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# The Role of Internal and External Reference Perspectives in Efficiency Wage Models: A Note

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# The Role of Internal and External Reference Perspectives in Efficiency Wage Models: A Note\*

## Abstract

Survey data suggests that in terms of wage rigidity the internal reference is more relevant in US-type firms while external comparisons play a more significant role in European-type firms. We generalize two theoretical approaches in efficiency framework to incorporate both the internal and external perspectives as variables that affect individual effort determination. Our framework suggests that the internal reference is essential for the existence of wage rigidity while the external reference ensures an upward-sloping wage-setting curve. It thus provides a modified efficiency wage model that is in line with empirical findings of nominal wage rigidity for firms acting in various labor market environments.

**JEL Classification:** E24, E32, J50.

**Keywords:** Efficiency wages, wage rigidity, internal and external reference wage.

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## 1. Introduction

Standard efficiency wage models such as the shirking model by Shapiro and Stiglitz (1984), Akerlof's (1982) partial gift exchange model and the adverse selection model by Weiss (1980) can explain why firms set wages above market clearing levels so that unemployment occurs in equilibrium. These models fail, however, to explain downward rigid wages during a recession, when wages are almost constant as negative aggregate shocks affect labor demand.<sup>1</sup> To find out, why wages actually don't fall, Bewley (1999) interviewed more than 300 business executives, labor leaders, professional recruiters and advisors to the unemployed. From his interviews he concluded that the workers' morale is important for workers performance. The workers' morale depends on being treated fairly *within* firms – for instance by paying “fair” wages according to some established internal pay structure. Concerning fairness comparisons with workers outside the firm, Bewley (1999) reports that

“workers usually know so little about pay levels of other firms that pay differences among firms have to be large before they affect worker attitudes.” (p. 106)

Campbell and Kamlani (1997) report that workers mainly compare their wages with their own past wages, the wages of other workers *within* the firm, and with firms' profits. These authors thus implicitly reject one of the essentials of efficiency wage models, i.e. the comparison of the own wage with outside wages and outside options when determining individual effort.

In efficiency wage models, in which workers compare their wage with external wages only, the wage reaction is much more elastic than the employment reaction. Negative shocks that shift labor demand inwards also affect the *external* reference wage and thus induce workers to work harder, which in turn allows employers to cut wages. Thus, wages are highly volatile over the business cycle – contrary to the empirical

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<sup>1</sup> Holden and Wulfsberg (2007) and Dickens et al (2007) report strong evidence for the existence of nominal wage rigidity in 19 OECD countries.

findings. To overcome this weakness, Danthine and Kurmann (2006) present a modified version of the standard efficiency wage model, in which they replace the external by an internal reference wage that is dependent on the firm's output per worker. This *internal* reference is a measure of rent-sharing and indicates how fair workers are treated within firms. Their version of the efficiency model covers the reasons of Bewley's interview partners and exhibits a high degree of wage rigidity in a general equilibrium and even a negative relation of wage and employment adjustments.

However, the neglect of an external reference is not in line with survey data from Europe. Agell and Benmarker (2003, 2007) report from a random survey of Swedish human resource managers that two-thirds of their respondents believe that an increase in external wages is detrimental to workers' effort. Their results are in sharp contrast to the results from US surveys:

“Most Swedish managers indicate that *both* internal and external wages are important considerations in the local wage bargain.” (Agell and Benmarker 2003, p. 25).

Unionization plays a leading role here since it increases workers' knowledge about external wages, which they may not be able to acquire in decentralized labor markets.<sup>2</sup> Furthermore Agell and Benmarker (2003) report that the external reference is more important in larger firms and that the interest in external wages increases with the job level (also see Andrews and Henry 1963). By contrast, they find little evidence that unemployment benefit payments affect effort although they may be more important for the low-end of the labor market.

To cover both the traditional external reference and the internal reference, we develop a simple reduced-form general equilibrium efficiency wage model that allows for both internal and external references to affect individual effort determination. It thus enables us to reconcile the different survey results in a uniform framework. The internal reference is modelled as a rent sharing within the firm while the external reference takes into account the possibility of finding employment elsewhere or becoming unemployed.

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<sup>2</sup> In the same line Franz and Pfeiffer (2006) argue that the high degree of unionization may be one explanation why the insider-outsider comparison is more important in German labor markets than in the case of US labor markets.

