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Bargaining, Job-Satisfaction, and Taxation
in a Simple GE Model**

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September 2005

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ABSTRACT

Value of Work: Bargaining, Job-Satisfaction, and Taxation in a Simple GE Model

Job-satisfaction as a component of workers' utility has been strangely neglected, with work usually regarded as reducing utility and the benefits of leisure. This is contradicted by many empirical studies showing that unemployment is a major cause of unhappiness, even when income is controlled for. Here we develop a simple model where job-satisfaction is non-contractible but can be included in extended collective bargaining when workers participate in management, but employment is still chosen to maximise profit. Including taxation to fund unemployment benefits and public goods, we show that switching from traditional bargaining over wages to extended (but still second-best) bargaining can generate a Pareto welfare improvement.

JEL Classification: J28, J52, J65

Keywords: job-satisfaction, bargaining, unemployment

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1. Introduction

In spite of early contributions by Borjas (1979), Freeman (1979) and Hamermesh (1977), the inclusion of job-satisfaction as a component of worker utility has been strangely neglected. This is all the more remarkable as most people spend much of their lives at work. In her comprehensive text on unions and collective bargaining, Booth (1994) mentions job-satisfaction once, but does not offer any discussion or attempt to include the concept in models of bargaining. The comprehensive, advanced labour text by Cahuc and Zylberberg (2004) does not include job-satisfaction in the index.

On the other hand, growing interest in economic and other determinants of happiness in general over the past decade, that is surveyed by Frey and Stutzer (2001) and Layard (2005), has encouraged some empirical studies that focus on job-satisfaction, including early contributions by Clark (1997) and Clark and Oswald (1996), and a recent cross-country study and survey of the literature by Diaz-Seranno and Cabral Vieira (2005). Work and job-satisfaction are often found to be important determinants of happiness, together with family and other relationships, while (relative) income in cross-section studies has a significant but smaller influence on well-being, most particularly for individuals below the poverty level. The most famous and frequently replicated finding in this area, going back to Easterlin's (1974) pioneering study, is that average happiness levels have not increased in wealthy economies with half a century of real income growth

None of this work has had much influence yet on the standard utility functions used by almost all economists. In addition to the income or consumption that is usually the only variable with a positive effect, 'effort' or working time is often included and invariably assumed to have a negative direct influence on welfare, (as opposed to the positive relationship between 'effort' and income). It follows that an unemployed person with the same income as when employed should enjoy greater utility from zero effort and additional leisure. This does obviously not capture the well-documented, devastating effects of job-loss on welfare.

Many jobs, particularly the unskilled, do seem to offer very little intrinsic satisfaction. Layard (2005) reviews a study of working women in Texas who evaluate their daily activities and report the second lowest satisfaction or happiness scores for their main activity – work, only marginally better than the worst activity, commuting. On the other hand, skilled jobs with autonomy and responsibility provide high levels of satisfaction even with long hours. On average, job-loss and involuntary unemployment, even when controlling for income, is a major cause of unhappiness, comparable to divorce or close family bereavement (Winkelmann and Winkelmann, 1998). Interestingly, these authors find that older, inactive individuals suffered no loss of happiness, though in their German panel, where (in contrast to Britain), this group consists mainly of early retirees on very generous pensions. The asymmetric psychological effect of losses, particularly job-loss, on well-being, is clearly difficult to capture in a simple static model.

Here we develop a simple, but fairly general theory of job-satisfaction in a collective bargaining framework. Unemployment benefits provide the minimum level of utility, which is assumed to be too high for full employment. Ignoring efficiency wage considerations for simplicity, a perfectly competitive, unregulated labour market will pay a wage that is higher than benefits to compensate for the disutility of the worst kind of jobs and give workers the same utility as in unemployment. Wage bargaining then allows unions to obtain higher wages and a share of firm rents, with subsequent profit-maximising employment under the employer's usual 'right to manage'.

To extend this standard model, we introduce a trade-off between productivity and job-satisfaction that depends on the firm's choice of work organisation, effort, working time and other amenities. Since these choices are multidimensional, and since their precise effect on worker satisfaction is difficult or impossible to measure objectively, we assume that the trade-off – essentially the firm's choice of job-satisfaction offered – is *non-contractible*. Then it follows that initial bargaining over job-satisfaction (as well as wages) is pointless because it is unenforceable, and employers will always end up choosing the minimum or least-cost level of job-satisfaction

permitted under existing government regulation of the more ‘observable’ components such as health and safety or working time¹.

Our second departure from the traditional bargaining model is to recognise that there may after all be a feasible route to exploiting possible efficiency gains from the trade-off between satisfaction and productivity, gains that are precluded by the corner solution just outlined. The alternative is actually the well-trying direct involvement or participation of employees in management of the firm, though this is usually seen as a strategy to increase motivation and productivity rather than satisfaction. However it seems plausible that workers or their representatives are best placed to monitor their own satisfaction in the ongoing work process, and could thus enforce a bargain that included work organisation if they were given appropriate formal rights for participation in managerial decision making.

The obvious precedent for legally mandated worker participation in both establishment- and board-level management is the German system of co-determination. This system is formally quite distinct from collective bargaining over wages and working time but does give employee representatives considerable influence over personnel decisions and working conditions. The negative consequences predicted by employer organisations and some economists have not been observed, and some benefits can be identified². Our highly stylised model here, however, will not attempt to capture institutional details of co-determination.

Instead, we shall simply assume an ‘*extended bargaining*’ alternative to traditional, arm’s length wage bargaining, in which a simultaneous agreement on job-satisfaction and wages is reached, depending on relative union bargaining power, and then enforced by appropriate institutionalised participation. In at least rough correspondence with co-determination, we allow the firm to choose profit-maximising employment, rather than adopting fully efficient bargaining. This means that we remain in a ‘second best’ situation where the welfare effects of switching to our

¹ Of course in practice, bargaining often does extend to such contractible components of satisfaction or working conditions, but without attempting to encompass the more inclusive general notion.

² FitzRoy and Kraft (2005) provide evidence on productivity gains from extending the power of employee representation on supervisory boards of large firms, while Addison (2005) surveys the much more extensive research on establishment-level works-councils.

extended bargaining are not *a priori* obvious. More importantly, perhaps, an interesting discussion of the efficiency of employment decisions by the firm requires some realistic uncertainty and other complications that are omitted for the sake of tractability in our initial approach.

We do include taxation to fund unemployment benefits and a public good in a simple general equilibrium framework. It is important to distinguish between conventional relative union power in the Nash bargaining objective, and the role of extended bargaining with participation. In fact, our main result is that even when union power is low, a switch to extended bargaining can generate a Pareto improvement with a finite increase in job-satisfaction and a lower wage if the trade-off with productivity is favourable. The compensating wage reduction then generates higher profit and employment. It is also possible that extending the scope of bargaining with worker participation in management will increase the bargaining power of employees in all dimensions, which Gorton and Schmid (2004) argue has been the case with co-determination. However the subjective and unobservable nature of job-satisfaction does raise serious problems of implementation in practice, and in any model with realistic uncertainty. Innovative employers and entrepreneurs have initiated many examples of employee participation with high performance work organisation, but contrasting examples also abound, and employers have always opposed co-determination laws. These are all important issues of corporate governance that go far beyond the scope of our simple model here.

