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Title: Progression in taxation of earned income, wage formation and labour market performance [1]

Author: Helge Sigurd Næss-Schmidt (sns@fm.dk)

Abstract:

The main aim of this paper is to focus on the relevance of theoretical models and empirical work which predict that increased progression in wage taxation may be helpful in reducing structural unemployment, e.g. by reducing the pressure for wage increases. For policy makers this may appear to be a highly attractive double dividend in the context of the increased focus in recent years on improving the work incentives of low skilled workers without reducing economic welfare for unemployed persons. First, reduce replacement rates by lower taxes on wage incomes at the bottom level to improve work incentives for these groups. Second, raise marginal tax rates to finance such reductions while at the same time reducing wage pressures.

However, a range of plausible and realistic assumptions about the crucial parameters in labour and product markets gives the opposite results, i.e. more progression leads to increased unemployment.

Finally, some policy considerations on the future taxation of wage income are presented. A main argument is a call for a division of labour in economic policy making. For instance, if wage claims are pushed up by union rent seeking in (semi) monopoly industries this should be addressed through competition policies, not by raising marginal tax rates on labour income which, as widely recognised, may have negative effects on the economy's longer term potential.

1 The views and analyses presented in the working paper are the sole responsibility of the authors. The papers may therefore include views, which are not necessarily shared by the Ministry of Finance. *Very helpful comments and suggestions have been received from in particular head of division Jakob Hald and senior adviser Kåre Clemmensen, both from the Ministry of Finance.*

A. Wage taxation and formation in simple, union models

During the 1990s, a number of theoretical and empirical studies argued that higher progression in taxation of wage income dampens wage claims, and thus contributes to lower unemployment (see reference list for examples). A common feature of these models is imperfect labour markets with wage formation dominated by unions negotiating wages and work conditions on behalf of their members. The union acts rationally on the basis of the perceived preferences of its members and knows the demand curve for its "products".

The aim of section A is to illustrate how optimal wages for such a union is determined by a number of alternative assumptions concerning the progressiveness of wage taxation, the degree of centralisation in wage formation, the (lack of) competition in product markets, the potential for substitution between the union members and other types of labour, the length of unemployment spells among union members and the ability of unions to influence work conditions other than the hourly wage e.g. number of hours worked and fringe benefits.

Presentation of a simple model

To give a simple presentation, the focus is on the most simple union model, namely the monopoly union that sets the wage level unilaterally while the firm determines the number of workers employed. The choice of model is not based upon a careful examination of what is the most realistic situation: the aim is to illustrate that even in the most restrictive union model it is debatable whether higher marginal taxes reduce wages or not.

In the first type of model, and in line with most literature, consumer prices, the tax system and unemployment benefit rates are seen by unions as exogenous: unions cannot through wage setting and the resulting effects on employment affect overall prices and public finances to an extent which should be internalised by a union acting rationally.

The first set-up analyses a simple union utility function where the sole aim is to maximise total disposable income (C) of union members. The tax system operates with a marginal tax rate (t), a lump sump tax credit on earned income (WC) paid to all employed persons. In the case of unemployment the unemployed receives a tax-free benefit (B). *Working time is fixed and equal for all members.*

$$(1) \qquad C = W(1-t)L + WC\,L + B(UA-L)$$

With W, L and AU denoting respectively wage level, number of employed union members and total number of union members, all on a yearly and full-time basis, disposable income can be derived from (1) as the sum of total wage income after taxes, the total value of the tax credit and total unemployment benefits. Crucially, labour supply is assumed to be exogenous, and not affected by tax or benefit parameters.

The optimal wage must be set so disposable income cannot be increased by increases in wage levels. If the employment subsidy equals the rate of unemployment benefits, the problem translates into solving the classical problem for a monopoly producer: setting the price so that the elasticity of quantity (here labour demand) with respect to price (here wage) equals one numerically (see technical annex, in the following referred to as TA).

If the two rates differ, the optimum level of wages is determined as follows (see TA):

$$(2) \qquad W = (B-WC)/(1-t) - L/L_w$$

This expression is easy to interpret: the accepted net of tax wage (unions "reservation wage") must be at least equal to unemployment benefits. As wages are taxed, this implies that the wage must exceed unemployment benefits with a factor equal to the difference between unemployment benefits and the tax credit divided with one minus the marginal tax rate.

In addition, the union may demand a premium on the wage, depending on how sensitive labour demand is to changes in wage levels (L_w). If L_w is large numerically, the last term disappears, implying that the union has no effective market power.

Essentially, the model predicts how involuntary employment at the individual level can be consistent with voluntary unemployment for the union group as a whole. Total membership income is maximised by having some unemployment, while individual income for the unemployed would be higher by taking up paid work at the agreed level (or even somewhat less).

In the extended model the tax system is formulated in terms that precisely correspond to the central point in the discussion on the progressiveness of wage taxation: Any change in the marginal tax rate (t) is followed by a change in the tax credit that keeps the net-of-tax ex ante wage income constant for the representative union member being analysed[2]. As will be commented upon later, this is only possible at one single point on the scale of wage incomes: all other income groups will face either higher or lower net-of-tax wage incomes.

Such a set-up will give the following first-order condition for an optimal wage (see TA):

$$(3) \qquad dC/dW = (1-t) + El_w\,(1-at-d) < 0$$

At and d denote respectively the average tax rate on wage income (at the relevant wage income level) and the replacement rate, here defined as net-of-tax unemployment benefits divided by the gross wage. Thus, 1-at-d is the net gain divided by the gross wage resulting from one worker going from unemployment to paid work and becomes zero (by definition) when the overall net replacement is 100 per cent. *Note that at and thus 1-at-d are not affected by increased progression in wage taxation in this set-up, as the tax credit is precisely measured so that average wage taxation is kept constant.*

The interpretation of (3) is as follows: An increase in the wage of one unit leads to an after-tax increase of one minus the tax rate (1-t). This gain must be seen against the loss in wage income resulting from lower employment, which can be calculated as the elasticity of labour demand with respect to wages (El_w) multiplied with the net gain per worker as a result of higher employment (1-at-d). The optimum is reached where the two-right side terms in (3) are numerically of the same size.

The model embodies the classic feature of union wage models: increased progression dampens wages. An increase of the marginal tax reduces the loss associated with a reduction in wages while the net gain rate is unchanged. Finding a new optimal point thus requires the wage to fall until the elasticity of labour demand has fallen sufficiently to establish a new optimum. The existence of a new equilibrium

