Tests of alternative wage employment bargaining models with an application to the UK aggregate labour market

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In this paper we propose a test that discriminates among alternative models of bargaining for wages and employment. The test rests on a theoretical framework which encompasses both the labour demand and the efficient bargain models of wage and employment determination. It is based on testing the cross equation restrictions implied for the coefficients of union power variables in reduced form wage and employment equations. The test is illustrated for the Layard and Nickell model of the aggregate UK labour market, for which it is found that one can reject both the labour demand model and the hypothesis that wage employment bargains are efficient, in favour of a generalised model of inefficient bargaining for wages and employment.

1. Introduction

The issue of the appropriate model of the determination of wages and employment is central to labour economics and macroeconomics alike. There is a plethora of approaches, ranging from competitive equilibrium models, search models, disequilibrium models, implicit contract models and explicit collective bargaining models.

Among the latter, two particular approaches have dominated the recent literature. The model where employment is determined unilaterally by the firm, with the wage being either the outcome of a bargain or set by the union, and the model where there is efficient bargaining for wages and

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1See Nickell (1984) for a survey of alternative models. Oswald (1986) provides an extensive survey of union models, while implicit contract models have been surveyed by among others Rosen (1985).
employment. These approaches have been treated as alternatives [see for example McDonald and Solow (1981), Nickell (1984), Oswald (1986) and others], and for brevity we shall term them the labour demand model and the efficient bargain model respectively. There are two sub-categories of the labour demand model, that have been labelled the monopoly union model and the right-to-manage model, referring respectively to the cases where the wage is set unilaterally by the union and the case where the wage is the outcome of a bargain. Recently, Manning (1987a) has proposed a sequential bargaining framework, where firms and unions bargain separately for wages and employment. The equilibrium bargain could be inefficient, but more importantly for testing purposes, this is a model that encompasses the two more traditional models, treating them as special cases. The monopoly union model is a special case where the firm has no bargaining power in wage setting, and the union no power in employment setting, the right-to-manage model the case where both sides have some bargaining power in wage setting but the union has no power in employment setting, and the efficient bargain model the case where the bargaining powers of firms and unions are equal in wage and employment setting.

This paper proposes a test that would discriminate among these alternative models, and it differs from previous contributions in this area in that it considers a richer menu of such alternatives. Most of the contributions that have appeared in recent years [Ashenfelter and Brown (1986), MaCurdy and Pencavel (1986), Carruth, Findlay and Oswald (1986), Bean and Turnbull (1988), among others] have essentially concentrated on testing the labour demand model, interpreting rejections as evidence in favour of the efficient bargain model. What we propose here is a test that can in principle discriminate between general bargaining models, the efficient bargain model and the labour demand model.2

The issue of which model is the appropriate one is extremely important if one is to draw inferences about the impact of trade unions on welfare, or make suggestions for trade union legislation and policies for reducing unemployment. Given the importance and timeliness of the latter problem we illustrate our test using the well known model of the UK aggregate labour market developed by Layard and Nickell (1985, 1986).

The rest of the paper is as follows: In section 2 we briefly present the theoretical framework. In section 3 we suggest a testing procedure to discriminate between the labour demand model, the efficient bargain model and more general alternatives, and we discuss the test used in existing studies. Our test is illustrated in section 4 using the aggregate Layard and

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2 In fairness, it has to be noted that all the above authors are aware that rejecting the labour demand model does not necessarily suggest acceptance of the efficient bargain model. However, given their framework, this is the only alternative hypothesis.
Nickell model. Our conclusions and suggestions for future research are summarized in the last section.

2. A general bargaining model

We shall keep the discussion of theoretical considerations brief, as the model presented below is discussed more extensively in Manning (1987a).

Consider an employer and a trade union who bargain about wages and employment. Represent the preferences of the employer by a profit (or utility) function \( \Pi(w, N; X_1, X_2) \), where \( w \) is the real wage, \( N \) is employment, \( X_1 \) is a vector of variables that only affect the profit function, and \( X_2 \) is a vector of other variables affecting both profits and the utility function of unions. Represent the preferences of the union by \( U(w, N; X_3, X_2) \), where \( X_3 \) is a vector of other variables affecting union utility, but not affecting the profit function.