Even under extended bargaining some traditional results remain. An increase in labour's relative power always reduces profit while raising workers' utility. Our model also reproduces the familiar distributional conflict— whatever the degree of union power, full employment can be attained when benefits are low enough. However we also have the surprising result that if job-satisfaction is initially high enough, then after extended bargaining a tax reduction will not only raise employment but also supply of public goods.

The plan of the paper is to introduce a simple model of homogeneous workers and firms in section 2, followed by the standard wage bargaining model in section 3. In section 4, we motivate

extended bargaining to include job-satisfaction, and show how this changes the usual results. Examples are developed in section 5, and the public sector is introduced in section 6, where our main Pareto-improvement result is shown. Section 7 demonstrates the role of tax policy in relation to job-satisfaction, and conclusions are summarised in the final section 8.

2. Workers and Firms

The usual, rather minimalist, economic approach to job-satisfaction (when piece rates or time rates are infeasible) is to assume that workers have some simple utility function of work such as $V = w - e$ or $V = w(1 - e)$ where w is the wage or salary and e is effort, perhaps hours worked or disutility of work, per calendar time period. Then with unemployment benefits B , utility when unemployed is $V = B$, which may be higher than the utility of work if benefits are not too much smaller than wage income. This is often regarded as a disincentive to seeking work, though the duration of benefits seems to be the most important factor.

Here we want to focus on the positive value of work, and recognise that both productivity and job-satisfaction can often be increased by appropriate organisation and management of human resources. To concentrate on the trade-off between these two components of output, we assume that work organisation is efficient, in the sense that no more Pareto gains in material output and satisfaction per worker can be attained. Thus let $V(w, x)$ be the utility or value of work at wage w , where x is measure of loss of output or generalised ‘expenditure’ on increasing value of work. Choose a separable, concave, increasing form for simplicity:

$$V = wv(x)P(G)$$

where $P(G) > 1$ represents the utility from public goods produced by government expenditure G . As we show below, when workers have no bargaining power in a competitive labour market, firms will choose zero non-contractible expenditure on value of work, so we need $v(0)$ to be positive. We also argue that this initial value is determined by government regulation of the labour market, with an unregulated market providing the worst working conditions. These points will be developed and

illustrated in the examples below. Next we assume that an unemployed worker receiving benefits B has a different utility function, for simplicity just

$$U(B) = BP(G)$$

The firm's production or revenue function with constant output price is assumed to be of constant elasticity, with capital and entrepreneurial inputs fixed in our static approach, and decreasing returns to labour:

$$F(x, L) = (1 - x)^\lambda L^\lambda$$

where L is the labour force employed and $\lambda < 1$. This functional form is chosen for simplicity, and defines maximum output attainable with a given value of utility and our proxy for job-satisfaction, x , (which is essentially the share of labour input diverted to raising satisfaction). Profit in competitive product markets with a unit price is

$$\pi = (1 - x)^\lambda L^\lambda - (1 + T)wL$$

where T is a payroll tax. The FOC condition for profit-maximising gives optimal employment as

$$1) \quad \hat{L} = \left\{ \frac{\lambda(1-x)^\lambda}{\tau w} \right\}^{\frac{1}{1-\lambda}}$$

where the tax term is $\tau = 1 + T$.

3. Collective Bargaining

As noted above, we assume bargaining under the employer's 'right-to-manage', so bargainers know that optimal employment will subsequently be chosen as a function of the agreed wage. We also argued that the value-of-work variable or index, x , is non-contractible, so after the wage bargain and employment decisions, the firm will always choose profit-maximising $x = 0$, (subject to the participation constraint that worker utility remains above the unemployment level, since we not consider mobility between firms in our static model). This is then essentially a minimal value defined by regulation that puts a floor under the factors that raise productivity at the expense of satisfaction, and this decision is anticipated by both parties.

To set up the standard Nash bargaining maximand, we assume firm level bargaining. If L is the fraction of the available, homogenous, (firm-specific) labour force employed, which is normalised to unity, a worker's expected utility from a wage bargain and any given value of x , under 'right-to-manage' employment is

$$EV = \hat{L}(v(x)wP) + (1 - \hat{L})(BP)$$

and the surplus is

$$L(vw - B)P$$

If employee or union relative bargaining power is β , then the utilitarian Nash maximand is

$$2) \quad N = \hat{L}^\beta (vw - B)^\beta \hat{\pi}^{1-\beta}$$

where we now ignore the constant public goods term, which does not affect the following results due to separability, and maximised profit with optimal employment in the Nash maximand is

$$3) \quad \hat{\pi} \equiv (1-x)^\lambda \hat{L}^\lambda - \tau w \hat{L} = c \left(\frac{1-x}{\tau w} \right)^{\frac{\lambda}{1-\lambda}}$$

and c is a constant. Substituting (1) and (3) into (2) and differentiating logarithmically we get the FOC for the optimal wage, say \hat{w} :

$$4) \quad \frac{\beta(1-\lambda)v}{v\hat{w} - B} = \frac{\lambda + \beta(1-\lambda)}{\hat{w}}$$

so rearranging we get the optimal wage for any choice of x as

$$5.1) \quad \hat{w} = \frac{\gamma B}{\lambda v(x)} = mB$$

where $m \equiv \gamma / \lambda v(x)$ is the 'mark-up' and union power will now be measured for convenience by

$$5.2) \quad \gamma(\beta) \equiv \lambda + \beta(1-\lambda)$$

Utility under the wage bargain is then the usual mark-up of unemployed utility, with equality when union power is zero, so $\gamma(0) = \lambda$ and the value of work in general is

$$5.3) \quad \hat{V} \equiv v(x)\hat{w} = \frac{\gamma}{\lambda} B$$

Clearly, with no union bargaining power there is no employment rent, and the labour market is perfectly competitive, with utility determined by benefits, and the wage inversely related to the initial value, $v(0)$, which in turn depends on government regulation of the labour market.

4. Bargaining Scope and Employee Participation

While bargaining over any non-contractible variable such as x is regarded as infeasible under traditional arm's length bargaining prior to the production process, this situation changes when employees or their representatives participate in the management of the firm, as in German co-determination. Informational asymmetries are thus reduced, and workers are well placed to monitor the organizational variables that define x , so bargaining could then include this important determinant of utility. Thus we proceed to extend the *scope* of bargaining, while treating union power as predetermined. This dichotomy is of course extreme; in practice we expect to find some bargaining over work organisation, or aspects of x , even without participation in management, but perhaps with less union bargaining power than in wage negotiation.