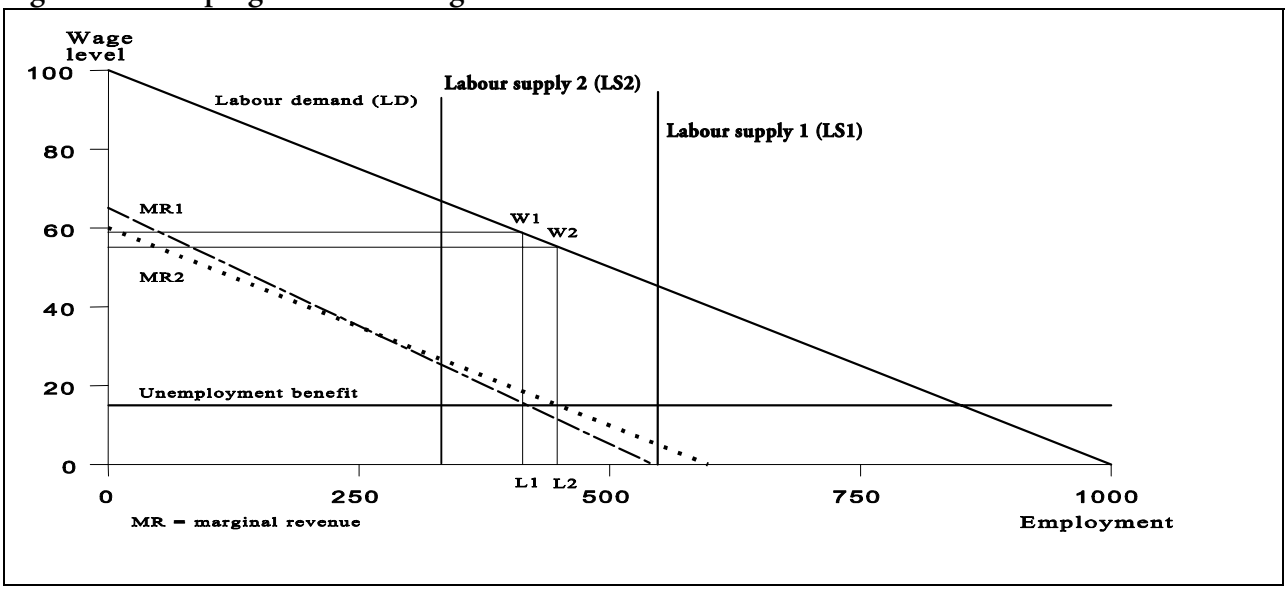
[2] Ex ante as the change in the tax system may induce changes in wages that changes the ex-post net-of-tax wage income.

requires simply that each percentage reduction in wages provides a declining percentage gain in employment, i.e. that El_w falls with increasing employment.

The effect of increased progression of wage taxation can be illustrated with a union facing a linear demand curve for its members cf. figure 1. Initially, with tax system I, the union optimises the total disposable income of members by setting the wage at W1 where the marginal revenue curve consistent with tax system I (MR1) crosses the line depicting the level of unemployment benefits. This gives an employment level of L1 and a level of unemployment equal to LS1 minus L1. Now the tax system is made more progressive (II) implying a flatter marginal revenue curve (MR2) that equals unemployment benefit at the lower wage level W2. As a result, employment will go up from L1 to L2 and unemployment is reduced accordingly.

Thus, the basic story about higher marginal tax rates that reduce wage pressures is intuitively appealing and easy to present in simple models and illustrations.

Figure 1. More progression and wage claims



The following sections outline a number of equally simple theoretical reasons why this conclusion may be wrong.

The slope of the labour demand curve

One of the many premises in the simple model above is that labour demand is relatively inelastic with respect to wage levels.

This point is illustrated in figure 1 where the analysed tax systems are the same as in figure 1 but where the labour supply curve is pushed to the left to LS2. In other words, in the whole relevant interval of labour demand from zero to full employment, disposable income increases when unions reduce wage claims irrespective of whether tax system I or II is in place. Thus, the first order condition is irrelevant in wage setting: disposable income is maximised at full employment; unions have no effective market power. This is equivalent to saying that labour demand has a high price elasticity at full employment.

The implication is *not* that this counter argument is only relevant if unemployment is zero. For example, unemployment could be caused by frictional factors that are only marginally affected by

general wage levels (see also subsequent sections on "other labour market models". Unions may then be in a situation where income maximization would benefit from lower frictional unemployment but employment is not really affected by lower wage claims.

At least two questions arise from this conclusion. What determines the elasticity of labour demand and under what conditions is it likely to be high?

Essentially, the labour demand curve is a derived demand curve, pointing to the importance of the conditions that employers face in product markets. To the extent that employers are price-takers, the labour demand curve must be close to horizontal. As a consequence, the marginal product of labour is determined exclusively by the market rate of interest, eventually adjusted for risk, the tax system etc., and the parameters of the production function. By definition, unions can have no market power when employers have no market power: any union premium in wage setting leads to employers cutting 100 per cent back on labour demand as they have no pure profits to share with employees.

In addition to competition in products markets, the slope of the labour demand curve is determined by the degree of substitution with other types of labour.

It should be kept in mind that the basic model as presented until now is based upon atomistic unions not able to affect macroeconomic outcomes, i.e. employing a relatively small proportion of the total work force. All other things being equal, one would expect precisely under these conditions that the firms would have a relatively large scope for replacing union members with other types of labour.

In other words, a model based upon atomistic unions implies relatively flat(ter) demand curves for union members, making the wage dampening effect less likely.

Centralised wage formation

If wage formation is dominated by one or only a few unions, the tax system should not, even with the highly restrictive assumptions of the monopoly union model outlined above, have strong effects on wage claims. The argument is simple: as wage incomes and transfers to unemployed persons constitute the bulk of total income in most countries, rational unions should internalise the unemployment effects of setting the wage to high. In the (unlikely) event that all public finance effects of variations in unemployment are paid by the labour force, then from a union point of view there is no net public subsidy to unemployment.

Working time is adjustable, leisure is precious and distribution among members matters

Recognising adjustable working time as an option, pricing leisure and focusing on the distribution of disposable income and leisure among union members are highly relevant elements in any formal analysis of union preferences. Yet, this complicates the math and presentation considerably: no attempt here is made to solve analytically a model with all relevant parameters. Rather, a more partial approach is taken with some broad conclusions.

If working time is adjustable, but leaving aside for a moment pricing of leisure, a straightforward application of the simple models described above leads to corner solutions in terms of hours worked. A longer workday implies more people on benefits while those still in jobs increase take-home pay. Whether this is worthwhile for union members as a whole depends on the relation between marginal tax rates and the replacement rate. If the marginal tax rate does not exceed the replacement rate – defined as net benefits divided by the before-tax wage – disposable income will be maximised by having the maximum number of workers receiving unemployment subsidies and concentrating work among as

few workers as possible. By contrast, if the marginal tax rate is higher than the replacement rate work sharing does pay.

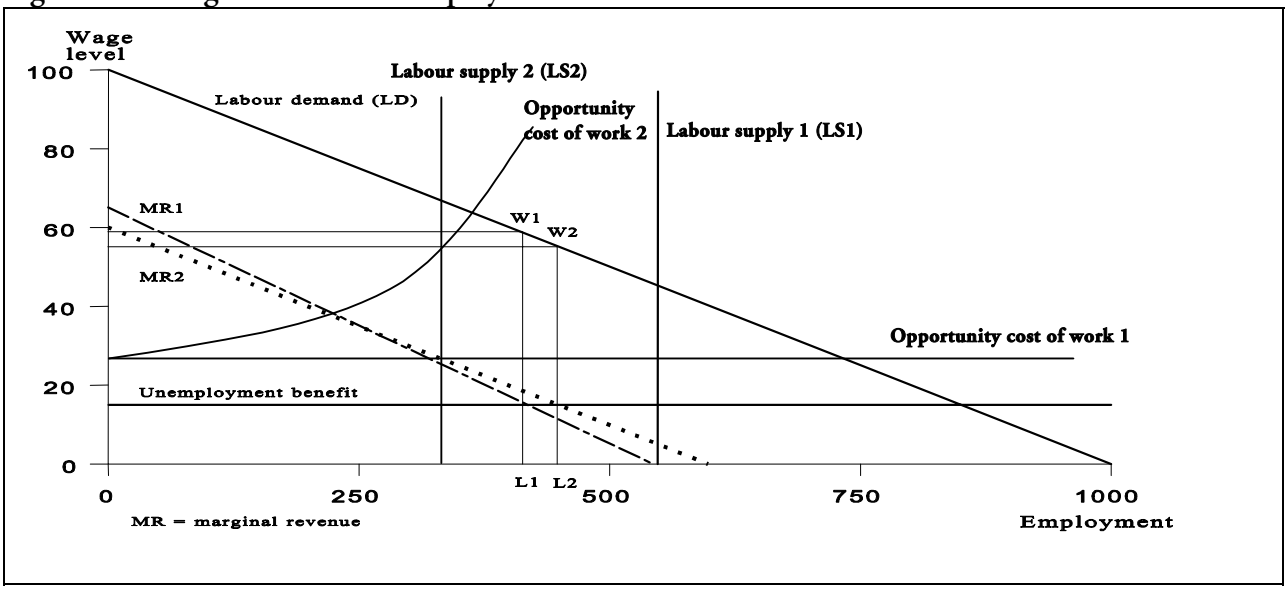
Thus in this simple model, unemployment measured in persons is very much affected by the progression of the tax system, while number of hours worked is not.