It turns out that wage rigidity is present even when the internal reference wage is given only a moderate weight in the workers' effort determination and that it is rather insensitive to changes in the weight as long as both references play some role.

## 2. Model

The set-up of our framework is closely related to the model in Danthine and Kurmann (2006) – DK in what follows. Firms use effective labor  $en$  to produce output  $y$ , with  $e$  denoting work effort and  $n$  the level of labor input. The production function is  $y = A(en)^\alpha$  with  $0 < \alpha < 1$ , where  $A$  represents the level of technology and can be interpreted as a shift parameter that reflects exogenous shocks. The price of the output good is normalized to one. We consider homogenous workers who are willing to provide effort according to the effort function

$$(1) \quad e = -a_0 + a_1 w^\gamma w_r^{-\gamma},$$

with  $a_0$ ,  $a_1$  and  $0 < \gamma < 1$  being positive constants (see Akerlof 1982, p. 561). The firm's wage is denoted by  $w$ , and the reference wage by  $w_r$ .

According to DK, “workers appreciate their salary offer in light of the firm's output per employee  $y/n$  and of their reservation wage  $b$ .” (DK, p. 280). Their definition of the reference wage with which workers compare their wage when deciding on their effort is

$$(DK) \quad w_r = \left(\frac{y}{n}\right)^\nu b^{1-\nu},$$

where  $0 \leq \nu < 1$  is assumed to be exogenous. The first term represents the maximum wage at which the entire rent is attributed to the worker. The second term denotes the minimum wage below which the worker would prefer the outside option. The reservation wage  $b$  is the minimum wage below which workers prefer to stay at home and collect unemployment benefits. Since, in the DK-setting, this reservation wage is a

constant share of the own wage, both terms actually reflect an internal reference and rule out any external wage comparisons.

External references, however, should be considered for at least the following four reasons. First, unionization increases labor market transparency and facilitates external wage comparisons. Second, larger firms also seem to be more exposed to external comparisons. Third, external reference importance rises with job level. Fourth, at the lower-end wage scale the comparison unemployment benefit payments become an external reference since unemployment benefit payments for low-wage jobs are normally bounded from below, and actually become independent of the own previous wage.

Defining the reservation wage of the worker in the usual way (see e.g. Nickell and Layard 1999), the component  $b$  should depend on the wage workers obtain if rehired by another firm, on the probability of reemployment, and on the level of unemployment benefits. Using the same functional form as suggested by Akerlof (1982, p. 561) for the external reference wage component and denoting  $\bar{w}$  as the equilibrium wage,  $\bar{n}$  as the equilibrium employment rate, and  $\bar{b}$  as the exogenously given unemployment benefit payment, we can define the external component as a geometric average  $b = \bar{w}^{\bar{n}} \bar{b}^{1-\bar{n}}$  so that the reference wage can be expressed as

$$(2) \quad w_r = \left( \frac{y}{n} \right)^{\nu} \left( \bar{w}^{\bar{n}} \bar{b}^{1-\bar{n}} \right)^{1-\nu}.$$

The firm maximizes profit by maximizing  $\pi = A(en)^{\alpha} - wn$  with respect to the wage rate and the employment level subject to the workers' effort function (1) and the reference wage (2). The profit maximization with respect to employment yields

$$(3) \quad w = \alpha \frac{y}{n} (1 + \varepsilon_{e,n}),$$

where  $\varepsilon_{e,n} = e_n n / e$  denotes the effort elasticity with respect to employment. Using (3), profit maximization with respect to the wage rate yields  $1 = \varepsilon_{e,w} - \varepsilon_{e,n}$ , where

$\varepsilon_{e,w} = e_w w / e$  is the effort elasticity with respect to the wage rate. If the internal reference wage is relevant, a marginal wage increase reduces employment, which in turn increases the reference wage via the consequent rise in  $y/n$ . “Thus, ceteris paribus, the last wage increase warranted in the external reference case would not pay for itself in the internal reference context.” (DK, p. 281). Adding an internal reference thus requires modifying the Solow condition.