In our simplified approach we can derive from (2) a second FOC for optimal x ,

$$6) \quad \frac{\lambda}{1-x} = \frac{\beta(1-\lambda)v'(x)w}{v(x)w-B}$$

Eliminating w from (4) and (6) we obtain the defining equation for the bargain 'expenditure' on job-satisfaction, say $x^*(\gamma)$, as a function of union power:

$$7) \quad \gamma(1-x^*)v'(x^*) = \lambda v(x^*)$$

Then as expected, the bargain 'expenditure' is an increasing function of union power, as follows.

Differentiate (7) logarithmically and, by concavity of the value, find that the derivative of $x^*(\gamma)$ is positive:

$$8) \quad \frac{d\gamma}{\gamma} = \left\{ \frac{1}{1-x^*} + \frac{v'(x^*)}{v(x^*)} - \frac{v''(x^*)}{v'(x^*)} \right\} dx^* > 0$$

Under extended bargaining, we can also define the equilibrium wage and profit as functions of bargaining power as follows:

$$5^*) \quad w^*(\gamma) \equiv \hat{w}(x^*(\gamma)) = \frac{\gamma B}{\lambda v(x^*(\gamma))} \equiv m^* B$$

$$\pi^*(\gamma) \equiv c \left\{ \frac{\lambda v(x^*(\gamma))(1-x^*(\gamma))}{\gamma \tau B} \right\}^{\frac{\lambda}{1-\lambda}}$$

Again as expected, the wage under extended bargaining is also an increasing function of worker power:

$$\frac{dw^*}{w^*} = \frac{d\gamma}{\gamma} - \frac{v' dx^*}{v(x^*)} > 0$$

by substituting from (8). It follows that the mark-up increases and profit decreases with increased worker power.

Our first key result on extending the scope of bargaining can now be stated as

Proposition 1: Expanding the scope of bargaining to include the value of work while holding bargaining power and the tax rate constant, and with positive unemployment, will raise employment under employers' 'right-to-manage'.

Proof: Go back to equation (1) for labour demand by the firm, and from this define the firm's optimal employment *at the wage bargain* for any value of x :

$$\tilde{L} \equiv \left\{ \frac{\lambda(1-x)^\lambda}{\tau \hat{w}} \right\}^{\frac{1}{1-\lambda}} = \left\{ \frac{\lambda^2 v(x)(1-x)^\lambda}{\gamma \tau B} \right\}^{\frac{1}{1-\lambda}}$$

(of course, under the 'right-to-manage', employment is excluded from bargaining, in contrast to 'efficient bargaining' models which include wages and employment). We assume that taxes and benefits are chosen such that employment is less than one, so there is positive unemployment, conditions that are formalised in the next section. Differentiating logarithmically yields

$$(1-\lambda)\frac{d\tilde{L}}{\tilde{L}} = \left(\frac{v'(x)}{v(x)} - \frac{\lambda}{1-x} \right) dx$$

9)

for all x , so for the bargain x^* and using (7) we find

$$(1-\lambda)\frac{d\tilde{L}}{\tilde{L}} \Big|_{x=x^*} = \left(\frac{\lambda}{\gamma(1-x^*)} - \frac{\lambda}{1-x^*} \right) dx$$

which is clearly positive for $\gamma < 1 \Leftrightarrow \beta < 1$. Now the RHS of (9) is clearly a decreasing function by concavity of v , so for $x < x^*$ the derivative remains positive and hence employment remains an increasing function of x . Thus \tilde{L} increases for all $x \in [0, x^*(\gamma)]$, as claimed.

Next we can extend this result to the firm's profit as well as employment, for which we need an additional assumption that will be motivated in the example below:

Proposition 2: Assume that $0 < x^(\lambda)$. Then extending the scope of bargaining to include the value of work while holding bargaining power and the tax rate constant will not only raise optimal employment, and worker utility (provided that bargaining power is non-zero³), but also increase profit, provided that employee bargaining power is not 'too high'.*

Proof: First we define optimal profit at the wage bargain (as in the previous Proposition) from (3) as

$$\tilde{\pi} \equiv c \left(\frac{\lambda v(x)(1-x)}{\gamma \tau B} \right)^{\frac{\lambda}{1-\lambda}}$$

and differentiate to obtain

$$\frac{d\tilde{\pi}}{\tilde{\pi}} = \frac{1}{1-\lambda} \left(\frac{v'(x)}{v(x)} - \frac{1}{1-x} \right) dx$$

³ Expected worker utility does not vary with x when employees have zero bargaining power from (5.3), because then $\hat{V} = B$.

Then from (7) it follows that $d\tilde{\pi} = 0$ is solved by $x = x^*(\lambda)$, and because the derivative of profit is again a decreasing function of x , it follows that $d\tilde{\pi}$ must be positive for $x \in [0, x^*(\lambda))$. Thus optimal profit is a concave function that increases up to a unique maximum and then declines. It follows by continuity that either there is some $\bar{x} \in (x^*(\lambda), 1)$ such that $\tilde{\pi}(0) = \tilde{\pi}(\bar{x})$, or if there is no such x , then $\tilde{\pi}(0) \leq \tilde{\pi}(1)$. Thus we can define a level of bargaining power, $\bar{\gamma}$, by the equation $x^*(\bar{\gamma}) = \bar{x}$ in the first case, and by $\bar{\gamma} = 1$ in the second case. Thus if, and only if, bargaining power γ is not ‘too high’, in the sense that $\gamma < \bar{\gamma}$, (in our first case above), then we have established the Proposition.

5. A Specific Functional Form, and Some Numerical Examples

The assumption in the last proposition may seem contrived, but we shall now present an example to show that it is, in fact, quite natural. First, to get some idea of the behaviour of the value function as worker power goes to zero, with $\beta = 0 \Leftrightarrow \gamma = \lambda$, consider a constant elasticity example, say

$$v(x) \equiv \xi(x_0 + x)^\alpha$$

with $0 < \alpha < 1$. The positive constant x_0 may be interpreted as the minimum contribution to job-satisfaction that has to be provided under government regulation, (though this is not made explicit in the production function), and ξ is a scaling factor that does not affect the equilibrium expenditure derived next. However both these constants do shift the value function and determine the initial value as noted above, and so may be interpreted as the result of labour market regulation of working time, safety and all other issues relevant for worker satisfaction. It can easily be verified that increasing the value function by regulation that raises the scaling factor increases both employment and profit, though costs of regulation are beyond the present model. Thus we do not attempt any analysis of regulation, but simply compare differing examples and parameters in the value function with this interpretation in mind. From (7) we get

$$\begin{aligned}\alpha\gamma(1-x^*) &= \lambda(x_0 + x^*) \\ \Rightarrow x^*(\gamma) &= \frac{\alpha\gamma - \lambda x_0}{\alpha\gamma + \lambda} \\ \Rightarrow x^*(\lambda) &= \frac{\alpha - x_0}{\alpha + 1}\end{aligned}$$

Thus provided the condition $\alpha > x_0$ holds, it follows that as bargaining power tends to zero, the extended bargain expenditure tends to $x^*(\lambda) > 0$. This does imply a discontinuity because without extended bargaining, we have argued that employers choose *ex post* profit-maximising, zero ‘expenditure’ on non-contractible value, or $x = 0$, whatever the degree of bargaining power in wage negotiation.

