DEPARTMENT OF ECONOMICS

Working Paper

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Working Paper No. 1999-19

ISSN 1396-2426

UNIVERSITY OF AARHUS • DENMARK

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Wage Bargaining: Reconciling Theory and Evidence

Eric Toulemonde*†

August 13, 1999

Abstract

One of the main results of the theoretical models of wage bargaining is that wages are independent of productivity when the production function has a constant elasticity. However empirical studies show that in the long run, wages fully react to productivity shocks. This paper reconciles both results. It identifies the assumptions that yield the theoretical result. By dropping these assumptions it shows that in the short run the degree of real wage rigidity increases with the union power. In the long run, real wages fully respond to productivity changes.

JEL Classification Numbers: E24, J3, J51.
Keywords: Productivity, union, real wages.

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*Eric Toulemonde, University of Aarhus, Department of Economics, Building 350, Universitetsparken, DK-8000 Aarhus C (Denmark), Phone: +45 89421604, Fax: +45 86136334, e-mail: etoulemonde@econ.au.dk

†To carry out this project at the University of Aarhus I have benefitted from a grant financed by the Training and Mobility of Researchers Program of the European Commission.

Introduction

The behavior of real wages over the business cycle has been the subject of numerous empirical studies. Still the research does not lead to a finding of systematically procyclical or countercyclical real wages (see Abraham and Haltiwanger (1995)). In a theoretical perspective different models of wage determination have been build to explain why fluctuations in the demand for labor lead to large changes in employment and small changes in real wages. The efficiency wage model of Solow (1979) is one of these models. Another popular explanation is the wage bargaining model which is the focus of this paper.

Under seemingly plausible assumptions, the wage bargaining model shows that real wages are rigid to fluctuations in productivity. This property is repeatedly emphasized in the literature, see e.g. McDonald and Solow (1981), Oswald (1985), Blanchard and Fischer (1989) or Booth (1995). While this property is useful to understand the behavior of real wages over the business cycle, it becomes awkward when the aim is to explain the long run pattern of real wages. In the long run, it is generally shown that the elasticity of real wages to productivity is close to one (see e.g. Tyrväinen (1995)). The wage bargaining model cannot account for this fact because it predicts that once there is wage bargaining, wages become independent of the productivity.

Moreover, in the wage bargaining model, the degree of real wage rigidity is constant and independent of the strength of unions. Even a weak union manage to obtain a rigid (low) wage. One would prefer a theoretical model that could establish a link between the strength of the unions and the degree of real wage rigidity. Finally, it is impossible to find a solution to a wage bargaining model in which the replacement ratio (alternative revenue / wages) is constant; this is a serious drawback.

In this paper I identify the assumptions that are responsible for these results. Dropping them, I show that it is possible to have a wage bargaining model in which the degree of real wage rigidity increases with the union strength in the short run. However, in the long run, the elasticity of real wages with respect to productivity is equal to one, whatever the strength of the union[1]. Hence, the theoretical model explains the behavior of real wages over the business cycle, and it is still able to account for the evidence of their long run behavior.

The Model

Assume that a union and a firm bargain over wages and let the firm determine the number of workers it wishes to employ (the firm has the *right to manage*). According to the Nash solution, wages maximize the following product

$$N \equiv \left[U(w,l) - \overline{U}\right]^{\phi} \left[\Pi(w,l) - \overline{\Pi}\right]^{1-\phi}, \tag{1}$$

where ϕ is the union bargaining power, $U(w,l)$ is the union utility, $\Pi(w,l)$ is the firm's profits, $\overline{U}$ and $\overline{\Pi}$ are the fall-back utilities.

The Union

To model union preferences, the utilitarian approach is widely used in this literature (see Oswald (1985), Farber (1986), or Booth (1995)). It derives the union objective from the preferences of its members[2]: $U(w,l) = lu(w) + (m - l)u(\overline{w})$ where $u(.)$ is the utility of income, m represents the union membership and $\overline{w}$ is the revenue of workers who do not have a job in the firm, that is, $\overline{w}$ is a mix of unemployment benefits and alternative wages in other firms[3].

Binmore, Rubinstein and Wolinsky (1986) show that the fall-back should be identified as income accruing to the workers in the course of a dispute. Let us define w^s as the workers' income in the course of a dispute. Hence, the union fall back becomes $mu(w^s)$ and the union contribution to the Nash product is

$$\begin{aligned} U(w,l) - \overline{U} &= lu(w) + (m-l)u(\overline{w}) - mu(w^s) \\ &= l\left[u(w) - u(\overline{w})\right] + m\left[u(\overline{w}) - u(w^s)\right]. \end{aligned} \tag{2}$$

[1] See also Andersen and Toulemonde (1999) for a similar result in a dynamic model.

[2] The expected utility approach gives a similar expression.

[3] This is the usual assumption concerning $\overline{w}$, see e.g. Layard, Nickell and Jackman (1991), Abowd and Lemieux (1993) or Blanchflower, Oswald and Sanfey (1996).

