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The determinants of real wage flexibility

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Abstract

A two-equation model of the labour market is separately estimated for each of the 48 contiguous states of the USA. Empirical estimates derived by running the model on data from the 1964–86 period enable state-specific estimates of long-run real wage flexibility to be derived. A further empirical investigation is then conducted in order to establish what factors determine inter-state variation in wage flexibility. We find, amongst other things, strong support for the efficiency wage interpretation of wage stickiness.

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1. Introduction

The role played by differences in real wage flexibility as an explanation of inter-country variation in macroeconomic performance is well established. Attempts to dig deeper below the surface, and hence to explain differences in wage flexibility across countries and regions, have been relatively rare. In this paper we provide measures of real wage flexibility for each of the 48 contiguous states of the USA, and then attempt to explain the observed inter-state variation by appeal to the available theories. This allows us to comment on the likely empirical relevance of such labour market models as the efficiency wage, insider–outsider, and efficient bargains hypotheses.

The paper is structured as follows: Section 2 develops our basic model of the labour market, and presents empirical estimates of wage flexibility for the 48

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states. Section 3 provides a discussion of the main theories which have been advanced in order to explain wage rigidity, and presents a model designed to account for the observed differences in wage induration across the 48 states. Conclusions are drawn in Section 4.

2. Estimates of wage flexibility

In this section we derive a two-equation model which focuses on the labour market. The model is essentially a simple version of the familiar system expounded by, amongst others, Layard et al. (1991). The main difference is that, since consistent indices of consumer prices are not available at state level, and since consumer prices are in any event likely to be determined within a national market, our version of the model does not treat prices as endogenous. Our main aim in this section is to derive from this model a measure of real wage flexibility which is specific to each of the 48 contiguous states. In so doing, we follow a methodology which is by now well established (see, for example, the work of Grubb et al. (1983) and Coe (1985)).

The following simple model is closely related to the 'battle of the mark-ups' model advocated by Layard and Bean (1989) and motivates the empirical research which forms the bulk of this paper. The notation is defined thus: p represents (log) prices, w is (log) wages, y is (log) real Gross State Product (GSP), and u is the unemployment rate. The superscript e denotes an expected value, and the subscript -1 denotes the series for a variable whose observations are lagged by one year. The price and wage mark-up equations are respectively given by (1) and (2) below.

$$p - w^e = a_0, \tag{1}$$

$$w - p^e = b_0 - b_1 u. \tag{2}$$

Suppose further that $w_{-1}^e = w_{-1}$, and that the price expectation mechanism takes the form

$$p^e = p_{-1} + c, \tag{3}$$

where c is the expected log price change. Substituting from (3) into (2), lagging (1) throughout and using the above condition on wage expectations, gives after routine manipulation,

$$\Delta w = a_0 + b_0 - b_1 u + c. \tag{4}$$

This is a fairly standard Phillips curve which says that wage inflation depends (negatively) on unemployment and (positively) on expected price inflation.

The demand side of the economy is represented by an Okun's law (Okun, 1962) relationship given by

$$u = d_0 - d_1(p + y - w) \tag{5}$$

and we assume y to be exogenous to the model. Taking first differences yields

$$\Delta u = -d_1[\Delta(p + y) - \Delta w]. \tag{6}$$

This relationship enshrines the principles of the inflation unemployment link investigated in the early work of Irving Fisher (1926), and we shall henceforth refer to is as the Fisher curve.

The data used in the sequel refer to the 48 contiguous states over the period 1964–86, and the frequency of observation is annual.[1] The estimating method used here is three-stage least squares, the two equations of interest being the *unrestricted* empirical equivalents of Eqs. (4) and (6) above. The set of instrumental variables used consists of the lagged national percentage growth of output and wages; extensive experimentation confirmed that our results are robust with respect to the choice of instruments.

The regression results for the Phillips and Fisher curves yield a number of interesting insights and are fully reported and discussed in Hyclak and Johnes (1992a). The goodness of fit of the equations is generally good, and the regression diagnostics reveal only a few cases where the residuals are ill-behaved[2]; in these cases the parameter estimates were little changed by use of the standard fixing procedures. For conciseness only the state-specific measures of the wage flexibility parameter are reported here, and these can be seen in Table 1.

