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Near rationality in wage setting

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This study argues that it is interesting to examine near rational behaviour in the context of an efficiency wage model, where there are positive if decreasing returns to increasing the wage beyond the efficient level. Previous research has found it difficult to distinguish between efficiency wage and bargaining models, which have similar empirical predictions. But unions are a priori more likely to develop in environments in which the technology favours efficiency wage payments. This makes it interesting to investigate what it costs the firm to deviate from the efficiency wage. If it does not cost a lot, firms may give in to union demands. This study derives expressions for the wage deviation and for the associated profit loss. For illustrative purposes, these are calibrated for UK, US and Indian manufacturing, taking a plausible parameterization of the effort-wage function and using available estimates of the wage and employment elasticities of output. While there is evidence of positive effort returns to wages in the UK and India, the results are consistent with wage bargaining pushing the wage above the efficient level. The associated profit loss is considerably larger in the UK than in India. In contrast, US firms pay wages that are insignificantly different from the efficiency wage.

I. Introduction

This study suggests the relevance of allowing for near rationality in wage setting behaviour and derives the expressions necessary to investigate it. To illustrate the argument, wage deviations and associated profit losses are calibrated for three countries for which estimates of relevant parameters are available.

Consider firms setting wages in an environment in which worker effort is wage-dependent. The optimal or efficiency wage is then the wage at which effort returns to increasing the wage exactly offset the costs. An interesting feature of this environment is that increasing the wage beyond the efficient level will yield positive (although diminishing) effort returns. Therefore, other things being equal, a firm operating in circumstances in which productivity is a function of the wage rate is more likely to give in to demands for wage increases. This may be argued to encourage unionization of its workers.

Previous research has remarked at the difficulty of disentangling union bargaining and efficiency wage effects. While inherently distinct, these two models of wage setting have in common that they can both explain certain stylized features of the labour market that are difficult to reconcile with a competitive model of the labour market. For example, both models are consistent with unemployment and wage differentials that persist after controlling for worker and job characteristics and that show little tendency to dissipate over time (e.g., Dickens and Katz, 1987; Krueger and Summers, 1988; Groshen, 1991). A useful way of investigating whether the observed wage is the efficient wage is to directly test the first

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order condition of the efficiency wage model. According to this, the output elasticities of employment and wages should be equal (see Section II). If a statistical test rejects equality, one can reject the null of optimality. This study argues that it is then interesting to investigate near rationality, or to investigate how large a profit loss the firm is incurring in having deviated from the optimal wage. Small deviations that result in small losses are consistent with transactions or information costs. A further possibility is that a small positive wage deviation arises on account of union power. If, in this case, the associated profit loss is small then the economic consequences of the distinction between the efficiency wage and bargaining models are limited.

In general, when the profit loss associated with deviating from the optimality condition is small then the decision rule used is near-rational. There is no rigorous definition of 'small' just as there is no definitive choice of statistical significance level. The idea of near rationality is discussed in Akerlof and Yellen (1985a, 1985b), who argue that the predictions of a hypothesis should be robust to near rational behaviour. In Akerlof and Yellen (1987) this is cast in terms of inertial behaviour, while Cochrane (1989) argues that near rational behaviour may arise on account of stylizations employed by the economist or on account of heuristic decision making. Empirical investigation of near rationality has been limited. In an early paper, Akerlof (1979) finds that the utility loss associated with fairly substantial deviations from optimal money holdings is trivial. More recently, Cochrane (1989) shows that deviations from the rule for intertemporal allocation of consumption implied by the permanent income hypothesis result in very small losses in utility. Both of these studies use macroeconomic data. There does not appear to have been any attempt to investigate near rational behaviour on the part of firms or, indeed, in an efficiency wage setting.[1] Cochrane (1989) points out that near rational behaviour is less likely amongst firms than amongst consumers because any slack in firm performance is likely to attract profit-seeking activities like takeover. However, if transactions costs or costs imposed by dissatisfied workers (or unions) rather than 'mistakes' underlie small deviations from profit maximization, then persistence in these costs can support persistence of near rational behaviour. In any case, the question is worth investigating so as to allow the data to speak for themselves.