The Pareto improvement from extending bargaining according to Proposition 2 could suggest that bargaining power might not be needed for the shift, but this then leaves open the question of how to prevent employers from renegeing on the ‘bargain’ when workers have no power, and thus reducing their utility below the benefit level. If workers could quit and immediately obtain benefits (if not alternative employment) in this case, then the employer would indeed be constrained from renegeing, but this is doubtful under any realistic extension of the model to restricted eligibility for benefits and other ‘frictions’ such as search costs. Going back to the non-contractibility of ‘expenditure’ on job-satisfaction, workers without bargaining and monitoring power who accepted lower wages in return for the promise of better jobs would be vulnerable to cumulative exploitation without legal recourse. It thus seems appropriate to assume that the competitive wage and zero ‘expenditure’ prevail when bargaining power is zero, and $x^*(\lambda)$ is just the mathematical limit of ‘expenditure’ as bargaining power tends to zero, that is unlikely to be actually observed. Put differently, in practice we would expect to see extended bargaining only in the presence of some positive level of bargaining power, although due to Pareto gains, a high degree of redistributive power should not be necessary.

There is still a question of why employers would not introduce sufficient worker participation to allow the realisation of potential Pareto gains, when labour is weak, or unions are

uninterested in extended bargaining, as in the Anglo-American tradition. A convincing answer must go beyond the simple model developed here to include the internal organisation of the firm, and start from the traditional resistance of management to any erosion of their ‘residual power’ and autonomy through employee participation⁴.

In the case of zero bargaining power and under the above condition $\alpha > x_0$, the value of work with zero ‘expenditure’ can be less than unity, so $v(0) = \xi x_0^\alpha < 1$, provided the scaling factor is not ‘too large’, and thus without extended bargaining, and with zero wage-bargaining power, the competitive wage is given by:

$$\hat{w}(0) = \frac{B}{v(0)} > B.$$

This is consistent with the evidence on ‘competitive’ wages (typically for unskilled workers). If workers are *without* significant bargaining power (and extended bargaining does not take place), the worst kind of working conditions are usually on offer. Under zero wage-bargaining power, there is no utility surplus, and the wage is just sufficient (in itself, yielding utility that exceeds the alternative utility from unemployment benefit) to compensate for loss of leisure and disutility of exploitative work. These points are illustrated in the following

Numerical example 1: $\alpha = 0.4$, $x_0 = 0.3$, $\xi = 1.5$, $\lambda = \gamma = 0.6$, $\tau = 1.3$, $B = 0.46$.

When workers have zero bargaining power, so that $\lambda = \gamma$, the firm cannot set the wage below $\hat{w}(0)$, which in this case is 0.4964, since under the above interpretation, workers would simply choose to be unemployed if lower wages were offered. Note also that $v(0) = 0.9267$ and $0.4964 > 0.46$, where $E\hat{V} = 0.46 = B$.

Furthermore, under extended bargaining but still zero union power the (limiting) value of work becomes

$$v(x^*(\lambda)) = \xi \left\{ \frac{\alpha(1+x_0)}{\alpha+1} \right\}^\alpha$$

⁴ This resistance may be quite rational for top management (Gorton and Schmid, 2004).

The term in the curly brackets is less than one but greater than x_0 , so that provided the scaling factor satisfies the following condition,

$$\left\{ \frac{\alpha(1+x_0)}{\alpha+1} \right\}^{-\alpha} < \xi < x_0^{-\alpha}$$

we have the interesting case where the equilibrium value of work under extended bargaining is greater than unity. Thus $v(x^*(\lambda)) > 1$, so there is a positive rent or ‘surplus value’ of work, compared to the utility of leisure from unemployment, even with minimum (i.e., zero) bargaining power, which is consistent with the evidence on job-loss as a major cause of unhappiness summarized above. Then the equilibrium mark-up under extended bargaining, $m^* \equiv \gamma / \lambda v(x^*(\gamma))$, from (5*) above, is less than one when bargaining power is at its minimum, $\gamma = \lambda$, but can be greater than one if bargaining power is large enough.

Perhaps more plausibly, a smaller scaling factor would require a higher-than-minimal level of bargaining power to generate a positive surplus value of work, and also increase the mark-up. Later we present simulations for this example, but it should be emphasized that the two propositions above did not depend on any particular parameter values.. Thus the equilibrium value of work could be less than one, implying a greater value for leisure when unemployed, for some or all levels of bargaining power, though this is hardly consistent with the empirical evidence.

Next we extend the first numerical example to include positive bargaining power:

Numerical example 2: $\alpha = 0.4, x_0 = 0.3, \xi = 1.5, \lambda = 0.6, \gamma \geq 0.6, \tau = 1.3, B = 0.46$.

Here, note that ξ is within the range specified in general terms above – for the above parameter values, it works out at (1.4861, 1.6186). With zero bargaining power and extended bargaining, $x^*(\lambda) = 0.0714$ and $v(x^*(\lambda)) = 1.0093$. The equilibrium mark-up of 0.9907 rises, however, to 1.0096 if γ increases modestly to reach 0.616 – with $x^*(\gamma) = 0.0785$ and $v(x^*(\gamma)) = 1.0169$.

With $\lambda = \gamma = 0.6$, pure wage bargaining ($x = 0$) yields $\tilde{L} = 0.8336$. Under extended bargaining, \tilde{L} , evaluated at $x = x^*(\lambda)$, rises (as in Proposition 1) to 0.9235. Expected worker utility is 0.46 for both types of bargaining, but profits rise under extended bargaining from 0.3586 to 0.3648. This is in accordance with Proposition 2.

With $\lambda = 0.6$ and $\gamma = 0.616$, pure wage bargaining ($x = 0$) yields $\tilde{L} = 0.7806$. Under extended bargaining, \tilde{L} , evaluated at $x = x^*(\gamma)$, rises (as in Proposition 1) to 0.8711. Expected worker utility rises from 0.4696 to 0.4707 and profits rise from 0.3447 to 0.3506 when bargaining is extended to cover value of work. Unsurprisingly, γ is not ‘too high’ in this case – although $\gamma = 0.791$ would be, given the other parameter values. All these results are consistent with Proposition 2.