From these estimates, real wage flexibility would appear to show considerable variation from state to state. Connecticut is characterised by rigid real wages, but the wage flexibility parameter rises as high as 2.9 in North Dakota. These results are typical of regional trends; the north east states are typically characterised by real wage inflexibility, while the west north central region is at the opposite end of the spectrum. Overall our results are very much in line with the figures obtained by Blackley (1989) for 26 states. However, the present study is the first to provide an index of wage flexibility for all 48 contiguous states.

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[1] Wage inflation is measured as the rate of change of average hourly earnings in manufacturing; the source of data is the Handbook of Labor Statistics. Unemployment data come from the Manpower Report of the President. Data on consumer price inflation are from the Economic Report of the President. GSP data were kindly supplied to us by the US Department of Commerce.

[2] We tested for: autocorrelation using the Durbin–Watson test for the Phillips curve and Durbin's h test for the Fisher curve; normality using the Jarque and Bera (1980) test; heteroscedasticity using the first-order auto-regressive conditional heteroscedasticity (ARCH) test due to Engle (1982); and functional form using the regression specification error test (RESET) devised by Ramsey (1969). In order to check for the possibility that unemployment might not be a stationary variable, we have also re-estimated the system using the change in unemployment as the dependent variable in the Fisher curve (and using only price inflation, nominal demand growth and the constant as regressors). This made virtually no difference to the estimates of wage flexibility parameter in any state.

Table 1
Mean estimates of real wage flexibility, 48 contiguous states[a,b]

State	Wage flexibility	Standard error	State	Wage flexibility	Standard error
Alabama	0.43	0.13	Nebraska	1.51	0.38
Arkansas	0.96	0.23	Nevada	0.71	0.34
Arizona	0.69	0.29	New Hampshire	0.38	0.19
California	0.82	0.18	New Jersey	0.08	0.21
Colorado	0.85	0.36	New Mexico	−0.12	0.38
Connecticut	−0.10	0.16	New York	0.09	0.17
Delaware	0.06	0.46	North Carolina	0.97	0.24
Florida	0.91	0.28	North Dakota	2.90	0.78
Georgia	0.48	0.25	Ohio	0.53	0.16
Idaho	0.87	0.38	Oklahoma	0.93	0.23
Illinois	0.59	0.13	Oregon	1.20	0.20
Indiana	0.91	0.17	Pennsylvania	0.67	0.18
Iowa	1.16	0.19	Rhode Island	0.37	0.19
Kansas	1.01	0.55	South Carolina	0.82	0.23
Kentucky	0.57	0.14	South Dakota	2.54	0.75
Louisiana	0.52	0.15	Tennessee	0.47	0.15
Maine	0.37	0.25	Texas	1.02	0.21
Maryland	1.46	0.47	Utah	1.46	0.40
Massachusetts	0.12	0.13	Vermont	0.73	0.20
Michigan	0.54	0.19	Virginia	0.80	0.35
Minnesota	0.79	0.24	Washington	1.10	0.22
Mississippi	0.37	0.18	West Virginia	0.53	0.10
Missouri	0.59	0.19	Wisconsin	0.86	0.12
Montana	1.17	0.72	Wyoming	0.74	0.55

[a] The wage flexibility parameter is the negative of the coefficient on unemployment in the 3SLS estimates of the state-specific Phillips curve.
[b] Aggregating these estimates to regional level gives the following unweighted mean estimates (standard errors in parentheses): New England 0.31 (0.28); Middle Atlantic 0.28 (0.28); East North Central 0.69 (0.16); West North Central 1.50 (0.82); South Atlantic 0.75 (0.38); East South Central 0.46 (0.07); West South Central 0.86 (0.20); Mountain 0.80 (0.43); Pacific 1.04 (0.16).