This study derives the necessary expressions for an efficiency wage model. It shows that the deviation of the wage from its optimal level can be cast in terms of the difference in the point estimates of the wage and employment elasticities of output, for a given parameterization of the effort function. The associated profit loss can then be calculated as a function of the wage deviation, the employment elasticity of output, and the curvature of the effort function. For illustrative purposes, available production function estimates for UK, US and Indian manufacturing are used to perform these calibrations.

Section II sets out the basic theory and the optimality condition, while Section III derives conditions that obtain in the neighbourhood of the optimum. In Section IV, the profit losses implied by estimates of wage-augmented production functions for the three countries are calibrated and their implications discussed. Section V concludes.

II. A Direct Test of the Efficiency Wage Hypothesis

The general case

The basic tenet of an efficiency wage model is that firms may find it profitable to pay wages in excess of the supply price of labour if this brings sufficiently large gains in productivity. Such behaviour is consistent with a range of theoretical models, surveyed by Katz (1986), Akerlof and Yellen (1986: 1–21), Layard *et al.* (1991). In the *recruit* (e.g. Weiss, 1980) *retain* (e.g., Stiglitz, 1974) and *motivate* (Shapiro and Stiglitz, 1984) versions of the model, paying a relatively high wage induces higher productivity through self-selection, lower turnover and higher morale respectively. In the original efficiency wage model of Leibenstein (1957), paying an absolute wage that may be higher than the competitive wage *enables* greater effort. This study will concentrate upon the Shapiro and Stiglitz model in which a wage premium raises productivity by discouraging shirking.

The unobserved effort of workers, E, is an input in the production function, $Y = Y(E(W), N(W), K, A)$, where Y is value added ouput, N is employment, K is capital stock, A is an index of productivity and W is the relative wage. Maximizing profits with respect to the wage and employment in this very simple and general framework yields the first order conditions $\partial Y/\partial N = W/P$ and $(\partial Y/\partial E)(\partial E/\partial W) = N/P$. Solving these yields the condition which defines the efficiency

[1] Levine (1992, p. 1103) remarks in passing that near-rational behaviour will result in the optimality condition being approximately verified by the data but does not proceed further.

wage: $e_{EW} = e_{YN}/e_{YE}$, where e_{ij} is the elasticity of i with respect to j. Neither e_{EW} nor e_{YE} is observable but rearranging gives $e_{YE}\, e_{EW} = e_{YN}$, or

$$e_{YW} = e_{YN} \tag{1}$$

The elasticities in Equation 1 are estimable. If the elasticity of output with respect to the wage equals its elasticity with respect to employment, then the firm is paying the efficiency wage. This wage pays for itself. The intuition is straightforward. Since the wage bill is symmetric in W and N, equilibrium must have the property that the marginal increase in N is as productive as the marginal increase in W. If wage bargaining coexists with efficiency wage considerations, one may expect that the agreed wage exceeds the pure efficiency wage. In that case, $e_{YW} < e_{YN}$, or the wage does not quite pay for itself. Notice that the *Solow condition*, $e_{EW} = 1$, is a special case of $e_{EW} = e_{YN}/e_{YE}$ that arises if and only if effort is specified as labour-augmenting (i.e., $e_{YN} = e_{YE}$).

A specific case

It is useful to impose some structure on the effort and production functions for purposes of the analysis in Section III. Let the production function incorporating effort, E, be

$$Y = AK^{\beta}N^{\alpha}[E(W)]^{\alpha}\nu \tag{2}$$

where ν is an i.i.d. productivity shock that is assumed to be uncorrelated with changes in A, N and K. Notice that effort is specified as a perfect substitute for employment. While this does not affect the optimality condition, it simplifies the ensuing profit loss calculations. Let

$$E = -\theta + W^{\delta}; \quad 0 < \delta < 1 \tag{3}$$

$E'(W) > 0$ and $E''(W) < 0$, or there are positive but decreasing returns to increasing the wage. A negative intercept is specified in the effort function so as to rule out the possibility of non-negative effort at a zero wage. If $\theta \le 0$, then a zero wage is the efficiency wage[2]. To avoid clutter, A and K are suppressed because they do not depend upon the wage. The function we work with is

$$Y = N^{\alpha}[-\theta + W^{\delta}]^{\alpha} \tag{4}$$

The first order conditions for profit maximization are

$$\frac{\partial\pi}{\partial N} = 0 \Rightarrow \frac{\alpha Y}{N} - \frac{W}{P} = 0 \tag{5}$$

$$\frac{\partial\pi}{\partial W} = 0 \Rightarrow \frac{P\partial Y}{\partial W} - N = 0 \tag{6}$$

