Do contracts matter in Canada?

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Abstract. This paper empirically examines the view that wage rigidity in long-term labour contracts matters for the behaviour of employment. In particular, I follow Bils's (1991) approach, which looks for systematic employment patterns in the first year of long-term contracts. Using a new panel data set which includes annual firm-level employment observations from the Canadian manufacturing sector, I find evidence in many industries that employment over-adjusts to shocks that occur during the contract. My examination of wage dynamics, however, indicates that for those industries in which contracts appear to matter for the behaviour of employment, there is little indication that contractual wage rigidity is the source of the over-adjustment of employment.

Est-ce que les contrats sont importants au Canada? Ce mémoire examine de manière empirique l'hypothèse que la rigidité des salaires dans les contrats de travail à long terme a de l'importance pour le profil de l'emploi. En particulier, l'auteur utilise l'approche de Bils (1991), qui cherche des patterns systématiques d'emplois dans la première année de ces contrats à long terme. Utilisant des données nouvelles qui fournissent des renseignements annuels sur l'emploi au niveau de la firme dans le secteur manufacturier canadien, l'auteur découvre que dans plusieurs industries le niveau d'emploi réagit de manière excessive aux chocs qui se produisent au cours de la période du contrat. Cet examen de la dynamique des salaires montre cependant que, dans les industries où les contrats sont importants pour le profil de l'emploi, il y a peu d'indications que la rigidité des salaires contractés est la source de cet ajustement excessif dans le niveau de l'emploi.

I. INTRODUCTION

One view of wage and employment determination, which has a long tradition in Keynesian macroeconomics, forming the basis of recent work by Fischer (1977) and

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Taylor (1980) among others, is that wages are fixed throughout a contract period while employment is variable and determined unilaterally by the firm. Given the rigidity of the contract wage, employment over-adjusts to labour demand shocks that occur during the contract period. This mechanism is thought by many to be one important channel through which fluctuations in nominal aggregate demand can affect the level of employment and output.

As Barro (1977) has argued, central to this view of long-term contracts is an inefficiency associated with the employment-determination rule; as long as employment is constrained to lie along the firm's labour-demand curve, then wage rigidity generates an over-adjustment of employment only by driving workers off their labour supply curves. As a result, there are unexploited gains from trade between the firms and workers, owing to the wedge between the marginal product of labour and the worker's marginal value of time. In a hypothetical world of fully flexible wages, employment would not over-adjust to shocks; wages and employment would always be at their efficient levels.

Such over-adjustment of employment in response to shocks can also occur in a world where firms and workers negotiate contracts that are efficient in the sense that wage/employment outcomes lie along a contract curve (McDonald and Solow 1981; Brown and Ashenfelter 1986; MaCurdy and Pencavel 1986). In such cases, firms and workers may agree to set the contract wage ex ante and to choose employment, given that wage, along the ex post contract curve. But as long as the wage-determination rule is sensitive to the level of expected labour demand, employment in such contracts may still over-adjust to shocks that occur after the wage has been set. Here, even though the contract is efficient, firms and workers would have chosen a different wage/employment outcome if both variables had been chosen ex post. In this sense, contractual wage rigidity can still generate excessive movements in employment during the life of the contract.

It is this possible over-adjustment of employment in the presence of long-term contracts that Bils (1991) explores in a recent paper. Bils's insight is that if contractual wage rigidities are important for the behaviour of employment, then any over-adjustment of employment made necessary by rigid contract wages should be corrected at the beginning of the subsequent contract when wages are renegotiated. Failure to observe such a realignment of wages and employment would then support the inference that contracts do not matter for the behaviour of employment. Bils finds, using industry-level employment data for twelve U.S. manufacturing industries, that such contracting effects on employment are observable. In particular, the motor vehicles industry seems strongly to support the view of long-term contracts that employment over-adjusts to shocks that occur during the contract.

In this paper I re-examine the issue of employment dynamics in long-term contracts using data that I argue are more appropriate to the task than the aggregate data used by Bils. Perhaps the most significant contribution of this paper is the introduction of a new panel data set of annual firm-level employment observations which is matched with data from union contracts in the Canadian manufacturing sector. The distinguishing feature of the new employment data is the availability of employment observations between contracting dates. This aspect contrasts with most contract-based data sets (e.g., Vroman 1984; Card 1990), which contain employment observations only at the time of contract negotiation. It is this feature of the new data that permits an examination of the dynamics of employment during the life of the contract.

To anticipate the results somewhat, I find compelling evidence in some industries that the behaviour of employment is significantly different from what would be expected in a hypothetical world of flexible wages. That is, I observe a realignment of employment at the beginning of new contracts which can be interpreted as an undoing of the shocks from the previous contract. In other industries, however, the results are consistent with the view that employment never over-adjusts to shocks that occur during the period of contractually fixed wages and so contracts do not matter for employment.

It is important to note that these conclusions are based only on an examination of employment dynamics throughout the life of the contract. As in Bils's work, the observed employment behaviour generates only an *inference* about the extent of contractual wage rigidity. When I do examine the dynamics of contract wages, I find some puzzling results similar to those found by Bils. Specifically, in those industries for which contracts appear to matter for the behaviour of employment, there is no direct evidence that it is contractual wage-rigidity that is responsible for the over-adjustment of employment. In other words, contract wages do not in general follow the dynamic pattern consistent with wage-rigidity's being the source of the observed over-adjustment of employment. One interpretation is simply that contract wages do not accurately reflect the complete marginal cost of labour.