It is useful as an aside to consider here the issue of unemployment hysteresis which may be due to the depletion of human or physical capital stocks or to the presence of insider power. Path dependence would present a challenge to the empirical specification of the Phillips curve used above. In order to test for the possible existence of hysteresis in the 48 states over the period of interest, we have re-estimated the system for each state, this time introducing a new variable – lagged unemployment – into the Phillips curve. Hysteresis is said to exist if the negative impact of current unemployment on wage inflation is offset by a positive coefficient on the lagged unemployment term (Coe, 1988); this would indicate that the level of unemployment matters little in the determination of wages, but

that any change in unemployment does have an impact. We found little evidence of hysteresis in most states, and for this reason we refer in the sequel to the estimates of wage flexibility derived from our simpler model of the Phillips curve. However, we did find some evidence of partial hysteresis in ten states.[3] Half of these form a contiguous band in and around the so-called 'rust belt'.

The considerable variation observed across states in the experience of wage flexibility begs the question: what factors determine the ability of real wages in a state to respond to local labour market conditions? This question, though of crucial importance, has received remarkably little attention in the empirical literature, even though theoretical work on this issue has advanced apace. It forms the subject of the next section.

3. Explanations of wage inflexibility

The second part of our analysis uses the estimates derived above in order to estimate functions which seek to explain the variation in wage flexibility observed across the 48 contiguous states. In so doing we shall use a generalised least squares estimator which weights each observation by the inverse of the estimated variance of the wage flexibility coefficients; this removes bias due to the use of a vector of regression estimates as the dependent variable. Our methodology follows that of Grubb et al. (1983), but the data used here have the advantage of referring to a relatively homogeneous legal, cultural and institutional setting. The explanatory variables used in this analysis are described below.

The first determinant of wage flexibility which we shall consider is the incidence of efficiency wage payments. Yellen (1984) and Summers (1989) present neat models to show how, under some circumstances, the wage performs two functions – it determines both the number of units of labour attracted to the firm and the intensity of effort exerted by each worker.[4] Two prices are needed, but only one – the wage – exists. The wage cannot perform both roles simultaneously, and the outcome is wage inflexibility and unemployment. Clearly the efficiency wage model is unconvincing in a share economy where productivity bonuses are available, or in meritocracies where promotion structures are clearly defined. But the careful study by Krueger and Summers (1988) – henceforth KS – suggests that there are systematic inter-industry wage differentials which are difficult to explain other than by reference to the payment of efficiency wages.

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[3] These states are: Connecticut, Georgia, Indiana, Maine, Maryland, Michigan, Missouri, Ohio, Oregon and Pennsylvania.

[4] These are both examples of the shirking variant of the efficiency wage hypothesis. Other variants also exist: the turnover, adverse selection, gift exchange, and nutritional models. For an excellent survey, see Carmichael (1990).

Two of the explanatory variables used in the sequel attempt to capture the effect of efficiency wages upon wage induration. The first is based on the efficiency wage estimates obtained by KS. Since they find that 'the industry wage structure is highly correlated ... in different regions of the country', we may use their efficiency wage measures to derive state-specific indices of efficiency wages as follows: the weighted average of the national industry wage differentials[5] is calculated for each state, using as weights the proportion of state employment accounted for by each industry. We call this variable *EWMIX*. To the extent that it truly captures inter-state variations in the use of efficiency wages, we expect *EWMIX* to be negatively related to wage flexibility.

The second variable which we use to capture the use of efficiency wages is the proportion of establishments within each state with 20 employees or less. This variable will henceforth be referred to as *SMALL*.[6] We expect that monitoring of worker effort should be easier in small establishments so that the wage need not be used as a means of inducing extra effort. Moreover, to the extent that smaller establishments coincide with smaller firms, we would note that such firms are generally less able than others to pay wages above the market level (Groshen, 1988; Brown, 1990). Moreover, high turnover of labour in small firms keeps the wage structure in such businesses in line with competitive pressures. We therefore expect *SMALL* positively to influence wage flexibility.

