larger here than with the variance ratio V . A decrease in unionization by 1 percentage point is estimated to increase persistence by just over 1%. The implied elasticity of persistence with respect to the unionization rate is around 1.21–1.43. Since unionization rates have fallen by about 10 percentage points over the past twenty years, this would imply over a 10% increase in persistence to shocks. All of these regressions were also run with state dummies instead of region dummies. The results were comparable. The regressions with regions dummies are presented to save space.¹³

6. Changes in Persistence over Time

During the postwar period the degree of persistence of shocks to aggregate employment has increased. Total nonagricultural em-

¹¹One of the difficulties in the estimation of ARMA models is that even if the parameters of the model are known, the innovations in a time series model with MA parameters are not identifiable. If the MA roots are strictly less than unity, then any dependence on presample information can be ignored in large samples. But if the ARMA processes have MA roots close to or equal to unity, Davidson (1981) has shown that parameter estimates tend to be seriously biased away from unity. This study is less concerned with this bias, concentrating on relative effects of unions rather than on the absolute effect.

¹²To estimate the ARMA process, we must first choose the parameterization. The classical statistical method is to include as many AR and MA parameters as are significant. Another approach is to use the Schwarz (1978) criterion or the Akaike (1976) criterion which maximize a likelihood function with penalty for additional parameters. But this study is less concerned with the order of the ARMA process than with its implications for persistence. Thus all ARMA models for the difference of log of employment with 1 to 3 AR parameters and 1 to 3 MA parameters were estimated. The ARMA (2,2) results presented here were representative of the other ARMA specifications. The ARMA parameter estimates varied significantly across specifications, but the limit of the implied impulse response function was remarkably stable across specifications.

¹³These results are also robust to changes in time periods. Similar regressions were run with unionization rates from 1977 and 1973, and measures of persistence over longer time periods such as 1967–87, 1959–87, 1947–87 and 1939–87. The unionization rate is usually significant at the 5% level, and its coefficient is always of the correct sign. And finally, total hours (average hours times employment) were examined. In response to shocks, firms may adjust hours instead of employment. The data on hours is only available for durables and nondurables from 1972. The unionization rate variable had the correct signs, but was never particularly significant.

TABLE 7. Persistence and Unionization: Regression on the Log of Impulse Response Limit M for ARMA(2,2)

	A	B
Constant	0.1705 (0.2723)	0.0435 (0.2449)
Union	-1.2501 (0.5664)*	-1.0611 (0.5432) [†]
Sector		
<i>Nondurable</i>	-0.2256 (0.1795)	-0.2144 (0.1796)
<i>Transport</i>	0.0720 (0.1938)	0.0410 (0.1922)
<i>Wholesale</i>	0.1859 (0.2144)	0.2326 (0.2102)
<i>Retail</i>	0.0771 (0.2197)	0.1293 (0.2144)
<i>Finance</i>	0.5306 (0.2360)*	0.6184 (0.2205)*
<i>Service</i>	-0.0576 (0.2177)	-0.0074 (0.2128)
Region		
<i>Northeast</i>	-0.3339 (0.2327)	-0.3155 (0.2324)
<i>Mideast</i>	0.2971 (0.2001)	0.3075 (0.2008)
<i>Great Lakes</i>	0.1904 (0.1900)	0.1868 (0.1903)
<i>Plains</i>	0.2458 (0.1799)	0.2663 (0.1791)
<i>Southeast</i>	0.0996 (0.1692)	0.1292 (0.1670)
<i>Southwest</i>	0.6384 (0.2106)*	0.6594 (0.2101)*
<i>Rocky Mountain</i>	0.1958 (0.1981)	0.2171 (0.1973)
<i>R²</i>	0.227	0.224
<i>SER</i>	0.810	0.811
<i>mdv</i>	0.203	0.203
<i>NOB</i>	314	314

NOTE: Standard errors are in parentheses.

*indicates significance at 5% level.

[†]indicates significance at 10% level.

regression A: actual unionization rate estimate.

regression B: 10% point unionization rate cell.

ployment during each of four ten-year periods since 1947 were examined in Table 8. Using both measures of persistence, V and M , persistence is found to have risen during this period. The variance of shocks to employment has also declined during this period. These observations are robust to changes in the sample subperiods, and also hold for aggregate sectoral employment data.

The previous results suggest that a part of this increase in persistence can be attributed to the decline in unionization. Union membership as a percent of total nonagricultural employment peaked at 32.5% in 1953, and has been declining since. The rate of decline has accelerated dramatically since the mid 1970s, and the union-

TABLE 8. *Changes in Persistence and Volatility over Time Total Nonagricultural Employment*

horizon k	Variance Ratio V				
	1947-56	1957-66	1967-76	1977-87	
10	3.469 (1.111)	4.920 (1.571)	4.893 (1.563)	6.178 (1.928)	
20	3.252 (1.309)	4.186 (1.680)	5.860 (2.353)	9.202 (3.631)	
30	2.265 (0.997)	3.341 (1.468)	4.429 (1.946)	9.995 (4.348)	
40	1.820 (0.819)	4.181 (1.881)	1.588 (0.714)	9.697 (4.356)	
Standard Deviation of Growth Rate					
	1947-56	1957-66	1967-76	1977-87	
	0.00509	0.00333	0.00261	0.00257	
ARMA(2,2) Impulse Response Function					
	horizon				
Period	10	20	30	40	lim M
1947-56	1.941	1.517	1.230	1.934	1.541
1957-66	2.855	2.881	2.881	2.881	2.881
1967-76	1.965	2.043	2.045	2.044	2.044
1977-87	3.425	4.295	4.591	4.691	4.743

ization rate is now around 16%. Average unionization rates over time are presented in Table 9. There is some uncertainty about the change in persistence from the 1957-66 period to the 1967-76 period. This may be due to the fact that unionization rates changed very little between these periods.