Figure 1, below, shows the appearance of the value function $v(x)$, the mark-up and the profits function in numerical example 2. Note the use of two separate vertical scales – because profits are of a lower order of magnitude than value and the mark-up. Recall that $v(x^*(\lambda))$ and $v(x^*(\gamma))$ are both just above unity, while the mark-up crosses from being less than one at $x^*(\lambda)$ to just above one under extended bargaining with some employee power. Figure 2 shows wages and employment, also for numerical example 2. It is probably unsurprising that the equilibrium under extended bargaining involves higher value of work, higher wages and lower employment when employees have some bargaining power (compared to when they have zero bargaining power).

Figure 1: Plot of $v(x)$ (upward solid), m (downward solid) and $\hat{\pi}$ (broken lines) against x for $\gamma = 0.6$ and 0.616 .

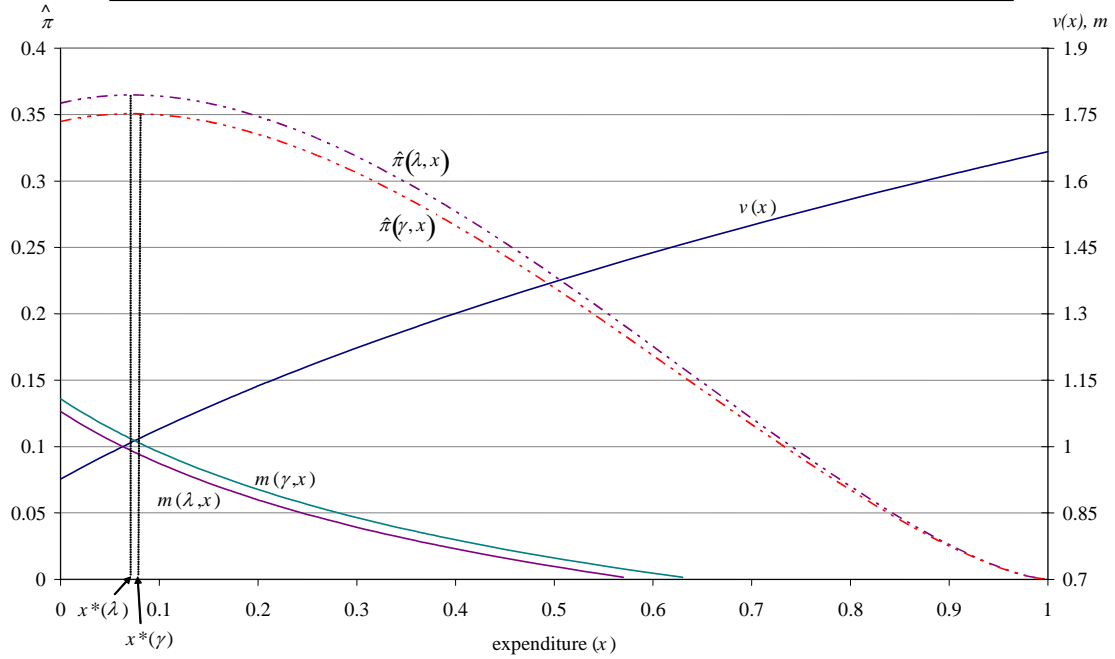
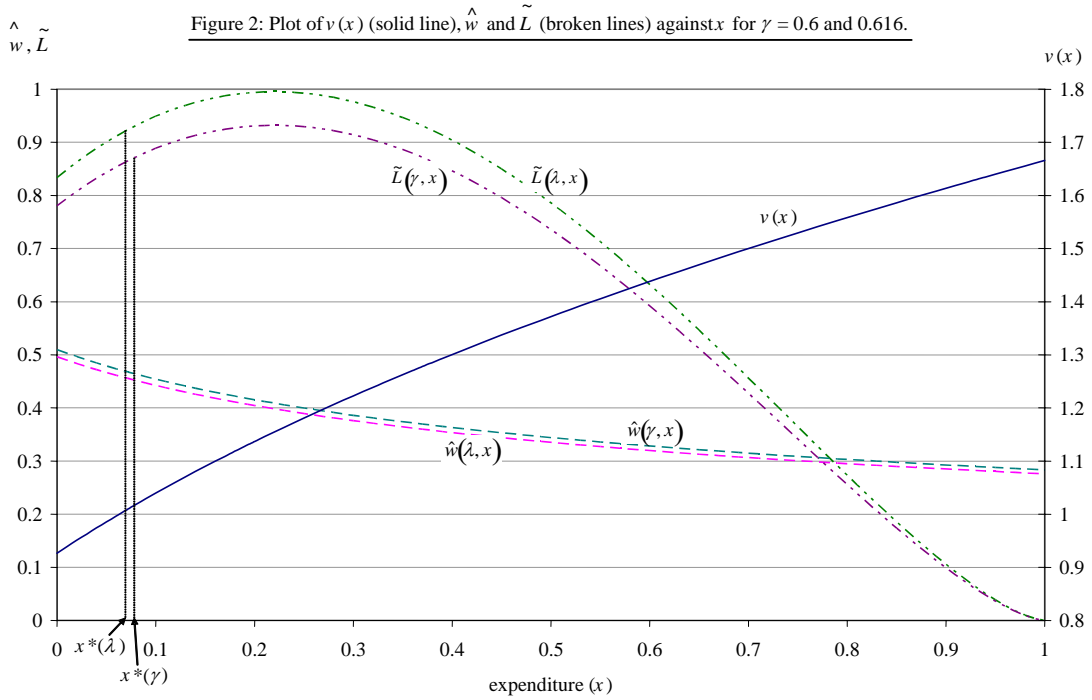


Figure 2: Plot of $v(x)$ (solid line), \hat{w} and \tilde{L} (broken lines) against x for $\gamma = 0.6$ and 0.616 .



6. Taxation and Fiscal Policy

So far, we have ignored the public sector and the government budget constraint, but with public good provision by government we cannot reach any final welfare conclusions without

integrating the public sector into our simple general equilibrium framework. Clearly when employment increases and tax rates are held constant, expenditure on unemployment benefits falls, but government surplus, G , for spending on public goods also depends on the payroll tax base, the change in which depends both on the falling equilibrium wage and the increase in employment. To explore this in more detail we now introduce the government budget in the usual way, at the wage bargain and optimal employment, for any value of x , as

$$10) \quad (\tau - 1)\hat{w}\tilde{L}N = B(1 - \tilde{L})N + \tilde{G}N$$

where N is the constant number of firms that will not play any role in the following. We require a balanced budget (no government deficit), so the surplus or residual per firm, G , remaining for expenditure on public goods after unemployment benefits have been paid, must be non-negative. In order to restrict attention to the most interesting case, we also want to ensure that there is always positive unemployment, so that

$$\tilde{L} < 1 \Leftrightarrow \lambda(1-x)^\lambda < \tau\hat{w} \equiv \tau mB$$

where m is the mark-up from (5).