Assume that bargaining is sequential and that the wage bargain is prior to the employment bargain, and allow the bargaining solution at each stage to differ. For simplicity assume that the bargaining solution at each stage is the outcome of an asymmetric Nash Bargain. Let the bargaining power of the union in the wage determination stage be \( p \), and in the employment determination stage be \( q \). Then, in the employment determination stage, when the wage has already negotiated, employment will be chosen to solve the following problem:

\[
N(w; q; X_1, X_2, X_3) = \arg \max_{N} \{ \Pi(w, N; X_1, X_2) \}^{1-q} \{ U(w, N; X_3, X_2) \}^q.
\]

(1)

Going back to the first, the wage determination stage, wages will be chosen to solve the following problem

\[
w(p, q; X_1, X_2, X_3) = \arg \max_{w} \{ \Pi(w, N; X_1, X_2) \}^{1-p} \{ U(w, N; X_3, X_2) \}^p.
\]

s.t. \( N = N(w; q; X_1, X_2, X_3) \).

(2)

Manning (1987a) showed that the more traditional models of trade union behaviour are special cases of this model, i.e. they represent particular values of \( p \) and \( q \). The monopoly union model [Dunlop (1944), Oswald (1982)] is the case \( p = 1, q = 0 \). The right-to-manage [Nickell (1982), Nickell and Andrews
(1983) is the case \( q = 0 \). The efficient bargain model [Leontief (1946), McDonald and Solow (1981)] is the case \( p = q \). Both the monopoly union and the right to manage models imply that wage–employment outcomes will lie on the labour demand curve, and as is well known, if the union cares about employment, such outcomes are inefficient. In the efficient bargain model the outcomes are Pareto efficient, i.e. wages and employment are such that the profit function and the union utility function are tangential. Using the general model outlined above, other outcomes are possible as well that lie neither on the labour demand curve, nor on the efficiency locus. Manning (1987a, b) argues that there are good theoretical reasons why we might be off both the labour demand curve and the contract curve, but clearly what is needed is formal empirical evidence.

(1) and (2) lead to reduced form employment and wage equations of the following type:

\[
\begin{align*}
\log(N) &= a_0 + a_1 X_1 + a_2 X_2 + a_3 X_3 + a_4 Z + u_1, \\
\log(w) &= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 Z + u_2,
\end{align*}
\]

(4)

From the point of view of empirical testing, (3) is unlikely to be operational as \((p, q)\) are not directly observable. However, we will assume that they are a function of observable variables; in particular, that both \( p \) and \( q \) are functions of \( X_q \) and \( Z \), where \( X_q \) is a subset of \( X = X_1 UX_2 UX_3 \), and \( Z \), a vector of variables that affect neither the profit function nor the union utility function.

Assuming that (3) is log-linear, we can write the general bargaining model in the following empirical form:

\[
\begin{align*}
\log(N) &= \alpha_0 + \alpha_1 X_1 + \alpha_2 X_2 + \alpha_3 X_3 + \alpha_4 Z + u_1, \\
\log(w) &= \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 Z + u_2,
\end{align*}
\]

where \( u_1, u_2 \) are assumed normal with a constant variance–covariance matrix.

It will be convenient in what follows to reparameterise the reduced form model of (4) to an exactly equivalent (i.e. exactly identified) form that would relate employment to wages. We do this by eliminating one of the elements of \( Z, Z_1 \) say, from the employment equation, substituting its solution from the wage equation. We can then write the system in (4) as

\[
\begin{align*}
\log(N) &= (\alpha_0 - \gamma \beta_0) + (\alpha_1 - \gamma \beta_1)' X_1 + (\alpha_2 - \gamma \beta_2)' X_2 + (\alpha_3 - \gamma \beta_3)' X_3 \\
&+ (\alpha_4(1) - \gamma \beta_4(1) )' Z(1) + \gamma \log(w) + (u_1 - \gamma u_2).
\end{align*}
\]

(5a)
\[
\log(w) = \beta_0 + \beta_1 X_1 + \beta_2 X_2 + \beta_3 X_3 + \beta_4 Z + u_2,
\]
(5b)

where \( \gamma = \left( \frac{\alpha_{41}}{\beta_{41}} \right) \) and we have partitioned \( Z \) into \((Z_1, Z_{(1)})\) and the parameter vectors \( \alpha_4 \) and \( \beta_4 \) into \((\alpha_{41}, \alpha_{4(1)})\) and \((\beta_{41}, \beta_{4(1)})\) accordingly.

