TITLE: *THE DETERMINATION OF HOURS OF WORK AND THE EFFECTS OF REDUCTIONS IN HOURS OF WORK ON EMPLOYMENT AND WAGES*

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ABSTRACT

This thesis examines the theoretical and empirical predictions of the effects of reductions in hours of work on wages and employment, the economic efficiency arguments for such reductions and the related issue of the determination of hours of work in a bargaining framework.

The conventional approach, assumes that workers will want to maintain their incomes in the face of reductions in hours of work per period. This is difficult to justify theoretically, when hours and union/worker utility are taken properly into account. Rather, unions and workers that desire reductions in hours of work are likely to opt for the same or even a reduced hourly wage, leading to a significant employment effect of any such measure.

We show that this result is true in labour markets and economies where unions determine or bargain over the wage and in models where firms set the wage because it affects their workers' productivity. It is also true when firms demand positive overtime, when such models account properly for the long-run movement of hours of work.

The thesis examines also the determination of hours, employment and wages in a bargaining framework and shows that the employment effects of unionism are likely to be overestimated when no account is taken of the hours determination procedure. This allows us also to provide an economic rationale for union behaviour regarding reductions in hours

of work and maximum hours legislation and determine the conditions under which reductions in standard hours of work can increase union utility and firm profits.

Finally, empirical evidence is provided with a test of the relationship between the hourly wage and weekly hours of work, using aggregate data. We use a large number of variables and different estimation techniques to avoid simultaneity. Our results suggest, in line with the theoretical predictions, that changes in hours of work have no effect on the hourly wage.

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OUTLINE

The thesis is organised as follows. ***Chapter I*** presents the effects of reductions in hours of work on employment in the basic competitive labour demand model which serves as a benchmark for the results obtained in later sections. We present also the available empirical evidence which suggests that the elasticity of employment with respect to hours of work, for a given wage, is significantly negative.

In ***Chapter II*** we allow the wage to be determined endogenously within a union and efficiency wage framework. We show that under a variety of different assumptions about the wage determination process a reduction in hours of work is unlikely to lead to an increase in the hourly wage, especially if such a reduction is demanded by the workers/unions themselves. This provides a theoretical justification for the income sharing hypothesis and suggests that reductions in hours of work will not lead to a negative indirect employment effect through increases in the hourly wage.

In ***Chapter III*** we relax the assumption of an exogenously given level of hours of work and assume that the level of actual hours of work is determined endogenously. We assume that actual hours exceed the level of "standard" hours so that workers work positive overtime. We show that a realistic modification of the cost structure of the traditional model allows us to take into account properly the negative long-run trend of actual hours of work. In this case we demonstrate that reductions in standard hours of work are likely to lead again to an increase in employment. We also show that if the wage is determined endogenously, such an increase becomes even more likely. The fact that actual hours of work are now endogenous allows us to examine the economic argument for reductions in standard hours of work; we show that for both "efficient" and "inefficient" outcomes for employment, hours and wages, a reduction in standard hours can lead to an increase in both union utility and firm profits.

In ***Chapter IV*** we examine in detail the hours determination process in a bargaining framework. We first examine the effects of introducing an extra bargaining variable on the traditional model where firm and union determine solely or jointly employment and wages. We then explain why the observed level of hours of work might exceed the optimal for the individual/union. This provides therefore a framework for the observed union and firm behaviour concerning reductions in hours of work, which was taken as given in ***Chapter I*** and ***Chapter II.*** We finally motivate union support for maximum hours legislation by determining its effect on the objectives of the union and the firm under alternative bargaining solutions.

In ***Chapter V***, we provide a test of the income sharing hypothesis using annual, post-war UK data. We first derive a static wage equation based on a general bargaining model and then proceed to estimate it using annual data. We then derive a dynamic wage equation, based on an intertemporal bargaining model and test it again with annual data. ***Chapter VI*** contains the main conclusions of the thesis and possible areas for future research.

Notation

h	=	number of hours worked by those on overtime
r	=	overtime premium
h_s	=	standard hours of work (= h, if r = 0)
T	=	maximum number of hours of work per period
s	=	number of shifts
m	=	capital utilisation rate

H	=	hours of work including overtime payed at the hourly wage = $(1+r)h-rh_s$
G	=	fixed cost of employment or training costs ($G = g_1w$, $g_1=gh_s$ or $g_1=gh$ when there is no overtime)
$\underline{H}$	=	$H + g_1$
$\underline{f}$	=	ratio of fixed to total labour costs ($g_1/(h+g_1)$)
N	=	number of employees
w	=	hourly wage
$\underline{r}$	=	rental price of capital
wh	=	c (income per period, when $r = 0$)
wH	=	$\underline{c}$ (income per period, when $r > 0$)

P	=	Profit function
Z	=	Utility function of the union
$\underline{P}$	=	"Fall-Back" Level of Profits
$\underline{Z}$	=	"Fall-Back" Level of Union Utility
X	=	Nash Maximand ($X=(P-\underline{P})(Z-\underline{Z})$)
U	=	Utility function of the individual
M	=	Number of union members
V	=	"Outside" utility
DU	=	U - V
u	=	Unemployment (rate)
$\underline{b}$	=	Unemployment benefit
e_{ij}	=	Elasticity of **i** w.r.t. **j** (elasticities are **not** defined in absolute values)
$\underline{e}_{ij}$	=	Direct elasticity of **i** w.r.t. **j** (ie holding other variables affecting **i** constant).
X^*	=	Optimizing value for variable X (where necessary)

CHAPTER I

INTRODUCTION AND THE BASIC LABOUR DEMAND MODEL

Introduction

The significant increase of unemployment in the 1980s and the apparent inability of demand and supply policies to reduce it, have generated significant interest in a reduction in the rate of labour utilisation [1] as a way of increasing employment, particularly in Europe (Fitzroy (1981), Blyton (1982), AGF (1983), Charpin (1984), Dreze (1986), White (1987)), but also in N.-America (Best (1981), Owen (1989)). Amongst the policies suggested the shortening of the working week has been supported as the measure with the greatest employment generation potential [2] (Cobham (1979), Van Ginneken (1984), Whitley and Wilson (1988), Plasmans and Vanroelen (1988)). A shorter working week has also been a persistent union demand which reflected union members' wishes for more leisure and their concern for high unemployment - see Bienefeld (1972) for the history of hours reductions and Jones (1985) for a survey of more recent developments.

The implications of a reduction in the length of the workweek for unemployment become even more important in the light of the persistence of unemployment in recent years [3]. In this context, a policy of reductions in hours of work could imply a permanent increase

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[1] It should be noted that interest in the issue is not new. According to Bienefeld (1972) the earliest documented case of work - and income - sharing in the UK was by the coalminers in the 1850's.

[2] Other measures include early retirement, longer holidays and promotion of part-time employment. Hart (1984b) describes their main characteristics and gives a good account of the state of the various dimensions of working time in OECD countries.

[3] One of the more popular explanations provided is based on a distinction between the currently employed "insiders" and the unemployed "outsiders" (see Lindbeck and Snower (1984) and Blanchard and Summers (1986)).

in employment without inflation if there was full income sharing which means no increase in the hourly wage. This is not accepted however by a number of authors (Department of Employment (1978), Hughes (1980), Hoel (1987), Layard et al (1986)); they claim that reductions in the length of the workweek would lead to a higher hourly wage than would otherwise be the case; this would therefore have an adverse effect on employment through the increases it would imply in labour costs and the ensuing fall in competitiveness and output.

Empirical research on the subject is based on survey evidence and direct observation, which usually confirms the view that workers do not accept a fall in their weekly income proportional to the fall in hours; in most cases income compensation clauses are explicitly included in labour contracts (Bosch (1986), Richardson and Rubin (1993)). However, such reductions in hours are jointly negotiated with other measures aimed at reducing costs for employers and increasing productivity, like reductions in setting-up times and breaks, the extension of the period covered by the contract, greater flexibility, etc (Charpin (1984), Bosch (1986, 1990)).

White (1983), after surveying 204 firms in 1982, following the introduction of shorter hours in 1981 through national agreements in the engineering, pharmaceuticals and printing industries, reports that "simple productivity improvements even after a year were common, like elimination of tea-breaks, although incidence of more complex changes were also found".

In the most recent study for the UK, Richardson and Rubin (1993), after surveying 102 establishments of the engineering sector that introduced shorter hours between 1989 and 1991, report that "over half of the cost of the reduction would be absorbed by productivity improvements and lower wage increases linked to the cut in the working week" and that "the two hours reduction added less than one per cent to expected manual labour costs when the responses were weighted by factory size"; They add that in large factories facing greater than average competitive pressure and where managers judged that unions resisted less to change "the shorter working week would actually lead to a fall or at most no increase in labour costs". These results suggest that it is difficult to derive definite predictions on the effects of lower hours on labour costs, from this type of analysis.

On the other hand macroeconomic simulations about the effect on employment of reductions in hours make assumptions about the reaction of the hourly wage rather than test it (eg Allen (1980), Whitley and Wilson (1988)). Similarly, simulations based on theoretical models (Booth and Schiantarelli (1988), Hoel (1987)) impose or derive rather than test the reaction of the hourly wage to reductions in hours.

Despite the importance of the argument there is little direct econometric evidence on the subject for European countries. In the UK, after estimating a real wage equation using annual post-war data, we were unable to establish a significant negative link between weekly hours of work and the hourly wage - Chapter V. Other studies following a similar framework (Andrews and Nickell (1983), Bean et al (1986), Layard and Nickell (1986)) did not report such a link - although not explicitly testing for it. Nymoen (1989), using quarterly data for Norway, found a small short-run effect [4] which disappears completely

[4] The elasticity of the hourly wage with respect to weekly hours is -0.26.

after one year. These results, although limited, contradict the conclusions based on simple direct observation and lend support to the hypothesis of income sharing.

The aim of this thesis is to examine the theoretical and empirical base of the income sharing hypothesis when the wage and hours determination process is considered explicitly and the effects of changes in hours of work on individual and union utility are taken into account. We aim to show that, under plausible assumptions, reductions in hours of work will not be accompanied by an increase in the hourly wage, especially if these are demanded by unions or desired by individuals. In such a case, employment will increase, if a reduction in hours of work leads to an outwards shift of the labour demand curve; any given amount of hours of work will thus be shared amongst more people.

In order to explain the effects of changes in hours of work on individual and union utility we provide a theoretical framework for the determination process of hours of work, wages and employment in a bargaining environment. This allows us to provide some answers to the relatively unexplored question of the economic efficiency of reductions in hours of work, to examine the implications of maximum hours legislation and to re-examine the employment effects of unionism.

1.0 LABOUR DEMAND

The effect of a reduction in weekly hours of work on employment will, generally, consist of a direct effect - assuming that the hourly wage does not change - and an indirect effect - which will depend on the size and sign of the hourly wage change.

In the simplest of frameworks, a labour (number of employees) demand function is derived with exogenous weekly hours of work exogenous and a fixed capital stock and utilisation rate (see for example Hart (1987)). Assume that the firm produces output according to a continuous twice differentiable production function with employment and hours as the only inputs. In this case the firm sets employment in order to maximize:

$$\max_{N} P = F(N,h) - whN \tag{I.1}$$

where N is the number of employees, h the number of hours worked per period and w the real hourly wage. We make the standard assumptions F_N, $F_h > 0$, F_{NN}, $F_{hh} < 0$. The FOC for the problem is:

$$F_N = wh \tag{I.2}$$

Assuming that the wage is some function of hours, differentiate equation (I.2) with respect to N and h to get in elasticity terms:

$$e_{Nh} = \underline{e}_{Nh} + e_{Nw}\, e_{wh} \tag{I.3}$$

It follows from equation (I.3) that the total effect on employment from a reduction in the level of hours is the sum of a direct effect ($\underline{e}_{Nh}$) and an indirect effect, through the wage ($e_{Nw}\, e_{wh}$). We analyse and present evidence on the direct effect in this Chapter and focus on the indirect effect (ie e_{wh}) in Chapter II.

To get an expression for $\underline{e}_{Nh}$ differentiate equation (I.2) holding w constant to obtain, in elasticity terms:

$$\underline{e}_{Nh} = e_{Nw}\, (1 - (hF_{Nh} / F_N)) \tag{I.4}$$

Since e_{Nw} is negative, employment will increase directly following a reduction in hours if the elasticity of the marginal product of employment (MPN) with respect to hours (hF_{Nh} / F_N) is smaller than unity. Any given reduction in hours leads to a proportional reduction in the marginal cost of an employee (RHS of (I.2)). Under the realistic assumption that the marginal product of employment falls following the reduction in hours of work ($F_{Nh}>0$), employment will increase if the MPN (LHS of (I.2)) falls by less than the marginal cost, ie if $[(hF_{Nh})/F_N] < 1$. The firm in other words, will find it profitable to expand employment if any given reduction in hours of work leads to a proportionately smaller fall in the marginal product of labour, because of more flexible schemes, better morale, improved organisation, etc. Note also that the number of people employed following a reduction in hours can rise even if total employeehours - and output, if a function of Nh - fall, as long as $\underline{e}_{Nh}$ is negative but absolutely smaller than unity. Hence, in this simplest of frameworks, a reduction in hours of work has ambiguous employment effects - unless one makes specific assumptions about the form of the production function.

If the production technology is Cobb-Douglas (CD) then the elasticity of the MPN with respect to hours is the elasticity of output with respect to hours; if this is smaller than unity or equal to that of output with respect to employment [5] then employment will increase following the cut in hours. Note that in this case productivity, defined as output/employeehour, will also be higher following the reduction in hours of work.

Two other plausible formulations of the production function which allow us to get definite results, are obtained from assuming that the long run production function is linear homogeneous of the form F(hN,mK) (Johnson and Layard (1984), Calmfors and Hoel (1989)). If the number of shifts is denoted by s then m = sh and ***if s is fixed***, we obtain (omitting constants) a short run production function of the form $F(N,h) = h\,F^1(N)$. In this case a cut in hours of work has no effect on employment [6] since it reduces proportionately the marginal product of employment ($hF^{1\prime}$) and its marginal cost (wh).

If m is fixed then we obtain (omitting constants) a short run production function of the form $F(N,h) = F^2(Nh)$. The number of hours capital is now used per period is fixed (the number of shifts will increase following the cut in h) and Nh is a constant for a given

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[5] In the CD case ($F(N,h) = N^a h^b$) it is easy to show that

$N = (w/a)^{1/(a-1)}\, h^{(1-b)/(a-1)}$ and $\underline{e}_{Nh} = (1-b)/(a-1)$.

[6] FOC is $hF^{1\prime} - wh = 0 \Rightarrow F^{1\prime} = w$ and $dN/dh = 0$.

wage [7].

Note that in both of these cases productivity is unaffected, although employment in the first case is unchanged whereas in the second it increases proportionately to the fall in hours. This implies that there is not necessarily a negative link between employment changes and productivity changes following a reduction in hours of work, because output produced after the hours reduction need not remain the same.

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[7] FOC is $hF^{2\prime} - wh = 0 \Rightarrow F^{2\prime} = w$ and $e_{Nh} = -1$.

1.1 Fixed Costs

With fixed employment costs a positive response of employment to a cut in hours is less likely. If we assume, for simplicity, fixed costs to be a proportion g_1 of the wage, the firm's problem and FOC are:

$$\mathbf{P = F(N,h) - w(h+g_1)N} \qquad \mathbf{(I.5)}$$

$$\mathbf{F_N = w(h+g_1)} \qquad \mathbf{(I.6)}$$

If $\underline{f}$ is the ratio of fixed to total costs, $g_1/(h+g_1)$, it follows that:

$$\mathbf{\underline{e}_{Nh} = e_{Nw}\ (1 - (hF_{Nh} / F_N) - \underline{f})} \qquad \mathbf{(I.7)}$$

Although it is not possible to say in general whether the elasticity of employment with respect to hours when $g_1>0$ is larger or smaller than when $g_1=0$ (since if $g_1>0$ employment will be lower for given w and h) it is possible to derive $\underline{e}_{Nh}$ for the three specific cases considered - see Table 1. In the CD case $\underline{e}_{Nh}$ will be absolutely smaller and could become positive and in the case where the number of shifts per period is constant employment will now fall following a cut in h. In the case where the number of hours capital is used per period is fixed, employment will increase, for plausible values of the elasticity of labour demand and of the ratio of fixed to total costs, but the increase will be smaller than in the $g_1=0$ case.

Note that in practice, legislation for reductions in fixed costs of employment has accompanied government initiated reductions in hours of work, with the explicit aim of increasing employment - eg Hart (1984a) for the French "Solidarity" contracts.

TABLE 1

Production Function	Hours Elasticity with fixed costs	Hours Elasticity without fixed costs
CD	$\underline{e}_{Nh} = [(1-b)-\underline{f}]/(a-1)$	$\underline{e}_{Nh} = (1-b)/(a-1)$
Linear homog.		
fixed number of shifts(s)	$\underline{e}_{Nh} = -\ \underline{f}\ e_{Nw} > 0$	$\underline{e}_{Nh} = 0$
fixed capital utilization rate(m)	$\underline{e}_{Nh} = -\ (\underline{f}\ e_{Nw} + 1)$	$\underline{e}_{Nh} = -1$

1.2 Variable Capital Stock / Utilization Rate

In order to be able to make comparisons with the case where the capital stock is fixed, we will illustrate the implications of assuming that the firm also chooses the capital stock by using a CD production function.

As one would expect in this case, the reduction in hours is less likely to lead to increased employment since the firm can also adjust the level of the capital stock. The profit function in this case is ($\underline{r}$ is the rental price of capital):

$$\mathbf{P = N^a h^b K^c - whN - \underline{r}K} \tag{I.8}$$

The FOCs with respect to employment and capital are:

$$\mathbf{P_N = 0 \;\Rightarrow\; aN^{a-1}\, h^b\, K^c = wh} \tag{I.9}$$

$$\mathbf{P_K = 0 \;\Rightarrow\; cN^a\, h^b\, K^{c-1} = \underline{r}} \tag{I.10}$$

and the SOC requires $a+c < 1$. Taking the ratio of equations (I.9) and (I.10) we obtain:

$$\mathbf{N/K = (\underline{r}/wh)\,(a/c)} \tag{I.11}$$

A reduction in the level of hours of work will therefore lead to an increase in the labour capital ratio since the ratio of marginal products is unaffected but employment becomes less expensive than capital at the margin (this is a general result if F(h,N,K) = g(h)G1(N,K), $G1_{NK} > 0$ and G1 is homogeneous). Solving equations (I.9) and (I.10) for N and K and taking logarithms we obtain:

$$\log N = -(1-c-b)/(1-c-a)\ \log h + f^1(w,\underline{r},a,c) \qquad \textbf{(I.12)}$$

$$\log K = -(a-b)/(1-c-a)\ \log h + f^2(w,\underline{r},a,c) \qquad \textbf{(I.13)}$$

It follows that employment will rise following a cut in hours if c + b < 1 (ie b > a), which is a stronger condition than b < 1, a necessary condition for employment to rise in the case where capital is fixed. Employment is therefore less likely to rise following a cut in hours if the firm is free to adjust the level of the capital stock.