The Firm

Consider a constant elasticity production technology. Profits are given as $\Pi = \theta l^\beta - wl$, where β is smaller than 1 and θ is a productivity factor. Since the firm has the right to manage, it maximizes its profits with respect to labor. This gives

$$l = \left(\frac{w}{\theta\beta}\right)^{\frac{1}{\beta-1}} \text{ and } \Pi = w^{\frac{\beta}{\beta-1}} \left(\frac{1}{\theta\beta}\right)^{\frac{1}{\beta-1}} \left(\frac{1-\beta}{\beta}\right). \tag{3}$$

Let us assume that in case of persistent disagreement between the union and the firm, the latter has a zero profit: $\overline{\Pi} = 0$. This is a common assumption in the wage bargaining literature.

The Bargaining

Replace the union and firm contributions to the Nash product with their values in (2) and (3). To find the bargained wage, maximize the resulting expression with respect to w. This gives

$$[\phi + (1-\phi)\beta]\left[1 - \frac{u(\overline{w})}{u(w)}\right] + \phi(\beta - 1)\frac{wu'(w)}{u(w)} +$$

$$(1-\phi)\beta m \frac{u(\overline{w}) - u(w^s)}{u(w)} \left(\frac{w}{\theta\beta}\right)^{\frac{-1}{\beta-1}} = 0. \tag{4}$$

The Assumptions

At this stage, some simplifying assumptions are often made in the literature.

A.1 The union bargaining power ϕ is 1. This is equivalent to the often used *monopoly union model.*

In equation (4), the productivity term θ appears only in the third term. Under A.1, this term vanishes. Another popular assumption is the following[4]:

A.2 The income in the event of disagreement is equal to the alternative revenue: $w^s = \overline{w}$.

[4] See for example Layard, Nickell and Jackman (1991, p.101), Abowd and Lemieux (1993) or Booth (1995, p.124).

Under A.2, the productivity term also vanishes in equation (4). Therefore, under A.1 or A.2, wages are independent of the productivity θ [5]. Among others, McDonald and Solow (1981) or Blanchard and Fischer (1989) highlight this result because it explains real wage rigidity and employment movements over the business cycle. This property is surely interesting in the short run, but it also suffers from several drawbacks.

First it holds in the short and in the long run. Still, in the long run, real wages do not seem to be independent of productivity improvements. Estimated wage equations show that productivity strongly influences wages (see e.g. Nickell and Wadhwani (1990), Layard, Nickell and Jackman (1991), Holmlund and Zetterberg (1991) or Nickell and Kong (1992)). In Tyrväinen (1995), it is shown that the elasticity of wages with respect to productivity is close to one.

Second, the model predicts that real wages are rigid whatever the strength of the union. Once there is a wage bargaining, there is wage rigidity even if the union is weak. A theoretical model in which the degree of wage rigidity would increase with the strength of the union would be preferable.

Third, it is generally argued that in the long run the alternative revenue $\overline{w}$ is proportional to the wage w if all firms are identical. Indeed, the alternative revenue includes wages in the other firms and the unemployment benefit which is institutionally linked to previous wages (see Blanchard and Katz (1999)). A weakness of assumptions A.1 and A.2 is that they do not allow for both a constant elasticity union utility ($wu'(w)/u(w) = \sigma$) and a constant replacement ratio $\overline{w}/w = a$. Since $u(\overline{w}) \simeq u(w) + u'(w)(\overline{w} - w)$, we can write $u(\overline{w})/u(w) \simeq 1 - \sigma(1 - a)$. Therefore, with either A.1 or A.2, equation (4) gives $[\phi + (1 - \phi)\beta]\, \sigma(1 - a) + \phi(\beta - 1)\sigma = 0$, which is generally not fulfilled.

Dropping the Assumptions

A way to avoid the above mentioned problems consists of dropping assumptions A.1 *and* A.2. When this is done, it is clear that according to (4), agents will adjust wages to changes in productivity since the last term of the

[5] This result always holds if $U - \overline{U}$ can be written as $lf(w)$.

expression does not vanish.

In the Appendix, it is shown that the elasticity of real wages with respect to productivity is positive: a higher productivity translates into higher wages. Two other results are also emphasized in the Appendix. First the higher the difference $[u(\overline{w}) - u(w^s)]$, the higher is the elasticity of wages with respect to productivity. Therefore, the more we depart from the assumption A.2 that $w^s = \overline{w}$, the more the productivity is influencing wages. It is only under A.2 that real wages are rigid. Second, the stronger the union (the higher the value of ϕ), the more rigid are wages with respect to changes in the productivity (with full rigidity when $\phi = 1$). Hence, the simplifying assumptions A.1 or A.2 have strong consequences on the predictions of the behavior of wages over the business cycle.