Pricing leisure, but keeping working time fixed, implies adding a new cost element to equation (3) above.

(3)′ $dC/dW = (1-t) + El_w$ ((1-at-d)- value of leisure) < 0

By increasing employment, union members do not only have to pay higher taxes and loose benefits, they also have less spare time. If the price of leisure is a linear function of hours worked/persons employed, the value of leisure (vol) can be inserted within the brackets (1-at-d) as a new constant (1-at-d-vol); if, as more likely, the marginal cost of foregone leisure rises as it becomes scarce, it will have to be defined separately. The two versions are illustrated as adding costs of foregone leisure to the (lost) unemployment benefits in figure 2, implied by the two curves of opportunity costs of work (ocw).

Figure 2. Pricing leisure reduce employment



Incorporating leisure in this way does not change the basic conclusion: as a first approximation increased progression implies lower wage pressures. But employment will of course be realised at a lower level because the marginal revenue curve crosses the marginal cost curve (ocw) at a lower level of employment.

However, both models described above, as well as the basic model, are built upon the fairly unrealistic assumption that only total leisure time and total disposable income matters while the distribution of these goods among union members is without importance. Hence, some of the results above are meaningless: all work will newer be concentrated among a few workers for at least two simple reasons: in the absence of very strong redistribution mechanism among union members (which in practice do not exist), the total distribution of both disposable income and leisure would be extremely skewed.

Consequently, in a realistic model, in addition to recognising that leisure is precious and working time is adjustable to some extent, distribution among union members clearly needs to be factored into a decision analysis.

In a simple version, one could argue that the pricing of leisure should exclusively take account of members in employment. This would be consistent with a world in which non-employed workers would be activated in labour market programmes at a level that was not at the margin a product of the number of hours worked by their employed colleagues, or where the costs of social exclusion of non-participation in the normal job market has a price commensurate with the benefits of having a lot of spare time.

In such a model, more progression with adjustable working time implies that the labour supply curve would shift to the left. For any given wage, employed workers would be better of by working fewer hours as the marginal price of leisure falls.

The result of more progression on wage pressures is thus indeterminate. Total disposable income will still be favoured by a lower wage but this may be more than offset by a higher required gross wage for any given employment measured in hours due to leisure becoming cheaper at the margin. The net result depends on a very wide range of parameters of which very few are known, particularly those relating to the importance of the distribution of leisure and income between union members. The less importance the union attaches to the conditions of non-employed (both the value of leisure and disposable income), the more likely is the result that more progression lifts wages.

The net effect on the number of unemployed person is also indeterminate. Even if the number of hours worked falls, unemployment measured in persons may fall, as more progression on the margin tends to boost the incentive to work sharing as suggested above. This result of course begs the question whether structural unemployment measured as a percentage rate (unemployed persons divided by labour force) really is reduced over a longer term by work sharing ("the fallacy of the lump sum of labour").

The incidence of long-term unemployment

It is assumed in practically all studies which look at the relationship between progressiveness of wage taxation and unemployment that union members are either employed the whole year or not at all. Generally, there seems to be little justification for this: On average, the incidence of long term unemployment range in OECD-countries from below 10 per cent in USA to above 50 per cent in a number of continental European countries, with the Nordic countries somewhat in between (see for example OECD, Employment Outlook, 2001).

This implies that a large group of the unemployed in any given year has substantial work income and that total income is well above the level of unemployment benefits. In Denmark, more than 50 and 20 per cent of the unemployed persons -- measured by their contribution to whole year unemployment -- had in 1996 a work income which exceeded, respectively, 25 per and 60 per cent of the work income of a whole-year employed Average Production Worker cf. table 1.

Table 1. Work and total income among persons unemployed in 1996

	Share of unemployed persons measured by their contribution to full year unemployment in 1996 whose work and total incomes exceed specific fractals of the income of an Average Production Worker (APW)			
	50 per cent	33 per cent	20 per cent	10 per cent
	---------- per cent of the income of an APW ----------			
Earned income.....	25	40	60	80
Total taxable income.....	60	65	75	90

Source: Danish "Law model" which includes income and tax data for 0,3 per cent of population. Data from 1993 with update based upon structure of unemployment in 1996 and recent aggregate wage data.

This observation should have some ramifications for the simple union models presented above. In the first place, it means that increases in work income for a substantial part of the unemployed are *not* or only to a limited degree affected by the taxation of work (and even more) other income at *the low end of the income scale* (unemployment benefits are taxable in Denmark).

A rational union will be aware of this and act accordingly. In considering how this should be constructed, one must look again at the interpretation of the model. Essentially, it says that the individual union member either 1) gets work, typically through a random choice mechanism, or 2) is unemployed constantly or at least for a full calendar year. However, a more realistic interpretation may be that a higher wage increases a) the average spell of unemployment for union members and/or b) the likelihood that the unemployed union member would have to find lower paid work elsewhere even if it implied, at least temporarily, leaving the union.

The importance of this can be illustrated in a simple model where unemployment among union members is either a full calendar year or split into spells of 6 months unemployment per calendar year or less. The tax credit has so far been seen essentially as a lump sump transfer to all employed persons that keeps the average wage taxation constant for the group concerned. However, in practice no one would introduce a lump sump payment which was paid to all employed persons irrespective of their working income or number of working hours: that would invite blatant abuse. A much more credible scheme would be a tax credit which provided a reduced tax liability for all work incomes up to, for example, half of the full year pay for the union member.

With unemployment distributed on spells of 12 months within a calendar year, the first row in table 2 tells the standard story: with a rise in marginal taxes, there is an incentive to cut wages. With the chosen parameters, a cut in wages of 1 per cent increases total disposable income by almost 0,1 per cent. However, if unemployment is split into spells of 6 months or less as in the second row, the reverse result holds true.

The reversal of the effect is intuitively appealing. As the tax credit is only increased for work income up to half the yearly income of an APW, it has no effect on marginal incentives given that all union members have work incomes at or above this level. Formally, the effect can be analysed in terms of a reformulation of (3) 1a.

$$(4) \qquad dC/dW = (1-t) + El_w (1-t-d) < 0$$

The important change is that the term (1-at-d) has been replaced by (1-t-d); the reason being that the employment subsidy (WC) has no effect at the margin as all union members, also those partly unemployed during the year, have work incomes above the upper threshold. It is thus a lump sump transfer to all union members, with no marginal incentive effects on wage bargaining. All that is required for the result that higher marginal taxes *reduce* the incentive to wage restraint – i.e. that the second term on the right hand side exceeds numerically the first term -- is that the elasticity of labour demand with respect to wages numerically exceed unity. This must in practice always be fulfilled for a monopoly union with market power as argued above.