It is also straightforward to consider within this context the case where the number of shifts (s) is fixed and the case where the utilization rate of capital (m=sh) is fixed. If s is fixed then $F(hN,shK) = N^a h^{(a+c)} K^c s^c$ and therefore (since b=a+c):

$$\underline{e}_{Nh} = -(1-a-2c)/(1-c-a) \qquad \textbf{(I.14)}$$

The long-run direct elasticity of employment with respect to hours can therefore be negative (if a+2c<1) even if the number of shifts is fixed.

If m=sh is fixed then $F(hN,shK) = N^a h^a K^c (sh)^c$ and therefore:

$$\underline{e}_{Nh} = -1 \qquad \textbf{(I.15)}$$

In this case, the result is the same whether the firm chooses capital or not, since what matters for the firm is the level of Nh and not its composition.

Another variable that can be set by the firm is the capital utilisation rate, ie the number of shifts. Since shiftwork is a common occurrence [8] in manufacturing and especially services, Calmfors and Hoel (1989) examine the effects of reductions in the exogenous level of hours of work on employment when the number of shifts is variable. They argue also that major reductions in hours of work could make it profitable for firms to introduce multiple shifts and separate capital operating time from the length of the working week. A reduction in hours in this context is equivalent to a reduction in standard hours when the firm chooses actual hours of work and the marginal product of overtime hours is less than the marginal product of standard hours. A formal proof is presented in Appendix E of Chapter III but the essential idea is that in both cases the reduction in hours is equivalent to an increase in fixed employment costs so that employment unambiguously falls.

It should be noted however that the majority of overlapping shiftwork is concentrated in the non-manufacturing sector and real shiftwork (ie consecutive shifts) is much less widespread - Calmfors and Hoel (1989) report it at 12.7% of total shiftwork in Sweden.

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[8] This is particularly true when shifts are overlapping; 37% of establishments in the UK used such shiftwork according to Millward and Stevens (1986) and 29% of the Swedish labour force performed such shiftwork in 1984 (Calmfors and Hoel (1989)). Figures for the rest of Europe in 1979 vary from 10.6% in the Netherlands to 41.5% in Luxembourg - see the study of the European Trade Union Institute (1979), quoted in Hart (1984b, p. 62).

Also, the introduction of flexitime accompanying hours reductions agreements (ie the possibility of spreading for instance 35 hours per week unequally on different days and/or take days off, as done in Germany, see Bosch (1990)) implies that cost increases due to increased shiftwork can and probably will be negligible. In this case, the model collapses to the one already analysed, where either shifts or capital operating time is held fixed. All these arguments imply that the negative effect on employment from a variable number of shifts, especially in manufacturing, is likely to be negligible [9].

[9] This seems to be supported by Calmfors and Hoel (1989); they comment that according to their simulations the direct employment effect is not very significant.

1.3 Firm Output Constrained

Given that high and persistent unemployment triggered the argument for a reduction in hours of work a number of authors looked at the implications of cuts in hours of work on employment in a cost minimizing framework where the firm is output constrained, (Nickell (1983), Hart (1984a, 1987), Bosworth and Westaway (1985), Neale and Wilson (1985)).

To illustrate the point consider a firm which sets employment and capital in order to minimize costs taking the level of hours as exogenous subject to a CD technology. The cost function in this case is:

$$\mathbf{C = whN + rK} \qquad \mathbf{(I.16)}$$

and $K = Y^{1/c} N^{(-a/c)} h^{(-b/c)}$, where Y is the fixed level of output. Solving for N and taking logarithms we get:

$$\mathbf{logN = - [(b+c)/(a+c)] logh + f^3(w,r,a,c,Y)} \qquad \mathbf{(I.17)}$$

As expected, given that the level of output is fixed, employment will now definitely increase following a cut in h (this is a general result if the marginal product of capital is increasing in hours ($K_{Nh} \geq 0$)). The same is obviously true if the level of capital is also fixed.

Toedter (1988) examines the same question using a CES production function within a fixed-price Barro-Grossman-Malinvaud model, by assuming that the firm can be in either a "Keynesian" (output constrained) or a "classical" (excess labour supply) regime. The main findings are similar to above - ie employment is more likely to rise in the "Keynesian" regime - but the use of this framework allows him to examine the possibility of a feedback from the goods market.

If the reduction in hours leaves total employeehours (Nh) unaffected - which is true in Toedter's model - then a reduction in hours will have a positive effect on employment from the goods market if the hourly wage rises to compensate fully or partly for the hours fall. In this case an increase in the hourly wage enhances the positive first round effect on employment by increasing demand. This example serves to highlight that in studies which assume no income sharing - ie they assume full or partial income compensation following a reduction in hours -, the total effect on employment might be positive if proper account is taken of second round effects.

In summary, if hours are determined exogenously the direct effect of a cut in hours of work on employment is ambiguous. If the long run production technology is linear homogeneous and the number of shifts is fixed then a reduction in hours of work will have no effect on employment. If the rate of capital utilisation is fixed or the short run production technology is CD with the output elasticity of hours smaller than unity then the reduction in hours of work will increase employment. If fixed costs of employment are important and/or the firm is free to adjust the level of the capital stock an increase in employment becomes less likely. The opposite is true if the firm is output constrained.

1.4.1 Empirical Evidence on the Direct Employment Effect of Hours Reductions

UK employment and actual hours of work in Manufacturing are plotted in Figure 1. The empirical evidence on the effect of hours reductions on employment is summarised in Table 2A and Table 2B; it comes firstly in a direct form, by estimating a labour demand equation (number of employees) and including a labour utilisation variable (usually weekly hours of work). This should provide a consistent estimate of $\underline{e}_{Nh}$ as long as variables capturing the effects of the other inputs and their adjustment costs are included. In Table 2A we present estimates of the coefficient of the utilisation variable from such studies. These are negative and range from -0.3 (Whitley and Wilson (1988)) to -1.7 (Pencavel and Holmlund (1988)).

The relatively small coefficients reported by Hart and Sharot (1978) are not elasticities. They are better thought of as adjustment coefficients - along the lines of Nadiri and Rosen (1969) - since their data is monthly; nevertheless in this case also, the long-run coefficients are significantly higher. The Whitley and Wilson (1988) elasticity of -0.3 is obtained as an average of 5 macroeconometric models which assume that there will be an increase in the hourly wage which will partially compensate for the income loss caused by the reduction in hours; this is partly the reason for which the long-run elasticity is (absolutely) lower than the short-run, unlike the other studies.

The estimates reported for the Belgian economy on the other hand (Plasmans and Vanroelen (1988)) assume no income compensation - full income sharing - in which case the SR/LR elasticities are almost the same. Van Ginneken (1984), p. 38-39) and Plasmans and Vanroelen (1988, p. 600) report also a number of elasticities for other European countries, derived from simulating macroeconometric models; for France and Germany these are negative and range for Germany from -0.62 to -0.84 and for France from -0.33 to -0.63, depending on the assumptions made about the size of the reduction in hours of work and the reaction of the hourly wage and output. For the Netherlands the estimates range from -0.48 to +0.19, the only reported estimates where a reduction in hours could lead to a fall in employment [10]. Ball and St Cyr (1966) impose an elasticity of -1 by assuming that the production function is of the form F(Nh). We conclude that a sensible range of $\underline{e}_{Nh}$ for the UK is -0.5 to -0.8 which means that a 5% reduction in the length of the workweek (going from 40 to 38 hours) would increase by 2.5% to 4% the number of people employed; at the average of UK employment for the period 1980-85 (17.5 mn) this means between 439,000 and 700,000 more jobs.

1.4.2 Empirical Evidence on the Size of the Output Elasticity of Hours of Work

The other body of evidence about the effect of reductions of hours on employment is indirect and comes from production function estimates of the output elasticity of hours. If the production technology can be approximated by a Cobb-Douglas function [11] then following a reduction in hours of work employment will increase if this elasticity is smaller than one - the reaction of employment will now depend also on the size of fixed costs,

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[10] Note that the +0.19 estimate assumes full wage compensation and a reduction in capacity following the hours reduction.

[11] This is a widespread assumption in the literature. Non-constant elasticity alternatives exist also (Hazledine (1978)).

whether the firm is output constrained or not and whether we are looking at the short run or the long run. In theory a fatigue effect from long hours would push the elasticity below unity but longer hours reduce the ratio of non productive - setting up time, tea-breaks, etc - to productive hours which would push the elasticity above unity.

Table 2B reports such estimates. The range of estimates is large but note that the three earlier studies reporting a range for the elasticity of 0.8 to 2.5 are based on a relatively small number of observations (36, 24, and 72 respectively) and are all estimated with OLS.

The Leslie and Wise (1980) study on the other hand uses a sample of 588 observations and instrumental variables estimation; in addition it shows that the elasticity of output with respect to hours falls from above unity to below it if one accounts properly for labour hoarding, cyclical effects and the possibility of different rates of technological growth for different industries. The Hart and McGreggor (1988) study of the W.-German manufacturing industry, by using also a large number of observations (380) and instrumental variables estimation, confirms the Leslie and Wise estimate of an elasticity below unity. The same is true of the Aberg (1987) study for Sweden.

According to the most reliable estimates therefore the elasticity of output with respect to hours is significantly smaller than unity, in line with the earlier reported results of a negative direct effect of reductions in hours on employment.

Conclusions

The aim of this Chapter was to examine the theory and available empirical evidence on the direct employment effect of a reduction in hours of work. We found that reductions in hours of work have an uncertain theoretical effect, that depends on the extent to which the marginal product of employment falls following the reduction in hours of work. We therefore examined the available empirical evidence from studies that estimated the direct employment effect of hours and studies that estimated production functions that included hours of work as one of the inputs. We concluded that reductions in hours of work will lead to an increase in employment with an elasticity in the region of -0.5 to -0.8; at the average of UK employment in the 1980-85 period (17.5 mn), this means that a reduction of the working week from 40 to 38 hours would lead to an increase in employment of between 439,000 and 700,000.

TABLE 2A

Hours Elasticities of Labour Demand

Study	Data/Estim. Method	e_{Nh}
Brechling (1965) (p. 200, eq. 17a)	British Manufacturing / TS 1949-63 / Quarterly / OLS	-0.8 (LR)[1]
Ball & St. Cyr (1966) (p. 180)	British Manufacturing / TS 1955-64 / Quarterly / OLS	-1 (SR/LR)
Hart & Sharot (1978) (p. 305, table I)	UK Manufacturing / TS 1961-72 / Monthly / OLS	-0.01/-0.03(SR)[1] -0.1/-0.4 (LR)[1]
Hart & Wilson (1988) (p. 176)	UK Metalworking / 52 firms Pooled CS / 1978-82 / GLS	-0.5 [2]
Pencavel/Holmlund (1988) (p. 1109, table 1(iv))	Swedish Manufacturing / TS 1950-1983 / Annual / IV	-0.8 (SR) -1.7 (LR)
Plasmans/Vanroelen(1988) (p. 576, table 26.6 [3])	Belgium Private Sector MARIBEL Macro-model	-0.8 (1yr) -0.7 (5yrs)
Whitley & Wilson (1988) (p. 295, table 12.3)	Average of 5 Macroeconometric models for the UK	-0.6 (1yr)[4] -0.3 (4yrs)[4]

CS/TS: Cross Section/Time Series LR/SR: Long Run/Short Run (where appropriate)

[1] Not an elasticity. [2] For non-overtime firms.
[3] Our estimate based on percentage change of N and h.
[4] Assumes partial income compensation.

TABLE 2B

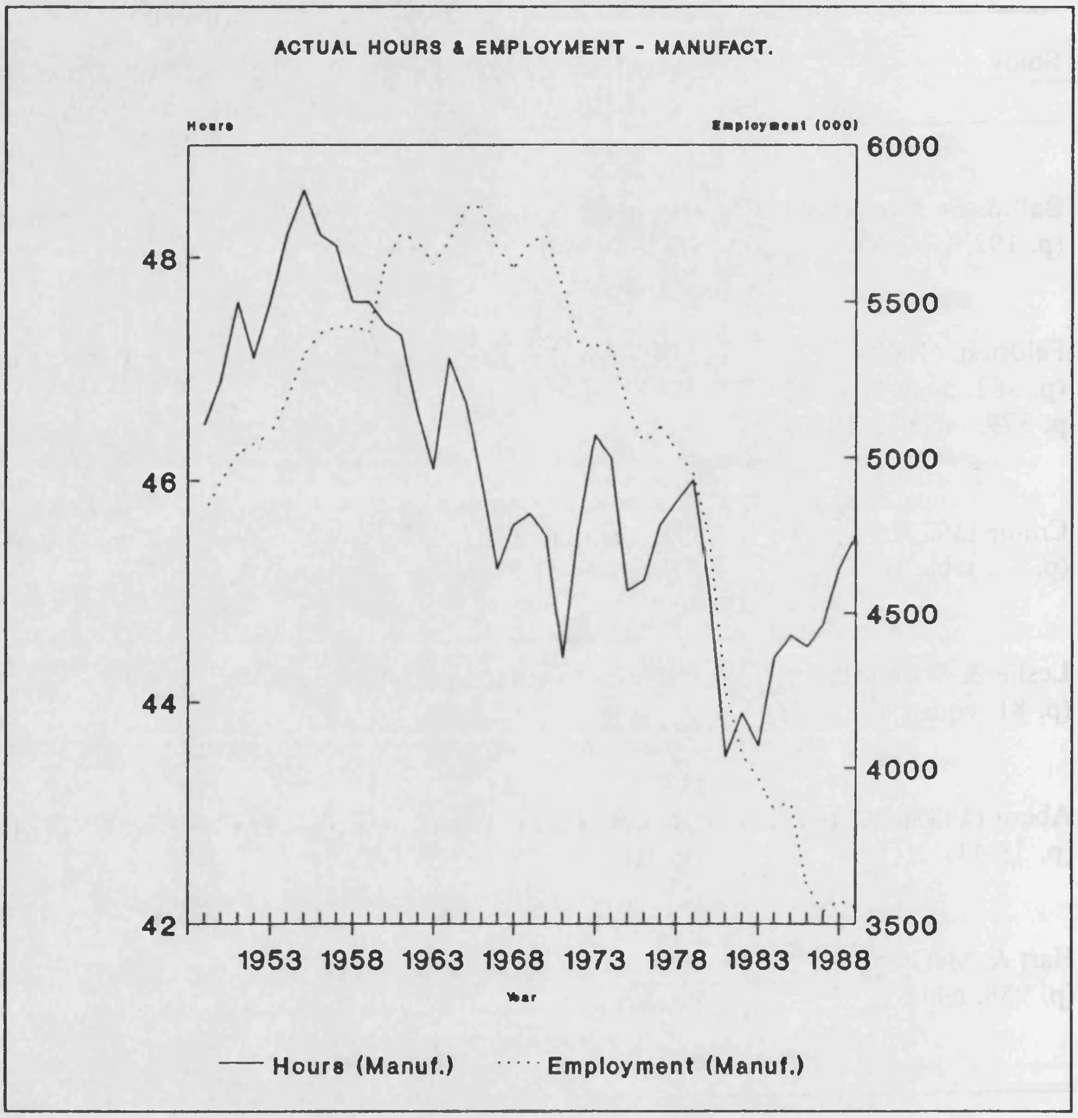
Output Elasticity of Hours of Work

Study	Data/Estim. Method	e_{Yh}
Ball & St. Cyr (1966) (p. 192, table VI)	British Manufacturing TS / 1955-64 / Quarterly / OLS	0.8-1.6
Feldstein (1967) (p. 382, table V, eq. 1 p. 379, table II, 1957)	UK - 24 Manufacturing Industries CS / 1954,57,60 / OLS	1.1-2.5
Craine (1973) (p. 43, table I)	US Manufacturing TS / 1949-67 / Quarterly / OLS	0.9-2.2
Leslie & Wise (1980) (p. 81, equat. 4*)	UK - 28 Manufacturing Industries Pooled CS / 1948-68 / OLS-IV	0.64
Aberg (1987) (p. 38-44)	Sweden Pooled CS / 1963-82 / OLS	0.55-0.73
Hart & McGreggor (1988) (p. 958, table 1)	German Manufacturing Industry Pooled CS / 1968-78 / Biannual / IV	0.81

CS / TS Cross Section / Time Series

FIGURE 1

Hours and Employment (Male) in Manufacturing



Sources: Department of Employment Gazette
Annual Abstract of Statistics

CHAPTER II

REDUCTIONS IN HOURS OF WORK, EMPLOYMENT AND WAGES

Introduction

In this Chapter we examine the effects of reductions in hours of work on the hourly wage by examining the determination of wages in a union and efficiency wage framework.

When considering economies which are unionized the conventional wisdom is that reductions in hours of work are associated with an increase in the hourly wage which compensates partly or fully for the per period income loss due to the fall in hours (eg Johnson and Layard (1984), Hughes (1980), Hoel (1987), White (1983)). It is then argued that even if a cut in hours increases employment directly, a rise in the hourly wage will indirectly reduce the size of the effect and could even counterbalance the direct effect, leading to a fall in employment.

In what follows we first highlight the forces at work when the wage is determined by a monopoly union by deriving an explicit expression for the elasticity of the hourly wage with respect to hours of work. We then show that if hours of work are at the optimal level for the individual initially, the wage will not react at all to any "small" change in hours. This means full income sharing which implies that, whether in a unionized economy or not, only the direct effect is relevant for assessing the employment implications of reductions in hours of work.

We then examine the robustness of our result assuming that the firm bargains with the union about the wage and that the union does not care about employment. In addition, we assume that the whole economy is unionised and analyse the general equilibrium implications of hours reductions. We show that in this case a reduction in hours will have an uncertain effect on the hourly wage. Unemployment however is likely to fall, because following a fall in hours of work, any given volume of work will be shared amongst more people and employment is likely to become more attractive relative to unemployment.