Define

$$\gamma \equiv \frac{\partial \ln Y}{\partial \ln W} = \frac{W}{Y}\left(\frac{\partial Y}{\partial W}\right) \tag{7}$$

Together Equations 5, 6 and 7 imply the optimality condition,

$$\gamma = \frac{WN}{PY} = \alpha \tag{8}$$

which is Equation 1. Thus profit maximization (or rationality) implies that the wage will be set at a level that equates the wage elasticity of output (γ) to the employment elasticity of output (α); γ and α are the key parameters, estimable from a production function. Using Equations 4 and 7, one can write γ as

$$\gamma = \alpha\delta W^{\delta}[-\theta + W^{\delta}]^{-1} \tag{9}$$

At the efficiency wage (W^*) where $\gamma = \alpha$, Equation 9 implies

$$(W^*)^{\delta} = \frac{\theta}{1-\delta} \tag{10}$$

Clearly, the optimal wage depends only upon the parameters of the effort function[3].

III. Near Rationality

The wage deviation

Let ω be the actual wage, ω^* the efficiency wage and $\Delta\omega$ the deviation defined by $\omega = \omega^* + \Delta\omega$. Then $\omega^{\delta} = (\omega^* + \Delta\omega)^{\delta} = (\omega^*)^{\delta}\,[1 + (\Delta\omega/\omega^*)]^{\delta}$, or

$$\omega^{\delta} \approx (\omega^*)^{\delta}\left[\frac{1 + \delta\Delta\omega}{\omega^*}\right] \tag{11}$$

[2] It is straightforward to demonstrate this. Without any loss of generality, let $\omega = (W/P^c)$. Now if $\theta = 0$, then $\pi = [PN^{\alpha} \times \omega^{\alpha\delta} - P^c\omega N] = [PN^{\alpha(1-\delta)}\,(\omega N)^{\alpha\delta} - P^c(\omega N)]$. From this, it is clear that π can be made arbitrarily large by making N large while keeping ωN (costs) constant. In other words, the optimum is at $N = \infty$, $W = 0$. Now let $\theta > 0$. Then $\pi = [PN^{\alpha} \times (\theta + \omega^{\delta})^{\alpha} - P^c\omega N] \ge [PN^{\alpha}\theta^{\alpha} - P^c\omega N]$ and, as before, it is clear that profits can be expanded infinitely by raising employment, keeping the wage close to zero. Also see Akerlof (1982).

[3] This follows directly from the specification of effort as labour-augmenting in Equation 2. It is nevertheless instructive to write down Equations 5–9 since they are used in Section IV.

It was demonstrated earlier that, at ω^*, $\gamma = \alpha$. Let us find γ when the wage deviates by $\Delta\omega$ from its optimal level. Substituting Equation 11 in Equation 9 gives

$$\gamma \approx \frac{\alpha\delta(\omega^*)^\delta[1+\delta\Delta\omega/\omega^*]}{\{(\omega^*)^\delta[1+\delta\Delta\omega/\omega^*]-\theta\}} \tag{12}$$

Substituting for ω^* using Equation 10 gives

$$\gamma \approx \frac{\alpha[1+\delta\Delta\omega/\omega^*]}{[1+\Delta\omega/\omega^*]} \tag{13}$$

or

$$\frac{\Delta\omega}{\omega^*} \approx (\alpha-\gamma)/(\gamma-\alpha\delta) \tag{14}$$

Though δ is unknown, we can use the fact that δ lies between 0 and 1 to calibrate the wage deviation implied by estimates of α and γ for alternative values of δ in this range (see Section IV).