Table 2. Progression in wage taxation and the structure of unemployment among union members

The elasticity of labour demand with respect to wage is set equal to minus 3.5 per cent. Parameters of unemployment benefits are defined in the note to the table

Unemployment structure:	Initial tax system: marg. rate 50 per cent, value of earned income tax credit 10 per cent of initial wage	Increase in marginal taxes: marg. rate 55 per cent, value of earned income tax credit 15 per cent of initial wage
	Percentage increase in disposable income with wage 1 per cent lower	
unemployment spells always 12 months or more	0	0,09
unemployment spells always 6 month or less	0	-0,18

Note: Net unemployment benefits set equal to 45 and 45 per cent of gross wage in the situation with respectively union members being unemployed 6 months and whole year, in order to ensure that the first order condition is fulfilled in both cases with the initial tax system: (1-t)+Elw (1-at-d)=0

Alternative remuneration to wages

The discussion above has had as point of departure that unions could only take out compensation in terms of wages or, at the limit, cuts in working time. This is unrealistic when analysing union responses to higher marginal taxes. In fact, unions may in the face of increased marginal tax rates attach a higher priority to:

- *Fringe benefits*. Often, these are either taxed not at all or at least at lower rates than normal wage income. A highly rational response to higher tax rates would be to increase all types of remuneration taxed at lower rates.
- *Less demanding work schedules.* If unions are not allowed to cut working time as the logical response to higher marginal taxation, they can negotiate changes in work schedules making the average work hour less demanding and implying more "leisure" at work e.g. by increasing the number of breaks. The overall effect is reduced hourly productivity.
- *Job security.* Essentially, the models presented deal with "rent-sharing" where unions exploit the market power that specific employers enjoy in product markets. Given higher marginal tax rates, unions may well, rather than cut wages to increase employment, opt for higher job security in their relatively well-paid occupation. In this case, higher marginal taxes may entrench labour market rigidities rather than alleviate them.

Overall conclusion on the theoretical union model

A formulation of wage formation with strong monopoly unions does not unambiguously point in the direction of higher marginal taxes being dampening on wage pressures. Strong competition in product markets, high incidence of short-term unemployment among union members, high value attached to the leisure time of union members are all factors which draw the conclusion in the opposite direction.

Moreover, it is not sufficient to look at how marginal taxes affect the desired hourly wage when assessing the impact on labour market performance. In all models with smaller unions (and strong individual supply response), higher marginal taxes increase the attractiveness of low taxed remuneration in terms of fringe benefits, lighter work schedules etc. Thus, lower hourly wages may be followed by unchanged (or higher) hourly wage costs. This point is particular important when reviewing the empirical research on the link between tax systems and the labour market.

Even if overall hourly average wage costs are reduced, employment may not necessarily be boosted by higher marginal tax rates. One has to be very careful before concluding on economy wide effects of reduced rent sharing in monopoly industries as discussed below

B. The importance of tax progression in other labour market models

While most academic work on the link between progression in taxation of wages and unemployment/wage formation has focused on union models, the implications of increased progression have also been analysed in job search and efficiency wage models.

In the basic job search model increased progression can lead to either quicker or slower acceptance of wage offers, and hence all other things being equal, shorter or longer unemployment spells. The reasoning is intuitive and can be illustrated in a simple two-year model where one job offer is given in each of the two periods, and where a refusal of a job remunerated at W is compensated by unemployment benefits.

When declining the job offer in the first period, the expected benefits equal in the first period unemployment benefits (UB), the monetary value of leisure by not working (ML) and in the second period the expected wage offer (We) (mean value in the job offer distribution) minus taxes at that wage level (Twe). When accepting the job offer, the expected benefits equals two times the accepted (or reservation) wage after taxes.

By combining the two conditions, the reservation wage be defined as:

$$(5) \qquad W_r = (UB + ML + W_e - T_{we})/2 + T_{wr}$$

Thus, the reservation wage on a period basis should equal or exceed total after tax benefits from first periods unemployment plus second years net of tax expected wage (the whole divided by two) plus the tax on the reservation wage[3].

Keeping aside for a moment the issue of taxation, the reservation wage can very well exceed the mean expected job offer if either unemployment benefits or the monetary value of leisure is high enough.

Looking at the impact of taxation we then define a more progressive tax system that keeps net unemployment benefits and expected net earnings unchanged after taxes at W_e. This implies that all

[3] For presentational convenience, the discount rate for comparing the two period benefits is set to zero.

wages lower than the mean of the expected wage offer are taxed at a lower average while wages at a higher level are taxed at a higher rate. By the same token, replacement rates are reduced for all wage levels below We and increased above.

To the extent that the original acceptance wage was below the mean job offer, the reservation wage falls. If not, it goes up. That is easily seen from the last term in equation (5), which is the only one that changes. If the initial reservation wage exceeds the value of the mean offer, Twr goes up and vice versa (by definition with a more progressive tax system).

For the labour market as a whole, the result of increased tax progression appears undetermined. It depends on the distribution of job offers facing potential job seekers, the individual pricing of leisure, the choice of point on the wage scale where the average tax burden is unchanged and the extent to which active labour market policies are effective in pushing down reservation wages by exposing the non-employed to the "risk" of activation.

A further complication comes from the fact that the actual choices facing unemployed job seekers is *not* to be either working or on unemployment benefits for a whole calendar year. As documented above, the vast majority of unemployed have unemployment spells of less than 6 months, and for the most part they will be spread between calendar years.

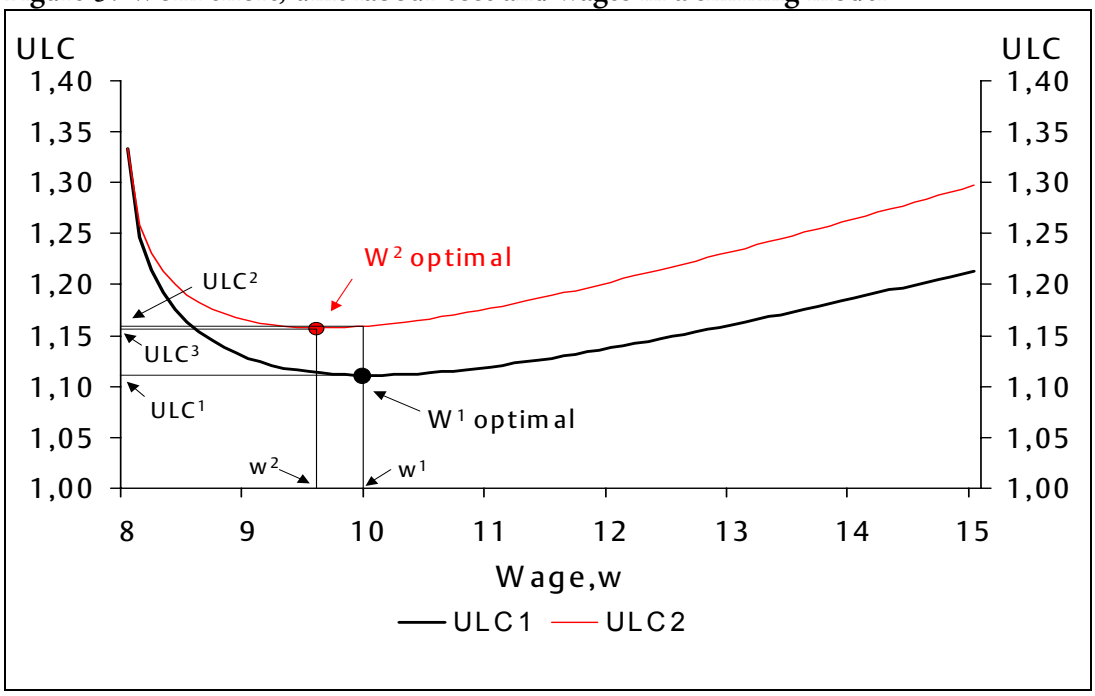
For such workers, the reservation wage relative to the expected mean job offer will have to be even lower for increased marginal taxation to lead to reduced search unemployment (se TA).

