Efficiency Wages Revisited: The Internal Reference Perspective*

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Abstract

The missing wage rigidity in general equilibrium models of efficiency wages is an artifact of the external wage reference perspective conventionally adopted by the literature. Efficiency wage models based on an internal perspective, in which the wage reference is made dependent on the firm's ability to pay, are capable of generating strong wage rigidity. This paper makes the point in the context of the gift-exchange framework originally proposed by Akerlof [1982].

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1 Introduction

Why don't firms lower wages in the face of depressed labor demand conditions? The efficiency wage theory was initially meant as *the* answer to that very question.[1] Recent developments have, however, put in doubt the ability of this theory to generate significant wage rigidity. In this note, we show that the efficiency wage hypothesis by itself implies neither wage rigidity nor a lack thereof. Wage rigidity rather depends on the interpretation of the *reference wage level* to which workers compare their salary when deciding on work effort. As long as this reference wage stays relatively constant, firms avoid large wage reductions following negative labor demand shifts because the thus realized cost savings would be more than offset by the resulting decrease in labor productivity.

Conventional formulations of the efficiency wage theory, such as Shapiro and Stiglitz' [1984] shirking model, Salop's [1979] labor turnover model, but also Akerlof's [1982] partial gift exchange model interpret the reference wage as *external* to the firm, based on the assumption that workers appraise their wage in light of the remuneration they could obtain if they were not under contract with their current employer. As we show in the present note, these models fail to generate wage rigidity in general equilibrium. We also demonstrate, however, that if the reference wage is made dependent on firm-*internal* measures of earnings per unit of labor – i.e. if what workers care for is the division of the rent with capital owners – the same efficiency wage model is capable of delivering strong wage rigidity in general equilibrium.

The intuition behind the difference in results is simple. In the external perspective, the wage reference of workers is positively related to outside earnings opportunities and the latter are sensitive to aggregate shocks. For example, when firms reduce employment in response to a labor demand shift, there is a general equilibrium fall of the wage reference, permitting individual firms to lower their wages and leading to a further decrease in the reference wage. All in all, it is possible for firms to lower wages without severe consequences on effort. Put graphically, the firm's wage setting curve in general equilibrium implies a steep positive relationship between employment and wages. By contrast, in the internal reference case and under the assumption that the marginal productivity of labor is decreasing, a reduction in the firm's payroll due to a labor demand shift increases earnings per unit of labor and thus the wage reference. Optimizing along the effort dimension therefore results in firms operating along a negatively sloped wage setting curve.[2]

Akerlof and Yellen [1990] also adopt an internal reference perspective when they examine the implications of a model where workers with different skills compare their wage to the wage of co-workers in the same firm when deciding on effort. They find that such a model has the potential to explain the intra-

[1] See Yellen [1984] for a survey.

[2] Furthermore, shocks to productivity not only shift the labor demand curve (as is the case in the external reference case) but also the wage setting curve. This shift neutralizes (part of) the wage fluctuation and implies that aggregate shocks potentially have a strong effect on employment while leaving real wages and productivity largely unchanged.

industry wage differentials observed in the data. Other formulations of efficiency wage have been proposed to remedy the failure of existing external reference models to deliver wage rigidity. Collard and De la Croix [2000] and an earlier study by the present authors (Danthine and Kurmann [2004]) extend Akerlof's original reduced-form effort function to include the workers past wage in the reference wage. Their simulations show that as long as this intertemporal wage link plays an important role, the model is capable of generating strong wage rigidity.

2 Internal vs. External Wage References

Consider an economy with identical workers and identical firms. Firms use effective labor en to produce output y as per

$$y = f(en) = A(en)^{\alpha},\ 0 < \alpha < 1 \tag{1}$$

where α is a constant, A stands for the level of the technology, n is the level of labor input and e stands for work effort which cannot be observed directly. Despite effort being costly to them (in terms of utility), workers are assumed to volunteer effort according to

$$e = -a_0 + a_1 \left(\frac{w}{w_r}\right)^{\gamma},\ 0 < \gamma < 1, \tag{2}$$

with a_0, a_1 and γ positive constants. In this relation, identified as the Effort Condition (EC), w denotes the workers' real wage per unit of labor while w_r stands for the reference wage in light of which workers evaluate their compensation. The larger the premium of w over w_r, the more the representative worker is willing to provide effort.

This EC subsumes various alternative versions of the efficiency wage story. In his seminal paper, Akerlof [1982] motivated it as the result of reciprocity: the exchange between workers and firms of a gift of effort against a gift of a remuneration over and above the wage reference.[3] The same condition could also be viewed as the reduced-form consequence of the shirking model of Shapiro and Stiglitz [1984] or of the turnover model of Salop [1979]. In both cases a real wage in excess of the reference wage is what induces the worker to provide effort, because being fired, respectively quitting, is thus made costly to him/her.