In efficiency wage models, the wage is set by firms who recognise that it affects their profitability through the productivity or turnover of their workers. The explanations given rest usually on some sort of asymmetry in information and include the firm trying to reduce turnover in the face of costly quits (Salop (1979)), reduce shirking due to imperfect monitoring (Shapiro and Stiglitz (1984)) or select the best from a pool of heterogeneous workers (Weiss (1980)). Yellen (1984) provides an informal description of the basic ideas and Akerlof and Yellen (1986) present a number of formal models. The hypothesis has also been supported by econometric evidence (Krueger and Summers (1988), Wadhwani and Wall (1990), Drago and Heywood (1992) and Levine (1992)).

In the second section of this Chapter we examine the effect of reductions in hours of work on employment using two efficiency wage models. In the first one, a higher wage increases the effort of the workers and therefore their productivity. In the second, the wage reduces the quitting rate and therefore training costs for the firm, but in this model, any given reduction in hours of work may have a smaller effect on employment, if training costs are assumed to be external to the firm and independent of hours of work.

In both cases we show that under the assumption of a constant elasticity of utility with respect to income the basic results are very similar to the monopoly union model. In partial equilibrium only the direct effect matters if hours are at or above their optimal level for the individual. In general equilibrium a reduction in hours has an uncertain effect on the wage but is likely to reduce unemployment.

2.0 UNION MODELS

2.1 The Basic Monopoly Union Model

Consider the standard monopoly union model (see for instance Oswald (1982)) where a union sets the wage in order to maximise the expected utility of its members subject to employment being determined unilaterally by a profit maximising firm. Union membership (M) is fixed and lay-offs are decided by random draw. If c is consumption and l leisure and if we denote by U(c,l) the common utility function of the union members and assume that there are no savings or dissavings (c=wh) and l = T-h (where T is the maximum number of hours per period), then the union sets the wage in order to maximise:

$$\max_w Z = N\, DU + MV \tag{II.1}$$

subject to $F_N(N,h) = wh$, which is the FOC for maximisation of profits ($P=F(N,h)-whN$, see equation (I.1)). $DU = U(wh,T-h) - V$, w is the hourly wage rate, V and h are the exogenously given levels of utility if unemployed and hours of work per period respectively and T-h is leisure for those employed. We also assume that prices are fixed and U_1, $U_2 > 0$, U_{11}, $U_{22} < 0$. The FOC for this problem is:

$$Z_w = 0 \;\Rightarrow\; N_w\, DU + NhU_1 = 0 \tag{II.2}$$

and SOC is $Z_{ww} = N_{ww}\, DU + 2hN_w\, U_1 + Nh^2 U_{11} < 0$. It follows from equation (II.2) that

$\partial w/\partial h = - Z_{wh}/Z_{ww}$ and $\partial w/\partial h$ will have the same sign as Z_{wh} . Calmfors (1985) derives $\partial w/\partial h$ in the general case and shows that it can not be signed without further assumptions for functional forms. A reduction in hours of work has in general an ambiguous effect on the hourly wage set by a union.

More can be said however by re-arranging equation (II.2) to get - see for instance Manning (1991):

$$U = [\ e_{Nw} \ / \ (\ e_{Nw} \ + e_{Uc}\ )\ ]\ V = k\ V \tag{II.3}$$

The union then sets the wage so that union members' utility is a mark up $k > 1$ on "outside" utility, which will be higher the smaller the absolute value of the elasticity of labour demand with respect to the wage - since in that case any given wage increase will lead to smaller employer losses - and the higher the elasticity of utility with respect to income - since in that case any given wage increase provides a higher benefit to union members.

If we assume that k is constant, by differentiating equation (II.3) with respect to w and h and rearranging we obtain:

$$e_{wh} = - (hU_h/wU_w) = -1 + (U_2 \ / \ wU_1) \tag{II.4}$$

where e_{wh} is the elasticity of the hourly wage with respect to hours of work at the optimum; this elasticity will therefore determine the sign and size of the indirect effect of reductions in hours on employment (second term on the RHS of equation (I.3)).

It follows from equation (II.4) that the elasticity will be equal to minus one, which means that the union will demand an exact compensation for the loss of the per period income of its members -no income sharing - if and only if union members derive no utility from leisure [1] i.e. if and only if $U_2 = 0$.

Although this is a widespread assumption in the union literature it is not a plausible one when examining the effects of hours reductions; it implies that unions have demanded persistently a policy which, ceteris paribus, would decrease the utility of their members and possibly of the unions themselves. Furthermore, both the history of determination of hours (Bienefeld (1972)) and the available survey evidence (Millward and Stevens (1992), Clark and Oswald (1991)) suggest that the issue of hours of work is of great importance to union representatives and members [2]. The evidence suggests that a reduction in hours will not,

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1 The assumption of a constant e_{Uc} is not necessary and the assumption of a constant e_{Nw} only sufficient to deliver the above result. It can easily be proved that if e_{Uc} is not a constant (eg if the utility function is Stone-Geary (SG)) then:

$$e_{wh} = -1 + \{ (e_{Nw} U_2 + whU_{12}) / (wU_1 (1 + e_{Nw} - R_R))\}$$

where R_R is the relative degree of risk aversion. The above expression also equals -1 if $U_2 = U_{12} = 0$. Similarly, if $F(N,h) = F^3(N) + F^4(h)$ and the labour demand elasticity is not a constant, then if $U_2 = U_{12} = 0$, $e_{wh} = -1$.

2 This is evident in the detailed history of hours determination in the UK since 1820, presented in Bienefeld (1972). More recently Clark and Oswald (1988) reported that 93% of the UK unions that responded to their survey "usually negotiated hours of work per week". This is the highest percentage amongst issues other than pay - employment and working practices. Millward et al (1992) report that, other than pay, managers considered working hours to be the most important employee relations issue in 1984 and 1990. Union demands for shorter hours were associated with the longest strike in German history - 6.5 mn days lost in 1984 (Bosch (1986)).

ceteris paribus, leave individual members' utility unaffected. We therefore adopt $U_2>0$, as the more realistic and plausible assumption when examining the effects of reductions in hours of work.

2.1.1 Reductions in Hours and Individual Utility

Additional insight about the likely reaction of the hourly wage can be gained by analysing the effect of a reduction in hours on individual and union utility. Under the assumption that leisure matters, note that the second term of equation (II.4) will be bigger than (equal to) unity if hours are initially above (at) their optimal level for the individual [3]. This is consistent with union demands and means that if the cut in hours increases the individual's utility - and the union's if $\underline{e}_{Nh} \leq 0$ -, or if hours of work are initially at the optimal level for the individual, then a reduction in hours of work will not lead to an increase in the hourly wage.

Note that this prediction is in line with the econometric results reported in the introduction (Nymoen (1989) and our results presented in Chapter V) which failed to establish a negative - let alone a compensating - response of the hourly wage to reductions in weekly hours of work when controlling for other factors influencing the hourly wage (productivity, union power, taxes). Although this is not the only explanation for the absence of such a link - see Nymoen (1989) - our analysis provides a plausible economic rationale within a trade union framework.

[3] The economic rationale underlying these initial conditions is provided in Chapter IV.

The above results suggest therefore that it is misleading to assume that unions will demand compensating increases in the hourly wage following reductions in the length of the workweek, based simply on observation of specific incidents. An explicit modelling of the hours determination process is needed to derive definite welfare/policy implications [4]. Our analysis suggests however that reductions in hours of work are unlikely to lead to an increase in the hourly wage, especially if such reductions are demanded by the unions themselves, as is usually the case.

Is it then possible to provide alternative convincing explanations for what is argued to be an observed negative e_{wh} ? If hours are at (or above) their optimal level for the individual initially then we must drop the assumption that both the mark up (k) and the level of "outside" utility (V) are constant. In order to get an increase in the hourly wage "outside" utility must increase when hours fall. This is not realistic however and in section 2.2 we show that the more plausible result is that utility from employment relative to unemployment increases when hours fall. Alternatively, if the mark-up is not constant - eg if the utility function is Stone-Geary (SG) (Booth and Schiantarelli (1988)) -, differentiate equation (II.3) to obtain:

$$\mathbf{e_{wh} = - (hU_h - hk_hV)/(wU_w - wk_wV)} \qquad \textbf{(II.5)}$$

Assume that hours of work are initially at their optimal level for the individual and e_{Nw} is constant. The wage will increase following a cut in hours as long as the mark-up increases

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[4] See Chapters III and IV, on the determination of hours of work.

(k_h is negative [5]). It seems implausible however to try and explain union demands for increases in the hourly wage as a result of the greater importance of any wage increase following reductions in hours of work.

If the initial level of hours is below the optimal for the individual then U_h is positive and the second term of equation (II.4) is smaller than unity $((U_2/wU_1)<1)$. The wage will therefore increase following a reduction in hours. To determine the conditions under which such a reduction would be desired by the union differentiate Z with respect to hours to get:

$$Z_h = \underline{N}_h \, DU + NU_h \qquad \textbf{(II.6)}$$

where $\underline{N}_h$ denotes the direct effect of hours on employment. A reduction in hours will therefore increase union utility and decrease individual utility if employment increases and the gain to the union from the additional utility of more employed members - the first term of equation (II.6) - outweighs the loss of existing employed members - the second term of equation (II.6).

This is then the only plausible explanation within the monopoly union model with a constant mark-up, for the co-existence of unions demands for lower hours and increases

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[5] This is what will happen if the utility function is SG; a reduction in h increases the elasticity of utility with respect to income and therefore increases the mark-up.

in the hourly wage [6]. Even in this case, inspection of equation (II.4) reveals that the increase in the hourly wage would not compensate fully for the income loss (e_{wh} is absolutely smaller than unity) and some income sharing would result.

2.1.2 Wage Bargaining/ Efficient Bargaining

The monopoly union model has been criticized both because it is not consistent with observed union-firm behaviour and for delivering Pareto inefficient employment-wage outcomes. We deal with the first point by examining the employment implications of reductions in hours when the union and the firm bargain about the wage with the firm then setting employment unilaterally (the so called "right to manage" model (Nickell, (1982)). The reason for examining reductions in hours of work within this context is that when the firm has some power over the determination of the wage and a cut in hours of work reduces or leaves profits unchanged then one would expect that it will be less willing to accept a large hourly wage increase following a reduction in hours of work per period. We assume that the solution to the wage bargaining problem is the symmetric Nash solution in which case w solves:

$$\max_w X = (P-\underline{P})(Z-\underline{Z}) = (F(N,h) - whN)(NDU) \qquad \text{(II.7)}$$

$$\text{s.t. } F_N = wh$$

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[6] Note that optimal hours for the individual and the union will coincide if either $\underline{e}_{Nh}=0$ or the union bargains about the wage and does not care about employment - see next section. The optimal level of hours will also be the same if unions and firms bargain over wages, employment and hours of work - see Chapter IV.

where we made the assumption that the bargaining power of the firm and the union are the same, the fall-back level of union utility ($\underline{Z}$) is MV and the fall-back level of profits ($\underline{P}$) is zero. The FOC for this problem is:

$$\mathbf{X_w = P_w\ Z + Z_w\ P = -hN\ NDU + [N_w\ DU + NhU_l]\ P = 0} \qquad \textbf{(II.8)}$$

and SOC is $X_{ww} < 0$. As is known the wage-employment outcome in this case lies below the monopoly union outcome on the labour demand curve.

In this case $\partial w/\partial h = -\ X_{wh} / X_{ww}$ and therefore the sign of $\partial w/\partial h$ will be the same as the sign of X_{wh}:

$$\mathbf{X_{wh} = P_{wh}\ Z + P_w\ Z_h + Z_{wh}\ P + Z_w\ P_h} \qquad \textbf{(II.9)}$$

Equation (II.9) includes Z_{wh} as one of the arguments and although P_w is negative and Z_w is now positive it is not possible to say in the general case whether a cut in hours is now more likely to lead to a smaller increase in the hourly wage [7]. We can get however an expression similar to equation (II.3) for the union members' utility as a mark up on "outside" utility by rearranging the FOC:

$$\mathbf{U = [(\ -\ e_{Pw}\ -\ e_{Nw}\}/(\ -\ e_{Pw}\ -\ e_{Nw}\ -\ e_{Uc})]\ V = k'\ V} \qquad \textbf{(II.10)}$$

[7] It is possible to say however that if the firm bargains with the union about the wage then $\partial w/\partial h$ is more likely to be a positive (or a smaller negative) number if Z_h is negative and P_h is positive, which is what seems to happen in reality since firms have usually opposed reductions in hours of work.

where $-e_{Pw}$=(Nwh/P). Note that [Nwh/P]=[1/((F/NF$_N$)-1)] and if e_{Nw} is a constant this term will also be a constant [8]. It follows that k'V will also be a constant if e_{Uc} is a constant and the results with regard to the elasticity of the hourly wage with respect to hours (e_{wh}) are identical to the monopoly union case; the wage and employment reaction to a reduction in hours is therefore the same whether the union sets the wage or bargains about it with the firm.

If the union does not care about employment (Layard, Nickell and Jackman (1991), Oswald (1985)) it is easily proved that equation (II.8) can again be rearranged in the above form - with the mark up independent of the labour demand elasticity - and therefore the results with respect to reductions in hours carry through. Furthermore, the first term of equation (II.6) is zero and Z_h has always the same sign as U_h; a reduction in hours is desirable for the union - ie Z_h is negative - if and only if it is also desirable for its members; in this case, the second term of equation (II.4) is larger than unity and the model predicts that the union will accept a cut in the hourly wage if hours of work fall. Note also that if output is a function of employeehours - F(N,h) = F^2 (Nh) - then any movement of hours away from the optimal for the individual in this case is inefficient, in the sense that both the individual and the union will be worse off and profits will be unaffected.

Efficient Bargaining and Simulation Results

Both the monopoly union model and the right to manage model result in a Pareto inefficient wage-employment outcome for the two parties; one or both of the parties can

[8] This is proved by integrating $F_N = e_{Nw}NF_{NN}$ (e_{Nw} = constant).

be made better off without the other party becoming worse off. To deal with this point consider the efficient outcome assuming for simplicity that the union and the firm bargain simultaneously over employment, the wage and hours. Assume again that the solution is the symmetric Nash one in which case the firm's problem and FOCs are:

$$\max_{N,h,w} X = (P-\underline{P})\ (Z-\underline{Z}) = (F(N,h) - whN)(NDU) \qquad \text{(II.11)}$$

$$X_N = P_N\ Z + Z_N\ P = 0 \qquad \text{(II.12)}$$

$$X_h = P_h\ Z + Z_h\ P = 0 \qquad \text{(II.13)}$$

$$X_w = P_w\ Z + Z_w\ P = 0 \qquad \text{(II.14)}$$

Booth and Schiantarelli (BS, 1988) calculate the effects of a reduction in hours of work when they are either set exogenously - i.e. they are not bargained over and equation (II.13) is not satisfied - or they are initially at their optimal level and equation (II.13) is satisfied. Although the theoretical prediction about the response of employment is again uncertain, BS say that simulations of their model for a plausible range of parameter values, imply that a reduction in hours of work is unlikely to lead to an increase in employment. We express doubts however about similar simulation results below (see 2.1.4) because of their unrealistic prediction that union utility might also fall when hours are reduced. Furthermore, when we consider such bargaining models in more detail in Chapter IV, we show that realistic parametrisations of the production and utility functions imply that both union utility and employment are likely to increase following a reduction in hours of work.

2.1.3 Total Effect on Employment

Having examined the likely sign of e_{wh} in the presence of a union we can now turn to the total effect on employment following reductions in hours of work. Recall that the total effect on employment is the sum of the direct and indirect effects, the first and second term of equation (I.3). By substituting equation (I.4) in (I.3) we obtain:

$$\mathbf{e_{Nh} = e_{Nw}\ (1 + e_{wh} - (hF_{Nh}\ /\ wh))} \qquad \textbf{(II.15)}$$

Since in general both the direct and indirect effect are uncertain we present in Table 3 the total effect on employment under different assumptions about F_{Nh} and the sign and size of e_{wh} ($e_{wh} = -1$, $-1 < e_{wh} < 0$, $e_{wh} > 0$).

If, as we have argued, the elasticity of the hourly wage with respect to hours is zero, then the only relevant effect on employment of a reduction in hours is the direct effect ($\underline{e}_{Nh}$) which is presented in the second row of the table, under the total effect (e_{Nh}). This allows us also to see under what conditions a union presence can reverse a direct positive for employment effect and whether these conditions are realistic (Hughes (1980)).

As we move down the table a direct positive employment effect becomes less likely. As we move from right to left an indirect positive employment effect becomes also less likely. Row (e) is more of a theoretical possibility, given the empirical evidence presented in Table 2A and table 2B in Chapter I. Row (a) is also unlikely, since it implies that the output gains from improved efficiency following the reductions in hours of work exceed the loss in output for the marginal worker. We include it however for completeness, since it might be relevant to firms and/or periods of time with significant labour hoarding or where the "efficiency" factor per unit of labour input is very important.

Column (A) leads to the most unfavourable indirect employment effect. This is also the only case in which the indirect effect can definitely counterbalance a direct positive employment effect (case (cA)). We have already argued however that both theory and empirical results suggest that e_{wh} is close to zero; even if it is negative, we should expect it to be closer to zero than to minus one, so that we should consider this possibility to be unrealistic.

In row (d) a fall in hours leads to an equal fall in its marginal product and cost and has therefore no direct effect on employment. In this case union and individual utility move in the same direction; if the union demands a reduction in hours it will also accept an hourly wage cut, if the mark-up is constant - column C; the indirect effect in this case will therefore lead to an increase in employment.

Summarizing the results from Table 3 we note that if the mark-up of union over alternative utility is a constant and leisure matters we can exclude the first column. The empirical results we have reported earlier suggest that $\underline{e}_{Nh}$ is negative or at worst zero so that row (e) can also be excluded. If the direct effect is zero (row (d)) we already argued that the union will not demand an increase in the hourly wage if it also demands the cut in hours so that we can also exclude case (dB). In all but one of the remaining cases a reduction in hours will definitely increase employment. The presence of a union may therefore reverse a direct positive for employment effect in one out of the seven possible outcomes of the table (case (cB)).

2.1.4 Simulation Results of Employment Reaction to Reductions in Hours of Work in the Monopoly Union Model

Other evidence about the total effect on employment from a reduction in hours of work comes from simulation of theoretical models. Booth and Schiantarelli (1988) carry out such simulations using a monopoly union model and assuming that the production technology is CD and the utility function Stone-Geary.

Using estimates for the parameters of interest - elasticities of output with respect to employment and hours, elasticities of utility with respect to consumption and leisure, "reference" levels of consumption and leisure, etc - from other econometric studies they say that a reduction in hours of work is not likely to lead to a rise in employment.

The authors comment however that union utility can also be reduced following a reduction in hours of work for plausible values of the relevant parameters. This result contradicts clearly the well documented persistence of unions for reductions in hours of work since the 1850's (see Bienefeld (1972)).