While the wage-setting curve in the DK model does not depend on aggregate employment anymore, the wage curve in the modified setting does. Under the assumption of a constant replacement ratio  $\bar{b} = \rho w$ ,  $0 < \rho < 1$ , applying the symmetric equilibrium conditions  $w = \bar{w}$ ,  $n = \bar{n}$ , the modified Solow condition, and the reference wage (2) gives the following optimal effort level

$$(4) \quad e = \frac{\gamma a_0 (1 - \nu)}{1 - \gamma(1 - \nu)}.$$

With equilibrium effort being determined by (4), the production function then implies that the modified aggregate wage-setting curve is given by

$$(5) \quad w = \frac{C^{\frac{1}{\nu\gamma}} A \rho^{\frac{(1-n)(1-\nu)}{\nu}}}{n^{1-\alpha}},$$

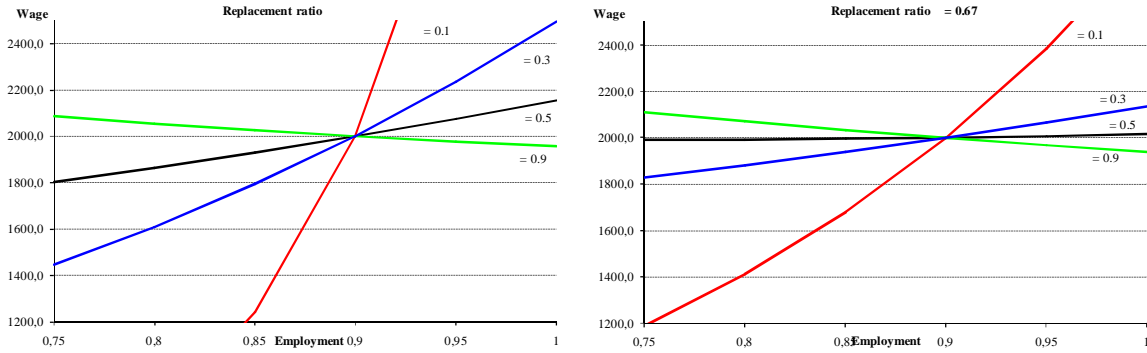
where  $C = \left[ \frac{1}{a_1} \left( \frac{a_0}{1 - \gamma(1 - \nu)} \right) \right]^{1+\alpha\gamma\nu}$   $[\gamma(1 - \nu)]^{\alpha\gamma\nu}$  is a constant. Figure 1 illustrates the wage

setting curves for different weights of the internal reference, described by  $\nu$ , and two different replacement ratios of 33 and 67 percent. The model is calibrated for a wage share of 2/3, and an equilibrium wage equal to 2,000 Euro for all weights when aggregate unemployment is exactly at 10 percent.<sup>3</sup>

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<sup>3</sup> The parameter values are as follows:  $A = 1$ ;  $a_0 = 1000$ ;  $a_1 = 990.095$ ;  $\gamma = .1$ .

Figure 1: The wage setting curve for different weights of the internal reference



If comparisons are mainly external (e.g.  $v = .1$ ), the wage setting curve is relatively steep. The more important the internal reference becomes, however, the less steep the wage curve becomes: firms prefer employment adjustments to wage adjustments or, in other words: wages become more rigid. If the reference is almost internal ( $v = .9$ ), wages may even fall with employment.<sup>4</sup> A higher replacement ratio will also flatten the wage-setting curve. This effect is the more pronounced, the more the external reference matters.

Formally, the general equilibrium wage elasticity with respect to employment, obtained from (5), cannot be signed unambiguously as we have

$$(6) \quad \frac{\partial w}{\partial n} \frac{n}{w} = (\alpha - 1) - \frac{(1 - v)}{v} n \ln \rho .$$

Condition (6) indicates that the degree of wage rigidity depends on the weight of the internal reference  $v$ . To see this, consider the two extreme cases. The limiting case  $v = 0$  in equation (2) represents the standard efficiency wage model with an external reference wage only and therefore a high variability of the efficiency wage. In this case, the reference wage reduces to  $w_r = \bar{w}^{\bar{n}} \bar{b}^{1-\bar{n}}$  and the wage elasticity becomes unambiguously positive

<sup>4</sup> The concavity of the production function ensures that for given effort the internal reference  $y/n$  is declining in employment.

$$(7) \quad \left. \frac{\partial w}{\partial n} \frac{n}{w} \right|_{v=0} = \frac{n}{1-n} (\ln w - \ln b) = -\frac{n}{1-n} \ln \rho > 0.$$