The profit loss

Profit in a neighbourhood of the optimum is given by a second-order Taylor series expansion

$$\pi(\omega^*+\Delta\omega) = \pi(\omega^*) + \pi'(\omega^*)\Delta\omega + \left(\frac{1}{2}\right)\pi''(\omega^*)(\Delta\omega)^2 \tag{15}$$

where $\pi'(\omega^*) = \mathrm{d}\pi/\mathrm{d}\omega$ and $\pi''(\omega^*) = \mathrm{d}^2\pi/\mathrm{d}\omega^2 < 0$, both evaluated at the efficiency wage, ω^*. Optimality implies that $\pi'(\omega^*) = 0$, so the proportional profit loss in deviating from the optimal wage, $[\pi(\omega^*) - \pi(\omega^*+\Delta\omega)]/\pi(\omega^*)$ is

$$\frac{\Delta\pi}{\pi(\omega^*)} = -\left(\frac{1}{2}\right)\pi''(\omega^*)\frac{(\Delta\omega)^2}{\pi(\omega^*)} \tag{16}$$

It is assumed that value-added prices (P) are exogenously determined. Until it becomes necessary to choose functional forms, the analysis proceeds with the most unrestrictive specifications. Profit is given by $\pi(\omega) = PY[N(W), E(\omega)] - \mathrm{WN(W)}$. Employment is taken to be set after the wage, by the marginal revenue product (MRP) condition, $\partial\pi/\partial N = 0$, which implies

$$P\left(\frac{\partial Y}{\partial N}\right) = W \tag{17}$$

Taking the total derivative of π with respect to the wage and using Equation 17 to simplify gives

$$\frac{\mathrm{d}\pi}{\mathrm{d}W} = \frac{P\partial Y}{\partial W} - N \tag{18}$$

Taking the second derivative, we have

$$\frac{\mathrm{d}^2\pi}{\mathrm{d}W^2} = P\left(\frac{\partial^2 Y}{\partial W^2}\right) - \left(\frac{\mathrm{d}N}{\mathrm{d}W}\right)\left[1 - P\left(\frac{\partial^2 Y}{\partial N\partial W}\right)\right] \tag{19}$$

Differentiating both sides of Equation 17 gives $\mathrm{d}[P(\partial Y/\partial N)]/\mathrm{d}W = 1$, or

$$P\left(\frac{\partial^2 Y}{\partial N^2}\right)\left(\frac{\mathrm{d}N}{\mathrm{d}W}\right) + P\left(\frac{\partial^2 Y}{\partial N\partial W}\right) = 1 \tag{20}$$

Using this to substitute out the term in square brackets in Equation 19 gives

$$\frac{\mathrm{d}^2\pi}{\mathrm{d}W^2} = \frac{P\partial^2 Y}{\partial W^2} - P\left(\frac{\partial^2 Y}{\partial N^2}\right)\left(\frac{\mathrm{d}N}{\mathrm{d}W}\right)^2 \tag{21}$$

Evaluated at the optimal wage and employment, Equation 21 provides $\pi''(\omega^*)$ in Equation 16. So as to obtain an expression for profit loss in terms of estimable parameters, the terms in Equation 21 are now computed for the specific production function, Equation 4.

The second derivative of Equation 4 with respect to N is

$$\frac{\partial^2 Y}{\partial N^2} = \alpha(\alpha-1)\left(\frac{Y}{N^2}\right) \tag{22}$$

Taking the second derivative of Equation 4 with respect to W gives

$$\frac{\partial^2 Y}{\partial W^2} = \left(\frac{\alpha\delta N^\alpha}{Z^2}\right)(\omega^\delta-\theta)^{\alpha-2}\omega^{\delta-2}\left[\delta(\alpha-1)\omega^\delta + (\delta-1)(\omega^\delta-\theta)\right] \tag{23}$$

where Z denotes the wage deflator (P^c or W^a as the case may be). Since the second derivatives are evaluated at the optimum, one can use Equation 10 in Equation 23, substituting ω^* for ω. Writing N^* for $N(\omega^*)$ and simplifying, this gives

$$\frac{\partial^2 Y}{\partial W^2} = \left[\frac{\alpha(\alpha+\delta-2)}{(W^*)^2}\right]\left[\frac{\theta\,\delta N^*}{(1-\delta)}\right]^\alpha \tag{24}$$