After these preliminaries, we can rearrange the budget (in ‘per firm’ terms for simplicity) to give

$$11) \quad \begin{aligned} B + \tilde{G} &= ((\tau - 1)\hat{w} + B)\tilde{L} = B(1 + (\tau - 1)m) \left\{ \frac{\lambda(1-x)^\lambda}{\tau mB} \right\}^{\frac{1}{1-\lambda}} \\ &= (1 + (\tau - 1)m) \left\{ \frac{\lambda(1-x)^\lambda}{\tau mB^\lambda} \right\}^{\frac{1}{1-\lambda}} \end{aligned}$$

The condition for positive \tilde{G} can be written as $B + \tilde{G} > B$, which using (11) gives

$$\tau mB < (1 + (\tau - 1)m)^{1-\lambda} \lambda(1-x)^\lambda$$

With the positive unemployment condition derived above, $\tau mB > \lambda(1-x)^\lambda$, we obtain from these two conditions and a positive tax, a non-empty *admissible interval* for benefits, B :

$$12) \quad \lambda(1-x)^\lambda / \tau m < B < \lambda(1-x)^\lambda (1 + (\tau - 1)m)^{1-\lambda} / \tau m$$

Since we need to consider values of x from zero up to the extended bargain, it is convenient to write the end points of the admissible interval as

$$\underline{a}(\tau, x) \equiv \lambda(1-x)^\lambda / \tau m = \lambda^2(1-x)^\lambda v(x) / \gamma \tau$$

$$\bar{a}(\tau, x) \equiv \lambda(1-x)^\lambda (1+(\tau-1)m)^{1-\lambda} / \tau m = \lambda^2(1-x)^\lambda (1+(\tau-1)m)^{1-\lambda} v(x) / \gamma \tau$$

Then for any given values of bargaining power and taxes define the maximum value of the lower, (positive unemployment) bound over the range of x , between pure wage- and extended bargaining, and similarly for the minimum value of the upper bound:

$$\underline{a}^*(\gamma, \tau) \equiv \max_{x \in [0, x^*(\gamma)]} \underline{a}(\gamma, \tau, x)$$

$$\bar{a}_*(\gamma, \tau) \equiv \min_{x \in [0, x^*(\gamma)]} \bar{a}(\gamma, \tau, x)$$

Now we can finally state the required constraint on the size of benefits

$$B \in (\bar{a}_*(\gamma, \tau), \underline{a}^*(\gamma, \tau)) \equiv A$$

This constraint ensures that both government expenditure and unemployment are positive under both systems of bargaining, so that we can make consistent welfare comparisons between the two systems with their respective values of $x=0$, when bargaining is restricted to wages, and $x^*(\gamma)$ under extended bargaining.

Next consider total government revenue at the bargained wage and for any given x , say

$$\tilde{R} \equiv (\tau-1)\hat{w}\tilde{L} = \frac{(\tau-1)\gamma B}{\lambda v(x)} \left\{ \frac{\lambda^2 v(x)(1-x)^\lambda}{\gamma \tau B} \right\}^{\frac{1}{1-\lambda}} = (\tau-1) \left\{ \frac{\lambda^{1+\lambda} v^\lambda (1-x)^\lambda}{\tau (\gamma B)^\lambda} \right\}^{\frac{1}{1-\lambda}}$$

Differentiating logarithmically we obtain

$$\frac{d\tilde{R}}{\tilde{R}} = \frac{\lambda}{1-\lambda} \left\{ \frac{v'}{v} - \frac{1}{1-x} \right\} dx + \left\{ \frac{1}{\tau-1} - \frac{1}{1-\lambda} \frac{1}{\tau} \right\} d\tau$$

It follows that revenue is maximised when

$$x = x^*(\lambda), \tau = \frac{1}{\lambda} \Rightarrow \tau - 1 = \frac{1-\lambda}{\lambda}$$

Clearly $\tau > 1/\lambda$ is on the downward-sloping portion of the Laffer curve for total revenue, or an inefficient tax.

Since public goods expenditure is

$$\tilde{G} = \tilde{R} - B(1 - \tilde{L})$$

it follows from employment being an increasing function of x in Proposition 1 that

$$\frac{\partial \tilde{G}}{\partial x} = \frac{\partial \tilde{R}}{\partial x} + B \frac{\partial \tilde{L}}{\partial x}$$

is positive at $x = x^*(\lambda)$. Thus (analogous to Proposition 2) there is either some $\tilde{x} \in (x^*(\lambda), 1)$ such that

$$\tilde{G}(0) = \tilde{G}(\tilde{x})$$

and a corresponding $\tilde{\gamma} \in (\lambda, 1)$ with $\tilde{x} = x^*(\tilde{\gamma})$, or $\tilde{G}(0) < \tilde{G}(1)$.

Thus we have proved

Proposition 3: If $B \in A$, and if employee bargaining power is not 'too high' ($\gamma < \tilde{\gamma}$ in the first case above, and also as defined in Proposition 2), then switching to extended bargaining is Pareto improving.

Using the same parameters as in the previous numerical examples, we now illustrate the behaviour of government revenue in the following:

Numerical example 3: $\alpha = 0.4, x_0 = 0.3, \xi = 1.5, \lambda = 0.6, \gamma \geq 0.6, \tau = 1.3, B = 0.46$.

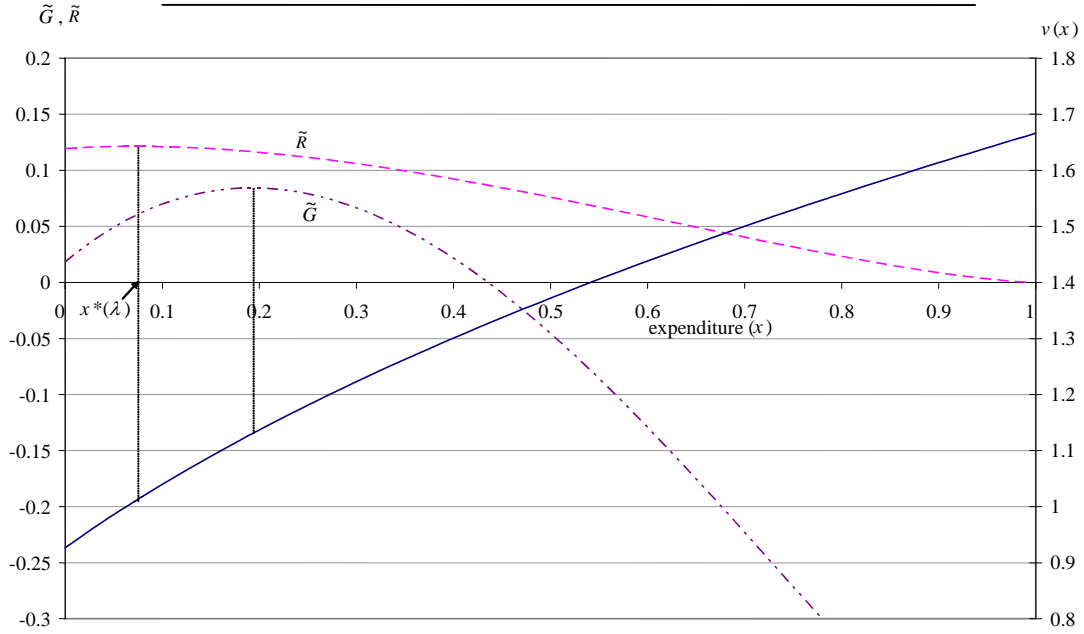
With $\lambda = \gamma = 0.6$, $A = (0.4433, 0.4785)$. Maximum government revenue at the 30% tax rate, which occurs at $x = x^*(\lambda) = 0.0714$, is 0.1263 – this compares to the maximum possible government revenue of 0.1508 at a tax rate of 66⅔% ($\tau = 5/3$). Public goods expenditure under the 30% tax rate is maximised at $x = 0.1929$. Thus, extending bargaining to include the value of work – as well as increasing equilibrium employment and profits, without reducing expected worker utility – increases government revenue and public goods expenditure. This Pareto improvement, for zero employee bargaining power, is in accordance with Proposition 3.