What should the reference wage w_r be? In the shirking and the turnover stories, but also in the gift exchange view proposed by Akerlof, the perspective is decidedly *external*. That is, workers compare their salary to the compensation they could expect to receive were they not employed with their current firm. Thus, w_r depends on the wage workers would obtain if rehired by another (identical) firm, $\bar{w}$, on the probability of reemployment after leaving the firm, which we identify as the aggregate level of employment $\bar{n}$ (with full employment

[3] Bewley (1999) considers the reciprocity view to be the most plausibly in line with the acknowledged behavior of the more than 300 US managers questioned in his survey.

being normalized at 1), and on the level of unemployment benefits the worker obtains if he is not re-hired, which we denote b. We adopt the functional form proposed by Akerlof who writes the reference wage as a geometric average of the above components :

$$w_r = \bar{w}^{\bar{n}} b^{1-\bar{n}}. \tag{3}$$

There is, however, an alternative approach, at least in the gift exchange perspective, one that places the issue of *rent sharing* between firms and workers at the center of attention. In this *internal* reference view, workers appreciate their salary offer in light of the firm's output per employee, y/n, and of their reservation wage b. The former represents the maximum wage at which the entire rent is attributed to the worker, the latter the minimum one below which the worker would rather stay home (and collect unemployment compensations).[4] The closer the actual w is to the most generous wage offer, the more workers are ready to volunteer effort; conversely a wage offer close to the worker's reservation wage, at which most of the rent goes to the firm, elicit a lower effort level.

In the spirit of the Akerlof functional form adopted as a representation of the external perspective, we define the internal reference as

$$w_r = \left(\frac{y}{n}\right)^{\nu} b^{1-\nu}, \tag{4}$$

where ν is some arbitrary constant between 0 and 1.

Equations (2) and (3) or (4) are part of firms' information set. That is, firms understand what makes workers volunteer effort and they choose labor n and the salary w in order to maximize profit $A(en)^{\alpha} - wn$ subject to the alternative set of constraints ((2), and either (3) or (4)).[5]

In the case of the external reference, the solution to the firm's problem take the form

$$w = \alpha \frac{y}{n} \tag{5}$$

$$1 = \varepsilon_{e,w} = \frac{\gamma a_1}{e} \left(\frac{w}{w_r}\right)^{\gamma}. \tag{6}$$

Equation (5) is the labor demand function. Equation (6) is the so-called Solow (1979) condition resulting from combining the labor demand with the first-order condition with respect to wages. Combining the EC with this SC implies that the optimal wage (from the perspective of the employer) is a constant markup over the reference wage w_r

$$\frac{w}{w_r} = \left(\frac{a_0}{a_1(1-\gamma)}\right)^{\frac{1}{\gamma}}, \tag{7}$$

[4]Alternatively, we could have assumed the existence of a mandated minimum wage. As long as this minimum is taken as given by the firm, however, the conclusions reached below remain unchanged.

[5]This statement only applies if total labor supply at the optimal wage is in excess of total labor demand, a condition that will prevail throughout.

and that

$$e = \frac{\gamma a_0}{(1-\gamma)}. \tag{8}$$

In the internal reference case, equations (5) and (6) take a slightly different form because the firm takes account of the consequences of changes in n on the wage reference and thus on effort.

$$\begin{aligned} w &= \alpha \frac{y}{n}(1+\varepsilon_{e,n}) \\ 1 &= \varepsilon_{e,w} - \varepsilon_{e,n}. \end{aligned} \tag{9}$$

We label the latter expression the Modified Solow Condition (MSC). It differs from (6) because, with an internal reference, a marginal wage increase has an additional effect on effort resulting from the fact that the induced decrease in employment has itself a (negative) impact on effort. Thus, ceteris paribus, the last wage increase warranted in the external reference case would not pay for itself in the internal reference context. The fact that the traditional Solow condition, universally associated with the efficiency wages hypothesis, no longer holds in the internal reference case underlines the ubiquity of the external reference perspective in the literature.[6]

Combining the MSC and the EC yield after some manipulations

$$\frac{w}{w_r} = \left(\frac{a_0}{a_1(1-\gamma(1-\nu))}\right)^{\frac{1}{\gamma}}, \tag{10}$$

from which one derives

$$e = \frac{\gamma a_0(1-\nu)}{1-\gamma(1-\nu)}. \tag{11}$$

The formal similarity between the two perspectives is evident. In both cases, given the selected functional forms, it is optimal to set the wage at a constant premium over the reference wage and this implies that optimal effort is *constant* in the sense of being unrelated to the equilibrium level of endogenous variables.