Furthermore, in a slightly modified model where the elasticity of utility with respect to consumption is constant, employment and union utility move in the same direction if hours are reduced (see Table 3, col. C and Appendix A). If therefore we adopt the realistic assumption that, ceteris paribus, union utility must rise following reductions in hours of work, employment will also rise. The above arguments confirm therefore the sensitivity of simulation results to changes in the functional form assumptions and suggest that results like the ones obtained by Booth and Schiantarelli (1988) must be treated with caution, given their unrealistic predictions about union utility.

2.2 Hours Reductions in General Equilibrium

To examine the effects of reductions in hours of work on unemployment we look at the general equilibrium (GE) implications of a cut in the exogenously given level of weekly hours in a context similar to the partial equilibrium framework already analysed; the difference lies in the assumption made about V, which in GE will be determined rather than taken as exogenous. Note that expected utility if not employed by the firm (V) is [9]:

$$\mathbf{V = u\ U(\underline{b},T) + (1\text{-}u)\ U(\underline{w}h,T\text{-}h)} \qquad \textbf{(II.16)}$$

where u is the unemployment rate with N = L(1-u), L is the constant labour force, $\underline{b}$ the unemployment benefit, $\underline{w}$ the alternative wage and leisure when unemployed is T. Since all firms and unions are identical in general equilibrium $\underline{w}$ is equal to w. By substituting w=$\underline{w}$ and equation (II.16) in equation (II.3) we obtain:

$$\mathbf{U(wh,T\text{-}h) = k\ \{uU(\underline{b},T) + (1\text{-}u)U(wh,T\text{-}h)\}} \qquad \textbf{(II.17)}$$

Denoting utility when unemployed ($U^u = U(\underline{b},T)$) to utility when employed ($U^e = U(wh,T-h)$) by B, substituting for k and re-arranging equation (II.17) we can solve for the unemployment rate:

Unemployment condition: $\mathbf{u = -\ [e_{Uc} / e_{Nw}]\ (1\text{-}B)^{-1}}$ **(II.18)**

[9] Layard and Nickell (1990) have an exposition of the approach.

If e_{Nw} and e_{Uc} are constant any changes in the unemployment rate will come through B; unemployment will thus be increasing in U^u and decreasing in U^e. To solve for the wage note that the partial equilibrium employment condition, equation (I.2) becomes the general equilibrium wage condition:

Wage condition: $$F_N\ (L(1-u),h) = wh \qquad \text{(II.19)}$$

We have plotted equations (II.18)-(II.19) in Figure 2 as the u-line and w-line respectively. Measuring unemployment on the horizontal axis and wages on the vertical, the w-line slopes upwards since the marginal product of labour is falling.

The u-line will have a negative slope if the ratio of U^u to U^e (B) is decreasing in the wage - Proposition 1, Appendix B. When the elasticity of utility with respect to consumption is constant this will be true if the unemployment benefit $\underline{b}$ is partially indexed or not indexed at all to the hourly wage. In this case a higher wage leads to a smaller increase in U^u relative to U^e so that the ratio (B) falls; this means that unemployment will be lower and the u-line is negatively sloped. If $\underline{b}$ is fully indexed to the hourly wage then the proportional increase in utility from unemployment and employment following an increase in the hourly wage is the same, B is constant and the u-line is vertical - see Pissarides (1985) and references therein. Figure 1 assumes partial indexation in which case the initial equilibrium unemployment rate is u1.

A fall in hours of work will shift the w-line inwards if it leads to higher employment for a given wage in partial equilibrium - see equation (I.4). If the production technology is

CD, this means that **b**, the elasticity of output with respect to hours, must be smaller than unity.

The u-line will shift inwards following a reduction in hours of work if utility from employment relative to utility from unemployment increases. This will be true if:

(a) hours are above the optimal level for the individual initially - so that U^e increases and B falls -, <u>or</u>

(b) hours are at their optimal level for the individual initially but the unemployment benefit is indexed - partially or fully - to hours of work so that utility when unemployed and B fall - Proposition 2, Appendix B.

The u-line will not shift if a change in hours does not affect B - $B_h=0$. When this assumption is made with respect to hours of work - Johnson and Layard (1984) - and workers derive some utility from leisure, it will only hold if a change in hours does not affect U^u - <u>b</u> is <u>not</u> indexed to hours - ***and*** U^e - hours are at their optimal level for the individual initially. The replacement ratio - unemployment benefit divided by basic weekly earnings - has remained fairly constant in the long-run however (see Figure 20 in Chapter V), which suggests that the unemployment benefit is indexed to hours - or weekly/monthly earnings - rather than the hourly wage alone. In Chapter IV we show also that there is no reason to expect, within an efficient bargaining framework, actual hours of work to be at the optimal level for the individual.

Table 4 summarises the unemployment outcomes for the eight cases combining the assumptions of a vertical or negatively sloped u-line with inwards or no shifts of the two curves. Given the evidence on the replacement ratio the last row of Table 4 is unrealistic. It follows that a reduction in hours is likely to lead to a reduction in the unemployment rate by increasing directly the number of employees needed for any given volume of work and by making employment more attractive relative to unemployment.

For a constant mark-up and for a given shift of the w-line, the reduction in unemployment will be larger, the more actual hours exceed the optimal for the individual, the less the unemployment benefit is indexed to the hourly wage and the fuller the unemployment benefit indexation to hours.

3.0 EFFICIENCY WAGE MODELS

3.1 Employment and Hours Reductions in the Basic Model

To illustrate the effects of hours reductions within efficiency wage models we will use first the most general version of the standard model where output depends on employeehours [10] multiplied by the "effort" or "efficiency" function. This in turn is a function of utility with the firm (U(wh,T-h)) relative to expected "outside" utility (V) which we assume to be constant in partial equilibrium. The firm sets employment and the wage to maximize:

$$\max_{N,w} P = F(Nhe(R)) - whN \qquad \textbf{(II.20)}$$

with R = (U/V), e' > 0 and e'' < 0. By solving the FOCs we obtain the familiar elasticity result, modified to take into account the effect of a change in the wage on utility:

$$e_{Uc} R (e'/e) = 1 \qquad \textbf{(II.21)}$$

The wage is therefore set so that the elasticity of the effort function [R (e'/e)] times the elasticity of utility with respect to consumption (e_{Uc}) is unity. If e_{Uc} is constant then by rearranging equation (II.21) and solving for R we get:

[10] Using the general F(Ne,h) instead of F(Nhe) does not affect the main argument. We comment where other results should be modified.

$$R = f' (e_{Uc}) = k_1 \quad \Rightarrow \quad U = k_1 V \qquad \text{(II.22)}$$

Utility is therefore again a mark-up k_1 on outside utility (V); it follows that for constant k_1 and V, the expression for the elasticity of the hourly wage with respect to hours of work is identical to the expression we derived in the monopoly union case -equation (II.4); the wage reaction following a reduction in hours in the two cases is therefore the same.

Employment will again be affected directly and indirectly; to see this solve the FOCs to get:

$$F'(Nhe)\ e = w \qquad \text{(II.23)}$$

If hours are initially at the optimal level for the individual then a reduction in hours of work will not affect the wage which means that the RHS of equation (II.23) is constant. Since effort is a constant ($e(R) = e(k_1)$) it follows that for equation (II.23) to hold F' must remain constant. Hence, by differentiating the LHS of this equation we obtain that the elasticity of employment with respect to hours is minus one ($\underline{e}_{Nh} = e_{Nh} = -1$) [11].

If hours are above the optimal level for the individual then, ceteris paribus, a reduction in hours of work makes the employees better off and therefore allows the firm to offer a lower hourly wage. This means that the LHS of equation (II.23) must fall and since effort

[11] The elasticity can be smaller (absolutely) for different forms of F - see Table 1 in Chapter I.

remains constant, employment will increase more than proportionately to the hours fall [12].

In this case the utility maximising level of hours is also the efficient one, in the sense that any move away from that level will make the employee worse off and leave the firm indifferent; a change in hours does not affect profits if the firm chooses employment since effort is constant [13]. It follows that a reduction in hours away from the optimal - which would be needed in order for the hourly wage to increase following a reduction in hours - would never be efficient since it would leave the firm indifferent but make the employee worse off.

To examine now the effects of reductions in hours of work on unemployment we follow the same steps as in section (2.2); assuming that V is given as in equation (II.16) we can again derive an expression for unemployment from equation (II.22):

Unemployment condition: $\mathbf{u = [k_1/(k_1-1)]\ (1-B)^{-1}}$ **(II.24)**

Similarly, since N = L(1-u) using equation (II.23) we get [14]:

Wage condition: $\mathbf{F'(L(1-u)he)\ e = w}$ **(II.25)**

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[12] A necessary and sufficient condition for this is that $F''<0$.

[13] This is not necessarily true if F does not take the form F(Nhe).

[14] If F takes the form F(Ne,h) then the wage condition would take the form $F_N(L(1-u)e,h) = wh$.

If the elasticity of utility with respect to income is constant - and the labour demand elasticity in the monopoly union case -, changes in hours will affect unemployment and the hourly wage through equations (II.24)-(II.25) as they did through (II.18)-(II.19), since effort is constant. The results with respect to the effects of reductions in hours on unemployment and the hourly wage are therefore identical to the union case.

3.2 Employment, Hours Reductions and Quitting Costs

An alternative version of the efficiency wage hypothesis assumes that a higher wage implies a fall in the quitting rate and therefore a reduced cost for the firm because of lower training and firing - costs (Salop (1979)). In the most general formulation of the quitting function, an employee will be less likely to quit the higher the benefit of staying with the firm relative to outside opportunities. We assume therefore that the quitting rate will depend negatively on R = (U/V). The rest of the problem is standard so that the firm sets employment and the wage to maximize:

$$\max_{N,w} P = F(N,h) - whN - G\,N\,q(U/V) \qquad \textbf{(II.26)}$$

where q is the net quit rate, with $q'<0$. We assume that the training costs are internal to the firm so that every period the firm has to hire qN employees which leads to training costs G=gwh per employee. From the FOCs with respect to employment we obtain a slightly modified version of equation (I.6), taking into account the quitting rate:

$$F_N(N,h) = wh\,(1 + gq) \qquad \textbf{(II.27)}$$

The FOC with respect to the wage is:

$$1 + gq + gq'e_{Uc}\,R = 0 \qquad \textbf{(II.28)}$$

Rearrange equation (II.28), noting that q and q' are functions of R, to obtain:

$$R = f^{5}(g, e_{Uc}) \implies U = k_2 V \qquad \text{(II.29)}$$

where k_2 is constant if g and e_{Uc} are constant. Utility with the firm is therefore again a mark-up on V and a reduction in hours will have exactly the same effect on the hourly wage as in the monopoly union case - equation (II.4) - and previous efficiency wage model - equation (II.22) [15]; if hours are initially at (above) the optimal for the individual level then the hourly wage will remain unchanged (fall). Employment will rise if the fall in its marginal cost - RHS of (II.27) - is larger than the fall in its marginal product (F_{Nh}).

To understand the results in this context note that if hours are at their optimal level initially then a reduction in hours does not affect the quitting rate and implies a proportional fall in variable employment - whN - and training - gwhNq - costs. The marginal cost and benefit of a wage rise fall proportionately and the hourly wage is therefore unaffected. The marginal cost of employment on the other hand falls following the reduction in hours by w(1+gq). If the marginal product of employment is not affected (F_{Nh}=0) or if it falls by less than its marginal cost (F_{Nh}<w(1+gq)) then employment will increase, just like in the basic labour demand model in Chapter I.

If hours are above the optimal level for the individual initially, then a reduction will, ceteris paribus, reduce the quit rate and lead to a fall in the hourly wage. An increase in employment is now more likely compared to the case where hours were at their optimal

[15] In general equilibrium we can use equations (II.27) and (II.29) together with the equation for V - (II.26) -, to derive again the wage and unemployment conditions. These are identical to the monopoly union case but for the fixed costs - Table 1 in Chapter I -, so we do not report them here.

level initially, since the reduction in hours will lead to a larger fall in the marginal cost of employment [16].

If training costs are external to the firm but proportional to hours - which will be true if hours are reduced throughout the economy - then the results are qualitatively identical to the case we just analysed. In Appendix G in Chapter III, we provide a formal model where a firm choosing the length of the training period for its workers and the amount of training per period in order to maximise profits can find it optimal, under quite general assumptions, to index its training costs to basic weekly earnings.

If training costs are external to the firm and independent of both hours of work and the hourly wage (G=constant), the effects on the wage and employment may be different. In this case the FOCs with respect to employment and the wage are:

$$\mathbf{F_N(N,h) = wh + Gq} \qquad \mathbf{(II.30)}$$

$$\mathbf{1 + Gq'e_{Uc}\, R = 0 \;\Rightarrow\; wh + Gq\; e_{qR}\; e_{Uc} = 0} \qquad \mathbf{(II.31)}$$

A reduction in hours of work will now reduce variable labour costs (whN) but will not affect training costs (GqN), if hours are at the optimal level for the individual initially ($U_h=q_h=0$). Since from equation (II.31) the ratio of variable labour costs to training costs

[16] Note that a fall in hours reduces the marginal cost of employment by [w(1+gq) + whgq$_h$], since the firm sets the wage. If hours are above the optimal for the individual level initially then $U_h<0$, $q_h>0$, so that the marginal cost of employment will fall by more than in the case where hours are at the optimal level for the individual initially ($U_h = q_h = 0$).

must be constant at the optimum [17], a higher wage is needed to bring back this equality. Employment is therefore less likely to rise. Note that, even for a given wage, the structure of training costs implies that employment is less likely to rise. This is because the marginal cost of employment (RHS of equation (II.30)) falls by less that in the case where training costs are linear in hours of work.

If hours are above the optimal for the individual ($U_h<0$), a reduction will lead to a lower quit rate and will therefore imply again a fall in variable labour costs (whN) and training costs (GqN). The reaction of the wage becomes uncertain and could rise, fall or remain unchanged depending on the size of U_h. Employment is again more likely to increase because of a larger fall of its marginal cost, compared to the case where hours were optimal for the individual.

In general equilibrium now, maintaining the assumptions of a constant e_{Uc} and e_{qR} and assuming that the unemployment benefit is fully indexed to the wage, a reduction in hours will increase unemployment if (a) hours are at the optimal level for the individual initially <u>and</u> (b) the unemployment benefit is not indexed to hours of work. This corresponds to the last row of Table 4 which we assessed as very unlikely and, if either of these two assumptions is not satisfied, the result becomes uncertain. Even the least favourable training costs structure for the effectiveness of hours reductions, does not necessarily imply therefore that a reduction in hours will increase unemployment.

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[17] This follows from equation (II.31) if the elasticity of the quitting function with respect to R (e_{qR}) is constant. This is true at the optimum when training costs are internal (G=gwh).

Hoel and Vale (1986) and Layard et al (1986) however, derive negative for unemployment results by using this cost structure. In the efficiency wage model of Layard et al, the firm is assumed to use a production technology with output proportional to hours ($F(N,h)=h F^1(N)$). The FOC with respect to employment is:

$$\mathbf{hF^{1\prime}(N) = wh + Gq} \qquad \textbf{(II.32)}$$

It is easy to show that in this case, and for given w and q, employment will fall following a reduction in hours since the marginal cost of employment falls by less than its marginal product. If the firm sets also the wage then lower hours can have an additional effect on employment through the wage (and q) on the RHS of equation (II.32). It is easy to show however, that any change in the wage does not affect the RHS of equation (II.32) precisely because the firm sets the wage. It follows that whether the firm sets the wage or not, a cut in hours in this model will reduce employment and that is a direct effect of the structure of training costs. The efficiency wage argument made by Layard et al is therefore irrelevant to the result they obtain. The empirical evidence we have already presented - see Tables 2A and 2B in Chapter I - suggests that output is not linear in hours and that a reduction in hours has a direct positive effect on employment.

Hoel and Vale (1986) assume that the new qN workers hired every period work only h-T hours in which case effective labour input is Nh-qNT and the firm's problem is:

$$\mathbf{\max_{N,w} P = F(N(h-Tq)) - whN} \qquad \textbf{(II.33)}$$

Because the quit rate is now included in the production function any change in hours will have in addition to the direct effect on employment [18] an effect through the wage - strictly speaking the quit rate. The direct effect is uncertain but a reduction in hours will now lead to an increase in the hourly wage, if hours are at the optimal for the individual level initially, and therefore to a negative indirect employment effect.

Note however that Hoel and Vale's results depend crucially on the assumption they make about training time being independent of hours. If training is internal however then one would expect it to be proportional to hours of work. If it is external then again one would expect the time spent training to be reduced when hours are reduced, to the extent that the aim of the exercise is to evaluate the effects on employment of economy-wide hours reductions. Furthermore we show in Appendix G of Chapter III that, under quite general assumptions, indexation can be the optimal response of a profit maximising firm. It follows that T=th is a more attractive formulation in which case the results are identical to the first case we analysed in this section; any reduction in hours implies no change (a reduction) in the hourly wage if hours are at (above) the optimal level for the individual initially and leads to a proportional increase in employment.

Hoel and Vale (1986) ignore this possibility and conclude that "reduced working hours are likely to increase unemployment". This is not a proposition supported by any of the models presented in this section or the empirical evidence presented in the introduction. The more plausible conclusion - which the authors, somewhat paradoxically, also draw - is that it is possible to construct an efficiency wage model where reductions in hours

[18] A fall in hours will again imply, ceteris paribus, a smaller increase in employment.

increase unemployment but we would not consider this to be a surprise finding.

Schmidt-Sorensen (1991) allows for a number of different channels through which changes in hours can affect productivity. His results suggest also that the effect of shorter hours on employment is uncertain, allowing for a general form of the effort function and overtime.

The last model we examine very briefly in this section is the shirking model of Shapiro and Stiglitz (1984). A reduction in hours in this model can reduce the incentive to shirk by reducing the gain from shirking - assume that effort is proportional to hours of work i.e. e=h$\underline{a}$, where $\underline{a}$ can be interpreted as a factor transforming actual hours (h) into "effort units" (e). In this case the wage premium the firm needs to pay to avoid any shirking taking place is also reduced and with it the amount of equilibrium unemployment.

In summary, a reduction in hours of work in efficiency wage models in partial equilibrium, will probably have no effect on the hourly wage and will lead to an increase in employment. In general equilibrium, a reduction in hours will have an uncertain effect on the hourly wage but is most likely to lead to a fall in unemployment, just like in the union models.

If training time is independent of hours of work then a reduction in hours can lead to a higher hourly wage. We expressed our doubts about the realism of the assumption but even if it is partially true, the intuition behind it is not related to income compensation. It is related rather to cost reduction through a lower net quitting rate; we doubt that the size of any such effect will be significant in practice.