It should be stressed that (5) is simply a reparameterisation of (4) which as we shall see below is particularly convenient for testing alternative models of collective bargaining.

3. Tests of alternative trade union models

In this section we discuss tests of the labour demand and efficient bargain models against the general bargaining model of (4) or (5). First, we will consider a test of the labour demand model.

To develop such a test, note that when the labour demand model is true the variables in \((X_3, Z)\), which do not directly affect the labour demand curve, can only affect employment through their effect on the wage. Writing this as a condition on \((\alpha, \beta)\) in (4) yields the following parameter restrictions as a test of the labour demand model against the general bargaining model:

\[
H_0: \alpha_3 = \gamma \beta_3, \quad \alpha_4 = \gamma \beta_4,
\]

\[
H_1: \alpha_3 \neq \gamma \beta_3, \quad \alpha_4 \neq \gamma \beta_4.
\]

The simplest way to test parameter restrictions is to note that if we adopt the parameterization of (5) then under \( H_0 \), the coefficients of \((X_3, Z)\) in the employment equation (5a) are zero, and (5a) can be written as

\[
\log(N) = (x_0 - \gamma \beta_0) + (x_1 - \gamma \beta_1)'X_1 + (x_2 - \gamma \beta_2)'X_2 + \gamma \log(W)
\]

\[+(u_1 - \gamma u_2).\]

(7)

We can test the labour demand model against the general bargaining model by a simple F-type test of (7) against (5a). If the labour demand model is the appropriate one, then the wage contains all the relevant information for employment that is contained in \((X_3, Z)\).

Consider next how we can test the efficient bargain model against the general bargaining model. If the efficient bargain model is correct we know that wages and employment lie on a contract curve whose position is determined by the variables \((X_1, X_2, X_3)\). The bargaining power variables \((X_4, Z)\) determine the point on the contract curve reached by collective bargaining.

If we hold the position of the contract curve constant and vary the autonomous measures of bargaining power \( Z \), then we know that the
relationship between the change in wages and the change in employment will solely be determined by the slope of the contract curve, i.e. $\gamma$.

Referring back to the model in (4) this condition implies the following parameter restrictions:

$$H_0: \alpha_4 = \gamma \beta_4,$$

$$H_1: \alpha_4 \neq \gamma \beta_4.$$

We can use $H_0$ as a test of the efficient bargain model against the general bargaining model. The easiest way to implement this test is to impose the restrictions on the employment equation (5a) which then becomes

$$\log (N) = (\alpha_0 - \gamma \beta_0) + (\alpha_1 - \gamma \beta_1)'X_1 + (\alpha_2 - \gamma \beta_2)'X_2 + (\alpha_3 - \gamma \beta_3)'X_3 + \gamma \log (W) + (u_1 - \gamma u_2). \quad (8)$$

Therefore, we can test the efficient bargain model against the general model by a simple $F$-test on the exclusion of $Z_{(1)}$ from an employment equation of the type (5a) which then becomes.

If we compare the employment equations for the labour demand model (7) and for the efficient bargain model (8) we can see that the former is a special case of the latter with $X_3$ excluded. So the labour demand model appears to be nested within the efficient bargain model. Yet, we know that the labour demand curve model is not theoretically nested within the efficient bargain model.