Moreover, in the external as well as the internal reference, as long as w_r belongs to the "ceteris paribus" – i.e. in a partial equilibrium context – the efficiency wage model generates strong wage rigidity. This is the argument made by Yellen [1984], among others. The crucial difference arises once attention is paid to the fact that in general equilibrium, the reference wage w_r is itself an endogenous variable and it may be strongly affected by external shocks. This is indeed the case in the external (but not the internal) perspective in which the only reason for firms to hold their wages constant is if all other firms keep theirs constant. But even if they were to do so, the decrease in employment

[6] Layard, Nickell and Jackman (1991) is a rare reference discussing situations where the Solow condition fails to hold. They mention the case of a more complex production function and another one that combines wage bargaining with efficiency wage considerations. These authors also briefly mention the possibility that the workers' goodwill could be influenced by the firm's ability to pay. They do not explore the implications of that hypothesis, however.

that follows a negative shock, in and of itself, decreases the wage reference. The result is that firms find it optimal to decrease their own wage and as all of them are in the same situation, nothing prevents both the wage offers and the wage reference from adjusting flexibly. Thus once imbedded in a general equilibrium model, the external reference efficiency wage model fails to generate sluggish wage movements, a point made early on by Danthine and Donaldson [1990] in a real business cycle context.

Pursuing this reasoning more formally, let us observe that with homogenous firms and workers, equilibrium implies $\bar{w} = w$ and $\bar{n} = n$. Hence, the wage setting curve (7) becomes

$$n = 1 - \frac{\log\left(\frac{a_0}{a_1(1-\gamma)}\right)}{\gamma(\log w - \log b)}. \tag{12}$$

The elasticity of w with respect to n along this wage setting curve is

$$\frac{\partial w}{\partial n}\frac{n}{w} = \frac{n}{1-n}(\log w - \log b) = \frac{-n}{1-n}\log\rho > 0. \tag{13}$$

The second equality is obtained under the plausible assumption that unemployment benefits in equilibrium are a fraction of the salary; i.e. $b = \rho w$ with $0 < \rho < 1$ being defined as the replacement ratio. This substitution permits expressing the elasticity independently from the parameters of the effort function (a_0, a_1, γ), or from other structural parameters $(\alpha,\ A)$.

Given that unemployment is between 5% and 10% in most industrialized economies and the replacement ratios vary between 0.35 and 0.65, the external reference model implies the following measures of wage rigidity[7]

	$\rho = 0.35$	$\rho = 0.65$
$n = 0.9$	9.45	3.88
$n = 0.95$	19.95	8.19

Even in the "most favorable" scenario ($n = 0.9$ and $\rho = 0.65$), labor demand shifts impact wages almost four times as much as employment.

By contrast, there is no difference in the internal reference case between the wage setting curve for the firm and the corresponding general equilibrium relation as the wage reference is a function of firm-internal measures and not of economy-wide aggregates. We use the solution for optimal effort and the fact that $y/n = Ae^{\alpha}n^{\alpha-1}$ to write the internal reference wage setting curve as

$$w = \frac{C^{\frac{1}{\gamma}}A^{\nu}b^{1-\nu}}{n^{(1-\alpha)\nu}}, \tag{14}$$

where $C \equiv \left[\frac{1}{a_1}\left(\frac{a_0}{1-\gamma(1-\nu)}\right)^{(1+\alpha\gamma\nu)}\right][\gamma(1-\nu)]^{\alpha\gamma\nu}$. Imposing again that $b = \rho w$ in equilibrium, the elasticity of w with respect to n along the wage setting curve

[7]This elasticity measure would not be constant over the cycle as n and b/w vary. Rather, it should be considered as an approximation around the steady state value of n (and $b = \rho w$).

is

$$\frac{\partial w}{\partial n}\frac{n}{w} = (\alpha - 1) < 0. \qquad (15)$$

Since α is commonly set around 0.6 to 0.7, the internal reference elasticity (15) is negative but small in size. Moreover, changes in employment brought about by labor demand shifts may also shift the wage setting curve. In particular, if labor demand increases because of a positive productivity shock to A, the wage setting curve shifts up and thus neutralizes (some of the) negative impact on wages.

3 Conclusions

This note has showed that the gift-exchange version of the efficiency wage model is capable of generating strong wage rigidity in general equilibrium provided the reference wage is viewed as an internal reference rather than (or in addition to) the external reference proposed by Akerlof in his original contribution and generally adopted by the ensuing literature.

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