The paper is organized as follows. Section II presents the theoretical framework used to derive the estimation equations for wage and employment dynamics. In section III I discuss in detail the data set used for the estimation. Section IV presents the empirical results for the behaviour of employment and wages. I offer some final remarks in section V.

II. THEORETICAL FRAMEWORK

Consider a labour market in which a union and firm enter into a contract in which the real wage is fixed for the duration of the contract.[1] The union is assumed unilaterally to set the real wage and the firm unilaterally to determine employment. It is not central to the analysis that the wage is determined by the union rather than being the outcome of some bargaining process. The important assumption is that once the real wage is determined, it is unable to respond immediately to shocks that occur during the contract. If the firm and union bargain over the wage, the

1 This example does not accurately reflect actual collective agreements in North America. As Card (1986) points out, most contracts determine the path of the nominal wage together with an indexation formula. Incomplete indexation (to the price level) is usual. It is only for simplicity that the discussion in this section proceeds under the assumption that the contract specifies the real wage. In section IV I discuss the case of fixed nominal wages and indexation.

model generates a different solution for the *level* of the wage and employment, but the implications for the *dynamics* of employment are unchanged. It is the latter issue that is the focus of this paper.

The firm's labour demand is subject to random shocks that are observable to both firm and union. In a long-term contract the real wage is set at the beginning of the contract, before the shock is revealed. This feature might be compared with a hypothetical spot market in which the wage would be set after the shock is revealed. In both long-term contracts and hypothetical spot markets the firm sets employment along its labour-demand curve after the shock is observed.

Since the goal of the theoretical framework is to provide an estimable employment equation that clearly shows the sense in which long-term contracts matter for the behaviour of employment, the key relationships in the wage and employment determination process are assumed to be log-linear. The model is thus represented by the following equations.

$$L_t = \alpha_t - \beta W_t, \qquad \beta \geqq 0 \tag{1}$$

$$\alpha_t = \rho\alpha_{t-1} + \epsilon_t, \qquad 0 \geqq \rho \geqq 1 \tag{2}$$

$$W_t = \gamma + \delta E(\alpha_t | I_0), \qquad \delta \geqq 0. \tag{3}$$

Equation (1) is a simple labour-demand curve, with L equal to the log of employment and W the log of the real wage; α is the random part of labour demand. Equation (2) permits the labour-demand shock to follow a first-order auto-regressive process with ρ being the degree of persistence of the shock; ϵ is a white noise disturbance. Equation (3) is the equivalent of the labour-supply curve but, in this unionized setting, is better thought of as the union's wage-setting locus. It shows the desired wage for the union as a function of the expected state of labour demand. I_0 is the information set used to generate the expectation, and includes all information available at the beginning of the contract. In a hypothetical spot labour market, I_0 would be replaced with I_t, reflecting the complete information at the time of wage-setting. Equations (1), (2), and (3) are assumed known by both the firm and the union.[2]

The wage rigidity in long-term contracts implies that employment over-adjusts to shocks that occur during the contract. This over-adjustment is relative to a hypothetical world in which both wages and employment respond instantly to all shocks. Bils's insight is that if wage rigidity is responsible for extreme employment behaviour during long-term contracts then this over-adjustment of employment should be corrected at the beginning of the next contract when the wage path is adjusted. To see this, consider the case of a multi-period contract. The union sets the entire path of wages at the beginning of the contract, based on information available at

2 Since α is observable ex post to both firm and workers, the model does not internally generate a reason for the absence of fully contingent contracts. An implicit assumption, therefore, is that such fully contingent contracts are prohibitively expensive to negotiate.

that time. Substituting equation (3) into equation (1) for each period of the contract, using the appropriate value of $E(\alpha_t)$ from equation (2) in each period and eliminating the unobservable terms, the employment equation is

$$L_t = \nabla + \rho L_{t-1} + \epsilon_t - (\beta\delta) Z_t \sum_{j=1}^{K} \rho^j \epsilon_{t-j}, \tag{4}$$

where K is the length of the *previous* contract and Z_t is an indicator function which takes the value 1 if t is the first period of a contract and the value 0 otherwise.[3]

In long-term contracts employment follows and AR(1) process with the degree of persistence equal to ρ. In each period there is the white-noise labour-demand shock, ϵ. But in the first year of contracts there is an error-correction term that reflects the shocks from the previous contract. This is the correction of past shocks discussed by Bils; it shows up as a negative moving-average (MA) component of the error term in the first period of contract and appears only if $\beta\delta$ is non-zero. If wages and employment were fully flexible, employment would be represented by equation (4) without the MA term; employment would follow a simple AR(1) process in all periods.

The intuition behind this negative MA component is straightforward and is based on the assumption that wages are predetermined in long-term contracts. The rigidity of wages during the contract means that, for example, a positive shock that occurs in one contract can be built into the union's wage demands only at the beginning of the next contract. As long as shocks to labour demand display some permanence ($\rho > 0$), then the upward adjustment of the wage at the beginning of the next contract results in a fall in employment. Employment in the first year of a new contract therefore displays an undoing of labour-demand shocks from the previous contract. If the previous contract was one period long, employment in the first year of the new contract undoes only the shock ϵ_{t-1}. If the previous contract was two or three periods long, there are more employment shocks to undo in the new contract. The order of the MA component in the error term is therefore equal to K, the length of the previous contract.