The reason for this apparent paradox is the following. The theoretical nulls in which we are interested can be written as:

Labour Demand Curve: $H_0: q = 0.$ \quad (9a)

Efficient Bargain: $H_0: q = p.$ \quad (9b)
These restrictions imply the models of (7) and (8). But, there are other theoretical possibilities that would also lead to the eqs. (7) and (8). So the actual nulls we are testing will be:

**Labour Demand Curve:** \( H_0: q = q(X_1, X_3). \) \hspace{1cm} (10a)

**Efficient Bargain:** \( H_0: q = q(p, X_1, X_2, X_3). \) \hspace{1cm} (10b)

In terms of the actual nulls it can be seen that (10a) is nested within (10b). Why are these the actual nulls? Take (10a): if \( q \) is a function of only the variables which affect the marginal product of labour curve, then only these variables will affect the relationship between wages and employment, but this relationship will not be a labour demand curve. A similar point is made by MaCurdy and Pencavel (1986) who basically make the point that if \( q \) is a constant then we will not be able to reject the labour demand curve model. So, at best, we are testing whether the observed data is consistent with the labour demand curve story; we cannot rule out the possibility that (7) seems to be an acceptable employment equation yet we are not on the labour demand curve.

A similar point applies to the actual versus the theoretical null for the efficient bargain model. However, the problems here might be potentially more serious than with the labour demand curve model. While we might have no reason to believe (10a) if (9a) is not true, we might well believe (10b) but not (9b). For example, Strand (1986) presents a model of a repeated union–employer game where outcomes lie on a one-dimensional relationship between wages and employment which is not the contract curve.

The problems discussed above are, of course, not unique to the models discussed here. They will arise whenever one is trying to test hypotheses about variables which are not observed directly but whose effects are captured by proxy variables.

Before illustrating our tests it is worthwhile considering the tests of union models that other studies have used. MaCurdy and Pencavel (1986), Brown and Ashenfelter (1986), Carruth, Oswald and Findlay (1986), Bean and Turnbull (1988) and others have attempted to test alternative trade union models. These studies are similar in that they only test the labour demand model against the efficient bargain model. No other possible alternatives are specified.

The test of the labour demand model against the efficient bargain model is as follows: First, note from (1) that if \( q = 0 \), the rule determining employment will be

\[
\Pi_N(w, N; X_1, X_2) = 0, \quad (11)
\]
i.e. employment maximizes profits given the wage. However, if the efficient bargain model is correct, the wages and employment will be on the contract curve, i.e. marginal rates of substitution between $w$ and $N$ will be the same for the employer and union. This implies,

$$\frac{\Pi_L(w, N; X_1, X_2)}{\Pi_u(w, N; X_3, X_2)} = \frac{U_L(w, N; X_1, X_2)}{U_u(w, N; X_1, X_2)}. \quad (12)$$

Comparing (12) with (11) we can see that one difference is the presence of $X_3$ in (12) and its absence in (11). Consequently, to test the labour demand against the efficient bargain model, we can run an employment equation including the wage, and see whether variables which affect union utility, but not the marginal product of labour, have an independent influence. The variable typically included to do this test has been some measure of the alternative wage available to union members. Mixed results have been found.

The important thing to note is that this test of the labour demand model against the efficient bargain model is exactly the test that we would use (compare (8) with (7)). But these studies cannot provide a test of the efficient bargain model. In our framework rejecting the labour demand model ($q = 0$) does not justify acceptance of the efficient bargain model ($p = q$).

Before illustrating our tests let us summarize our proposed testing procedure. First, we will estimate an employment equation of the form (5a). Then, on the basis of this model we shall test the restrictions that the efficient bargain and the labour demand models imply for the general one.

Before proceeding to our empirical application, it is worth remembering that even though we have considered a substantially wider range of alternative models than is usually done, we have not considered all possible models. In particular, we have only considered models where unions only affect wages and employment. If unions affect other variables, as is argued for example by Freeman and Medoff (1984), then our tests of the labour demand and efficient bargain models will not be appropriate. But, if this is the case, that is all the more reason to estimate very general employment equations of the form (5a). Also, Nickell and Wadhwani (1987) have argued that efficiency wage models can produce employment equations that are very similar to those implied by the efficient bargain model. Our tests cannot be used to accept or reject efficiency wage models.