Conclusions

The aim of this Chapter was to use a union and efficiency wage framework to assess the conditions under which reductions in hours of work will have a negative indirect employment effect. We found that the impact of reductions in hours of work on the wage depends on:

- the constancy of e_{Uc}/e_{Nw} and the initial level of hours relative to the optimal for the individual,

- the extent of indexation of the unemployment benefit to hours, if any, and

- the structure of training costs and in particular the degree of indexation to hours.

If the elasticity of labour demand with respect to the wage (e_{Nw}) and the elasticity of utility with respect to consumption (e_{Uc}) are constant then, a reduction in hours of work will leave the hourly wage unchanged (reduce it) if hours are initially at (above) the optimal level for the individual. This proposition holds true in union and efficiency wage models alike. In general equilibrium, a reduction in hours of work will lead to a lower wage and a reduction in unemployment if it increases the utility from employment relative to unemployment. This will be true if hours are initially below the optimal level for the individual or if hours are at their optimal level for the individual and the unemployment benefit is partially or fully indexed to hours of work.

TABLE 3

Total Effect on Employment of Reductions in Hours of Work

	(A)	(B)	(C)
	$e_{wh} = -1$	$e_{wh} > -1$	$e_{wh} > 0$
a) $F_{Nh} < 0$ [1]	$e_{Nh} < 0$ $\underline{e}_{Nh} < 0$	$e_{Nh} < 0$ $\underline{e}_{Nh} < 0$	$e_{Nh} < 0$ $\underline{e}_{Nh} < 0$
b) $F_{Nh} = 0$ [2]	$e_{Nh} = 0$ $\underline{e}_{Nh} = e_{Nw}$	$e_{Nh} < 0$ $\underline{e}_{Nh} = e_{Nw}$	$e_{Nh} < 0$ $\underline{e}_{Nh} = e_{Nw}$
c) $0 < F_{Nh} < w$ [3]	$e_{Nh} > 0$ $\underline{e}_{Nh} < 0$	e_{Nh} >or≤ 0 $\underline{e}_{Nh} < 0$	$e_{Nh} < 0$ $\underline{e}_{Nh} < 0$
d) $F_{Nh} = w$	$e_{Nh} = -e_{Nw}$ $\underline{e}_{Nh} = 0$	$0 \leq e_{Nh} < -e_{Nw}$ $\underline{e}_{Nh} = 0$	$e_{Nh} < 0$ $\underline{e}_{Nh} = 0$
e) $F_{Nh} > w$	$e_{Nh} > -e_{Nw}$ $\underline{e}_{Nh} > 0$	$e_{Nh} > 0$ $\underline{e}_{Nh} > 0$	e_{Nh} >or<0 $\underline{e}_{Nh} > 0$

NOTE: If $e_{wh}=0$, the total effect on employment is given in the second row.

[1] $F(N,h) = F^2(Nh)$ and $-hNF^{2''} > F^{2'}$. This is however an unlikely possibility.
[2] $F(N,h) = F^3(N) + F^4(h)$.
[3] $F(N,h) = N^a h^b$. The results assume $b<1$.

TABLE 4

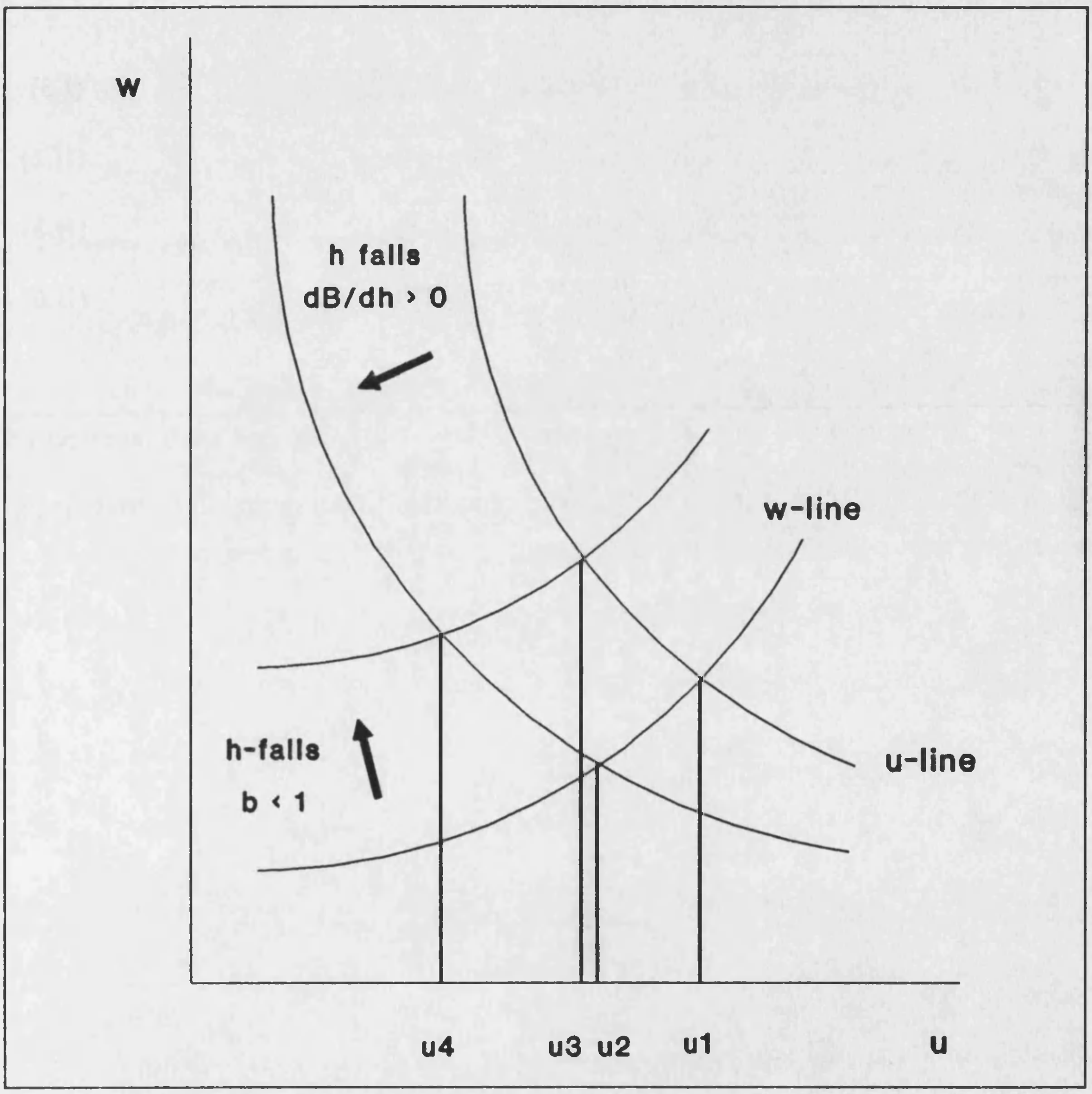
Unemployment Effects of Reduction in Hours of Work

			w-line	
			Inward Shift (if CD b<1)	**No Shift** (if CD b=1)
u-line (constant mark-up, $U_2 > 0$)	**Negative Slope** $e_{\underline{b}w} = 0$ or $e_{\underline{b}w} < 1$	**Inwards Shift** $h > h^*$ or $h=h^*$ & $e_{\underline{b}h} \leq 1$	u4=ua < ub	u2=ua<ub
		No Shift $h=h^*$ & $e_{\underline{b}h}=0$	u3=ua < ub	u1=ua=ub
	Vertical Slope $e_{\underline{b}w} = 1$	**Inwards Shift** $h > h^*$ or $h=h^*$ & $e_{\underline{b}h} \leq 1$	ua < ub	ua < ub
		No Shift $h=h^*$ & $e_{\underline{b}h}=0$	ua = ub	ua = ub

ua/ub unemployment rate after/before hours reduction (u4<u3<u2<u1, see Fig.1).
$e_{\underline{b}x} = 0$ unemployment benefit not indexed to x.
$e_{\underline{b}x} \leq 0$ unemployment benefit partially/fully (</=) indexed to x.

FIGURE 2

Wages and Unemployment in General Equilibrium



APPENDIX A

Proof of proposition of section 2.1.4 that employment and union utility move in the same direction if the mark-up is a constant. To prove the result we will use these four equations:

$$e_{Nh} = \underline{e}_{Nh} + e_{Nw}\, e_{wh} \qquad \text{(I.3)} \quad \text{(A1)}$$

$$N_w\, DU + NU_w = 0 \qquad \text{(II.2)} \quad \text{(A2)}$$

$$U(wh,T\text{-}h) = k\, V \qquad \text{(II.3)} \quad \text{(A3)}$$

$$Z_h = \underline{N}_h\, DU + NU_h \qquad \text{(II.6)} \quad \text{(A4)}$$

Note that in equation (A4) we use $\underline{N}_h$ to indicate the direct rather than the total effect (N_h) on employment of reductions in hours. Rewrite equation (A1) in partial derivative form:

$$N_h = \underline{N}_h + N_w\, w_h \qquad \text{(A5)}$$

From equation (A3) it follows that:

$$\partial w/\partial h = -\, (U_h/U_w) \qquad \text{(A6)}$$

From equation (A2) it follows that:

$$DU = -\, (NU_w/N_w) \qquad \text{(A7)}$$

Put (A6) in (A5), substitute $\underline{N}_h$ from (A5) and DU from (A7) in (A4) to get:

$$\mathbf{Z_h = \{N_h - N_w\,(-U_h/U_w)\}\,(-NU_w/N_w) + NU_h \qquad \Rightarrow}$$

$$\mathbf{Z_h = -\,(NU_w/N_w)\,N_h} \tag{A8}$$

N_w is negative and therefore N_h and Z_h will have the same sign if the mark-up is constant.

APPENDIX B

Proof of propositions in section 2.2. The equations for the ratio of utility when unemployed to utility when employed (B) and for unemployment are:

$$B = U^u/U^e = U(\underline{b},T)) \;/\; U(wh,T\text{-}h) \qquad \text{(B1)}$$

$$u = -\;[e_{Uc} \;/\; e_{Nw}]\;(1\text{-}B)^{-1} \qquad \text{(II.18)} \quad \text{(B2)}$$

Proof of Proposition 1: "If e_{Uc} and e_{Nw} are constant the u-line will have a negative slope if $\underline{b}$ is indexed partially or not at all to w. The u-line is vertical if $\underline{b}$ is fully indexed to w".

It follows from equation (B2) that:

$$\partial u/\partial w_{\;h=const} = k2\;(B_w) \qquad \text{(B3)}$$

Since k2 is positive (B3) implies that $\partial u/\partial w$ will have the same sign as B_w ($B_w=\partial B/\partial w$). The u-line will be vertical in w-u space if $B_w=0$.

Differentiating equation (B1) with respect to the wage and rearranging we get:

$$B_w = (U^u/wU^c)\ e_{Uc}\ \{e_{\underline{b}w} - 1\} \qquad \textbf{(B4)}$$

If $\underline{b}$ is partially indexed ($e_{\underline{b}w}<1$) or not indexed at all to the hourly wage ($e_{\underline{b}w}=0$), B_w is negative and the u-line is negatively sloped. If $\underline{b}$ is fully indexed to the hourly wage ($e_{\underline{b}w}=1$), $B_w = 0$ and the u-line is vertical.

<u>**Proof of Proposition 2**</u>: "If hours are at their optimal level for the individual initially the u-line will not shift (shift inwards) if $\underline{b}$ is <u>not</u> indexed (partially or fully indexed) to hours. If hours are above the optimal level for the individual initially the u-line will shift inwards".

It follows again from equation (B2) that :

$$\partial u/\partial h_{\ w=const} = k2\ (B_h) \qquad \textbf{(B5)}$$

The u-line will shift inwards following a reduction in hours in w-u space if B_h is positive and will not shift if $B_h=0$.

Differentiating (B1) with respect to hours and rearranging we get:

$$B_h = (U^u/hU^c)\ \{(e_{Uc}\ e_{\underline{b}h}) - e_{Uh}\} \qquad \textbf{(B6)}$$

where e_{Uh} is the total elasticity of utility with respect to hours of work ie it includes the effect through a change in consumption.

If hours are initially at their optimal level then e_{Uh} is zero and $B_h \geq 0$ iff $e_{bh} \geq 0$. If hours are above the optimal level for the individual, then e_{Uh} is negative and B_h is positive.

CHAPTER III

REDUCTIONS IN HOURS OF WORK, EMPLOYMENT AND WAGES WITH POSITIVE OVERTIME

Introduction

In this Chapter we examine the effects of reductions in standard hours of work on employment when actual hours of work are chosen endogenously and exceed the exogenously determined level of "standard" or "normal" hours (h_s) - ie there is positive overtime. This can be justified on the grounds that the level of actual hours may be determined regularly at a firm or industry level whilst the level of standard hours is determined at a higher level at infrequent intervals and is taken as given by the individual firm and union.

There are two reasons for examining the case of positive overtime separately. First, the theoretical predictions about the effects of reductions in standard hours of work on employment can be the opposite of the case where overtime is zero and since the incidence of overtime is uneven [1] the analysis of this Chapter is only relevant to those sectors/plants that use extensive overtime. Second, since actual hours are now determined endogenously, more can be said about the economic efficiency of reducing standard hours of work. Such arguments could not be made in Chapter II since we did not provide there a detailed framework about the way in which the level of hours of work is determined initially.

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[1] More than 60% of operatives in GB manufacturing worked no overtime at all in 1989 - see Table 6. In the detailed study of Ehrenberg (1971), 37% of his 2,013 establishments in non-manufacturing industries used no overtime at all. Most manufacturing industries did but there is very large variability in overtime hours worked both across different industries and across establishments within the same industry.

The existence of overtime is considered to be one of the main reasons for which reductions in standard hours of work may not lead to significant employment gains (Allen (1980), Hart (1987), Booth and Schiantarelli (1988), Calmfors and Hoel (1988)). The reason is simple: when the firm sets employment and actual hours of work, a reduction in standard hours is equivalent to an increase in fixed costs of employment. It therefore leads unambiguously to a fall in employment as firms substitute more expensive "employees" with extra hours of work.

The main problem with this approach however is that for most "standard" production function formulations, a reduction in standard hours is accompanied by an increase in actual hours of work. The prediction is clearly against the empirical evidence which suggests that the elasticity of demand of actual with respect to standard hours is positive and near unity (Hart and Sharot (1978), Bodo and Giannini (1985), Bosworth and Westaway (1985, 1987)). An argument could be made that this reflects compositional effects, since the aggregate observations include overtime and non-overtime establishments. This is clearly rejected however by the very detailed study of Hart and Wilson (1988) covering 52 establishments in the UK Metal Working industry for the 1978-82 period. The authors distinguish explicitly between overtime and non-overtime establishments and find a significant positive elasticity of actual with respect to standard hours, in the **overtime** establishments (+0.802).

The prediction is also not supported by survey evidence; White (1983), after surveying 123 firms that introduced shorter hours in 1981 in the engineering and printing industries, comments that attitudes to overtime seemed to have changed from "inevitable consequence" in 1979 to "actively trying to reduce it" in 1981.

The predicted increase in actual hours is also against the long-run movement of average weekly hours in most industrialised countries, especially in Europe [2] - see Table 7. The conventional explanations for this trend are a positive relationship between standard and actual hours on the supply side due to a strong income effect and structural changes in the labour market - increased participation of women and part-time workers. It is difficult to accept the first argument as sufficient explanation if, ceteris paribus, following a reduction in standard hours, the demand for actual hours increases. The explanation is even more implausible given the very low estimates of the elasticity of hours demand with respect to the wage (Pencavel and Holmlund (1988), Riechel (1986), Bosworth and Westaway (1987)).

Concerning compositional and structural changes in the labour market note that the figures of Table 7 refer to manufacturing which has witnessed relatively minor structural changes - see Wilson (1985, Table 2.9) for a detailed analysis of the UK. Even in this case the long-run paths of actual hours are fairly similar across countries that have witnessed different changes in the structure of their labour markets. In Figure 3 and Figure 4 we show also that a negative long-run trend is present in actual hours worked by male manual full-time workers in GB manufacturing; these are the workers who work predominantly overtime - see Table 8. Structural and compositional changes in the labour force, can not provide

[2] In the US, a very large reduction in weekly hours has taken place in the pre-war period; average weekly hours of work have fallen by 32% in the 1900-1940 period (Kniesner (1976)). In the post-war period, the level of annual hours of work has been reduced mainly with increases in holidays rather than further reductions in the length of the working week.

therefore a satisfactory explanation of this trend.

We show in this Chapter that a realistic modification of the assumptions concerning the fixed cost and payment structure implies that demand for actual hours of work will be a positive function of standard hours. This means that reductions in standard hours can have a positive effect on employment and we determine the conditions under which this will be true.

We examine next the effects of lower standard hours of work on employment when the wage is determined endogenously. The structure is similar to the models analyzed in Chapter II so we present only the case where the wage is determined by a monopoly union. We show that the union is now even less likely to demand an increase in the hourly wage, compared to the case where there was no overtime; employment is therefore even more likely to increase.

The endogenous determination of hours of work allows us also to address the relatively unexplored issue of the economic efficiency reasons behind demands for reductions in the length of the workweek. In this Chapter we concentrate on the implications of the bargaining structure. We show first why unions might demand reductions in standard hours, if the first best solution of simultaneous bargaining over all relevant variables can not be implemented. We then present the conditions under which such reductions will be efficient. We show next that even when employment, hours of work and wages are bargained over simultaneously between the union and the firm, reductions in standard hours can improve efficiency and increase employment.

4.0 LABOUR DEMAND WITH POSITIVE OVERTIME

4.1 Sources and Movement of Overtime

Almost all studies examining overtime take the existence of a two-tier wage schedule as given. We also make this assumption in the models analysed in the remainder of this Chapter, but we review very briefly here some of the reasons offered for the existence of an overtime premium.

When hours paid at a premium are perfect substitutes for hours payed at normal rates [3], the basic explanation for the existence of an overtime premium is wage discrimination on the part of monopsonistic employers (Bilas (1984)). Trejo (1991) has argued that in a large number of cases where firms offer overtime, they offer weekly earnings that do not differ from equivalent non-overtime jobs, by paying a lower standard wage.

If on the other hand, demand for overtime hours is more inelastic than demand for normal hours, it will be in the interest of unions to wage discriminate between normal and overtime hours - see Appendix C. In the face of uncertainty, firms are also likely to offer state dependent overtime (Ashworth et al (1977)) [4]. The varying cyclical patterns of

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[3] This is not necessary always the case, see Santamaki (1988).