In policy terms the conclusions in terms of the job search model and tax progression could be the following. If a high level of unemployment benefits and/or high disutility of work have driven the reservation wage above most realistic job offers, more tax progression will drive search unemployment even higher. This effect is compounded by the fact that in a realistic world, the reduction of taxes on wages on the lower part of wage income is a pure lump-sum transfer also for many unemployed as they already have earned some money during the tax year. As a result, more progression implies higher replacement rates when not working during the remainder of the year.

Efficiency wages
In the efficiency model employers voluntarily offer high(er) wages to retain costs.

In the *"shirking-version"* employers increase wages to encourage work effort. The underlying idea is that serious work effort cannot be observed without costs. At the margin, the employer faces the choice of introducing more direct and costly control measures or raising the costs for employees of getting caught. The latter can be done simply by offering a more attractive wage, making unemployment benefits and alternative jobs less alluring. Assuming that increases in net wages have a decreasing marginal effect on work effort, then wages are raised up to the point where the increase in wages starts exceeding the gains in productivity (point W1 in figure 3).

Figure 3. Work effort, unit labour cost and wages in a shirking model



Now we increase the overall progressiveness of wage taxes while keeping average taxes – and thus the cost of non-employment – unchanged at the wage level W_e.

However, the costs of getting a lower paid job have fallen, thus reducing the cost of shirking. So for any given wage, productivity must be reduced corresponding to an outward shift of the W-ULC curve. Thus the first-round effect must be higher unit-labour costs – rising from ULC1 to ULC2 -- and lower employment.

Moreover, seen from the employers' point of view any given reduction/increase in wages is followed by a smaller fall/rise in productivity than before. So employers start cutting wages until the loss in productivity equals the gains in terms of lower wages. As a result, ULC is subsequently reduced from UCL2 to ULC3.

However, as ULC1 was the lowest unit labour cost level associated with the original tax system and as the new tax system implies an outward shift of the W-ULC curve, *it follows unambiguously that unit-labour costs in the new equilibrium have risen.*

In the *"turn-over model"* employers raise wages to prevent costs associated with recruiting and training staff. By offering attractive wages, employees are encouraged to stay with the firm rather than quit. Quitting can only be to non-employment or another firm. Quit rates are thus a direct function of the net replacement rate and relative wages. If we assume that each additional increase in wages buys a smaller marginal reduction in quits to non-employment or other firms, then wages are raised until the marginal reductions in turn-over costs equals the increase in wages.

However, this strategy is pursued by all firms. In a two firm- world, when firm A raises its wage while firm B keeps its wage offers constant, the latter experiences higher quit rates. Given an initial equilibrium it must pay for firm B to raise its remuneration levels. When does this wage spiral stop? If the quit rates between the two firms are only affected by relative wages, then the only stopping stone is

that the marginal returns in form of reduced quitting to non-employment are steadily reduced.

Again, we introduce a more progressive tax system with unchanged average taxes at level W. The incentives to quit to non-employment are thus unchanged, while the incentive to move to a better paid job is reduced. Both firms thus realise that it pays to reduce wages as the incidence of quitting to another firm has been reduced.

In principle, then a more progressive tax system produce lower wages and hence, other things being equal, higher employment.

Missing elements

A more general caveat implies that the above models may miss out on some aspects of the clearing mechanisms in the labour market. Essentially, one should ask the question: is it unambiguously good for employment if price signals in the labour market are blunted through high marginal taxes? Take the example of two jobs A and B with the latter implying unpleasant work conditions and/or long transport time. In a non-tax world you would expect a market clearing that would provide the same net value to the employee in terms of the total value of benefits implying that job B would had to be paid somewhat better. In turn, this would reduce the number of job offers of type B as the derived product price would also increase. But that is only fair and square: B-workers produce output with higher social costs per unit of input.

However, once you introduce marginal taxation, you also start taxing the compensation for inconvenient work conditions at large, shifting labour supply towards lower paid but "nice" jobs. It is clearly problematic for welfare – society's marginal willingness to pay for type B-products is larger than the (before tax) wage premium required by employees. But it may also adversely affect structural unemployment. There may not be enough Type-A job offers around and the increased supply of workers for that category may push job offers downwards relative to reservation wages.

Generally, there has not been much focus – theoretically and empirically – on the importance of job shifts between firms in the process of market clearing to shifting market conditions and the role that taxation plays in this respect.

Economy wide effects and inter-action between different models

Great care should be taken before extrapolating isolated contributions from different models of the labour market to the whole economy. A crucial question is for example what happens to the "surplus" of labour supply in any of the models described above.

In the union model, the dampening effect on wages requires imperfections in both product and labour markets and for the effect to be dominant; these imperfections must be prevalent throughout the economy. Assume for example that the whole *labour* market is characterised by (semi)monopoly unions and that a large number of firms sell products under monopoly conditions. Thus, employment in the monopoly industries is reduced for two reasons. First, standard monopoly behaviour predicts that firms will sell products at higher than (long run) marginal costs, thus constraining output and employment in that sector. Second, wage costs in these sectors will be pushed upward by "rent-sharing" as unions exploit the market power of employers in product markets. As a consequence, employment in these industries may be for example 25 per cent rather than 27 per cent of the labour force.

If the remaining industries sell products under perfect competition they can over time absorb any amount of labour at prevailing (or slightly reduced) wage conditions in those sectors. Thus, the size of

employment in the monopoly sectors has in this instance no overall effect on employment. Moreover, if the simple, non-revised union model "works", higher marginal taxes lead to a (economic beneficial) redistribution of employment towards the monopoly industries and lower aggregate wage costs *but* overall employment is unaffected.

An example of inter-action; if the turn-over model suggest that less progression leads to higher unit labour costs what happens to the persons being fired: are they and others more likely to seek jobs quickly because their reservation wage *may* at the same time be reduced in search model, and will more people seek higher paid but unpleasant jobs and thus reduce too fierce competition for lower paid jobs as suggested as a possible model in "Missing elements"?

It is the combined effects of all models working to some extent at the same time and the overall labour market environment, including labour market polices, that determines the final outcome.

C. Empirical tests of progression and wage formation

As the wage dampening effect requires a number of specific conditions on labour *and* product markets, empirical testing seems warranted.

In fact, a number of analyses have been carried out as surveyed below. The overall conclusion is that while many point in the direction of a wage dampening effect, the overall properties of the regressions often seem problematic. As well, a number of more theoretical problems arise in the context of interpreting the results. While not pretending to be an exhaustive review of empirical work on the issue, the sections below are included to put the finger on some of the tricky problems related to choice of variables, functional forms and interpretation of results.

A review of four (five) regressions from UK, Sweden and Denmark

Two of the studies often quoted as evidence of the wage dampening effect -- Lockwood (93) and Holmlund (95) looking respectively at UK and Swedish data -- are in effect only at the limit supporting this view. In fact, the authors of the studies are quit open about this in their presentation. In Lockwood, the most obvious problem is that all estimated parameters are insignificant, see table 4. In Holmlund only coefficients to average income and indirect taxes are significant. However, that says nothing about the importance of progressivity. As unemployment benefits in Holmlund as in most other equivalent studies are included as net of all taxes, that implies simply that net-of-tax replacement rates may have an effect on wages which is much less controversial than the wage dampening effect of more progression.