4. An illustration for the aggregate UK labour market

In this section, we illustrate the tests of the labour demand and efficient bargain model using the model of the UK aggregate labour market of Layard and Nickell (1985, 1986).
This model is one of the most thorough attempts to account for the rise in British unemployment, and it relies on an explicit model of collective bargaining: the labour demand model. Yet, this model is not tested against any alternatives and this is the aim of this section.

There are obvious drawbacks in using aggregate data to test models of collective bargaining which are based on a single bargaining unit. Such problems beset all aggregate labour market models, and the justification, as in Manning (1988), is usually in terms of representative agents. The way to view our tests would therefore be not as comprehensive tests of alternative models of collective bargaining, but as an illustration of our testing principle, and a test of alternative models of the determination of aggregate employment. In any case, we should warn the reader to apply caution in interpreting our results.

The Layard–Nickell model is a three-equation system consisting of price, wage and employment equations. For our purposes, we only need to estimate an employment equation. Our methodology [following Spanos (1986)] is first to check that our reduced form equation is statistically well defined. Our chosen reduced form is very similar to that of Layard–Nickell but slightly more parsimonious.

To implement the tests of the previous section, we need to partition our variables into three subsets; those that affect the profit function (X₁, X₂), those that affect the union utility function but not the profit function (X₃) and those variables that affect bargaining power but neither the profit nor the union utility function (Z).

Our chosen classification is shown in table 1. In most respects it is the same as the Layard–Nickell classification. The variables in (X₁, X₂) are those included in their employment equation plus their index of structural mismatch and import prices. We include mismatch as structural imbalance is likely to affect the relationship between aggregate employment and aggregate average wages even if all individual firms have a conventional labour demand equation. And, we include import prices as their exclusion from the Layard–Nickell employment equation is based on a restriction on the production function and rejection of this restriction does not imply that the labour demand model is wrong.

The variables in X₃ consist of two types of variable. TAX represents the wedge between the real product wage (which we use as our wage variable) and the real consumption wage. The other two variables represent variables we might expect to affect the alternative wage available to union members who do not find employment in the union sector. The replacement ratio is affected by the level of benefits and the level of unemployment is likely to affect the probability of finding employment elsewhere.

Finally, let us consider the variables in Z. Here the classification is potentially more problematic. One could probably construct arguments as to
Table 1

Classification of variables: Aggregate data* (Dependent variable: $\log(N)=\log$ of employees in employment).

**Variables affecting the profit function: ($X_1, X_2$)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log(W/P)$</td>
<td>log of Real Product Wage</td>
</tr>
<tr>
<td>$\log K$</td>
<td>log of the capital stock</td>
</tr>
<tr>
<td>$AD$:</td>
<td>adjusted deficit</td>
</tr>
<tr>
<td>$WT$:</td>
<td>deviation of world trade from trend</td>
</tr>
<tr>
<td>$\log(P^*/P)$:</td>
<td>log of competitiveness</td>
</tr>
<tr>
<td>$MM$:</td>
<td>mismatch</td>
</tr>
<tr>
<td>$\log(P_m/P)$:</td>
<td>import prices</td>
</tr>
</tbody>
</table>

**Variables affecting the Union Utility Function but not the Profit Function: ($X_3$)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>TAX:</td>
<td>the tax wedge = the sum of direct tax rate, indirect tax rate and labour tax rate</td>
</tr>
<tr>
<td>$\log(RR)$:</td>
<td>log of the replacement ratio</td>
</tr>
<tr>
<td>UR:</td>
<td>male unemployment rate</td>
</tr>
</tbody>
</table>

**Variables affecting Bargaining Power but neither Profit nor Utility Function: ($Z$)**

<table>
<thead>
<tr>
<th>Variable</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log(DEN)$:</td>
<td>log of trade union density</td>
</tr>
<tr>
<td>$U_p$:</td>
<td>union-non-union wage mark-up</td>
</tr>
<tr>
<td>$IPD$:</td>
<td>incomes policy dummy taking the value 1 for 1976–1977 and zero in other periods</td>
</tr>
</tbody>
</table>

*All variables except log(DEN) are defined in Layard–Nickell (1985) who kindly provided us with their data. log(DEN) was calculated as log of union membership minus log N. Figures for union membership are from Bain and Price (1980) and the Department of Employment Gazette.

why log(DEN) and $U_p$ should enter the union utility function and so should be included in $X_3$. But it has been conventional to use these variables as measures of trade union power [see Layard and Nickell (1985, 1986), and Nickell and Andrews (1983)], and it is difficult to see alternatives. The absence of good measures of autonomous bargaining power variables is a weakness of working with aggregate data.