[4] In the model of Ashworth et al (1977) employment is fixed and cannot change after the realisation of demand which corresponds to frequent relatively "small" demand shocks. Note that in the equivalent certainty case the firm will offer no overtime so that the positive overtime outcome is purely a result of the uncertainty and the assumption about constant employment.

different industries contribute then to the existence of positive overtime hours throughout the cycle.

Ehrenberg (1970) has also shown that in the face of a perfectly anticipated absentee rate, firms will use overtime because overtime payments will only be made if an employee is present whereas the firm will have to incur the fixed cost of hiring and training an employee, whether the employee is present or not. The proposition has found some support in a positive and significant relation between work injury rates and overtime (Mabry (1976)) but the direction of causality could be questioned.

In empirical studies, demand for overtime hours is usually modelled as an increasing function of fixed costs of employment and a decreasing function of the overtime premium (Appendix D, Hart (1987)). The empirical evidence however is somewhat mixed. Ehrenberg (1971) has used cross-section 1966 data from 4,009 establishments for the US non-agricultural sector to estimate an overtime hours equation by industry. He found that the ratio of fixed employment costs to overtime premia is positively related to overtime hours for all 24 industry groups, but he does not report separate coefficients. Bosworth and Westaway (1987) on the other hand, using quarterly post-war UK aggregate data, found a significant positive effect on overtime from higher fixed costs but no effect from the overtime premium.

Tables 6 and 8 and Figures 3 and 4 provide some evidence on the occupational characteristics of the workers working large amounts of overtime, the distribution of overtime hours and percentage of operatives on overtime and the movement of average overtime hours in the UK in the post-war period. The evidence on the distribution of standard and actual hours suggests that it is the majority of manual males that work overtime - see Table 8.

Table 6 reports the breakdown of overtime into the proportion of operatives working overtime and average overtime hours per operative in 16 manufacturing industries in 1970, 1980 and 1989. For the whole manufacturing industry, in 1989, less than 40% of operatives worked any overtime, but there is some variability across industries. The correlation between the two variables is positive but not significant; the Chemical Industry for instance, has the second lowest percentage of operatives on overtime but the highest level of average overtime hours [5].

Both overtime hours and the percentage of operatives on overtime are cyclical depending on the industry (eg Motor Vehicles, Timber and Furniture) and are relatively stable for less cyclical industries (eg Other Transport Equipment and Food, Drink and Tobacco).

Figures 3 and 4 show the path of actual and standard hours for full-time manual males in UK Manufacturing. Figure 4 includes a linear trend which shows a small positive long-run trend in overtime, but the period is somewhat short for a definite conclusion. For a detailed descriptive analysis of the way in which overtime hours have developed in post-war UK by occupation and by industry see Wilson (1985).

[5] Our analysis concentrates on the level of overtime hours. The percentage of operatives or workforce on overtime is taken to be exogenous throughout.

4.2 Employment and Reductions in Standard Hours of Work

In all of the models examined in this section we will assume that the firm faces a given overtime premium (r), which it must pay for the number of hours it demands in excess of the exogenous level of standard hours. We assume also for simplicity, that standard and overtime hours are perfect substitutes in production and fixed employment costs are proportional to the hourly wage ($G=g_1w$). The firm's problem then is to choose actual hours of work and employment - the number of employees - to maximise [6]:

$$\max_{N,h} P = F(N,h) - Nwh_s - Nw(1+r)(h-h_s) - g_1wN \qquad \text{(III.1)}$$

By rearranging the cost side of equation (III.1) we obtain:

$$\max_{N,h} P = F(N,h) - Nw(1+r)h - Nw(g_1-rh_s) \qquad \text{(III.2)}$$

As can be seen from equation (III.2), a reduction in the length of the standard week (h_s) is now equivalent to an increase in the fixed costs of employment (g_1) and implies an increase in costs without a direct effect on output. The ratio of marginal products is unaffected, but an employee now costs more than an hour at the margin and employment

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[6] We assume that all employees work some overtime; assuming that an exogenously determined proportion of the workforce is doing any overtime makes no qualitative difference to the results. For a formal solution to the problem, along with the implications for the employment impact of reductions in standard hours with a variable capital stock, when the firm is output constrained and when the marginal product of standard and overtime hours differs see Hart (1984a, 1987).

unambiguously falls.

The reduction in employment implies that the cost of an extra hour is now lower. What happens to actual hours worked will therefore depend on the sign and size of the effect the reduction in employment has on the marginal product of hours. If the reduction in employment increase the marginal product of an extra hour or leaves it unaffected then it is profitable for the firm to expand actual hours. The same is true if the fall in employment decreases the marginal product of an extra hour but the reduction is smaller than the reduction in the marginal cost (ie the hourly wage). In all these cases actual hours worked and income of those employed - when the wage is fixed - will rise. With a CD technology, demand for hours of work and employment is (see Appendix D):

$$\mathbf{h^* = (b/(a-b))\ (1/(1+r))\ (g_1 - rh_s)} \qquad \mathbf{(III.3)}$$

$$\mathbf{N^* = (w(1+r)/b)^{1/(a-1)}\ h^{(1-b)/(a-1)}} \qquad \mathbf{(III.4)}$$

Note that, conditional on h_s, demand for hours is independent of the hourly wage, but depends positively on the ratio of fixed employment costs ($w(g_1-rh_s)$) to the overtime wage rate ($w(1+r)$). This is an attractive feature of the CD and labour cost structure assumptions, given that there is weak econometric evidence about demand for hours of work depending negatively on the wage [7].

Note also that fixed employment costs affect employment only through changes in actual

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[7] See Hart and Sharot (1978), Riechel (1986), Bosworth and Westaway (1987), Pencavel and Holmlund (1988).

hours of work. Although a reduction in employment reduces the marginal product of an hour the condition we mentioned above is satisfied and actual hours worked unambiguously rise [8]. As we argued earlier this prediction is not in line with the movement of actual and standard hours in the manufacturing sector of the UK and most other industrialised countries.

It seems therefore appropriate to alter the model in order to take into account the fact that actual hours of work fall or remain unchanged following a cut in standard hours and we do that in the next section. Within the current model, ***increases rather than decreases in standard hours*** would be a more accurate reflection of union demands and would be in accordance with the long run negative movement in actual hours - although the model would now predict a reduction in overtime hours. In this case however the direct effect on employment will be positive; In section 5.1 we show that in such a case employment is also likely to rise, when the wage is set by a monopoly union.

A final point concerns the analogy between the model we presented above and the one we referred to in section 1.2 of Chapter I, where the firm can choose the number of shifts. In Appendix E, using a CD technology, we show that a slight modification of the overtime hours model allows us to interpret overtime as shiftwork. Assuming then that shiftwork is paid at a premium we show that the qualitative effects of reductions in standard hours on employment and actual hours of work/the number of shifts are the same.

[8] The same is true for realistic values of a CES function and other production function formulations which deliver a positive overtime demand like $F(N,h)=F(NJ(h))$. If $F(N,h)=F^2(Nh)$ or $F(N,h)=hF^1(N))$, the results are trivial ie either no overtime is demanded or no output produced.

4.3 Employment and Reductions in Actual Hours of Work

Within the conventional competitive model there are two plausible ways in which a reduction in standard hours can increase the ratio of the marginal cost of hours to employment and thus produce a negative effect on the demand for actual hours. First, the marginal cost of an hour following the reduction in standard hours might rise, which will be true if the overtime premium is rising in the level of overtime hours ($r=r(h-h_s)$, $r(0)=0$, $r'>0$) [9].

Second, the marginal cost of employment can fall and that will happen if fixed costs of employment are a positive function of standard hours - we will assume for simplicity that fixed costs are fully indexed to basic weekly earnings, ie $g_1=gh_s$ and $G=gwh_s$.

Consider first the case where the overtime premium is increasing in overtime. The firm must choose the number of employees and hours of work in order to maximise:

$$\max_{N,h} P = F^2(Nh) - Nwh_s - Nw(1+r)h_o - Nwg_1 \qquad \text{(III.5)}$$

where h_o is overtime hours ($h_o=h-h_s$), $r=r(h_o)$, $r'>0$ and $r(0)=0$. Assume for simplicity that output is a function of employee-hours ($F^2(Nh)$). Solve the FOCs to get (Appendix F):

[9] Hart and Ruffell (1993) have found little evidence to support this hypothesis in UK production industries.

$$h^* = (g_1 - rh_s)/(re_{rho}) \qquad \textbf{(III.6)}$$

Subtract h_s from both sides of equation (III.6) to get:

$$h_o^* = (g_1/re_{rho}) - h_s\,[1+(1/e_{rho})] \qquad \textbf{(III.7)}$$

where we use e_{rho} to denote the elasticity of the overtime premium with respect to overtime. Assume this elasticity is constant, differentiate equation (III.6) and rearrange to obtain:

$$\partial h/\partial h_s = (g_1-(rh_o/e_{rho}))\,[g_1+rh_o]^{-1} \qquad \textbf{(III.8)}$$

Equation (III.8) can be positive or negative. If it is positive note that it will be smaller than unity so that any fall in standard hours will increase overtime. A fall in standard hours is also more likely to lead to a fall in actual hours, the larger the fixed costs of employment (g_1) and the larger the elasticity of the overtime premium with respect to overtime (e_{rho}). Equation (III.8) can be evaluated for realistic values of actual hours, overtime and the premium [10]. For a relatively high value of g_1, $\partial h/\partial h_s$=0.75 and this means that a 2 hours fall in the length of the workweek implies a 1.5 hours fall in actual hours. For a lower value of g_1, $\partial h/\partial hs$=0.50, so that a fall in standard hours leads again to a fall in actual hours but implies a relatively large increase in overtime.

[10] The assumptions made are h_s=40, h_o=8, r=0.3, g=21.6/16.8 (which corresponds to a ratio of fixed to total labour costs of 30% and 25% respectively). For the large g_1 value, $\partial h/\partial h_s$=0.75, for the small one, $\partial h/\partial h_s$=0.50 - see Table F1 in Appendix F.

By differentiating the FOC for employment - see equation (F2) in Appendix F - we obtain:

$$\underline{e}_{Nh_s} = \underline{\underline{e}}_{Nh_s} + \underline{e}_{Nh}\, e_{hh_s} \qquad \textbf{(III.9)}$$

$$\underline{\underline{e}}_{Nh_s} = -\,(h_s/h)\,[wr(1+e_{rho})/NhF^{2''}] \qquad \textbf{(III.10)}$$

The direct effect on employment is now made up of two components. The first one ($\underline{\underline{e}}_{Nh_s}$) is positive and reduces employment, since a reduction in standard hours still acts as an increase in the fixed cost of employment; as can be seen from equation (III.10), further assumptions about the production function are needed in order to determine its size. The second one ($\underline{e}_{Nh}\, e_{hh_s}$) increases employment through the reduction in actual hours of work since $\underline{e}_{Nh} = -1$. In the two examples used earlier, the second component of the direct effect on employment ($\underline{e}_{Nh}\, e_{hh_s}$) is -0.625, if $\partial h/\partial h_s = 0.75$, and -0.415, if $\partial h/\partial hs=0.50$. A reduction in standard hours of work will lead to an increase in employment if the direct elasticity of employment with respect to standard hours ($\underline{\underline{e}}_{Nh_s}$) is smaller than 0.415 (if $\partial h/\partial hs=0.50$) or smaller than 0.625 (if $\partial h/\partial hs=0.75$) [11].

The justification for fixed employment costs being a positive function of standard hours is twofold. First, the ratio of fixed to total labour costs has been constant or slightly rising in the long-run, if one controls for changes in employers' tax rates - see Table 9 and

[11] The available econometric evidence (Hart and Wilson (1988, Table 9.4)) suggests that $e_{hhs}=0.802$ and $\underline{\underline{e}}_{Nhs}=0.411$. If $\underline{e}_{Nh}= -1$, the net direct effect of a 10% reduction in standard hours would be a 4% increase in employment in overtime establishments.

Figure 5 for the UK [12] and Hart (1984b, p. 14), for other OECD countries. In the UK, during 1975-1986, employers' National Insurance Contributions were fully indexed to weekly earnings; assuming that fixed costs are indexed to standard weekly earnings is therefore not a bad approximation of their movement. Second, if fixed costs are training costs, then one can argue that they should be modelled as a linear function of standard hours [13].

We use again a CD production function which allows us to compare with earlier results and will also be used in the following section. We assume for simplicity that the amount of time spent training per period (g_1), is some proportion g of standard hours [14]. In this case the firm chooses employment and actual hours of work to maximise:

$$\max_{N,h} P = N^a h^b - Nwh_s - Nw(1+r)(h-h_s) - gwh_sN \qquad \text{(III.11)}$$

Note that other than the assumption made about the production function, the only difference with the conventional profit function (see III.1) is the last term. The solutions for hours and employment are:

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[12] Note that for the UK, strictly speaking, it is not possible to distinguish between the National Insurance Contribution rate for the employer and the base on which it is calculated before 1975.

[13] Assume that training increases the marginal product of employment per period and a minimum amount of training per period is necessary to achieve this increase. It can be shown that in this case the firm will choose this amount - rather than more training per period for fewer periods. If this minimum amount of training is some proportion of standard hours, then training time -and costs - will also be a proportion of standard hours, see Appendix G.

[14] Assuming that g_1 is partially indexed to standard hours does not affect qualitatively the results. We comment where it makes a quantitative difference.

$$h^* = (b/(a-b))\ (1/(1+r))\ (g-r)\ \ h_s = \underline{d}\ h_s \tag{III.3'}$$

$$N^* = (w(1+r)/b)^{1/(a-1)}\ h^{(1-b)/(a-1)} \tag{III.4}$$

The solution for employment is identical to the earlier case. The solution for hours however implies that actual hours of work are a proportion $\underline{d}$ of standard hours. $\underline{d}$ must be larger than unity if firms employ overtime. This means that actual and standard hours move in the same direction but implies also that overtime hours will be falling with standard hours. If training time is only partially indexed to standard hours, the elasticity of actual with respect to standard hours would be below unity; this means that overtime would be approximately constant, or even rising, in the long-run.

By differentiating equation (III.4) with respect to standard hours we can now obtain an explicit expression for the direct effect of reductions in standard hours of work on employment. Using also equation (III.3') we get in elasticity terms:

$$\underline{e}_{Nhs} = [(1-b)/(a-1)]\ e_{hhs} = (1-b)/(a-1) \tag{III.12}$$

The RHS of equation (III.12) is negative since the SOCs require 0<**b**<**a**<1. The condition **b**<**a** implies also that the elasticity of employment with respect to standard hours is absolutely larger than unity. If training time is only partially indexed to standard hours, e_{hhs} will be smaller than unity and any given change in standard hours will lead to a smaller increase in employment.

It should be noted that this result does not depend on the CD assumption. In the general case the firm's problem is:

$$\max_{N,h} P = F(N,h) - Nwh_s - Nw(1+r)(h-h_s) - gwh_sN \qquad \text{(III.13)}$$

It is easy to show that in this case the total effect of a reduction in standard hours on employment is:

$$\partial N/\partial h_s = w(g-r)F_{hh} \,/\, \underline{D} \qquad \text{(III.14)}$$

where $\underline{D} = F_{NN}F_{hh} - [F_{Nh}-w(1+r)]^2$ and must be positive for the SOCs to be satisfied. It follows that, since $F_{hh} < 0$, a reduction in standard hours will always increase employment, when fixed employment costs are indexed to standard weekly earnings, if total fixed costs of employment - ie (g-r) - are positive.

5.0 UNION MODELS WITH POSITIVE OVERTIME

5.1 Employment, Wages and Reductions in Standard Hours

In order to look at the total effect on employment from a reduction in standard hours we must take again into account the way in which the hourly wage will react to such a reduction. In Chapter II we examined wage determination in monopoly union, bargaining and efficiency wage models. We showed there that the basic results concerning the effects of reductions in hours on employment and unemployment were unaffected by the wage determination process. We will therefore illustrate the main argument in this section using only the basic monopoly union model.

Since we have now added actual hours to the set of variables to be determined we must also specify which variables are set by whom and the timing of this process - for the implications of the timing of the process in a wage-employment framework see Manning (1987). There is no consensus in the literature about either of the two [15], which should come as no surprise, given the conflicting evidence on the appropriate model of employment determination.

We make the relatively simple assumption that the employer has unilateral control over both hours of work and employment and sets both simultaneously, after the wage has been determined by the union. The main theoretical argument for such a solution is that the

[15] See Pencavel (1991, p. 108-114) for a summary.

unions/employees cannot monitor costlessly the level of employment and hours of work, if the firm can make them contingent on the state of demand - see Farber (1986). They therefore bargain only over the wage, avoiding concessions in their wage demands for promises of higher employment - and lower hours, see Chapter IV - that can not be confirmed and therefore enforced. Alternatively, firms follow a LIFO policy in which case unions may be indifferent about employment (Oswald (1985)).

The assumption is also in accordance with observed firm behaviour of making specific hours offers to employees and has been used and supported in the literature [16] (Booth and Schiantarelli (1988), Earle and Pencavel (1990)). The problem then facing the union is to maximise its expected utility subject to the factor demand functions of the firm:

$$\max_w Z = N\{U(wH,T-h)-V\} + MV = NDU + MV \qquad \text{(III.15)}$$

$$\text{s.t. } P_N = P_h = 0$$

where $DU = U(wH,T-h) - V$ and $H=((1+r)h-rh_s)$. With a general specification of the production function the results are uncertain. The union must take into account the effect its wage setting behaviour will have on employment and on actual hours. The reaction of both to an increase in the hourly wage is ambiguous. We adopt therefore the profit function we presented in the previous section in which case the union's problem is to

[16] Earle and Pencavel (1990) present a number of alternatives and express support for the assumption made in the text. They ask the question "Should work hours be characterised as a variable subject to joint control by the union and management or ... as determined unilaterally by the union or by management?". Their answer is "The industrial relations literature does not provide a clear answer to this question...". Neither does any quantitative empirical evidence to date.

maximise equation (III.15) subject to the factor demands given by equations (III.3') and (III.4). It is now again possible to derive an expression for union utility as a mark-up on outside utility - see Appendix H:

$$\mathbf{U\ (wH,\ T\text{-}h) = [e_{Nw}\ /\ (\ e_{Nw}\ +\ e_{Uc}\ )]\ V = k\ V} \qquad \mathbf{(III.16)}$$

The expression is similar to the case where there is no overtime [17]. We can obtain the effects of changes in standard hours on the hourly wage, when e_{Nw} and e_{Uc} are constant, by totally differentiating equation (III.16) with respect to w and h_s:

$$\begin{aligned} \partial w/\partial h_s &= -\ (U_{hs}/U_w) + [\ -\ (U_h/U_w)\ (\partial h/\partial h_s)] \\ &= (rw/H) + [\ -\ [(w(1+r)U_1 - U_2)/(HU_1)]\ \partial h/\partial h_s] \qquad \text{(III.17)} \end{aligned}$$

Note that the expressions above will be identical to the case where there is no overtime (r=0) if $H=h=h_s$. A reduction in standard hours now has a direct positive effect on the hourly wage because it leads, for given actual hours, to an unambiguous increase in income and therefore moderates union wage demands - first term of equation (III.17). The indirect effect, through actual hours of work, depends on the direction of movement of actual hours following the standard hours reduction - in this case $\partial h/\partial h_s = \underline{d}$, see equation (III.3') - and on the level of hours relative to the optimal for the individual (ie whether U_h is positive, zero or negative at the level of actual hours demanded by the firm). The second term of

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[17] Recall that Trejo (1991) found evidence which supports this result namely that in a large number of cases where firms offer overtime, they offer weekly earnings that do not differ from equivalent non-overtime jobs, by paying a lower standard wage. This will be true under the assumption that k and V are the same for overtime and non-overtime employees.

equation (III.17) will therefore be positive or zero if actual hours are above or at the optimal for the individual; it will be negative if they are below it.