An expression is now derived for N^*, the optimal level of employment. Since $Y = N^\alpha\,[-\theta+\omega^\delta]^\alpha$, $Y^* = (N^*)^\alpha\,[-\theta+(\omega^*)^\delta]^\alpha$. Using Equation 10 again to substitute for ω^*, this gives

$$Y^* = \left(\frac{\theta\delta N^*}{1-\delta}\right)^\alpha \tag{25}$$

Using Equation 25 to substitute for N^* in Equation 24, one has

$$\frac{\partial^2 Y}{\partial W^2} = \left[\frac{\alpha(\alpha+\delta-2)Y^*}{(W^*)^2}\right] \tag{26}$$

One now needs an expression for the third term in Equation 21, $\mathrm{d}N/\mathrm{d}W$. For a given wage, the optimal employment level is given by the MRP condition. For, $Y = N^\alpha E(W)^\alpha$, $\partial\pi/\partial N = 0$ implies

$\alpha N^{\alpha-1}E(W)^{\alpha}=W/P$. Taking the derivative of log N with respect to log W gives

$$\frac{(\alpha-1)\mathrm{d}\ \ln N}{\mathrm{d}\ \ln W}=1-\alpha\left(\frac{\mathrm{d}\ \ln E}{\mathrm{d}\ \ln W}\right) \tag{27}$$

Since Equation 2 implies that the effort-wage elasticity is unity (the Solow condition), Equation 27 implies the intuitive result that *the wage elasticity of employment is minus one at the efficiency wage*:[4]

$$\frac{\mathrm{d}\ \ln N}{\mathrm{d}\ \ln W}=-1=\frac{W(\mathrm{d}N/\mathrm{d}W)}{N} \tag{28}$$

Substituting Equations 22, 26 and 28 in Equation 21 gives

$$\frac{\mathrm{d}^2\pi}{\mathrm{d}W^2}=\alpha\frac{(\delta-1)PY^*}{(W^*)^2} \tag{29}$$

Substituting Equation 29 into Equation 16 gives the proportional profit loss incurred in deviating from the efficiency wage:

$$\frac{\Delta\pi}{\pi(\omega^*)}=-\left[\frac{\alpha(\delta-1)}{2(1-\alpha)}\right]\left(\frac{\Delta W}{W^*}\right)^2 \tag{30}$$

where we have used the fact (see Equation 8) that $\pi(W^*)=PY^*-W^*N^*=PY^*(1-\alpha)$. With Equation 14, the wage-deviation term in Equation 30 can be eliminated if one wants an expression for profit loss in terms of α, γ and δ instead of in terms of α, δ and a wage deviation.

IV. An Illustration: Estimates for the UK, USA, and India

In this section, Equations 14 and 30 are used to estimate the profit loss arising from deviations from the efficiency wage in each of the three countries for which a direct test of the first-order conditions is available. Using data for the UK, the USA and India respectively, Wadhwani and Wall (1991), Levine (1992) and Bhalotra (1995), estimate versions of the production function:

$$\ln Y_{it}=\alpha\ln N_{it}+\beta\ln K_{it}+\theta\ln H_{it}+\varphi\ln S_{it}+\gamma\ln W_{it}+\tau_t+(a_i+\varepsilon_{it}) \tag{31}$$

where subscripts i and t denote the manufacturing unit and year of observation. The τ_t are time dummies denoting aggregate productivity growth; Y is a measure of value added, N is employment, K is capital stock, H is an index of utilization, S represents skill, W is the relative wage, a_i are unobserved time-invariant efficiency effects, and ε_{it} denotes i.i.d. productivity shocks. As is clear from Equation (9), γ is a function of the wage level. To allow for this, the Indian study includes a quadratic in the log wage, though the squared term turns out to be insignificant. The other studies do not allow this. However, one is not primarily concerned here with the correctness of the published studies as the purpose is only to illustrate the nature of the calculations. For the same reason, the institutional backgrounds in the three countries are not discussed.