2SLS estimates of the empirical counterpart of eq. (5a) are presented in table 2, column 1. The effect of the current wage is identified by excluding the union wage mark-up. We have included mostly lagged variables that can be safely treated as predetermined and not endogenous. However, we also experimented with alternative specifications. For example, we included the current aggregate demand effects ($AD_t$ and $\log(P^*/P)$ instead of their lags, but this resulted in a higher standard error. In any case, the coefficient of $AD_t$ was not statistically significant, and it had the 'wrong' sign.

The first thing to notice in the estimated equation in column (1) is that there is little, if any, evidence of statistical misspecification, although there may be some problem with parameter instability. Note, that as this is an exactly identified model, there are no over-identifying restrictions to test. However, the estimated coefficients are not very satisfactory; few are
Table 2

Aggregate employment equations, 1954–1983

<table>
<thead>
<tr>
<th></th>
<th>(1)</th>
<th>(2)</th>
<th>(3)</th>
<th>(4)</th>
</tr>
</thead>
<tbody>
<tr>
<td>$\log(N_t-1)$</td>
<td>0.63</td>
<td>-0.58</td>
<td>-0.43</td>
<td>-0.30</td>
</tr>
<tr>
<td></td>
<td>(0.93)</td>
<td>(1.90)</td>
<td>(4.10)</td>
<td>(5.34)</td>
</tr>
<tr>
<td>$\log(W/P_t)$</td>
<td>0.63</td>
<td>-0.12</td>
<td>0.015</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(1.39)</td>
<td>(0.60)</td>
<td>(0.13)</td>
<td>-</td>
</tr>
<tr>
<td>$\log(W/P_{t-1})$</td>
<td>-0.39</td>
<td>-0.15</td>
<td>-0.26</td>
<td>-0.12</td>
</tr>
<tr>
<td></td>
<td>(1.89)</td>
<td>(1.09)</td>
<td>(2.75)</td>
<td>(2.63)</td>
</tr>
<tr>
<td>$\log(K_t)$</td>
<td>-0.34</td>
<td>0.47</td>
<td>0.29</td>
<td>0.27</td>
</tr>
<tr>
<td></td>
<td>(0.78)</td>
<td>(2.37)</td>
<td>(2.70)</td>
<td>(4.55)</td>
</tr>
<tr>
<td>$AD_{t-1}$</td>
<td>0.002</td>
<td>0.008</td>
<td>0.006</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(0.74)</td>
<td>(0.33)</td>
<td>(4.27)</td>
<td>-</td>
</tr>
<tr>
<td>$WT_t$</td>
<td>0.016</td>
<td>0.163</td>
<td>0.187</td>
<td>0.11</td>
</tr>
<tr>
<td></td>
<td>(0.16)</td>
<td>(2.49)</td>
<td>(2.71)</td>
<td>(3.15)</td>
</tr>
<tr>
<td>$\log(P^{*}/P_{t-1})$</td>
<td>0.22</td>
<td>0.07</td>
<td>0.10</td>
<td>0.07</td>
</tr>
<tr>
<td></td>
<td>(2.07)</td>
<td>(0.99)</td>
<td>(2.85)</td>
<td>(3.25)</td>
</tr>
<tr>
<td>$MM_t$</td>
<td>-0.004</td>
<td>-0.008</td>
<td>-0.006</td>
<td>-0.009</td>
</tr>
<tr>
<td></td>
<td>(0.52)</td>
<td>(1.46)</td>
<td>(1.15)</td>
<td>(2.89)</td>
</tr>
<tr>
<td>$v\log(P_{m}/P_{t-1})$</td>
<td>-0.44</td>
<td>0.05</td>
<td>-0.17</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(1.40)</td>
<td>(0.23)</td>
<td>(1.15)</td>
<td>-</td>
</tr>
<tr>
<td>$TAX_{t-1}$</td>
<td>-0.32</td>
<td>-0.45</td>
<td>-</td>
<td>-0.54</td>
</tr>
<tr>
<td></td>
<td>(1.33)</td>
<td>(2.24)</td>
<td>-</td>
<td>(10.00)</td>
</tr>
<tr>
<td>$\log(RR_{t-1})$</td>
<td>0.019</td>
<td>-0.043</td>
<td>-</td>
<td>0.087</td>
</tr>
<tr>
<td></td>
<td>(0.25)</td>
<td>(0.63)</td>
<td>-</td>
<td>(3.13)</td>
</tr>
<tr>
<td>$UR_{t-1}$</td>
<td>1.29</td>
<td>-0.28</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>(1.43)</td>
<td>(0.63)</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>$\log(DEN)_{t-1}$</td>
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<td>-</td>
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<td>(2.33)</td>
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<td></td>
<td>(0.86)</td>
<td>-</td>