(cf. DK, equation (13)). For an unemployment rate of 10 percent ( $n=.9$ ) and a replacement ratio  $\rho=.67$ , the wage reaction is almost four times as high as the employment adjustment. By contrast, if we disregard the labor market conditions in the reference wage by setting  $\bar{n}=0$  in equation (2), the model boils down to the model by DK and the elasticity of the wage with respect to employment becomes unambiguously negative:

$$(8) \quad \left. \frac{\partial w}{\partial n} \frac{n}{w} \right|_{\bar{n}=0} = (\alpha - 1) < 0$$

(cf. equation (15) of DK). A comparison of (7) and (8) highlights the interpretation of the more general case as represented in (6). Rewriting (6) as

$$(9) \quad \frac{\partial w}{\partial n} \frac{n}{w} = \frac{1}{v} [v(\alpha - 1) - (1 - v)n \ln \rho].$$

shows that an increase in the parameter  $v$  i) lowers the level of the elasticity and ii) shifts the weight of the two perspectives and thus becomes decisive for the degree of observed wage rigidity: the more important the internal reference relative to the external view becomes, the more rigid wages react to exogenous demand shocks.

*Table 1: wage elasticity and the weight of the internal reference*

Unem- ployment rate	Weight of the internal reference for different replacement ratios													
	.1		.3		.4		.5		.6		.7		.9	
	.33	.67	.33	.67	.33	.67	.33	.67	.33	.67	.33	.67	.33	.67
<b>5.0%</b>	9.06	3.13	2.10	.57	1.23	.24	.71	.05	.36	-.08	.11	-.17	-.22	-.29
<b>10.0%</b>	8.57	2.95	1.97	.52	1.15	.21	.66	.03	.33	-.09	.09	-.18	-.22	-.29
<b>20.0%</b>	7.58	2.59	1.73	.42	.99	.15	.55	-.01	.25	-.12	.04	-.19	-.24	-.30

The numerical examples in table 1 illustrate for the same assumptions as made in figure 1 that the degree of wage rigidity increases with the weight given to the internal reference, falls with the replacement ratio, but this result is rather insensitive to the

actual labor market performance. Strong wage rigidity is observed when the internal and external references are almost equally important for individual effort determination: a reduction of the unemployment rate by 9 percent, starting at  $n = .9$ , changes the wage by 0.66 percent when the replacement ratio is low and by 0.03 percent when the replacement ratio is high. For intermediate values of the internal reference weight, we may not observe much difference in the degree of wage rigidities among countries with different labor market institutions. This conclusion is very much in line with Knoppik and Beissinger (2005, p. 14) who do not find conclusive empirical evidence for systematic differences between Europe and the US with respect to downward nominal wage rigidity. By contrast, Dickens et al (2007) findings that wages are more rigid in Europe than in the US may be due to more general unemployment benefit systems.

### **3. Conclusion**

The aim of this note was to highlight the role both internal and external references play in an efficiency wage framework. Our reduced-form generalized efficiency wage model allows us to disentangle these two perspectives. It is open to the way in which the external reference affects the wage setting of firms. It may be due to reciprocity in a gift exchange or due to an explicit comparison with outside wages in e.g. more unionized sectors. The former channel has been analyzed in a very innovative new paper by Danthine and Kurmann (2007) who consider reciprocity in an efficiency wage framework. There, the external reference is not needed to determine the penalty for those caught shirking but to determine a minimum wage above which the firms' wage offers are only considered a gift in exchange for effort. Although they model a purely internal gift exchange, the external reference, which is essential for creating unemployment in efficiency wage models, still serves as a benchmark. Their results are very similar to ours though the focus is somehow different. Our model is more open to how internal and external references determine the reference wage and may be more tractable, while their model provide a eloquent micro-foundation of reciprocity in the

efficiency wage framework. Both models capture the essence of standard efficiency models that firms will set the wage above market clearing level to promote effort and allow for a strong degree of wage rigidity as long as the internal wage comparison is non-negligible.

In so far the reference wage is a weighted average of internal and external components our model also allows for differences as suggested by the survey data for the US and Europe and would predict that wage rigidity is more pronounced in labor markets where internal references matter more – although the differences might be very small. Gathering firm-specific data concerning the earnings per worker and aggregate data concerning average wages, unemployment and the generosity of the unemployment benefit system may help to empirically estimate the relative weights of internal and external references. This has to be delegated to further research.

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