Relevant specifics of the three studies are presented in Table 1. The US study expresses all variables as growth rates and estimates the equation by OLS. The UK and Indian studies both use the GMM estimator of Arellano and Bond (1991). The Indian study presents estimates for a range of alternative estimators including 1-step and 2-step GMM. The 2-step GMM estimates for India are reported here for comparability with the UK estimates but the 1-step estimates are also reported as they are likely to be more reliable (also see Bhalotra 1998).[5]

Recall that the efficiency wage model predicts $\alpha=\gamma$. Estimates of Equation 31 reject this equality for the UK but not for the USA. For India, the preferred estimator (1-step GMM) cannot reject equality but an alternative estimator (2-step GMM) rejects equality at the 1% level. In both Britain and India, the point estimates $\alpha>\gamma$, and this is consistent with bargaining resulting in a wage greater than the efficiency wage, though the difference in the point estimates is much larger and more significant in Britain. If indeed union bargaining is overlaid on the efficiency wage environment in Britain and India, how much of a wage premium does unionization extract over and above what the firm would like to offer? The figures in Table 2 illuminate this question. The point estimates for the USA indicate that companies pay less than the efficiency wage, though not significantly less. As they are optimizing, the question of near rationality does not strictly arise. Calculations based upon the point

[4] Recall that a given percentage increase in employment has the same effect on costs (the wagebill) as the same percentage increase in the wage so that, at the efficiency wage, the output produced by marginal changes in employment and the wage is equal (Section III).

[5] Investigations by Arellano and Bond indicate that the two-step estimates are associated with spuriously small standard errors in finite samples but the UK study reports only the two-step GMM estimates. In principle, therefore, the statistical rejection of $\alpha=\gamma$ that the UK study finds may be reversed using the one-step estimates. In practice, the absolute difference for the UK of $\alpha-\gamma=0.65-0.39$ is large enough that this is unlikely. Indeed, the results in Table 2 indicate that the size of this difference implies very large deviations from optimal wages and profits.

Table 1. Estimates of production functions incorporating a relative wage term: UK, USA and Indian manufacturing

Country	UK	USA	India
Authors	Wadhwani & Wall (1991)	Levine (1992)	Bhalotra (1995, 1998)
α = *employment elasticity*	*0.65 (s.e. = 0.05)*	*0.27* (*n.a.*)[1]	*0.55 (s.e. = 0.03): 2-step estimates* 0.57 (s.e. = 0.08): 1-step estimates[2]
γ = *relative-wage elasticity*	*0.39 (s.e. = 0.08)*	*0.46* (*s.e. = 0.19*)	*0.44 (s.e. = 0.06): 2-step estimates* 0.50 (s.e. = 0.25): 1-step estimates
Test of H_0: $\alpha = \gamma$	*Reject equality at 1% and 5%*	*Cannot reject equality*[1]	*Reject equality at 1%, not 5% (2-step)* Cannot reject equality (1-step)
Sample	219 manufacturing companies	369 businesses drawn from 250 large manufacturing companies.	18 industries disaggregated by location in 15 states: 270 manufacturing units in the cross-section.
Sample period	1972–82, annual	1970–1985, annual. Panel not exploited.	1979–87, annual
Estimation method	2-step GMM with company and time fixed effects.	OLS, variables expressed as changes over 3-year periods. No fixed effects.	2-step GMM with fixed effects for time and for each industry-state unit.
Instrumental variables	Deep lags of regressors, cash ratio, profits.	None	Deep lags of regressors, industry price index, index of cost of living which is heavily weighted by agricultural prices.
Measure of relative wage	Company wage relative to industry wage weighted by the probability of employment and adjusted for unemployment benefits.	Manager's subjective assessment of average hourly compensation relative to three largest competitors, controlling for occupation.	Wage in industry-state unit relative to state-average of manufacturing wages. There are no unemployment benefits in India.
Dependent variable	Real sales	Real sales	Real value added

Notes: The authors make attempts to control for skill and rent-sharing effects on wages. For details, see the papers.