These employment dynamics are illustrated in figure 1. The upward-sloping curve is the wage-setting locus. The downward-sloping curves are different expected and actual labour-demand curves. For simplicity, it is assumed that all contracts are one period in length. The union sets the wage for period 1 before actual labour demand is observed. The wage is chosen at W_1 and the expected outcome is at point A. If a positive shock occurs, actual labour demand is given by $L_1(W_1)$.

3 Note that the only source of persistence in employment in this model comes from the error structure. It is natural, however, to think that costly adjustment of employment also induces persistence (Nickell 1986; Hamermesh 1989). If equation (1) was modified to include lagged employment (with coefficient c), there would be an additional lag of employment in equation (4), with coefficient c, and the coefficient on the MA term would be $(\rho + c)^j$. When I estimated this modified version of equation (4), however, the estimate of c was never significantly different from zero, suggesting that, with annual employment data at least, adjustment costs are not important.

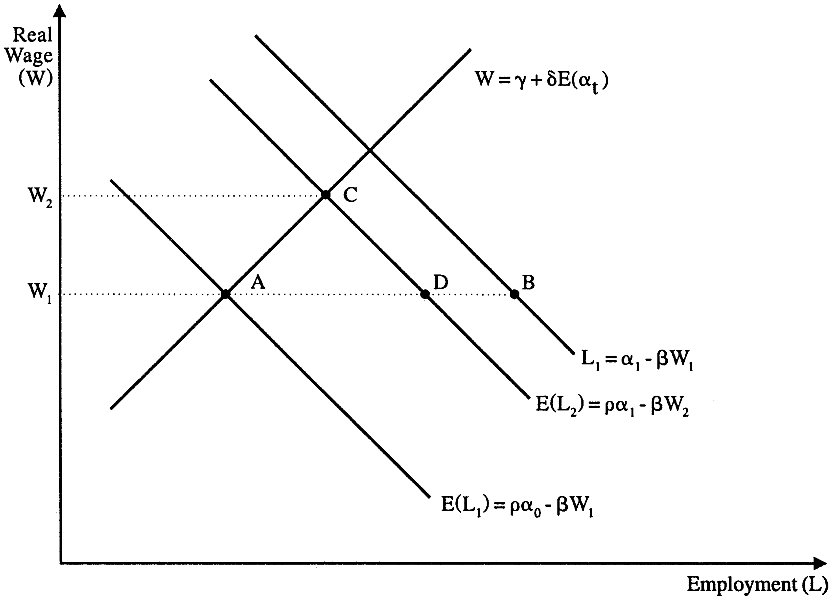

FIGURE 1 The undoing of previous labour demand shocks

Employment is therefore given by point B, since the union provides all labour demanded at the predetermined wage.

If ρ lies in the $(0, 1)$ interval, then the expected labour-demand curve for period 2 lies inside the actual labour-demand curve for period 1. The wage for the contract beginning in period 2 is W_2, and expected employment in period 2, given by point C, undoes some of the period 1 labour-demand shock. The extent of the undoing is represented by the horizontal distance between C and D, whereas the distance between B and D reflects the size of ρ.

Note from equation (4) that wage rigidity matters for the behaviour of employment only if $\beta\delta$ is non-zero. If real wages play no allocative role in the labour market ($\beta = 0$) or if the union's desired wage is independent of the state of labour demand ($\delta = 0$), then contracts do not matter for employment behaviour. In this case the wage rigidity in long-term contracts would not be responsible for any over-adjustment of employment. Thus, the empirical test in this paper, which is based on equation (4), is not about whether wages are rigid or predetermined (since they clearly are in the contracts in the sample), but, rather, whether there is any evidence that employment over-adjusts to shocks during the contract.

One final point about the interpretation of employment dynamics should be mentioned. Estimating equation (4) requires only information about employment levels, contract lengths, and contracting dates. There are no data required about contract wages. Yet the theoretical structure above suggests that we can interpret the presence of the negative MA term in equation (4) as evidence that wage rigidity is important for the behaviour of employment. Clearly, a much stronger test of the hypothesis that it is wage rigidity (and not something else) that leads to employment behaviour like that of equation (4) requires an examination of wage dynamics. In section IV, after examining the empirical behaviour of employment, I show the wage equation consistent with equation (4) and estimate it.

III. A NEW FIRM-LEVEL DATA SET

Bils estimates an equation similar to equation (4) using industry-level employment data for twelve manufacturing industries in the United States between 1958 and 1985. The industries are heavily unionized and also appear to follow a general industry bargaining pattern. One advantage of data at this level of aggregation is that long time series are relatively easily available, and, in addition, data can be collected at quarterly intervals. This makes the estimation of time-series relationships like equation (4) reasonably convincing.

There are two drawbacks to using Bils's data for the estimation of equation (4). The first concerns the match between the theoretical framework and the level of aggregation of the data. The theoretical framework is clearly aimed at describing the behaviour of a firm/union bargaining pair; for two reasons it is doubtful that industry-level data are appropriate. First, some fraction of the workers in each industry are not unionized, and the process of wage and employment determination for those workers may be very different from that of the unionized workers. The second, and probably more important, reason to be uneasy about the aggregate data is that Bils is forced to impute contracting dates for the industry as a whole by observing contracting dates for a group that represents at least half of the workers in the industry. So any minority group of an industry's workers who actually contract at different times from the majority are recorded in the data with incorrect contracting dates. Significant minorities may therefore generate employment dynamics that tend to smooth out those of the majority, yielding aggregate employment behaviour that is smoother than that of the underlying bargaining pairs. This might explain why Bils finds that the negative MA term in equation (4) is strongly present in only two of the twelve industries in his sample.