Two Danish studies appear also in the first instance to support the hypothesis that high marginal tax rates dampen wage pressures. Nevertheless, the study by Tranæs (95) shares, in line with the studies referred to above, the weakness that the coefficients of progressivity and average tax rate are non-significant. Only in Hansen (95), are coefficients to all included variables significant implying a wage dampening effect.

Moreover, the four studies share a specific problematic feature in addition to the more general issue referred to below: the development of real wages over periods in excess of 20 to 30 years are explained solely in terms of tax rates, the rate of unemployment (in fact not included or insignificant in three out of four studies) and unemployment benefits. A priori, one would have expected that technological progress would have been the driving force in explaining rising living standards for workers over such a long period. The risk is that the trend rise in real wage caused by rising productivity are statistically "explained" by equivalent trend changes in tax variables etc. without strong causal links. Thus, without going into an extensive econometric discussion, one may conclude that the lack of productivity

indicators in the determination of real wage developments is troubling and that the coefficient to other regressors - unemployment benefits in particular - may pick up trend correlations between productivity and these other regressors.

Finally, three studies have yearly wages rather than hourly wages as regressed variables. This provides a substantial problem of interpretation: do apparent lower wages in conjunction with higher marginal tax rates imply reduced hourly wages, i.e. an effect on wage formation or reduced labour supply trough a reduction of working time, i.e. fully consistent with more traditional theories on the functioning of the labour market?

Table 4. Progression and wage formation: some regressions

	Lockwood(93)	Holmlund(95)	Tranæs(95)	Hansen(95)
Regressed variable	ln real *yearly* wage divided by benefit rate 1)	ln real *yearly* product wage	ln *yearly* product wage	ln real hourly product wage
regressors	Effect on regressed variable from an increase in regressor 2)			
unemployment rate.	- (n.s.)	-	+ (n.s.)	n.i.
marginal tax rate or degree of progressivity.....	- (n.s.)	- (n.s.)	-	-
average tax rate	+ (n.s.)	+	+ (n.s.)	+
indirect tax rate.....	- (n.s)	n.i.	+	+
unemployment benefits net-of-tax...	n.i.	+	n.i.	+

1) Thus in reality the reverse replacement rate.
2) "+" denote increase in regressed variable, "-" a decrease. N.s. means non-significant at 5% level, n.i. means not included in regression.
Note: Estimation periods are in chronological order 1954-1987, 1975-1992 and 1970-1992 for last two studies.

In a recent Danish study (Rasmussen et al (2000)) a number of these data and functional problems have been directly addressed[4]. Using a union model as the general framework, wage models for six groups of workers with collective wage agreements have been estimated. In all estimations increased tax progression leads to higher wages, which is seen as an indicator that competition dominates monopoly effects in wage setting.

More fundamental problems and issues

A more fundamental problem arises in the context of interpreting what such estimates may convey of information. The problem is that a multitude of alternative hypotheses may be supported by the same data set. This observation is not restricted to progressive wage taxation in a union model context, but relevant to any empirical study on the link between the tax system and wage levels.

[4] Inter alia that the dependent variable is the hourly wage, and productivity is included as independent variable and does have some bite.

On the one hand, an empirical estimation showing that higher marginal tax rates reduce wage levels over a certain period could be interpreted as a movement from point L1 to point L2 along the labour demand curve in figure 1. Thus, with the caveats regarding the link between average wage levels and overall unemployment described above, one could argue that more progression had been shown to damp wage pressures and boost employment.

One the other hand, one could just as easily put forward three other explanations, which provide the reverse policy conclusions. The first would be to interpret the lowering of wages as a highly rational response from unions, now favouring non or lower taxed fringe benefits not included in wages (or wage cost) data. Thus total wage and fringe benefit related costs may not have fallen, and employment thus either remained unchanged (or have fallen!). The second would be to interpret lower wages as a result of lower work effort as marginal economic activity is taxed higher (more leisure at work, less tight work schedules as described above). Indeed, that is the central feature of for example the "shirking" efficiency model referred to above. Third, it could be interpreted more as a long run consequence of having a more progressive tax system, which reduces incentives to skills formation and upward earnings mobility. In all three cases, the observed statistical observation corresponds to an inward shift of the demand curve, not a movement along the curve. As a consequence, there is no presumption that lower wages imply higher labour demand. i.e. higher employment.

The overall conclusion is that the empirical question is still wide open. In addition to the problems outlined above, a number of issues relating to the quantitative and qualitative aspects of labour supply need to be analysed better. A few are mentioned below.

If unions are really determining how individuals arrange their working time, then econometric estimates of individual responses to changes in marginal tax rates are somewhat misleading. The focus should then be on how the tax system over time affects the number of negotiated hours; conditions for overtime work, effective working time ("leisure at work" argument) within a credible framework for the formation of union preferences and actions.

More generally, whatever the underlining theoretical labour market model, greater care should be taken to ensure that variables expressing number of hours worked represent reality. In this respect, and with still more workers across industries moving from contracts based upon hourly remuneration to monthly salaries based upon a fixed, sometimes only notional, working time schedule, data on negotiated or standard working hours, may convey serious misrepresentation of actual work patterns.

D. Reflections on policy conclusions

The interest given to union wage models in Nordic countries is linked to the undisputable high degree of unionisation. There are thus good reasons to believe that central features of the labour market are strongly influenced by the preferences embodied in unions' decision making. As well, a number of econometric estimates seem to suggest that individual supply responses to variations in marginal tax rates may be modest, underpinning the central tenet in union models that labour supply is relative inelastic.

The models' potential interest for policy makers are also furthered by the increased focus in recent years on improving the work incentives of low skilled workers without reducing economic welfare for unemployed persons. In this respect, the models apparently promise a double dividend. First, reduce replacement rates at the bottom level to improve work incentives for these groups. Second, raise marginal tax rates for low and/or middle-income groups to finance such reductions while at the same time reducing wage pressures.

This paper has so far tried to make the point that, looking across the most plausible versions of labour market models, increased progression is as likely to increase as to reduce structural unemployment cf. table 5. While the table only suggests isolated contributions to labour market performance, it does not reflect that all these models work at the same time, and that they interact as discussed in the section on "*Economy wide effects and inter-action between models".*

Table 5. A heroic attempt to sum up on theory and empirical work on the links between more progressiveness of taxation of wages and its effect on wage costs, unemployment and productivity

	Hourly wages	**Unit labour costs**	**Unemployment Isolated effects**	**Productivity**
Union models				
If steep demand curves, high incidence of long term unemployment, restricted choice in the number of parameters included in local wage negotiations, high regard for distribution among union members	Down	Down	Down	Not much of an issue
All adjectives reversed relative to above!	Up or unchanged	Up or unchanged	Up	Not much of an issue
Efficiency wage models				
Shirking version	Down	Up	Up	Down
Turn-over version	Down	Down	Down	Down
Effects on supply of labour in different segments of the labour market	?	?	Probably up	Most certainly down
Search models				
Low/high reservation wage relative to mean wage offer	Down/Up		Down/up	Down/Up
High/low incidence of long term unemployment	Down/Up		Down/up	Down/Up
Empirical work	All over the place, huge problems in interpreting results			

However, even if one accepted the basis tenet: higher marginal taxes may provide a boost to employment it would by no means be clear that rates should be raised. Whilst marginal tax rates on this presumption would reduce employment measured in persons is has a number of negative effects on economic performance, which may well more than offset this gain. First, is will most probably reduce total number of hours work, and most among persons with high incomes and productivity. The size of the effect will depend on the specific characteristics of the country in question and the specific tax measures implemented. Second, it may more generally reduce work effort, and thus productivity. Third, it reduces incentives to skills-formation and may be an impediment to entrepreneurship as medium and higher earning individuals have less scope for saving capital for business formation. Fourth, it may imply an overall tax system, which is less coherent as marginal rates on wage income could be too divergent from rates on capital income and thus increase distortions and socially unproductive tax planning.