Further theories designed to explain wage inflexibility include the theories of implicit contracts (Baily, 1974; Azariadis, 1975), right-to-manage and monopoly union models (Nickell and Andrews, 1983; Oswald, 1985), efficiency bargains (McDonald and Solow, 1981) and insider–outsider behaviour (Lindbeck and Snower, 1988). These theories would all lead us to expect that union activity would render the real wage less responsive to labour market conditions. We therefore include in our analysis a number of union variables. The first of these is union density (henceforth denoted by *UNION*). In constructing this variable the estimates of Troy and Shefflin (1985) have been used; the average density across the four observations supplied by that source within our study period is used. The second variable which is used to establish the strength of union activity refers to the state-specific legal framework. States which have 'right-to-work' laws are distinguished from other states by assigning the former a unit value in the binary variable *RTW*. The 'right-to-work' legislation makes union and agency shops (which compel employees to join or contribute financially to a union) illegal; the existence of such laws in certain states likely proxies the institutional and social climate within which labour relations are conducted. *RTW* is therefore expected positively to influence wage flexibility.

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[5] As estimated by KS for each of six single digit non-manufacturing industries (from KS, Table 1, column 1) and 20 two-digit manufacturing industries (KS, Table 2, column 1).

[6] Data for this variable are obtained from the 1977 County Business Patterns.

Although consistent with a union interpretation, insider–outsider theory does not depend upon this; rather than regard unemployed workers who are not union members as outsiders, we could with equal validity deem this group to consist of the long-term unemployed.[7] The proportion of the labour force which has been unemployed for over 26 weeks is denoted by *LTU*26. An analogous variable, *LTU*52, which denotes the proportion of the labour force unemployed for more than one year is also used in the analysis which follows. Both these variables are calculated by averaging the available data over the sample period.

Two further variables are used as regressors in the wage flexibility equation. The first is the state-specific percentage of unemployed workers who were on layoff, again averaged over the study period (*LAYOFF*). It is expected that a high incidence of unemployment due to layoff leads to relatively flexible real wages, since wage demands are more likely to be moderated in response to involuntary job loss than as a reaction to voluntary quits. Moreover, those workers on temporary layoff may be willing to take short term jobs at low wages since the possibility of imminent recall to their previous jobs would render substantial investment in job search (that is, a high reservation wage) inefficient.

The final determinant of wage flexibility which we shall consider is the minimum wage. This is of special interest in view of current debate in the EU concerning the Social Chapter of the Maastricht Treaty. Although the vast majority of workers in the United States earn wages well above the state-specific legal minima, and despite the erosion imposed on these minima by inflation, it remains important to consider the possibility that such legal floors adversely affect employment. Even if minimum wage legislation directly affects the wages only of workers with the least human capital, pressures to maintain pay differentials may mean that the legislation has a positive impact upon wages (and a negative one on employment) further up the jobs hierarchy. The variable *RELMIN* therefore measures the relative minimum wage, state by state, averaged across the relevant time period; we expect *RELMIN* negatively to influence wage flexibility.[8]

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[7] Data on unemployment duration are obtained from the Department of Labor publication, *Geographical Profile of Employment and Unemployment*. The same data source was used for the layoffs variable described below.

[8] We have also experimented with a number of further variables which might influence wage flexibility. These include a measure of industrial mismatch between the skills of the unemployed and the vacancies which remain unfilled (Layard and Nickell, 1986; Hyclak and Johnes, 1992b), and the extent of shocks to aggregate demand (Grubb et al., 1983). These were not successful in early regression runs, however, and we have not reported results which call upon these variables in the sequel.

The regression results obtained for the wage flexibility function are reported in the first two columns of Table 2, alongside descriptive statistics for each of the regressors. The estimation method used is generalised least squares, with each observation weighted by the inverse of the estimated variance of the dependent variable. The weighting procedure is employed in order to bypass heteroscedasticity problems which we would otherwise expect to arise owing to the use of a set of regression coefficients as the dependent variable.