The second drawback to Bils's data relates to the relatively high frequency of the data, in his case quarterly. By estimating equation (4) on quarterly employment data, the correction of the over-adjustment of employment hypothesized to take place in the first period of a new contract is restricted to occur within a single quarter. But this limitation may be requiring too much of the data if firms experience some costs in adjusting their employment levels. With lower frequency data, such as annual, the estimation of equation (4) requires the undoing to take place only in the first year of the contract. So if firm-level adjustment costs are present to any significant degree, annual data may be more appropriate for the task.

Ideally, estimation of equation (4) would use employment data at the level of the firm, together with dates when contracts are negotiated. Moreover, it is essential to have observations on employment *between* contracting dates. The latter requirement renders most contract-based data sets inadequate, since they generally include employment figures only at the time the contract is signed.

The data set used in this paper is composed of two parts. The first is an existing data set which provides information on contracts for 299 firm/union bargaining pairs in the Canadian manufacturing sector. It is drawn from Labour Canada's Wage Tape, which contains information on all collective agreements in Canada covering more than 500 workers.[4] The tape contains, among other things, information on base wages throughout the contract, contracting dates, monthly duration of the contract, and the number of workers covered by each collective agreement.

The second part of the data set – the part unique to this paper – is a new collection of annual firm-level employment observations for a subset of the bargaining pairs represented on the Wage Tape. These data are assembled from annual submissions from union locals, as required under the Corporations and Labour Unions Returns Act (CALURA) of 1962. This act requires all union locals to submit the total size of their membership as of 31 December of every year as well as a breakdown of membership by location of employment. Membership for purposes of these submissions is the total number of dues-paying members, and with few exceptions unemployed members are not required to pay union dues. Memberships found in the CALURA files therefore represents the number of currently employed union members.[5]

From the total of 299 bargaining pairs, annual employment data from the CALURA files are found for a subset of 197.[6] Though the main factor responsible for exclusion is availability, some bargaining pairs are excluded intentionally. In particular, contracts that represent 'collective' bargains, in the sense that they cover several firms and/or several groups of workers and therefore are not well captured by the theoretical framework, are excluded. The exclusions on this basis are the British Columbia pulp and paper industry; much of the clothing industry; multi-province firms that sign national contracts; and the major auto makers.

The final sample includes 1,385 contracts negotiated by 197 bargaining pairs in the Canadian manufacturing sector between 1964 and 1985. The total number of annual employment observations is 2,876. The sample represents roughly 200,000 workers, which is just over 9 per cent of total manufacturing employment, or about 21 per cent of unionized manufacturing employment in Canada.

Table 1 shows summary statistics for the data set. The sample is quite unbalanced in its industrial coverage, being heavily represented by Food, Paper, Primary Metals, and Transportation and Electrical Equipment, and lightly represented by Leather,

4 I am grateful to David Card for making this data available. See Card (1990) for a description of this data.

5 Note that there is potentially a difference between the number of employed union members and the number of workers covered by the collective agreement. For instance, workers could be covered by the agreement but not be union members (even though they would still pay union dues). Alternatively, a single union local may represent workers who are typically covered by different collective agreements so that, with respect to a single agreement, some union members would be uncovered workers. Unfortunately, there are no data (that I know of) which deal with the covered/uncovered distinction.

6 See Ragan (1992) for a detailed discussion of the construction of this employment data.

TABLE 1
Summary statistics for data set

Industry	Bargaining pairs	Contracts	Annual obs.	Average employment	(s.d.)	Contract duration 1	2	3	> 3
Food & Beverages	23	171	308	624	(357)	61	83	27	0
Tobacco Products	5	38	69	829	(307)	9	27	2	0
Leather Products	1	10	19	691	(200)	1	9	0	0
Primary Textiles	8	55	120	1,049	(901)	12	22	20	1
Clothing	3	22	41	599	(135)	6	13	3	0
Wood Products	1	5	10	470	(127)	1	3	1	0
Furniture	1	12	20	510	(85)	4	8	0	0
Paper Products	24	181	368	922	(539)	36	104	40	1
Printing & Publishing	3	23	40	870	(320)	11	8	3	1
Primary Metals	30	204	465	1,605	(2,416)	51	53	93	7
Fabricated Metals	5	38	86	738	(239)	6	17	14	1
Machinery	10	67	147	1,298	(1,340)	17	22	26	2
Transportation Equipment	24	163	365	1,303	(944)	37	55	66	5
Electrical Equipment	24	163	332	1,445	(1,624)	46	65	52	0
Non-Metallic Minerals	12	83	170	631	(218)	18	46	16	3
Rubber Products	11	61	154	929	(390)	12	5	44	0
Chemical Products	8	61	110	727	(399)	24	27	9	1
Miscellaneous	4	28	52	671	(161)	7	18	3	0
Totals	197	1,385	2,876	1,084	(1,297)	359	585	419	22

Wood, and Furniture. Note also that there is considerable variation in the size of firms, as measured by employment.