Moreover, a highly practical problem arises from the problem that more progression in conjunction with broadly unchanged average taxation is only possible for a very small group of workers. A workable tax system implies that increased progression means (more or less) unchanged taxes for a small minority while the rest would face either higher or lower taxes. Simple simulations on Danish data suggest that a realistic revamping of the tax system that reduce replacement rates for low income groups would imply

higher replacement rates for a large majority of workers, including those working in highly unionised sectors.

Finally, one should carefully think about division of labour in overall economic policy making and individual country characteristics. An obvious point is whether incentives to reduce structural employment should focus on labour market policies in a more narrow sense -- e.g. for example by more stringent conditionality when assessing benefits claims and use of obligatory jobs to press reservation wages downwards – rather than restructuring of tax systems which may present more complicated trade-offs. A final point related to the discussion in this paper concerns the following problem: As the wage dampening effect in the union model requires wide-spread distortions in products market, the rational response would be supply side reform such as deregulation, enhancement of overall competition policies etc. rather than implementing second best policies with known, negative side-effects as described above. Such supply side measures have indeed been a central feature in OECD-reform efforts for at least a decade. In addition, if unemployment, especially long-term, is already is low, tax progression high and income inequality low, then proper evaluation of trade-offs may suggest that higher marginal tax rates are not really called for.

Such a policy stance would in particular be relevant if one shared the view that competition between firms and branches within and between countries is increasing due to inter alia lowering of trade barriers and deregulation. Thus, if the trend is indeed towards "globalisation" -- which in most descriptions certainly also include more competition between low skilled workers in formerly protected industries - then the wage dampening effect seems steadily less likely as an outcome of more progressive taxation of wages. In other words, historical estimates may no longer be valid. In addition, it may be a steadily less available recourse given potentially more competition between countries for key managerial and research oriented manpower at the higher end of the income scale.

Technical annex

Union model

The first set-up analyses a simple union utility function where the sole aim is to maximise total disposable income (C) of union members. The tax system operates with a marginal tax (t), a yearly after-tax lump sump employment subsidy (WC) paid to all employed persons. In the case of unemployment the unemployed receives a tax-free benefit (B). *Working time is fixed and equal for all members.*

(1) $C = W(1-t)L + WC\,L + B(UA-L)$

With W, L and AU denoting respectively wage level, number of employed and labour supply, all on a yearly and full-time basis, disposable income can be derived from (1) as the sum of total wage income after taxes, the total value of the employment subsidies and total unemployment benefits. Crucially, labour supply is assumed to be exogenous, and not affected by tax or benefit parameters.

The demand for union members(L) is inversely related to the wage level set by unions.

(2) $L = L(W),\ L_w<0$
(L_w denotes the derived of labour demand with respect to wages)

The optimal wage must be set so that disposable income cannot be increased by increases in wage levels.

(3) $dC/dW = (1-t)\,L + (1-t)\,W\,L_w + WC\,L_w - B\,L_w < 0$

The last two right side terms cancel each other out if the employment subsidy equals the rate of unemployment benefits. In this case, optimising the wage level simply implies solving the classical problem for a monopoly producer: setting prices so that the elasticity of volumes (here labour demand) with respect to price (here wage) equals one numerically:

(4) $El_w = -1$

Intuitively, this appears reasonably. When the lump-sum employment subsidy equals unemployment benefits, the marginal subsidy to employment or unemployment is zero. Just as for a "normal" monopolist, the marginal tax rate does not affect the optimal production level.

If the two rates differ, the optimum level of wages is determined as follows:

(5) $W = (B-WC)/(1-t) - L/L_w$

This expression is also easy to interpret: the accepted net of tax wage (unions "reservation wage") must be at least equal to unemployment benefits. As wages are taxed, this implies that the wage must exceed unemployment benefits with a factor equal to the difference between unemployment benefits and the employment subsidy divided with one minus the marginal tax rate.

Such a set-up will give the following first-order condition for an optimal wage:

(6) $dC/dW = (1-t) + El_w\,(1-at-d) < 0$

At and D denote respectively the average tax rate on wage income (at the regarded wage income level) and the replacement rate, here defined as net-of-tax unemployment benefits divided by the gross wage. Thus, 1-at-d is the net gain divided by the gross wage resulting from one worker going from unemployment to paid work and becomes zero (by definition) when the overall net replacement is 100 per cent. ***Note that at and thus 1-at-d are not affected by increased progression in wage taxation in this set-up, as the employment credit is precisely measured so that average wage taxation is kept constant.***

The interpretation of (6) is as follows. An increase in the wage of one unit provides an after-tax increase of one minus the tax rate (1-t). This gain must be seen against the loss in wage income resulting from lower employment, which can be calculated as the elasticity of labour demand with respect to wages (El_w) multiplied with the net gain per worker as a result of higher employment (1-at-d). The optimum is reached where the two left side terms in (6) are numerically of the same size.

The model embodies the classic feature of union wage models: increased progression dampens wages. An increase in the marginal tax rate reduces the loss associated with a reduction in wages while the net gain rate is unchanged. Finding a new optimal point thus requires the wage to fall until the elasticity of labour demand has fallen sufficiently to establish a new optimum. The existence of a new equilibrium requires simply that each percentage reduction in wages provides a declining percentage gain in employment, i.e. that Elw falls with increasing employment.

The effect of increased progression of wage taxation can be illustrated with a union facing a linear demand curve for its members:

(7) $L = K - b\,W$, where $b > 0$

Using the methodology and terminology described above, marginal revenues (MR) for the union must in optimum equal unemployment benefits (B):

(8) $MR = (1-t)/b + WC - 2(1-t)\,L/b = B$

The wage and employment effects from changes in the progression in wage taxation are depicted in figure 1 where the calibration is based upon the parameter values in table 1 below, choosing the steep labour demand curve.

High degree of competition in product markets

If there is a high degree of competition in product markets, the labour demand curve must be close to horizontal irrespective of conditions in labour markets. This can be shown with Cobb-Douglas production function:

(9) $F = k\,K^{a}\,L^{(1-a)}$

With the employer as price-taker, it its well known that the market rate of interest(r) corresponds to the marginal product of capital (Fk):

(10) $F_k = r$

Under these conditions, the relationship between capital and labour is strictly determined by the market rate of interest and the parameter a in the Cobb-Douglass function:

(11) $L/K = e\,\ln(a/r)/(a-1)$

With the relationship L/K fixed, the marginal product of labour is also fixed at:

(12) $Y_l = a\,(1-a)/e\,\ln(a/r)/(a-1)$

As a consequence, the marginal product of labour is determined exclusively by the market rate of interest, eventually adjusted for risk, the tax system etc., and the parameters of the production function. By definition, the unions can have no market power when employers have no market power: any union premia in wage setting leads to employers cutting 100 per cent back on labour demand as they have no pure profits to share with employees.

Search models

By declining the job offer in the first period, the expected benefits equal in the first period unemployment benefits (UB), the monetary value of leisure by not working (ML) and in the second period the expected wage offer (We) (mean value in the job offer distribution) minus taxes at that wage level (Twe).