The regression estimates are in broad accord with our expectations, and the equation provides a remarkably good fit. The diagnostic statistics reveal no severe statistical difficulties. Particularly significant (in the statistical sense) is the efficiency wage variable, *EWMIX*. This provides a measure of empirical support to the efficiency wage hypothesis, although it might more generously be interpreted as evidence for any theory which explains stable inter-industry wage differentials. The coefficients on the long-term unemployment variables (*LTU*26 and *LTU*52) are signed as expected, but are insignificantly different from zero. This contrasts with the results obtained in our work on the British regions (Hyclak and Johnes, 1992b); we speculate that this may be due to the fact that (in contrast with the UK at the time of this study) the long term unemployed in the US are not generally entitled to unemployment benefit, an institutional feature which might serve to encourage both wage flexibility and extensive job search amongst this group.

A further explanation for the insignificance of *LTU*26 and *LTU*52 might be that long-term unemployment and wage flexibility are simultaneously determined. Likewise it would seem sensible to check for the possibility that layoffs are simultaneously determined with wage flexibility. In order to investigate these possibilities we conduct a further analysis using two-stage least squares. For conciseness, we report only the 2SLS wage flexibility equation here, and this appears in column 3 of Table 2.[9] The effect of allowing for possible simultaneity is to strengthen the coefficients on both *LAYOFF* and *LTU*52, though the hypothesis that *SMALL* influences *WFLEX* is now no longer supported at conventional levels of significance.

[9] Alongside wage flexibility, the following exogenous variables are supposed to determine the rate of long-term unemployment: *UNION*; the average annual percentage change in GSP; the average replacement ratio (henceforth denoted by *UI*); and the average proportion of employment service applicants placed into jobs. The exogenous variables introduced into the layoffs function are: *UI*; *UNION*; the average percentage of workers employed in manufacturing; and a shocks measure, namely the variance of the annual rate of GSP growth over the study period. The inclusion of *UI* in both these functions leads to a policy implication worthy of note. Although we could not detect a direct link between benefits and wage flexibility, there is evidence here that benefits significantly lengthen unemployment spells and raise the proportion of unemployed on layoff. Since the long-term unemployed are limited in their ability to bid wages down, benefits must therefore exacerbate wage rigidities.

Table 2
Wage flexibility functions[a]

Variable	Mean	Standard deviation	GLS1	GLS2	2SLS
Constant	1	0	− 8.29	− 8.78	1.48
			(1.64)	(1.70)	(0.26)
EWMIX	− 0.92	1.123	− 0.38	− 0.38	− 0.24
			(9.50)	(9.50)	(4.00)
SMALL	0.88	0.01	14.07	14.59	2.00
			(2.72)	(2.72)	(0.32)
UNION	0.22	0.08	− 5.70	− 6.03	− 1.78
			(2.84)	(3.16)	(1.03)
RTW	0.42	0.49	0.60	0.59	0.41
			(3.53)	(3.47)	(2.41)
RELMIN	0.45	0.06	− 7.62	− 7.72	− 5.38
			(3.31)	(3.33)	(2.72)
LAYOFF	0.16	0.05	6.66	6.50	4.92
			(3.54)	(3.44)	(2.73)
LTU26	0.14	0.04	− 2.16		
			(0.63)		
LTU52	0.04	0.02		− 2.24	− 17.16
				(0.37)	(2.52)
Adjusted R^2			0.89	0.88	0.43
RESET (F form)			1.56	1.48	1.62
Normality χ^2			1.06	1.33	1.64

[a] t-statistics in parentheses.

4. Conclusion

Earlier work on wage flexibility has highlighted substantial cross-country differences in the extent to which real wages are responsive to labour market conditions. More surprising is the evidence provided by both Blackley (1989) and by the present analysis that wage flexibility varies markedly across regions within a single country where the institutional and socio-political environment is reasonably homogeneous.

In the above analysis we have investigated empirically the determinants of wage responsiveness to labour market conditions. Our results provide a degree of support to theories which explain wage induration by appeal to efficiency wages and insider–outsider effects. They also indicate that union activity and statutory minimum wage legislation operate upon wage flexibility in the direction suggested by theory. To the best of our knowledge, this is the first study of this kind to be conducted using data for the regions of a single country; that being so, it is inevitable that a degree of caution should be exercised in

interpreting the results. Nevertheless, our conclusions accord with intuition, and indicate that these are avenues which those (including ourselves) who are interested in such matters could profitably follow.

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