The duration of a contract (in years) is taken to be the number of employment observations, taken on 31 December of each year, which fall between the starting dates for subsequent contracts. For example, a contract that begins in July 1980 and expires in January 1982, though only eighteen months long, is treated as a two-year contract, since it spans two of the annual employment observations. Thus, the values of K used in the estimation of equation (4) are integers which take the possible values $\{1, 2, 3, 4, 5\}$. This method of computing contract duration has the possibility of misrepresenting the true duration of contracts if actual contract lengths (in years) of non-integer values are common in practice. A frequency distribution of monthly duration for contracts in the sample shows that 1,166 of the 1,385 contracts have durations of precisely twelve, twenty-four, or thirty-six months; relatively few contracts fall between these yearly values.

In addition, the third column in table 1 reveals that there are some industries for which the number of employment observations is very low; certainly low enough to make precise estimation of equation (4) unlikely. For this reason, the eighteen two-digit industries are combined into nine groups on the basis of the nature of the products; industry groups are shown separated by blank horizontal rows. The number of annual employment observations for an industry group ranges from 170 for Non-Metallic Minerals, to 465 for Primary Metals.

IV. EMPIRICAL RESULTS

I use an iterative estimation procedure to estimate equation (4). First, excluding years that begin new contracts, I estimate with OLS a first-order auto-regression in employment for each industry group. This process yields a consistent estimate of ρ, which is then used, in conjunction with the predicted residuals, to generate the MA component to the error term. OLS is then used to estimate equation (4), yielding a new estimate of ρ. This procedure is repeated until all estimated coefficients converge to within 0.00001. All variables are expressed as logged deviations from firm-specific means.

1. Employment dynamics

Table 2 shows the results of estimating equation (4). The point estimate of ρ is in the (0, 1) interval for each industry group and in each case is significantly different from zero. The second column shows the estimated coefficient on the MA component of the error term. If contracts matter for the behaviour of employment, then these point estimates should be negative and significantly different from zero. Eight out of the nine industry groups display negative estimates, though several are estimated very imprecisely. Indeed, only in the first industry (Food & Beverages and Tobacco) is there strong evidence of the undoing of previous employment shocks in the first year of new contracts. The interpretation of (−0.15) as the estimated coefficient on the MA term is that 12 per cent (= (0.80)(0.15)) of the shocks from the previous contract are undone at the beginning of the new contract. In the pooled regression the estimated coefficient is negative but is not significantly different from zero.

The precision of the estimates improves considerably, however, when year controls are used. With year controls, three additional industry groups display significant and negative coefficients on the MA term (Fabricated Metals and Machinery, Electrical Equipment, and Non-Metallic Minerals) and a fourth (Primary Metals) moves considerably in that direction. The estimates are of considerable economic significance in the Fabricated Metals and Non-Metallic Minerals industries; the estimates suggest that about 25 per cent of the employment response to previous shocks is being undone at the beginning of new contracts.

Though only four industries out of nine have precise enough estimates to confirm the over-adjustment of employment predicted by the model, one cannot avoid a sense that, with the exception of the Textiles industries, and possibly the Rubber and Chemicals industries, most industries do seem to display the negative MA term. The Textiles industry group, indeed, appears to be the odd one out; the coefficient on the MA term in that industry is positive and very significantly different from

TABLE 2
Results by industry group for employment equation (4)

Industry group	ρ	$-(\beta\delta)$	Year controls	$\bar{R}^2$	N
Food & Beverages	0.804	−0.153	No	0.57	377
Tobacco	(0.041)	(0.087)			
	0.835	−0.231	Yes	0.58	377
	(0.040)	(0.087)			
Leather	0.410	1.356	No	0.31	180
Primary Textiles	(0.083)	(0.352)			
Clothing	0.353	1.565	Yes	0.37	180
	(0.091)	(0.462)			
Wood Products	0.614	−0.010	No	0.36	438
Furniture	(0.048)	(0.129)			
Paper Products	0.594	−0.043	Yes	0.39	438
Printing	(0.052)	(0.140)			
Primary Metals	0.647	−0.040	No	0.34	465
	(0.050)	(0.144)			
	0.701	−0.186	Yes	0.52	465
	(0.049)	(0.134)			
Fabricated Metals	0.768	−0.106	No	0.49	233
Machinery	(0.063)	(0.131)			
	0.648	−0.403	Yes	0.59	233
	(0.073)	(0.188)			
Transp. Equip.	0.541	−0.055	No	0.27	365
	(0.063)	(0.169)			
	0.517	−0.029	Yes	0.31	365
	(0.064)	(0.188)			
Elect. Equip.	0.730	−0.114	No	0.47	332
	(0.051)	(0.100)			
	0.736	−0.200	Yes	0.50	332
	(0.052)	(0.108)			
Non-Metallic Min.	0.631	−0.284	No	0.27	170
	(0.083)	(0.195)			
	0.599	−0.407	Yes	0.35	170
	(0.085)	(0.249)			
Rubber	0.575	−0.005	No	0.35	316
Chemicals	(0.055)	(0.158)			
Misc.	0.547	0.030	Yes	0.37	316
	(0.059)	(0.182)			
All industries	0.624	−0.045	No	0.35	2,876
	(0.020)	(0.050)			
	0.618	−0.077	Yes	0.39	2,876
	(0.020)	(0.051)			