Using the estimated coefficients from Tables 4-7, along with the data on changes in unionization from Table 9, essentially all of the decline in the volatility of aggregate employment can be attributed to the decline in unionization. However, only about 1.3-

TABLE 9. *Unionization Rates over Time Union Membership as a Percent of Nonagricultural Employment*

Period Averages	1947-56	1957-66	1967-76	1977-84
	31.93	29.83	28.91	22.95

Source: Troy and Sheflin (1985).

4.4% of the increase in persistence can be attributed to declining unionization. It is not that the impact of unionization on persistence has been small, but that the actual increase in persistence has been so large.

The changing composition of aggregate employment also had some effect on volatility and persistence. First, there has been a shift of employment away from goods-producing to service-producing sectors. Durables manufacturing, nondurables manufacturing, and transportation and public utilities have seen a decline in their employment shares from 1950 to 1985, while wholesale trade, retail trade, finance, insurance and real estate, and services have seen increases. The regression estimates from Tables 4-7 along with data on sectoral employment shares allow us to measure the effect of these shifts. Sectoral shifts account for about 34.6% of the decrease in volatility. However, these shifts did not increase persistence. They served to decrease the amount of persistence by about 0.8-1.2% of the change. Given the level of unionization, shocks to services appear to be less persistent than shocks to durables and nondurables manufacturing since the coefficient on the service sector dummy variable was negative in each of the persistence regressions above. Since services experienced the largest employment growth while manufacturing experienced the largest declines, these shifts served to actually decrease persistence.

There were also significant regional shifts during the postwar period. The Southeast, Southwest, Rocky Mountains and the Far West gained employment shares at the expense of the Northeast, Mideast, Great Lakes, and Plains. These shifts served to more than offset the effect on persistence of the sectoral shifts. They account for about 1.3-1.5% of the increase in persistence. They also offset some of the decreasing volatility resulting from the sectoral shifts. The regional shifts increased volatility by about 24% of the actual change in volatility.

Thus the decreasing unionization rates, sectoral and regional shifts can account for the decrease in employment volatility during the post-war period, but they can only account for about 1.4-5% of the increase in persistence during this time.

7. Direction of Causality

One challenge in studies of this type is demonstrating the actual direction of causality. Is employment volatile in particular sectors because they are unionized, or are these sectors unionized be-

cause employment is volatile? Heywood (1989) argues that the degree of employment security strongly influences the probability of unionization. Following work by Duncan and Stafford (1980), he argues that workplaces with important shared goods give rise to unions. Unions act to reveal worker preferences and hence economize on search and mobility costs. Being unionized permits workers to more easily receive a compensating differential for their employment volatility.

Determining the actual direction of causality is difficult to impossible, particularly under circumstances which do not lend themselves to Granger or Sims type causality tests. An attempt was made to test for the actual direction of causality by examining employment in states with and without right-to-work laws.

Right-to-work laws outlaw workplaces where workers must join a union or pay the equivalent of dues within 30 days to maintain their jobs. Twenty states adopted right-to-work laws in the United States between 1944 and 1958.¹⁴ *Ceteris paribus*, these states have lower unionization rates, typically on the order of ten percentage points. This may be because it is difficult to organize workers in these states because of serious "free-rider" problems. Alternatively, residents of these states may merely have attitudes, tastes or preferences against unionization. The right-to-work laws may merely proxy these omitted variables in empirical work. In either case, all that is important here is that, holding economic conditions constant, right-to-work states have lower unionization rates.

These right-to-work laws are expected to have a direct impact on unionization, but no direct impact on volatility or persistence. Thus, if unionization causes volatility, these laws should change the level of unionization and thus indirectly change the degree of volatility. Here unionization is all the information you need to explain volatility. Right-to-work status would provide no additional information on volatility once you know the level of unionization. On the other hand, if volatility causes unionization, these laws will change the level of unionization but have no impact on employment volatility or persistence. Thus volatility would be causing less unionization in states with right-to-work laws. In a regression, once you

¹⁴Right-to-work laws currently exist in Alabama, Arizona, Arkansas, Florida, Georgia, Iowa, Kansas, Louisiana, Mississippi, Nebraska, Nevada, North Carolina, North Dakota, South Carolina, South Dakota, Tennessee, Texas, Utah, Virginia, and Wyoming.

have controlled for the level of unionization, right-to-work states would have more employment volatility and less persistence.

The regressions on Tables 4-7 were run again with an additional dummy variable for states with right-to-work laws. If volatility caused unionization, the right-to-work dummy would be significant in these regressions. They should be significantly positive in the employment volatility regressions, and significantly negative in the employment persistence regressions. The right-to-work dummy variable was not significant in any of the specifications. When the coefficient was of the correct sign, the *t*-statistic was always less than one. These results are consistent with unionization causing volatility.

8. Conclusion

Using both a parametric and a non-parametric measure of persistence, shocks to employment in the U.S. are found to be less persistent in the more unionized labor markets after controlling for regional and sectoral factors. Shocks to employment are also observed to have become more and more persistent during the post-war period as unionization rates have fallen. Of course, it is possible that these results are due to some omitted variables. The actual direction of causality was tested by an examination of employment in states with right-to-work laws. The results are not consistent with the insider-outsider theory of unions where the employed are the insiders and the unemployed are outsiders. Rather, they provide additional support for the wage rigidity theory of unions.

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