With $\lambda = 0.6$ and $\gamma = 0.616$, $A = (0.4318, 0.4673)$. Maximum government revenue at the 30% tax rate, which occurs at $x = x^*(\lambda) = 0.0714$, is 0.12138 – this compares to the maximum

possible government revenue of 0.1449 at a tax rate of $66\frac{2}{3}\%$ ($\tau = 5/3$). However, government revenue for a 30% tax rate under extended bargaining at $x = x^*(\gamma) = 0.0785$ is 0.12136, and this is well above the corresponding revenue at $x = 0$ (0.1193). Public goods expenditure under the 30% tax rate is maximised at $x = 0.1923$ – a slightly lower expenditure on value of work than was the case when employees had zero bargaining power. Extending bargaining to include the value of work with positive worker bargaining power – as well as increasing equilibrium employment, profits and expected worker utility – increases government revenue and public goods expenditure. This Pareto improvement is also in accordance with Proposition 3.

Figure 3, below – using the parameter values from the second part of numerical example 3 (with extended bargaining and positive employee power) – shows that expenditure on public goods (\tilde{G}) varies rather more with expenditure on the value of work than overall government revenue (\tilde{R}). In this example, \tilde{G} is positive throughout the most relevant range of values of x , and minimum spending on benefits occurs at a higher level of x than that which gives maximum expenditure on public goods (this is the value of x , which, given the other parameter values, also maximises \tilde{L}).

Figure 3: Plot of $v(x)$ (solid line), \tilde{G} and \tilde{R} (broken lines) against x for $\gamma = 0.616$ at a tax rate of 30%.



7. Aspects of Optimal Taxation

A common feature of second-best models of taxation and unemployment that is reflected in real-world policy is the conflict between tax-cutting to boost employment, and the consequent loss of revenue for provision of public goods. Only when taxes are ‘too high’ does the conflict disappear, and tax reduction raise both revenue and employment on the downward-sloping section of the Laffer curve. A surprising result of our model is that when the value function is large enough the conflict also vanishes, and public good expenditure is maximised at the full-employment tax rate.

To see this, differentiate (11) logarithmically with respect to the tax and obtain the condition for government expenditure on public goods to increase:

$$13) \quad \frac{\partial \tilde{G}}{\partial \tau} > 0 \Leftrightarrow v(x) < \frac{\gamma(1-\lambda\tau)}{\lambda}$$

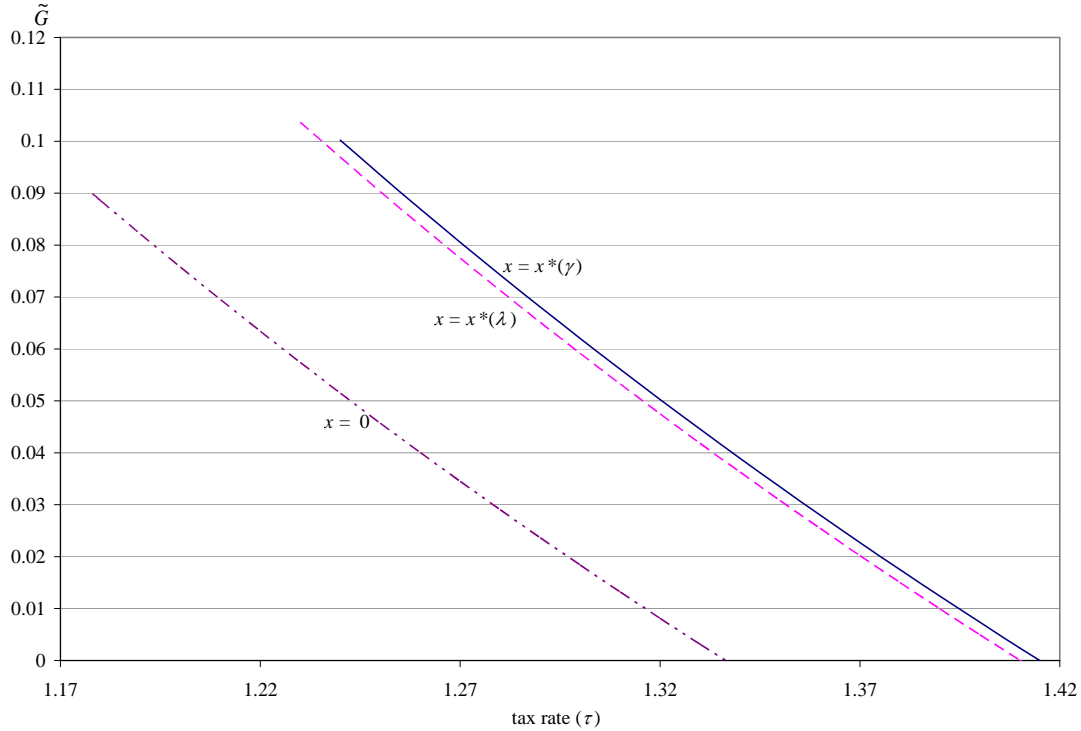
Clearly this requires that the tax term be less than the *revenue*-maximising tax, $1/\lambda$, derived above, and of course the tax must be greater than the full-employment tax defined by (12). Under these conditions there is an interior *expenditure*-maximising tax at which the inequality in (13) becomes an equality.

On the other hand, an upward shift of the value function can clearly reverse the inequality in (13) so that \tilde{G} becomes a declining function of the tax, and tax-reduction raises government expenditure as well as employment, so the optimal tax is then just the employment-maximising tax. In particular, if $v(0)$ satisfies (13) but $v(x^*(\gamma))$ does not, for some level of bargaining power, then switching to extended bargaining shifts the economy from the upward- to the downward-sloping segment of the Laffer curve, and allows further Pareto gains from reducing taxes to the full employment level

It is worth emphasising again that the value function can be raised both by extended bargaining and by ‘regulation’ (through an increase in the parameters ξ or x_0 , and hence the initial level of the value function). Though the costs of regulation are not modelled here, we next provide numerical illustrations of welfare gains from tax cuts with a ‘high’ value function, followed by the more familiar hump-shaped Laffer curve when the value function starts at a lower initial level.