<td>-</td>
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</tr>
<tr>
<td>$U_{m-1}$</td>
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<td>-</td>
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<tr>
<td></td>
<td>-</td>
<td>-</td>
<td>-</td>
<td>(1.61)</td>
</tr>
<tr>
<td>Constant</td>
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<td>6.40</td>
<td>3.81</td>
<td>4.33</td>
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<tr>
<td></td>
<td>(0.65)</td>
<td>(2.30)</td>
<td>(4.11)</td>
<td>(7.76)</td>
</tr>
<tr>
<td>$R^2$</td>
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<td>0.79</td>
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<td>0.0081</td>
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<td>$BAS$</td>
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<td>7.76</td>
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<td>(2.15)</td>
<td>(5.15)</td>
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</tr>
<tr>
<td>$AR2$</td>
<td>0.44</td>
<td>1.07</td>
<td>1.33</td>
<td>4.00</td>
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<td>(2.15)</td>
<td>(2.16)</td>
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<td>3.93</td>
<td>0.53</td>
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<td>(3.12)</td>
<td>(3.14)</td>
<td>(3.17)</td>
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<td>$LIN$</td>
<td>1.38</td>
<td>1.23</td>
<td>1.15</td>
<td>2.13</td>
</tr>
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<td></td>
<td>(2.13)</td>
<td>(2.15)</td>
<td>(2.18)</td>
<td>(2.17)</td>
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<td>$ARCH$</td>
<td>1.87</td>
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<td>0.83</td>
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<td>(2.10)</td>
<td>(2.12)</td>
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<td>(4.13)</td>
<td>(4.16)</td>
<td>(4.15)</td>
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<td>0.18(2)</td>
<td>0.44(2)</td>
<td>0.60(2)</td>
<td>1.19(2)</td>
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*All equations were estimated by instrumental variables, the only endogenous variable being $\log(W/P_t)$. The instruments used were the exogenous variables in the equation plus $U_{m-1}$. Asymptotic t-ratios are in parentheses below estimated coefficients. s is the standard error of estimate. The misspecification tests are described in the appendix.
The estimates in column (2) are those of the efficient bargain model (8). It passes most of the diagnostic tests reported, although there is some evidence of heteroscedasticity. As it fails the test of the over-identifying restrictions, there is some evidence that we will be able to reject this model against the more general alternative. Again, there is a problem with the estimated coefficients being insignificant, although most now have the expected sign. The negative coefficients on the wage would suggest that the contract curve is downward-sloping.

The estimates in column (3) relate to the labour demand model (7). Apart from some evidence of non-linearity it passes all the diagnostics reported. Most of the estimated coefficients are now significant. Our estimates are similar in most respects to those of Layard and Nickell (1985) (see their table 1), and our standard error is slightly below theirs in their single equation estimates. However, this equation fails a test of its over-identifying restrictions suggesting that it is not a completely adequate representation of employment.