[1] Levine compares the estimated wage elasticity of 0.46 with the share of labour in manufacturing sales (0.27) rather than with an estimated employment elasticity (not clear why). We therefore do not have a standard error on 0.27. Levine states that the productivity effects of an equal-cost increase in employment and wages are statistically not significantly different but does not state a significance level.

[2] The 2-step estimates from Bhalotra are highlighted for comparability with Wadhwani and Wall who report 2-step estimates. However, the 1-step GMM estimates from Bhalotra are also presented because simulations conducted by Arellano and Bond (1991) indicate that the standard errors of the 2-step estimates are spuriously small in finite samples.

My handmade *t*-test for WW (ignoring cov(AB)) is 2.76 which rejects at 1 and 5%. The formula is A − B/s.e.(A − B) where s.e.(A − B) = sqrt(varA + varB).

Table 2. Estimated profit loss for hypothetical and estimated deviations of the wage from the efficient wage

	$\delta = 0.1$		$\delta = 0.5$	
	Wage deviation	Profit loss	Wage deviation	Profit loss
Panel 1: Hypothetical wage deviations				
UK	0.05	0.0021	0.05	0.0012
	0.10	0.0083	0.10	0.0047
USA	0.05	0.00042	0.05	0.00023
	0.10	0.0017	0.10	0.00093
India (2-step)[1]	0.05	0.0014	0.05	0.00077
	0.10	0.0055	0.10	0.0031
India (1-step)[1]	0.05	0.0015	0.05	0.00083
	0.10	0.0060	0.10	0.0033
Panel 2: Estimated wage deviations				
UK	0.80	0.53	4.0	7.43
USA	0.44	0.030	0.59	0.032
India (2-step)[1]	0.29	0.046	0.67	0.14
India (1-step)[1]	0.16	0.015	0.32	0.035

Notes: Hypothetical wage deviations of 5% and 10% are arbitrarily specified. The estimated wage deviations are computed using equation (14) in the text and the estimates of α and γ in Table 1. Profit loss calculations use equation (30) in the text.
[1] Bhalotra (1995, 1998) reports both 1-step and 2-step GMM estimates (see Section 4 of the text).

estimates are nevertheless presented so as to allow the reader to compare the profit losses in a case where the statistical test cannot reject optimality with a case in which it can.

Both Equations 14 and 30 depend upon the curvature of the effort-wage function. one does not know δ but it is known that $0 < \delta < 1$.[6] In addition, Equation 14 implies the range, $0 < \delta < (\gamma/\alpha)$.[7] The wage and profit deviations can therefore be calibrated for δ in the range $0 < \delta < \min(1, \gamma/\alpha)$ While this is not as convenient as knowing δ, theoretical restrictions place it in a fairly narrow range. In his investigation of the utility loss incurred by deviating from an optimal consumption rule, Cochrane (1989) similarly needs to assign a value to the relative risk aversion parameter. He selects the (rather larger) range 1 to 10, and occasionally 30. This is based not on a theoretical restriction on the parameter as in the present study, but on the range of estimates of it obtained by other authors.

Two exercises are conducted. First, only equation 30 is used and the profit loss compute for hypothetical wage deviations of 5% and 10%. It is expected that the profit loss will be increasing in α, decreasing in δ and independent of γ. Equation 14 is then used, which allows one to estimate the wage deviation implied by the data and plug this into Equation 30. Now the profit loss is increasing in $|\alpha - \gamma|$ and increasing in δ (via the wage deviation). The results are shown in Table 2.

Consider the first panel, showing hypothetical wage deviations for given values of δ. As expected, profit loss is increasing in α. It is therefore larger in the UK than in India. In both cases, the losses are small: the profit function is indeed very flat in the neighbourhood of the optimum. For instance, for $\delta = 0.1$, a 5% deviation in the wage from its optimal value results in profit losses that range between 0.2% in the UK and 0.14% in India. Consistent with a statistical test being unable to reject optimality, the corresponding profit loss in the USA is 0.04%. For larger values of δ, the losses are even smaller. *Intuitively, the larger is δ the greater is the effort-return to increasing the wage, and this mitigates the profit lost from paying too much.*