(14) $UB + ML + W_e - T_{we}$

By accepting the job offer, the expected benefits equals two times the accepted (or reservation) wage after taxes:

(15) $2\,(W_r - T_{wr})$

By rearranging equations 14 and 15, the reservation wage be defined as:

(16) $W_r = (UB + ML + W_e - T_{we})/2 + T_{wr}$

Thus the acceptance wage on a period basis should equal or exceed total after tax benefits from first periods unemployment plus second years net of tax expected wage (the whole divided by two) plus the tax on the reservation wage1.

(17) $W_r/2 - (T_{wr} - T_{wr}/2) + W_r - T_{wr}$

If the job offer is refused, the benefits equal:

(18) $(UB-ML)/2 + W_e - T_{we}$

Thus the reservation can be rearrangement be determined as:

(19) $W_r = (UB+ML)/3+2/3\,((W_e - T_{we}) + T_{wr} + (T_{wr} - T_{wr/2}))$

Efficiency wage model

The following equations constitute an efficiency wage model:

(1) $P = A + b(Nw_0 - Nw_a)^a$

(2) $ULC = \frac{w}{P}$

(3) $Nw = w - T$

(4) $T = -C + dw$

Where the different variables are defined as follows:

P: productivity
ULC: unit labour costs
w: gross wage
Nw_0: net wage (after-tax wage)
Nw_a: net wage, alternative job-offer
A,a,b: constant parameters
d: tax rate
C: lump sum tax transfer

The model is solved for the optimal wage by differentiating the expression for unit labour cost with respect to the wage –setting equal to zero. Rewriting the equation for ULC by using (1), (3) and (4):

(2') $ULC = \frac{w}{A + b(Nw_0 - Nw_a)^a}$

$= \frac{w}{A + b((1-d)w + C - Nw_a)^a}$

Differentiating with respect to w yields:

$$\frac{dULC}{dw} = \frac{A + b((1-d)w + C - Nw_a)^a - w * b * a * ((1-d)w + C - Nw_a)^{a-1} * (1-d)}{(A + b((1-d)w + C - Nw_a)^a)^2} = 0$$

$$A + b((1-d)w + C - Nw_a)^a = wba((1-d)w + C - Nw_a)^{a-1} * (1-d)$$

With the parameters A=6, b=3, a=0,6 and Nw_a=5 and with the tax system d=0,5 and C=1:

$$6 + 3 * (0{,}5 * w - 4)^{0{,}6} = w * 3 * 0{,}6 * 0{,}5 * (0{,}5 * w - 4)^{-0{,}4}$$

$$6 * (0{,}5 * w - 4)^{0{,}4} + 3 * (0{,}5 * w - 4) = 0{,}9w$$

$$6 * (0{,}5 * w - 4)^{0{,}4} = 0{,}9w - 1{,}5w + 12$$

$$(0{,}5w - 4)^{0{,}4} = -0{,}1w + 2$$

$$(0{,}5w - 4)^2 = (-0{,}1w + 2)^5$$

This is an equation of the fifth degree, which has the most obvious solution w=10. (the other 4 solutions should be imaginary).

In optimum the optimal wage rate that minimizes unit labour costs thus equals w*= 10. With a wage rate of w=10 the unit labour cost (ULC) is equal to 1,111111.

Increasing the tax rate to d=0,6 and adjusting C such that the net wage is unchanged at the wage rate W=10, which implies an unchanged average tax payment, T –in this case a C-value of 2.

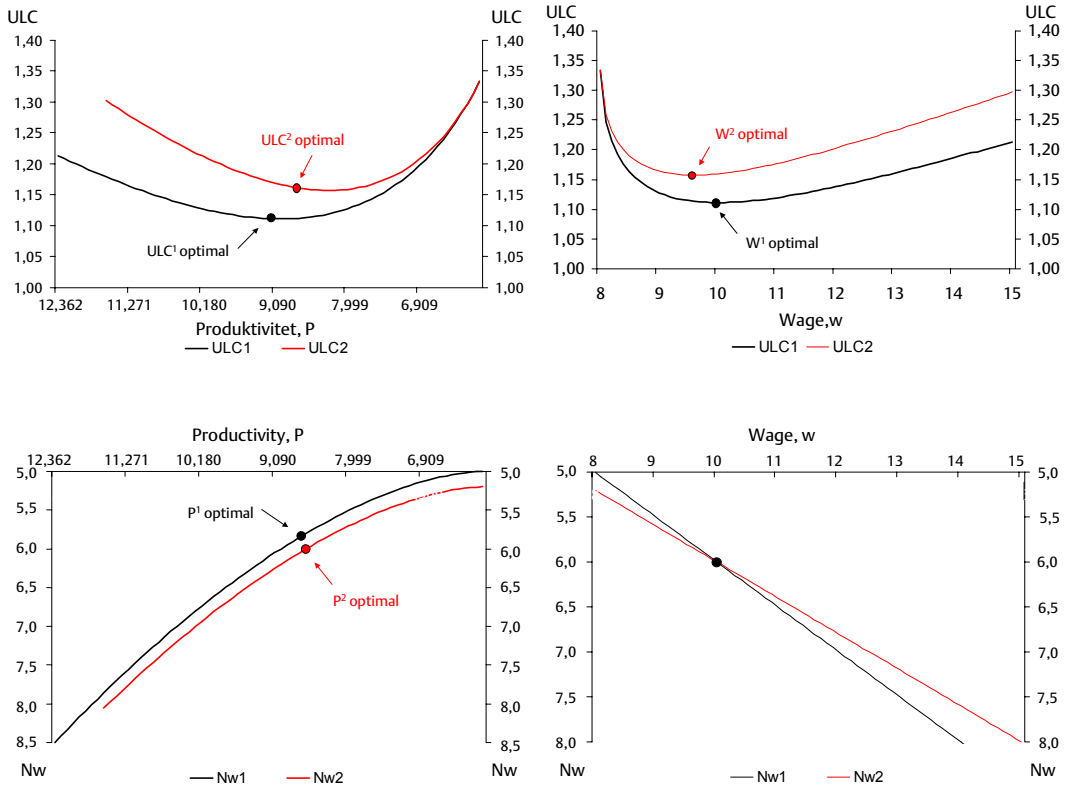
With b=0,6 and C=2 the optimal wage rate becomes, w*=9,6. The net wage, the productivity and the unit labour cost subsequently turns out to be respectively Nw=5,84, P=8,295246 and ULC=1,157289.

Summarized in a table this is:

Tax rate, d	Wage, w*	Net wage, Nw	Productivity, P	Unit labour cost, ULC
0,5	10,0	6	9	1,111111
0,6	9,7	5,84	8,295246	1,157289

The following graph shows the situation for d=0,5 and d=0,6. The black curves refers to b=0,5, the red ones to b=0,6.

Illustration:



From this exercise we can draw the conclusion, that a higher tax rate implies (I) lower productivity and (II) higher unit labour costs.

I. Lockwood and Manning write: ”It should be noted that the estimated coefficients...tend to have low t-statistics, which implies that it would be relatively easy to accept any hypothesis about the effects of the tax system on wages” (page 21 in article). Holmlund and Ann-Sofie Kolm note: “The empirical analyses has given some support for the.." (wage dampening effect) ", although, the results may perhaps be given alternative interpretations. As usual, the empirics cannot prove the theory”.

II. Holmlund expressively underlines the potential importance of these kind of issues.

III. Insert some references.

IV. Various studies suggest that more progressive taxation of wages is most problematic in countries with a narrow distribution of wage income and with tax system (and benefit) systems which already imply high marginal taxation in the span of income where rates go up. See for example OECD, Employment outlook 1996 and 1997.

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