Figure 4, below – using the parameter values from the second part of numerical example 3 (with extended bargaining and small positive employee power), illustrates the high value case and shows how public goods expenditure varies with the tax rate, separately for the three different values of x (zero, $x^*(\lambda)$ and $x^*(\gamma)$). For these parameter values, all tax rates that give rise to positive unemployment and non-negative public goods spending are on downward-sloping Laffer curves.

Figure 4: Plot of public goods spending against the tax rate, for three values of x (with $\gamma = 0.616$ and $\xi = 1.5$).

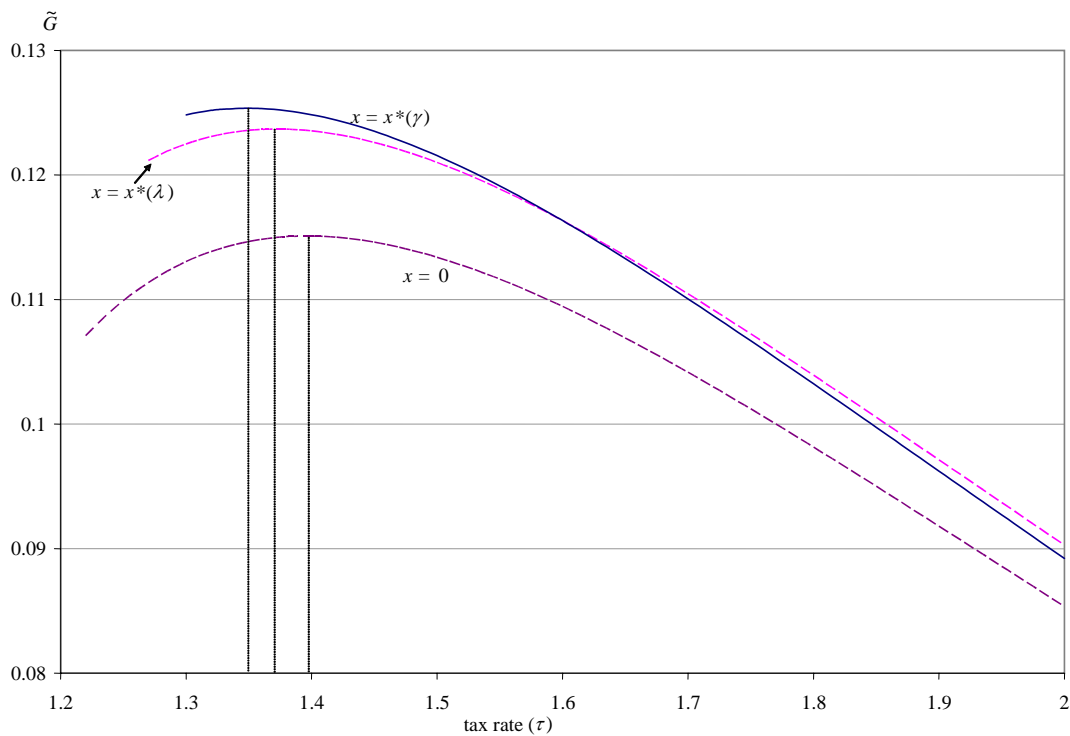


Numerical example 4: $\alpha = 0.4$, $x_0 = 0.3$, $\xi = 0.35$, $\lambda = 0.6$, $\gamma = 0.8$, $B = 0.08$.

This numerical example shows how more employee bargaining power cannot necessarily compensate for a lower value function due to smaller ξ . As noted already, the lower value of ξ should be viewed as representing a less regulated labour market, in which there is less of requirement for employers to care about working conditions. While the values chosen for α , x_0 and λ are all the same as in the previous numerical examples, higher employee bargaining power ($\gamma = 0.8$) and the rather unregulated labour market ($\xi = 0.35$) combine to yield much lower levels for the value of work (for given x). Thus: $v(0) = 0.2162$, $v(x^*(\lambda)) = 0.2355$ and $v(x^*(\gamma)) = 0.2548$. Meanwhile, the mark-up is much higher than previously – varying (inversely with x) between 5.23 and 6.17 (rather than modestly either side of unity, as in the previous numerical examples). With the value of work being lower, B needs to be set lower (0.08) to prevent unemployment from being too attractive. Nor do we consider very low tax rates, since these are likely to be associated with the case of full employment.

Figure 5, below, shows that this combination of parameter values yield some ranges of tax rates that are on an upward-sloping section of the Laffer curve – where there is a need to trade-off lower taxes against less expenditure on public goods. Other notable features of Figure 5 are that the tax rate which maximises public goods expenditure varies inversely with x ; and the Laffer curves for $x = x^*(\lambda)$ and $x^*(\gamma)$ cross over at a tax rate of just over 60% ($\tau = 1.6007$). It can also be shown that, when the tax rate is chosen to maximise public goods expenditure, expected worker utility varies positively with x – from 0.0989 when $x = 0$ to 0.1043 when $x = x^*(\gamma)$, with higher value of work more than compensating for a wage fall from 0.4933 to 0.4186. Profits also vary positively with x – from 0.3252 when $x = 0$ to 0.3423 when $x = x^*(\gamma)$.

Figure 5: Plot of public goods spending against the tax rate, for three values of x (with $\gamma = 0.8$ and $\xi = 0.35$).



8 Conclusions

The simple model developed here suggests that there are important welfare and employment gains to be had from institutional measures that overcome the non-contractibility of working conditions. General government regulation of the labour market is one component, that on our interpretation shifts the value function upwards, but is often opposed by business with claims that it reduces competitiveness. Extending the bargaining power of labour by involvement or participation in management is the other, complementary, component, which has traditionally been even more strongly opposed by most managers defending their own power and autonomy, in spite of some notable exceptions.

The ‘macroeconomic’ benefits of raising the value function by appropriate regulation can be realised as either more employment, or higher unemployment benefits and hence greater utility for both employed and unemployed. As our examples show, a large-enough initial value, $v(0)$, also allows extended bargaining to make work more attractive than unemployed leisure with the same income, which in turn puts the economy on the downward-sloping portion of the Laffer curve, so that tax reduction then increases both employment and public goods expenditure. On the other hand, if the initial value is too low, then extended bargaining, even with strong unions, cannot compensate.

Since Adam Smith, economists have looked for ‘compensating differentials’ or wage premiums for less pleasant work. Here we argue in the other direction that expenditure on raising job-satisfaction allows a given level of utility to be maintained at a lower wage, which in turn generates higher employment. As an additional bonus, if the value of work is high enough initially (due to appropriate regulation of the labour market), then tax reduction will increase employment sufficiently to offset lower revenue per worker and increase expenditure on public goods.

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