These results are therefore very much like the no-overtime case, except for the first term of equation (III.17). This was absent in the no-overtime case and implies that the union will set a lower hourly wage following a reduction in standard hours, even if the level of actual hours is optimal for its members.

To calculate the total effect on employment we must once more sum up the direct and indirect effects from the fall in standard hours. In elasticity terms the total effect is:

$$\mathbf{e_{Nh_s} = \underline{e}_{Nh_s} + e_{Nw}\, e_{wh_s}} \qquad \textbf{(III.18)}$$

In the CD case $\underline{e}_{Nh_s} = \underline{e}_{Nh}\, e_{hh_s}$. Substituting the relevant elasticities from equations (III.3') and (III.4) we obtain:

$$\mathbf{e_{Nh_s} = [(1-b)/(a-1)] + [1/(a-1)]\, e_{wh_s}} \qquad \textbf{(III.19)}$$

The first term is the direct effect which will increase employment following a reduction in standard hours. The second term is the indirect effect and will also increase employment under the assumptions we made earlier (ie $e_{wh_s}>0$). It is worth noting that these findings are contrary to the common belief that the existence of overtime makes an increase in employment following a reduction in standard hours much less likely. This is even more the case if a union is present.

It is also interesting at this point to present briefly the effects of reductions in standard hours on the hourly wage and employment using the "traditional" model, where the overtime premium is constant and employment costs are not indexed to standard weekly earnings. We can again use equations (III.3), (III.4) and (III.16) to determine hours, employment and the wage. By differentiating equation (III.16) we obtain:

$$\partial w/\partial h_s = (rw/H) - [(w(1+r)U_1 - U_2)/(HU_1)]\ \partial h/\partial h_s \qquad \textbf{(III.20)}$$

The first term is again positive. If actual hours are above the optimal level for the individual - which would justify union demands to reduce them - then the second term of the above expression is negative. If it is larger than the first one, equation (III.20) will be negative. In this case a reduction in standard hours will reduce employment, profits and individual and union utility so that it is not possible to provide any justification for such a reduction [18].

In such a model, an increase in standard hours would be a more accurate reflection of union demands and would also be consistent with observed movements of actual hours. Since overtime in such a case would fall the analysis can also be used to examine the employment effects of an induced rather than compulsory reduction in demand for overtime[19].

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[18] Doubts about the employment generation potential of reductions in standard hours have been expressed however, based on variations of this model - see Booth and Schiantarelli (1988), Calmfors and Hoel (1988).

[19] Note that most countries - the UK is in fact an exception - have mandatory limits for overtime. For a comprehensive overview see Arrowsmith (1988).

If standard hours are increased in the "traditional" model, employment will also increase - directly. When the wage is set by a monopoly union and actual hours are above (at) the optimal for the individual, then the increase in standard hours and ensuing reduction in overtime will increase (leave unchanged) individual utility and will lead to a reduction in the hourly wage and a positive for employment indirect effect. An increase in standard hours in this model will therefore increase employment both directly and indirectly, just like in the first case analysed in this section, where actual and standard hours move in the same direction.

A final point in this section concerns the implications of assuming that V is determined endogenously by noting that V now is:

$$\mathbf{V = u\ U(\underline{b},T) + (1\text{-}u)\ U(\underline{w}H,T\text{-}h)} \qquad \mathbf{(III.21)}$$

where $H=((1+r)h-rh_s)$. Substituting this back in equation (III.16) we can obtain again an unemployment condition and, after substituting $N=L(1-u)$, use equation (III.4) as a wage condition, just like in section <u>2.2</u> in Chapter II. The results are therefore very similar to the no-overtime case with a CD function and we therefore do not repeat them here.

5.2 The Efficiency of Reductions in Standard Hours

We have assumed implicitly so far that reductions in hours of work are desirable if they increase employment and reduced unemployment, without providing any efficiency argument for reductions in hours of work.

The main economic argument for reductions in hours of work in the current literature relies on efficiency gains from redistributing the total volume of work in cyclical downturns. Fitzroy (1981) discusses informally the economic reasons and Dreze (1986) provides a more formal model. He claims that the absence of future workers - the "young" - from current wage bargains prevents the wage contract agreed from guaranteeing employment to the young in the event of a downturn in the future. The participation of the "young" in current wage bargains could reverse the market failure but Dreze calls such an idea "preposterous". The argument is similar to the "insider-outsider" models such as the one developed by Blanchard and Summers (1986).

Fitzroy and Hart (1985) show also that efficient labour contracts will include state dependent hours, in at least some states. The realisation of a bad state will therefore not necessarily lead to lay-offs only, when hours of work are taken into account.

In this section we look at the implications of the assumed cost and institutional structure for the efficiency of reductions in standard hours of work. A reduction will be taken to be efficient, if it increases either or both of the parties' pay-offs, without reducing the pay-off of the other.

We will use two models. In the first one the firm sets actual hours of work and employment after the union has determined the wage. As argued earlier, this is a realistic model and it is identical in structure to the one presented in section 5.1; we also use the same functional forms. In the second model, we address the problem of the "inefficient" outcome generated by the first model, by assuming that the union and the firm bargain simultaneously over employment, the wage and hours of work. Further assumptions on functional form are needed in order to derive definite predictions about the employment effects of lower hours. We show again that reductions in standard hours can improve overall efficiency.

Consider first the model we presented earlier in section 5.1. With a Cobb-Douglas production technology, the profit function of the firm and the - expected - utility function of the union are:

$$\mathbf{P = N^a h^b - wH - gwh_s N} \qquad \textbf{(III.22)}$$

$$\mathbf{Z = N\{U(wH,T-h)-V\} + MV = NDU + MV} \qquad \textbf{(III.23)}$$

where $H=(1+r)h-rh_s$. Since we assume that the firm determines employment and hours of work after the union has determined the wage, N^*_F, h^*_F and w^*_B will satisfy:

$$\mathbf{P_N = P_h = 0} \qquad \textbf{(III.24)}$$

$$\mathbf{Z_w = 0,\ s.t.\ P_N = P_h = 0} \qquad \textbf{(III.25)}$$

Assume now that h^*_F, exceeds the optimal level of hours for the individual, h^*_{IND}. Since the direct effect on employment from a reduction in hours of work is negative - due to the CD assumption - and the union cares about employment, h^*_{IND} exceeds the optimal for the union (h^*_{UN}). In such a case therefore, unions would be justified to demand reductions in standard/actual hours of work.

What are the effects of such a reduction on union and firm objectives? By using the envelope theorem it follows that:

$$P_{hs} = P_w\,(\partial w/\partial h_s) + \underline{P}_{hs} \qquad \text{(III.26)}$$

$$Z_{hs} = N_{hs}\,DU + N\,(U_h\,h_{hs} + \underline{U}_{hs}) \qquad \text{(III.27)}$$

where $\underline{P}_{hs}$ and $\underline{U}_{hs}$ denote the direct effects from reductions in standard hours on profits and union utility respectively, holding all other variables constant. Starting with profits, note that the first term on the RHS of equation (III.26) is negative, since P_w is negative ($P_w = -N(H+wgh_s)$) and ($\partial w/\partial h_s$) is positive, since $h^*_F > h^*_{IND}$. A reduction in standard hours increases profits because it leads, ceteris paribus, to a lower hourly wage. The second term ($\underline{P}_{hs} = -wN(g-r)$), is also negative, if total fixed costs of employment are positive - which is necessary for actual hours to exceed standard. A reduction in standard hours will therefore increase profits under these conditions because it leads to a lower hourly wage and to lower fixed employment costs.

Looking next at union utility, note that the first term of equation (III.27) is negative since $N_{hs} = N_h h_{hs}$, and $N_h < 0$ with $h_{hs} > 0$ - see equations (III.3') for h and (III.4) for N. The second term is also negative since U_h and $\underline{U}_{hs}$ are negative, U_h by assumption and $\underline{U}_{hs}$=-rw. A reduction in standard hours increases therefore also union utility under the assumptions made, because it increases employment, utility from leisure and income of those employed.

Given the framework for the determination of employment, hours of work and the wage [20] and a constant mark-up, it is not unrealistic to assume that the actual level of hours might exceed the optimal for the individual/union, when most reductions in hours of work have been demanded and initiated by unions. The key assumption therefore for the above result [21] is the proportionality between fixed employment costs and standard weekly earnings. This implies that actual hours are proportional to standard and that a reduction in standard hours reduces, ceteris paribus, labour costs ($\underline{P}_{hs}$<0). We have argued that this is a realistic assumption. The evidence about the way in which reductions in standard hours have been introduced in practice [22] supports also the argument made about the efficiency of reductions in standard hours.

Consider now the case where the firm and the union bargain simultaneously over employment, hours of work and the wage [23]. Assume that the objectives of the firm and the union are the same as earlier but without loss of generality, rewrite individual

[20] The monopoly union wage determination assumption is made for simplicity. All results would carry through if the union bargained with the firm over the wage and then the firm determined employment and hours of work unilaterally.

[21] The CD assumption ($N^a h^b$) is not necessary for the result; this is important since in order for the profit maximisation problem to be well defined with a CD function **b** must be smaller than **a**. This is not always supported by the empirical evidence.

[22] We refer to the French "solidarity" contracts of 1981, see Hart (1984a).

[23] This model is analysed in detail in the next Chapter.

preferences as $U(wH,h)$, $U_1>0$, $U_2<0$, U_{11}, $U_{22}<0$; this simply facilitates the derivation of some of our results. We assume that the solution to the bargaining problem is the symmetric Nash one, so that employment, hours of work and the wage are set to maximise:

$$\max_{N,h,w} X = (P-\underline{P})(Z-\underline{Z}) \tag{III.28}$$

where $\underline{P}$, $\underline{Z}$ are the levels of profits and utility obtained by the firm and the union if a bargain is not struck - the "fall back" levels. If we assume that $\underline{P} = 0$ and $\underline{Z} = MV$, the problem becomes:

$$\max_{N,h,w} X = [F(N,h) - wHN - gwh_sN]\ [NDU] \tag{III.29}$$

The FOCs are:

$$X_N = P_N Z + DU P = 0 \tag{III.30}$$

$$X_h = P_h Z + NU_h P = 0 \tag{III.31}$$

$$X_w = (-N(H+gh_s) Z + NU_w P = 0 \tag{III.32}$$

Equations (III.30) to (III.32) determine then the efficient levels of employment, N^*_{EB}, hours, h^*_{EB} and wages, w^*_{EB}. Without solving for an open solution we can derive at this stage the effects of reductions in standard hours on X, by applying the envelope theorem:

$$X_{hs} = \underline{P}_{hs} NDU + \underline{Z}_{hs} P \qquad =>$$

$$X_{h_s} = \{-wN(g-r)\}\ NDU + \{-rwNU_1\}\ P \qquad \text{(III.33)}$$

The RHS of equation (III.33) will be negative if g>r, ie if total fixed costs of employment are positive. This result depends again on the assumption made about fixed employment costs being fully indexed to standard weekly earnings. The assumption of simultaneous bargaining delivers now the somewhat remarkable result, that, ***irrespective*** of production function technology and preferences, reductions in standard hours will increase the pay-offs to the two parties by lowering costs for the firm and increasing income for the employed union members.

To derive definite predictions about the effects of lower standard hours on employment, actual hours and wages it is necessary again to introduce specific functional forms. Under the assumptions of a CD technology and a constant elasticity of utility with respect to consumption, equations (III.28) and (III.30) can again be solved for - see Appendix J:

$$N^*_{EB} = \{2w/(1+a)\}^{1/(a-1)}\ h^{(1-b)/(a-1)}\ \{(1+r)+[(h_s/h)(g-r)]\}^{1/(a-1)} \qquad \text{(III.34)}$$

$$U^*_{EB} = k_E\ V \qquad \text{(III.35)}$$

where k_E will be constant since e_{Uc} is constant. Equation (III.29) becomes:

$$P_h = -P\ (U_h/DU) \qquad \text{(III.36)}$$

Unlike the earlier models, without further assumptions about the form of the utility function we can not derive an explicit solution for h^*_{EB}. It follows from equation (III.36) however, that either $P_h=U_h=0$, or P_h and U_h have the opposite sign. We can therefore distinguish between three regimes for h^*_{EB} - see also Figure 6 in Chapter IV:

(i) h^*_{EB} is such that $U_h = P_h = 0$

(ii) h^*_{EB} is such that $U_h < 0$, $P_h > 0$

(iii) h^*_{EB} is such that $U_h > 0$, $P_h < 0$

In regime (i) the level of hours bargained is such that the firm and the union would not benefit from an ex post unilateral movement away from that level. In this case it is possible to determine what that level of hours is by using the $P_h=0$ condition - see Appendix J:

$$\mathbf{h^*_{EB} = \{[2b/((1+a)-2b))]\ (1/(1+r))\ (g-r)\}\ h_s = \underline{d}'\ h_s} \qquad \textbf{(III.37)}$$

Inspection of equation (III.34) reveals that, in this case, any "small" reduction in standard hours will lead, through a reduction in actual hours, to an increase in employment.

If h^*_{EB} is in either regime (ii) or (iii), the former being the more realistic, in order to obtain an explicit solution for actual hours, we need to make the further assumption that the elasticity of utility with respect to hours of work for given consumption ($\underline{e}_{Uh}$), is constant. This means that, ceteris paribus, individual hours supply is independent of the wage. In this case equation (III.36) can be rearranged in a quadratic in the variable (h/h_s). If a solution therefore exists, and assuming it is unique and acceptable (ie $h^*_{EB} > h_s$), it will have the form:

$$\mathbf{h}^{*}_{\mathbf{EB}} = f^{*}\ (e_{Ua}, \underline{e}_{Ub}, a, b, r, g) \quad \mathbf{h}_{s} = \underline{\mathbf{d}}'' \ \mathbf{h}_{s} \tag{III.38}$$

where $\underline{d}''$ is just a constant, assumed to be larger than unity.

The elasticity of actual with respect to standard hours is again unity. It follows that in regime (ii), where, unions would desire reductions in actual hours of work opposed by firms, a reduction in standard hours will reduce actual hours and the hourly wage and increase employment.

Conclusions

The aim of this Chapter was to examine the extent to which overtime work implies that reductions in standard hours of work will have less favourable employment effects. We showed that the impact of lower standard hours of work on employment depends crucially on the extent to which fixed costs of employment are really fixed. If these costs are indexed to standard hours of work, then a reduction in standard hours is likely to lead to lower actual hours. This is consistent with the observed movement of standard and actual hours. The results concerning the direct and indirect employment effects of reductions in standard hours are then similar to the case where there is no overtime.

We also provided in this Chapter an economic rationale for reductions in standard hours of work, by demonstrating that, under the assumption of hours indexation of fixed employment costs, reductions in standard hours of work can improve efficiency:

- when a firm sets employment and hours of work after a union sets the wage, and

- when a firm bargains with a union about actual hours, employment and wages, because of the structure of labour costs.

TABLE 6

Overtime Hours and Percentage of Operatives on Overtime
UK Manufacturing: 1970 - 1980 - 1989

	1989		1980		1970	
Industry	**Oper (y)**	**Overt (x)**	**Oper (y)**	**Overt (x)**	**Oper (y)**	**Overt (x)**
Mechanical Engineering	47.7	9.7	30.2	8.3	51	8.2
Other Transport Equip.	46.3	9.4	43.5	7.1	43.8	7.6
Motor Vehicles	45.8	9	13.7	7.5	42.1	6.8
Metal Goods NES	43.3	9.8	22.8	7.5	39.7	7.9
Timber/Wooden Furnit.	42.2	10	28.2	6.8	41.8	7.7
Non-Metallic Mineral	39.9	10.5	30.5	10.1	17.9	8.5
Metal Manufacturing	39	9.4	38.6	5.3	30.5	8.8
Rubber & Plastics	38.8	10.5	20.4	7.3	38.5	8.8
Food, Drink & Tobacco	36.5	10.1	35.5	9.6	34.1	9.6
Paper, Printing & Publ.	35.8	10.2	30.7	7.9	36.3	8.1
Electr. & Electron. Eng.	34.3	9.4	24.4	7.6	32.4	7.6
Instrument Engineer.	32.3	8.3	23.9	6.2	40.1	7
Textile Industry	29.9	9.4	18.7	7.7	21.9	8.1
Other Manufacturing	29.1	8.9	22.8	8.6	32.6	8.5
Chemical Industry	29	10.6	26.3	8.7	26.1	9.3
Footwear & Clothing	12.4	5.8	4.7	5.4	9.8	5.2
All Manufacturing	37.5	9.7	26.3	7.9	34.4	8
Mean (Unweighed)	36.4	9.4	25.9	7.6	33.7	8
Standard Deviation	*8.8*	*1.2*	*9.4*	*1.3*	*10.6*	*1.1*

y: Percentage of all operatives working overtime in GB manufacturing industry.
x: Average number of overtime hours worked per operative working overtime.