NOTE: Standard errors are shown in parentheses.

zero. Repeating the pooled estimation with year controls, but excluding the Textiles industry group, the results are

$$L_t = \underset{(0.02)}{(0.63)} \cdot L_{t-1} - \underset{(0.05)}{(0.11)} \cdot Z_t \sum_{j=1}^{K} \rho^j \epsilon_{t-j}; \qquad N = 2696,\ \bar{R}^2 = 0.39,$$

confirming the suspicion that the Textiles industry is the exception rather than the norm. Based on table 2, one can conclude, over almost all industries taken together, that contracts do matter for the behaviour of employment and that they matter in the way predicted by the model developed above. In the Textile industries contracts also matter, but the interpretation of the positive coefficient on the MA term is puzzling. One possible interpretation of this result is offered later in the paper.

Following Bils, I also estimate a modified version of equation (4):

$$L_t = \rho L_{t-1} + \omega Z_t + \eta(\rho\epsilon_{t-1} + \rho^2\epsilon_{t-2}) - (\beta\delta) Z_t \sum_{j=1}^{K} \rho^j \epsilon_{t-j} + \epsilon_t. \tag{5}$$

The second regressor in equation (5) allows the possibility that there are systematic employment adjustments taking place in the first year of contracts that are unrelated to the size and persistence of previous shocks. The third regressor allows the possibility that firms adjust their employment level to previous shocks, but not only in the first year of new contracts. If the estimate of η is significantly negative, I refer to this as 'mean-revision' in employment.

Table 3 shows the results of estimating equation (5) with year controls. The estimates of ρ are not shown, because there is very little change from the estimates in table 2. Note first that none of the estimates of ω is large in magnitude; typically, employment adjustments in contract years (which are unrelated to previous shocks) are less than 2 per cent in magnitude. In only one industry (Non-Metallic Minerals) is this effect statistically significant. Furthermore, most industry groups display mean-reversion in employment, though in only four cases is this behaviour statistically significant. The most important finding in table 3 is the extent to which the inclusion of these extra regressors reduces the economic and statistical significance of the MA term in equation (5). Only the Fabricated Metals and Electrical Equipment industries display the predicted pattern: Food/Tobacco, Primary Metals, Transportation Equipment, and Non-Metallic Minerals have the predicted negative coefficient, but none is significantly different from zero.

In the pooled regression in table 3 there is a significant amount of mean-reversion, but contract years do not show a significant undoing of previous labour-demand shocks. In the pooled results, at least, contracts appear not to matter for the behaviour of employment. To see the extent to which the results are affected by the Textiles industry group, which again displays a large positive coefficient on the MA term, I re-estimate the pooled regression over the sample but exclude the Textiles industries. In this large subsample, despite a significant amount of mean-reversion in employment, which occurs in all years of contracts, there is also evidence that

TABLE 3
Results by industry group for employment equation (5)

Industry group	ω	η	$-(\beta\delta)$	$\bar{R}^2$	N
Food & Beverages Tobacco	0.017 (0.011)	−0.244 (0.067)	−0.079 (0.078)	0.60	377
Leather Primary Textiles Clothing	−0.012 (0.029)	−0.241 (0.399)	1.161 (0.380)	0.36	180
Wood Products Furniture Paper Products Printing	0.016 (0.015)	−0.248 (0.117)	0.081 (0.114)	0.39	438
Primary Metals	−0.027 (0.016)	−0.307 (0.080)	−0.073 (0.091)	0.54	465
Fabricated Metals Machinery	0.028 (0.026)	0.244 (0.240)	−0.500 (0.250)	0.59	233
Transp. Equip.	−0.012 (0.036)	−0.162 (0.215)	−0.006 (0.159)	0.30	365
Elect. Equip.	0.016 (0.020)	−0.035 (0.106)	−0.178 (0.112)	0.50	332
Non-Metallic Min.	−0.060 (0.021)	−0.282 (0.155)	−0.187 (0.181)	0.39	170
Rubber Chemicals Misc.	−0.010 (0.019)	0.292 (0.277)	0.088 (0.237)	0.36	316
All Industries	−0.006 (0.007)	−0.140 (0.048)	−0.043 (0.044)	0.39	2,876

NOTES
Standard errors are shown in parentheses.
Year controls are included as regressors in all industry groups.

the first year of contracts displays the negative MA term; the p-value associated with the estimate of $\beta\delta$ is 0.09.

$$
\begin{aligned}
L_t = \underset{(0.03)}{(0.70)} \cdot L_{t-1} - \underset{(0.01)}{(0.01)} \cdot Z_t - \underset{(0.05)}{(0.13)} \cdot (\rho\epsilon_{t-1} + \rho^2\epsilon_{t-2}) \\
- \underset{(0.04)}{(0.07)} \cdot Z_t \sum_{j=1}^{K} \rho^j \epsilon_{t-j}; \qquad N = 2696;\ \bar{R}^2 = 0.40
\end{aligned}
$$

Perhaps the safest conclusion to draw from table 3 is that there are specific groups of industries for which the rigidity of wages in long-term labour contracts appears to have a considerable impact on the behaviour of employment. In these cases the first year of new contracts displays an adjustment of employment which can be interpreted as an undoing of the labour-demand shocks that occurred over the previous contract. But there are also notable exceptions to this pattern. First, there are several industries in which over-adjustments of employment, and their subsequent corrections, do not appear to occur. This does not mean that wages are in fact flexible in these industries; for the mere existence and nature of the collective agreements suggests otherwise. What this finding does suggest is that the wage rigidity in these industries does not lead to extreme adjustments in the level of employment. As figure 1 shows, this fact might be due to a very inelastic labour-demand curve, or it may be due to the workers' desired wage's being independent of the state of labour demand. In either case, contractual wage rigidity does not matter for the behaviour of employment in these industries.