We tested the employment equations of columns (2) and (3) against the equation of column (1). The results are presented in table 3. The efficient bargain model can be marginally accepted against the general model at conventional significance levels but the labour demand curve model can be rejected against both the general model and the efficient bargain model. However, as we have some evidence that the efficient bargain model fails a test of its over-identifying restrictions we decided to look for a better model.

Column (4) presents an employment equation with a standard error substantially below that of the other three columns. Employment seems to be positively related to union density and the replacement ratio, and negatively related to the union mark-up and the wedge. However, this equation is not without its problems. It fails a test for heteroscedasticity and parameter constancy. Investigation of this seemed to suggest that the parameter
stability test is failed not because of large changes in the coefficient estimates but because of large changes in the standard error of the regression. This could also account for the heteroscedasticity we find. So although we do have evidence that the labour demand curve model is inadequate, we have found it hard to produce an acceptable model which passes all the misspecification tests.

In terms of the general bargaining model presented in this paper, one could give the following interpretation to the findings. First, given the wage, employment should depend positively on union power over employment, $q$ [see Manning (1988) for details]. If the elasticity of substitution between labour and capital is less than one (which is probably reasonable), then the wage will depend negatively on $q$. So $q$ will appear to be negatively related to the wage and positively related to the variables that tend to raise the wage like the alternative wage. This can account for the observed sign on the alternative wage in an employment equation. Similarly, a high union mark-up is perhaps evidence that $q$ is low (as $q$ tends to depress wages). This can explain the coefficient on the mark-up.

However, there are other possible explanations for our findings. Nickell and Wadhwani (1987) have interpreted a positive coefficient on the alternative wage in an employment equation as evidence in favour of an efficiency wage model. The negative coefficient on the mark-up could be interpreted in a similar way as a high mark-up is likely to increase worker effort and depress employment.

Burgess (1988) argues that union power and alternative wage effects in employment equations appear because these variables affect the costs of adjusting employment. We are quite happy with this interpretation. If union power affects employment through the cost of adjustment this is a rejection of both the efficient bargain model and the labour demand curve model (as unions are affecting employment through channels other than the wage). So, we would hope that our tests of both the labour demand curve and efficient bargain models would pick up the effects emphasized by Burgess, if they are present.

This discussion should highlight the difficulties that are involved in testing alternative models of union behaviour when a wide variety of labour market models might be considered as possible alternatives. However, all of these alternatives suggest that a simple labour demand curve may not be an adequate description of employment determination.

5. Conclusions

In this paper we have presented a model of collective bargaining which encompasses the two most popular models in current use. We have shown
how it can be used to develop a simple test of these special models. We have illustrated this test using the Layard and Nickell model of the aggregate UK labour market.

On the basis of the evidence presented, both the labour demand model and the efficient bargain model of employment determination are generally rejected. This finding may have important policy implications; as discussed in detail in Manning (1987a), reductions in trade union power may not increase employment and may even decrease it.

However, tests based on aggregate data are probably the weakest form of evidence on alternative bargaining models. The task for future research would be to implement the test we propose in the context of other data sets, especially industry or establishment data. Although our tests shed light on appropriate models for the determination of aggregate employment, studies based on industry or establishment data would provide more direct evidence on the appropriate model of collective bargaining.

Appendix

Misspecification tests

The misspecification tests used were:

AR(2) is the LM test for residual autocorrelation, based on an auxiliary regression of the residuals on two lags of the residuals and the fitted values of the original regression.

LIN is the RESET test for linearity based on an auxiliary regression of the residuals on the fitted values of the original regression and their squares.

HET is the RESET test for homoscedasticity based on an auxiliary regression of the squared residuals on the fitted values of the original regression, their squares and cubes.

ARCH(2) is the Engle test against autoregressive conditional heteroscedasticity based on an auxiliary regression of the squared residuals on two lags of the squared residuals.

BAS is the Basmann test of the over-identifying restrictions, based on an auxiliary regression of the residuals on the instruments.

CHOW is the second Chow test for parameter stability based on estimation of the equation over the whole sample period and leaving out the last four periods.

NORM is the Bera–Jarque skewness-kurtosis test for normality based on the third and fourth moments of the residuals.

References

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