This result is relevant not only for analyzing the effects of productivity on wages; the effects of any parameter that influences labor demand will be strongly affected by assumptions A.1 or A.2. For example, labor can be taxed (or subsidized), in wich cases, w becomes the *net wage* received by workers and $w(1+t)$ the wage paid by the firm (if $t < 0$, labor is subsidized). A value added tax ν can be imposed, or, if the firm sells its production abroad, it may have to pay a tariff τ per unit sold. In these cases the bargaining gives an expression similar to (4) in which θ is replaced with $\theta/(1+t)$ or $\theta(1-v)$ or $\theta(1-\tau)$ respectively. The tax (or subsidy) terms t, v and τ appears only in the third term of (4). Therefore, in a monopoly union model or in a wage bargaining model in which the fall-back is equal to $mu(\overline{w})$, wages will be independent of the level of taxes (subsidies). It is only by dropping assumptions A.1 and A.2 that these taxes have some effects on the bargained wage.

Assume now that in the long run $\overline{w}/w = a$ and $w^s/w = b$ where $b < a$. Consider again the case of a constant elasticity union utility $(wu'(w)/u(w) = \sigma)$. Equation (4) gives

$$w = \theta\beta \left\{ \frac{-(1-a)\left[\phi + (1-\phi)\beta\right] + (1-\beta)\phi}{(1-\phi)\beta m(a-b)} \right\}^{1-\beta}. \tag{5}$$

It is now possible to have both a constant elasticity union utility and a constant replacement ratio. Moreover in the long run, real wages fully react to technological shocks (θ). Therefore, they also completely adjust to changes in t, ν or τ, which was not the case under assumptions A.1 or A.2. In accordance with the empirical literature (see Tyrväinen (1995)), the elasticity of real wages with respect to productivity is equal to one in the long run.

Conclusion

Models of wage bargaining emphasize that wages are independent of productivity when the production function has a constant elasticity. However empirical studies show that in the long run, wages fully react to productivity shocks.

In this paper I show that the full real wage rigidity is caused by one of the following assumptions. First, the union has a monopoly power ($\phi = 1$). Second, in the event of a dispute between the union and the firm, workers receive the same income as they would get by leaving the firm ($w^s = \overline{w}$). These assumptions are often made in the literature because they simplify the theoretical models. By dropping both simplifying assumptions, I show that the elasticity of real wages with respect to productivity decreases with the strength of the union. Therefore, the degree of rigidity increases with the union power, culminating in full rigidity when the union has a monopoly power. In the long run, when there is a constant replacement ratio, the elasticity is equal to one (unless the union has monopoly power), in accordance with the empirical literature.

Therefore, faced with a temporary shock, an economy dominated by strong unions will see minor variations in real wages and large changes in employment. The opposite holds when unions are weak. Faced with a permanent shock, wages will quickly reach their new equilibrium when the unions are weak; the adjustment will be slow when the unions are strong.

The results of the paper are relevant not only for the analysis of the effects of productivity on wages. They also have strong implications for the wage effects of any parameter that affects the labor demand (all kinds of taxes or tariffs for example). Making one of the above mentioned simplifying assumptions implies that these parameters do not affect real wages. By dropping these assumptions, these parameters influence wages, and in the long run, the elasticity of real wages with respect to them is one.

Appendix: Comparative Statics of the elasticity of wages with respect to productivity

The elasticity of wages with respect to productivity can be written as

$$\frac{\partial w}{\partial \theta}\frac{\theta}{w} = \left(\frac{-\partial(4)}{\partial \theta} / \frac{\partial(4)}{\partial w}\right)\frac{\theta}{w} \equiv \delta_{w\theta}\frac{\theta}{w},$$

$$\text{where } \frac{\partial(4)}{\partial \theta} = -(1-\phi)\frac{\beta}{\theta}m\left[u(\overline{w}) - u(w^s)\right]\left(\frac{w}{\theta\beta}\right)^{\frac{1}{1-\beta}} < 0,$$

$$\frac{\partial(4)}{\partial w} = \beta u'(w) + \phi(\beta-1)wu"(w) + \frac{1-\phi}{\theta}\frac{1}{1-\beta}m\left[u(\overline{w}) - u(w^s)\right]\left(\frac{w}{\theta\beta}\right)^{\frac{\beta}{1-\beta}} > 0.$$

Denoting $\kappa = [u(\overline{w}) - u(w^s)]$, we have

$$\frac{\partial \delta_{w\theta}}{\partial \kappa} = \frac{(1-\phi)\frac{\beta}{\theta}m\left(\frac{w}{\theta\beta}\right)^{\frac{1}{1-\beta}}\left[\beta u'(w) + \phi(\beta-1)wu"(w)\right]}{\left[\frac{\partial(4)}{\partial w}\right]^2} > 0, \text{ and}$$

$$\frac{\partial \delta_{w\theta}}{\partial \phi} = \frac{(\beta-1)wu"(w)\left[\frac{\partial(4)}{\partial \theta}\right] + \frac{1}{1-\beta}\frac{m}{\theta}\kappa\left(\frac{w}{\theta\beta}\right)^{\frac{\beta}{1-\beta}}\left[\left(\frac{-w}{\theta}\right)\left[\beta u'(w) + \phi(\beta-1)wu"(w)\right]\right]}{\left[\frac{\partial(4)}{\partial w}\right]^2} < 0.$$

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