The Textiles industry perhaps represents the most troubling estimates. In this industry there is evidence of a significant degree of perverse adjustment to previous labour-demand shocks in the first year of long-term contracts. The Wood/Paper and Rubber/Chemicals industry groups also appear to have perverse employment adjustment, though the estimates in these industries are much less precise than in the Textiles industry group.

One last comment should be made about estimating the employment equation. The model above assumes that the contract specifies the path of the real wage. In contrast, actual collective agreements in North America are better characterized as setting a path for the nominal wage and, in some cases, a cost-of-living adjustment (COLA) clause. Incomplete indexation is a usual outcome (Card 1986). This incomplete indexation has important implications for the behaviour of employment. If the nominal wage path is set to offset the effects of expected inflation and the COLA clause is designed to offset the effects of unexpected inflation, then the employment equation can be modified to include a term that reflects both the unexpected inflation over the contract and the degree of indexation; employment will rise if there is positive unexpected inflation and incomplete indexation. I estimated an appropriately modified version of equation (5) to see if this influenced the results. In each industry group the estimates of $-(\beta\delta)$ are changed only very slightly, and in no case is the statistical significance altered.

2. Wage dynamics

The theoretical model that forms the basis for the empirical work in this paper suggests that inferences about the importance of contractual wage rigidity can be made by examining the dynamics of employment. For those industries in which we observe the negative MA component in the employment equation we may be led to conclude that it is the rigidity of wages that results in the over-adjustment of employment. But it is important to note that this conclusion is not based on any direct examination of wage behaviour. Indeed, the actual behaviour of wages may be markedly different from what the model would predict, given the observed behaviour of employment.

I estimate a wage equation consistent with the employment equation, which is easily derived from the model in section 2. The wage equation, with the first two regressors included to ensure consistency with the modified employment equation (5), is

$$W_t - \hat{\rho} W_{t-1} = \psi Z_t + \lambda(\hat{\rho}\hat{\epsilon}_{t-1} + \hat{\rho}^2 \hat{\epsilon}_{t-2}) + \delta Z_t \sum_{j=1}^{K} \hat{\rho}^j \hat{\epsilon}_{t-j} + \epsilon_t, \tag{6}$$

where a hat denotes predicted values from the estimated employment equation (table 3). The model predicts that, to the extent that the union's wage-setting locus is upward sloping ($\delta > 0$), the contract wage rises (falls) at the beginning of a new contract in response to positive (negative) labour-demand shocks in the previous contract. Indeed, it is precisely this wage adjustment that generates the negative MA term in the employment dynamics. The slope of labour demand (β) does not enter the dynamics of wages.

I use the nominal contract wage deflated by the Producer Price Index to generate a measure of the real product wage. Table 4 shows the estimates of equation (6) by industry group, including year controls as regressors.[7] One striking finding in table 4 is the extent to which there is a systematic fall in the real wage in the first year of contracts; this pattern is true in five of the nine industry groups. This finding is in contrast to separate findings for the United States by Bils (1990) that long-term labour contracts display significant front-loading of the wage. The result changes only slightly when wages are deflated by the Consumer Price Index.

Other than these systematic contract-year effects on wages, real wages do not seem to adjust significantly to previous labour-demand shocks, in either contract or non-contract years. Only the Wood/Paper industry group displays the predicted positive estimate of δ, and therefore only in this industry is there observed in the first year of contracts an adjustment in real wages reflecting previous labour-demand shocks. It is interesting that employment in this same industry displays no significant undoing of the previous shocks (table 3); in the Wood/Paper industry, at least, contracts appear to matter for the behaviour of wages but not for the behaviour of employment.

The model used to derive the estimating equations predicts that if contracts matter for the behaviour of employment then they *must* matter for the behaviour of wages. This is so because employment displays the undoing of previous labour-demand shocks only because the wage adjusts, at the beginning of new contracts, to those shocks. But the reverse is not true. Real wages may adjust at the beginning of new contracts but this adjustment will have no effect on employment if the real wage is not used to allocate labour – that is, if labour demand is perfectly inelastic, or if the firm and union sign strongly efficient contracts (Brown and Ashenfelter 1986). The finding in the Wood/Paper industry that contracts matter for wages but not for employment is therefore not inconsistent with the theoretical framework. It is possible that labour demand in that industry is very inelastic or, more generally, that wages are not important for the determination of employment. In either case,

7 There are only minor changes to the estimated coefficients when the consumer price index is used to deflate the nominal wage.