The estimated wage deviations in the second panel of Table 2 depend upon the estimated divergence between α and γ for a given δ. They are strikingly large in each case, being smaller in India than in the UK.[8] Since the UK has the biggest α (and so big numbers in Panel 1) and also the biggest difference between α and γ (and so even bigger numbers in

[6] This is a strict inequality. If $\delta = 0$ then effort is not wage dependent. If $\delta = 1$ then the effort-wage relation is linear but the more plausible situation is that there are decreasing effort returns to increasing the wage.
[7] Suppose $1 > \delta > (\gamma/\alpha)$, which implies that $\alpha > \gamma$. Simple rearrangement shows that $(\alpha - \gamma)/(\gamma - \alpha\delta) < (-1)$ which, by Equation 14, implies $\Delta W/W^* < (-1)$. But this implies $W < 0$, which is absurd.
[8] In fact, the divergence $|\alpha - \gamma|$ is even smaller in India than in the USA. As discussed, the fact that the US study does not reject optimality while the preferred estimates of the Indian study do may be put down to the latter, using the correct IV estimator. This strengthens the case for complementing a statistical test of the first-order conditions with an estimate of the economic implications of small deviations suggested by the second order calculations.

Panel 2), the profit losses implied by the UK data are so large that they are produced only for illustrative purposes: the Taylor series approximations used to derive Equations 30 are not valid for such large changes. However, for present purposes, all that matters is that they are so large that they are not consistent with near rational behaviour. This is an interesting result in itself and it suggests an important modification to the interpretation of the Wadhwani and Wall (1991) paper. While Wadhwani and Wall reject the pure efficiency wage condition and acknowledge that union activity is likely to have pushed wages beyond the efficiency wage, they emphasize that a significant positive coefficient on the relative wage (i.e., a significant γ) supports the efficiency wage model. The analysis presented here emphasizes the *quantitative* importance of union activity or other factors that push wages above the efficient level in the UK.

Consider the other two country cases presented in Panel 2. The wage deviation implied by the US estimates is large but it translates in to profit losses of the order of 3%, which may be deemed tolerable. In the case of India, the two-step GMM estimates imply profit losses that range between 4.6% and 14% (as δ ranges between 0.1 and 0.5) but the one-step estimates imply losses of 1.5% to 3.5%, similar to the case of the USA. Notice that the estimated *wage deviation is increasing in* δ and that this effect dominates the effect seen in Panel 1, as a result of which the profit losses in the second panel of Table 2 are increasing in δ.

Although none of the three countries for which estimates of Equation 31 are available quite fits this pattern, it is conceivable that, for some other sample of data, the pure efficiency wage condition, $\alpha = \gamma$, is rejected but the associated profit losses are very small. This is likely if, for example, α is relatively small, the divergence between α and γ is large, and their standard errors of estimate are small. In this situation, the analysis suggested in this study would importantly modify the statistical conclusion by identifying near rational firms in which the offered wage almost pays for itself.

V. Conclusions

This study argues that it is interesting to study near rational behaviour in the context of an efficiency wage model because, with effort being a positive function of the wage, the profit-wage function may be expected to be flatter than otherwise. Deviations from the exact optimum may arise because of heuristic decision making, mistakes, transactions costs, and also, possibly, on account of firms finding that it does not cost too much to indulge union wage demands. An expression for the wage deviation is derived and the associated profit loss that permit these quantities to be calculated using estimates of parameters of a wage-augmented production function. The force of the argument is illustrated by performing these calculations using UK, US and Indian data. Using hypothetical wage deviations one finds, as expected, that the profit function is remarkably flat in all three countries. A statistical test is unable to reject the hypothesis that employers in the USA pay the efficient wage. In Indian and British manufacturing, however, wages are higher than the efficient wage. This is consistent with the coexistence of wage bargaining and efficiency wage considerations. The calculations suggest a considerable difference in what this costs employers in the two countries. Profits in the UK are substantially lower than would be expected in a pure efficiency wage model – the wages paid in the UK do not pay for themselves. The profit lost in paying a wage above the efficient wage in India is small by contrast. This is useful information with which to complement the standard statistical metric applied to testing the predictions of economic models.

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