TABLE 4
Results by industry group for wage equation (6)

Industry group	ψ	λ	δ	$\bar{R}^2$	N
Food & Beverages Tobacco	0.001 (0.007)	−0.014 (0.037)	0.025 (0.048)	0.15	377
Leather Primary Textiles Clothing	0.016 (0.010)	−0.021 (0.088)	−0.023 (0.133)	0.64	180
Wood Products Furniture Paper Products Printing	−0.009 (0.005)	−0.008 (0.026)	0.096 (0.034)	0.77	438
Primary Metals	−0.016 (0.007)	0.010 (0.028)	−0.029 (0.042)	0.38	465
Fabricated Metals Machinery	−0.020 (0.006)	0.073 (0.034)	−0.044 (0.054)	0.57	233
Transp. Equip.	−0.017 (0.005)	0.012 (0.014)	−0.001 (0.020)	0.75	365
Elect. Equip.	−0.021 (0.006)	0.030 (0.026)	0.031 (0.034)	0.38	332
Non-Metallic Min.	0.006 (0.005)	−0.021 (0.033)	−0.036 (0.048)	0.67	170
Rubber Chemicals Misc.	−0.006 (0.007)	0.025 (0.052)	−0.074 (0.078)	0.58	316
All Industries	−0.006 (0.002)	0.011 (0.010)	−0.001 (0.014)	0.31	2,876

NOTES
Standard errors are shown in parentheses.
Year controls are included as regressors in all industry groups.

there is no evidence that wage rigidity in that industry is the cause of excessive employment fluctuations.

The two industry groups for which interpretation of the results is particularly difficult are Fabricated Metals and Electrical Equipment. In these industries there is strong evidence that employment in the first year of contracts adjusts to undo previous shocks, suggesting that contractual wages are also adjusting to those shocks. But there is no direct evidence at all that the wages are adjusting in this manner. Thus, while contracts do appear to matter for the behaviour of employment in these industries, there is no evidence that it is wage rigidity that leads to this employment behaviour.

V. DISCUSSION

If contractual wage rigidity leads to excessive fluctuations in employment, then employment at the start of new contracts should adjust to undo some of these past mistakes. I have examined this proposition, first explored by Bils (1991), using a new collection of firm-level employment data from the Canadian unionized manufacturing sector. This new data set enables an examination of the dynamics of employment throughout the life of the contract and thus is ideal for uncovering any evidence of excessive employment fluctuations caused by wage rigidity.

It is worth emphasizing that the approach taken in this paper is not well suited to distinguishing between wage/employment outcomes that lie on a labour-demand curve and those that lie on a contract curve. The approach taken here is to look specifically for evidence that wage rigidity forces an over-adjustment of employment during the contract period, and thus that contractual wage rigidity matters for the behaviour of employment. Such an over-adjustment of employment is possible in both labour-demand models and contract-curve models.

For the results in table 3, I conclude that there is considerable evidence to support the hypothesis that contacts matter for the behaviour of employment. This evidence is very strong in selected industries such as Fabricated Metals and Electrical Equipment. Though I cannot reject the hypothesis that contracts do not matter when I estimate a pooled regression over the entire sample, it is clear that the pooled results are very sensitive to inclusion of the Textiles industries. When I exclude this industry group from the pooled regression, I conclude for the remaining industries that contracts do matter for the behaviour of employment.

There are, however, some significant puzzles remaining. The dynamics of employment in the Textiles industry should not be dismissed lightly. In that industry the estimates from table 3 suggest that contracts matter but in a very unusual way; employment in the first year of contracts moves to accentuate, rather than to dampen, the effect of previous shocks. This finding suggests that some important dynamic behaviour is missing from the analysis. One possibility is that unions respond to past positive shocks by *lowering* their wage demands in an effort to maintain employment at the higher level. This is the essence of the insider-outsider models examined by, among others, Blanchard and Summers (1986), Gottfries and Horn (1987), and Lindbeck and Snower (1988).

Perhaps the most troubling aspect of the results, also found by Bils, is the poor performance of the wage equations in table 4. In particular, for those industry groups that display so strongly the importance of contracts with respect to their employment behaviour, there is no evidence that contracts matter for wages. This fact is troubling because the interpretation of the observed employment dynamics offered by the model in this paper is that contracts matter for the behaviour of employment only because they matter for the behaviour of wages; any undoing of previous labour-demand shocks occurs only because wages are adjusted to reflect those past shocks.

In other industry groups there was no evidence that contracts mattered for either wage or employment behaviour. But this finding is at least consistent with the theoretical framework: if the union's desired wage is independent of labour demand ($\delta = 0$) and the real wage does not allocate labour ($\beta = 0$), then contractual wage rigidities are indeed irrelevant for both wage and employment behaviour.

Finally, it should be mentioned that any inconsistencies in the wage and employment results (e.g., Fabricated Metals) do not weaken the view that (in some industries, at least) employment does over-adjust to shocks that occur during the contract and that these mistakes are corrected only at the beginning of new contracts. One possible interpretation of the apparent inconsistencies of the wage and employment dynamics is that the model presented here is substantially accurate but that the base wage specified in the contract does not accurately reflect the full marginal cost of labour. If the behaviour of contract wages differs significantly from that of the marginal cost of labour, then it is not surprising that contracts appear not to matter for wage behaviour even through they do matter for employment behaviour. Indeed, it is difficult not to believe that non-wage benefits and overtime wages are central determinants of the marginal cost of labour, and that the dynamics of non-wage benefits are different from the dynamics of wages themselves. And it is precisely these well-known problems with using the contract wage in place of the unobserved marginal cost of labour that make Bils's approach, based purely on the dynamics of employment, so useful.

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