Source: Department of Employment Gazette (DEG)

TABLE 7

Actual Hours in Manufacturing in 13 OECD countries: 1950-91
(1950=100)

	55	1960	65	1970	75	1980	85	1991	1950-91 GROWTH % Total	pa[1]
USA	100.3	98.3	101.7	98.7	98	98.3	100.3	100.8	+0.8	+0.0
JAP[2]	104.8	109.5	101.5	99.1	89.5	94.2	94.7	91.4	-8.6	-0.21
CAN	96.3	95.7	96.9	94.9	92.1	91.7	92.4	90.1	-9.9	-0.24
GER	100.2	90.2	84.5	83.1	75.3	74.5	72.9	70.4	-30	-0.72
FRA	102.1	106.9	105.3	103	96.5	94.2	89.6	89.8	-10	-0.25
UK	101	99	95.8	92.5	85.9	82.7	85.4	84.4	-16	-0.38
ITA	103.3	103.6	92.2	91.1	77	79.2	75.9	79.6[3]	-20	-0.55
NET	100	101.4	94.9	88.9	80.9	78.3	77.2	76.2[4]	-24	-0.61
SWE[2]	99.5	94	89.8	83.2	76.9	71.4	64.8	56.3	-44	-1.1
DEN[2]	98.2	93.2	90.3	83.3	74.6	74.1	75.1	66.6	-33	-0.81
NOR		100	97.5	89.8	85.2	78.9	77.9	76.8[4]	-23	-0.80
BEL[2]		100	97.8	92.5	80.7	80.5	66	64.7[5]	-35	-1.2
SWI				100[6]	99.1	97.8	96	92.5	-7.5	-0.42

1 Not compounded **2** Monthly Hours **3** 1987 **4** 1989 **5** 1990 **6** 1973

Sources: OECD, Economic Indicators - EUROSTAT (Hours Worked in Industry, Italy 1980-1987) - Yearbook of Statistics of the Netherlands (Male Weekly Hours in Manufacturing, 1980-89).

TABLE 8

Distribution of Actual & Standard Hours in 1970 (%)

	Aver.	<37	37-39	39-40	40-45	45-49	>49
Manual Male							
Standard Hours	40.2	3.9	6.6	78.7	8.1	1.3	1.4
Actual Hours	45.8	8.2	4.2	22.4	19.7	16.1	29.4
Manual Female							
Standard Hours	38.4	17.5	9.7	65.6	6.4	0.8	
Actual Hours	39	28.1	10.2	39.5	14	4.7	2.7
Non-manual Male							
Standard Hours	37.8	38.5	32.4	19.4	7.1	1.2	1.4
Actual Hours	39.1	33	28.9	14.5	13.7	4.8	5.1
Non-Manual Female							
Standard Hours	36.8	47.9	29.3	9.7	12.8	0.3	
Actual Hours	37.1	45.2	28.9	9.4	15	1.0	0.5

Source: New Earnings Survey, 1970.

TABLE 9

Fixed Employment Costs and Employers' National Insurance Contributions

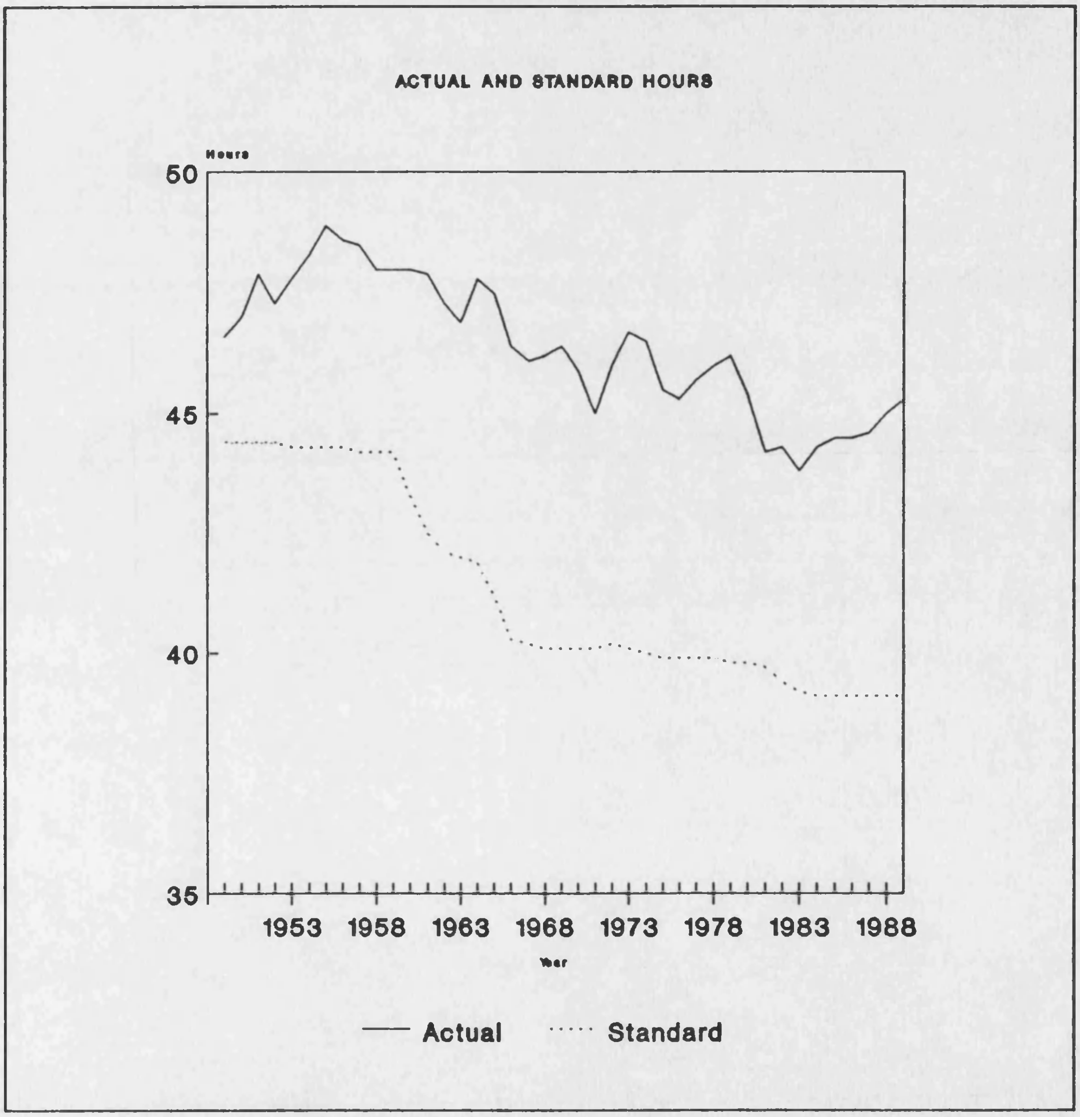
Year	Estimated Fixed Costs [1]	Tax Rate [2]
1955	0.063	0.023
1960	0.074	0.027
1965	0.087	0.054
1970	0.100	0.147
1975	0.133	0.069
1980	0.157	0.109
1985	0.157	0.083
1990	0.134	0.069
1991	0.142	-

1. Ratio of Employment Contributions to Wages and Salaries - Source: Central Statistical Office (CSO) Monthly Digest.

2. Ratio of Weekly National Insurance Contributions to Weekly Manual Earnings for Males - Source: Annual Abstract of Statistics.

FIGURE 3

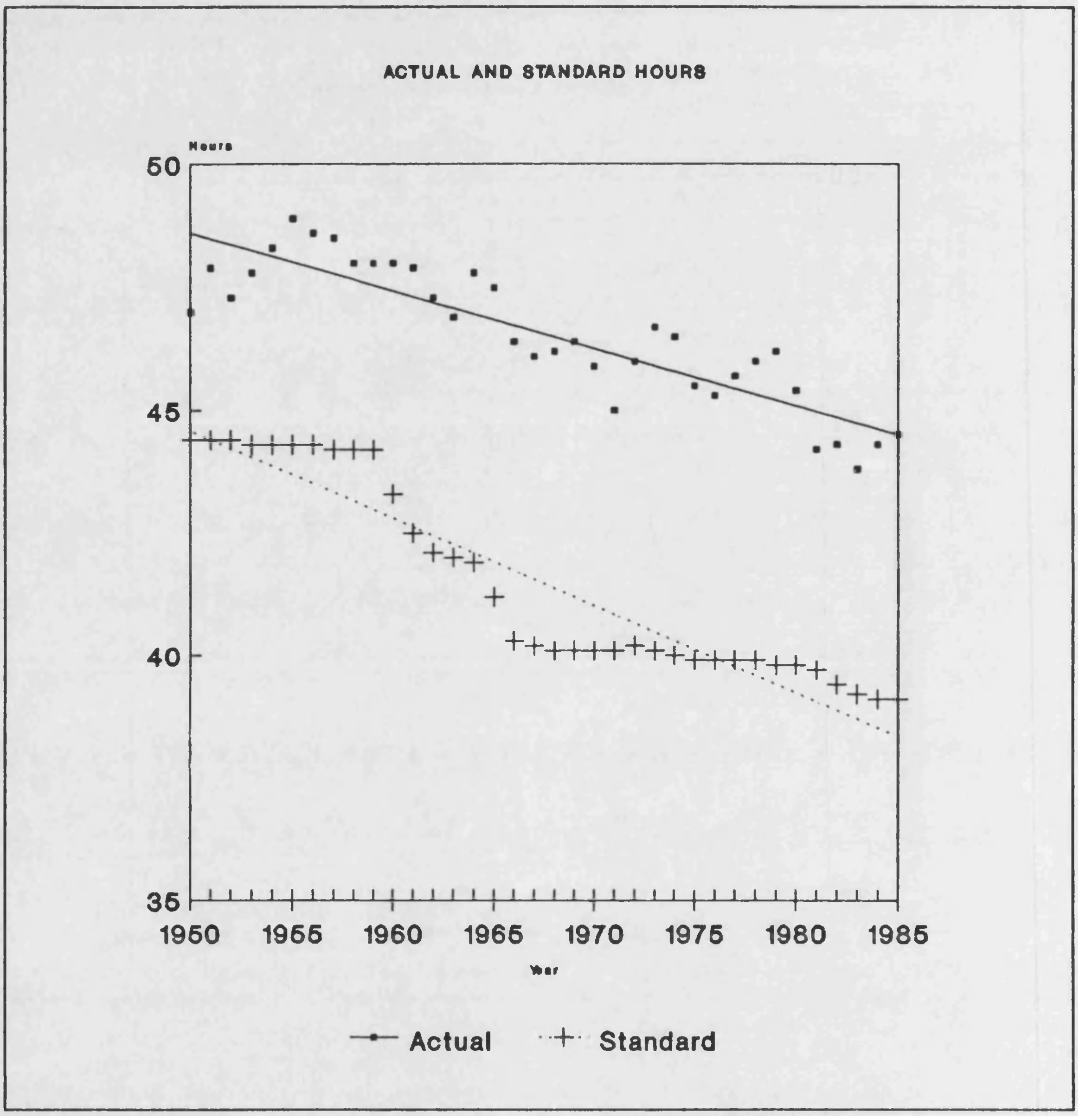
Actual and Standard Hours of Manual Males



Source: Department of Employment Gazette (DEG)

FIGURE 4

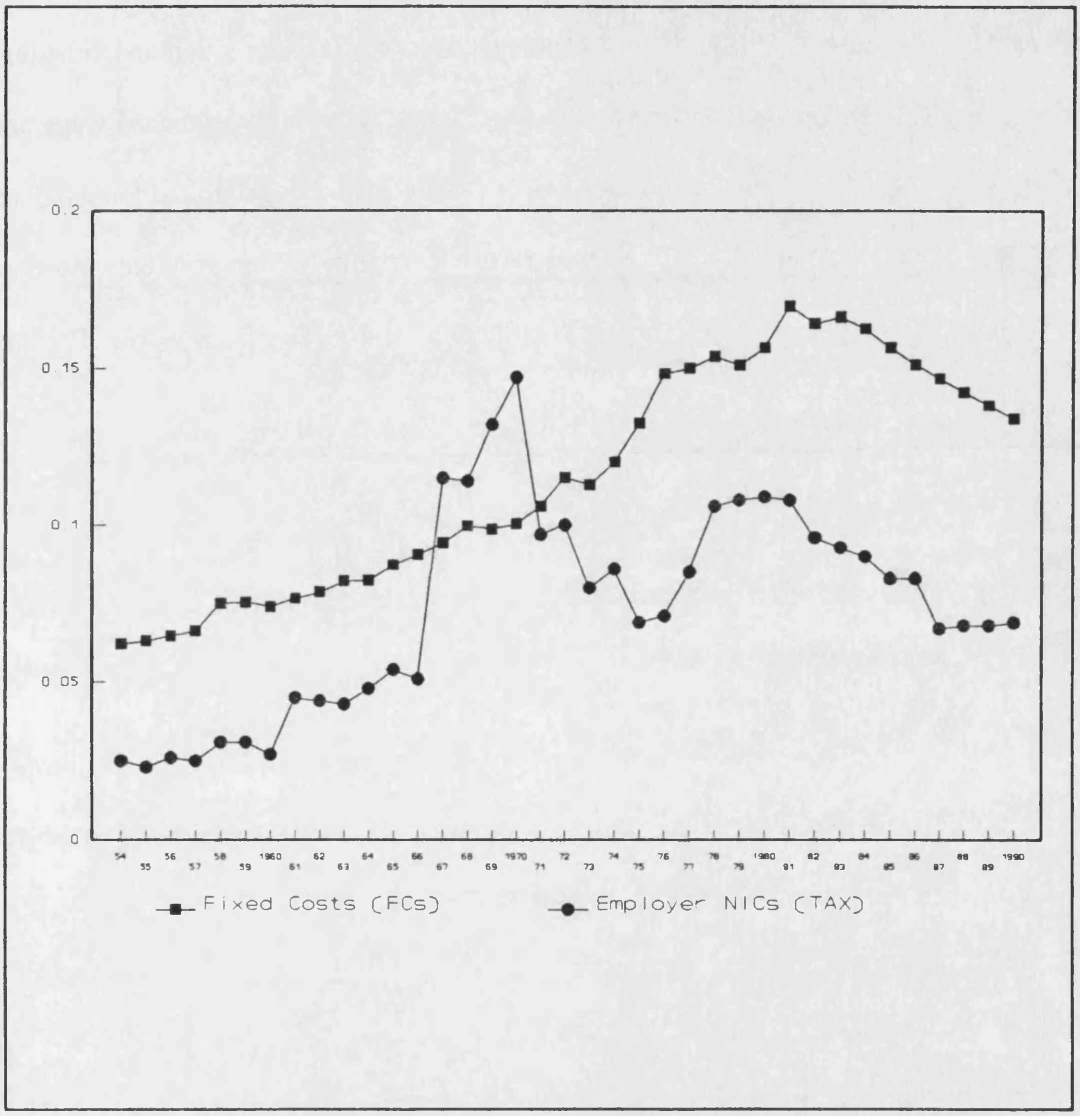
Actual and Standard Hours of Manual Males (With Linear Trends)



Source: see Figure 3.

FIGURE 5

Fixed Employment Costs and Employers' National Insurance Contributions



Source: See Table 9.

APPENDIX C

Monopoly Union and the Overtime Premium

Assume that a monopoly union can set the standard wage and the overtime wage in order to maximise expected utility of its members, subject to the firm's demand functions for standard ($h_s=h_s(w,X)$) and overtime hours ($h_o=h_o(wp,Z)$). w is the standard wage and pw the overtime wage (p=1+r). X and Z are other variables affecting demand for standard and overtime hours respectively - eg absentee rates, uncertainty in demand, etc. Assume for simplicity that employment is fixed and that there is no disutility from work. The union's problem then is:

$$\max_{w,p} Z = N\{U(wh_s + wph_o) - V\} + MV \tag{C1}$$

$$\text{s.t. } h_s=h_s(w,X) \text{ and } h_o=h_o(wp,Z)$$

where V is outside utility and M is membership, both fixed. U{.} has the usual properties and $\partial h_s/\partial w=h_{s.w}<0$, $\partial h_o/\partial pw=h_{o.pw}<0$. By substituting the constraints in the union objective and differentiating we obtain the first order conditions:

$$Z_w = NU_1(h_s + ph_o) + NU_1 w\, h_{s.w} + NU_1 wp^2\, h_{o.pw} = 0 \tag{C2}$$

$$Z_p = NU_1\, wh_o + NU_1 w^2\, p\, h_{o.pw} = 0 \tag{C3}$$

By rearranging equation (C3) we get:

$$h_o\ (1 + e_{ho.pw}) = 0 \tag{C4}$$

where $e_{ho.pw}$ is the elasticity of overtime hours with respect to the overtime wage - $[(w/h_o)(h_{o.pw})]$. Substituting this back in equation (C2) we obtain:

$$h_s\ (1 + e_{hs.w}) = 0 \tag{C5}$$

The union therefore sets w and p so that the elasticities of standard and overtime hours with respect to their prices are equal to minus one. By using equations (C4) and (C5) and expanding the elasticity expressions we obtain that:

$$(w/h_s)\ (-h_{s.w}) = (wp/h_o)\ (-h_{o.pw}) \tag{C6}$$

If demand for overtime hours is more inelastic than demand for standard hours, then $(-h_{s.w}) > (-h_{o.pw})$. For equation (C6) to hold, (w/h_s) must be smaller than (wp/h_o), which in turn means that $p^*>1$ and $h_o^* < h_s^*$.

APPENDIX D

Profit Maximisation with a Cobb-Douglas Technology

and Positive Overtime

The profit function is:

$$\mathbf{P = N^a h^b - NwH - g_1wN \text{ where } H = (1+r)h - rh_s} \qquad \mathbf{(D1)}$$

FOCs are:

$$\mathbf{P_N = 0 \quad => \quad aN^{a-1}\,h^b - wH - g_1w = 0} \qquad \mathbf{(D2)}$$

$$\mathbf{P_h = 0 => \quad bh^{b-1}\,N^a - Nw(1+r) = 0} \qquad \mathbf{(D3)}$$

SOC requires **a,b <1** and DET = $F_{NN}F_{hh} - (F_{Nh} - w(1+r))^2 > 0$.

In the CD case $(F_{Nh} - w(1+r)) = \{b(a-1)N^{a-1}\,h^{b-1})\}$

and thus DET = $a(a-1)b(b-1)N^{2a-2}\,h^{2b-2} - \{b(a-1)N^{a-1}\,h^{b-1}\}^2$

For $X=N^{2a-2}\,h^{2b-2}$ => DET $= a(a-1)b(b-1)X - (b(a-1))^2X$
$= (a-1)bX\,(a(b-1) - b(a-1))$
$= (a-1)bX(b-a)$ => **DET > 0 iff a>b.**

Solving for h and N we get:

$$\mathbf{h^* = \{b/((1+r)(a-b))\}\ (g_1-rh_s)} \qquad \textbf{(D4)}$$

$$\mathbf{N^* = (w(1+r)/b)^{1/(a-1)}\ h^{(1-b)/(a-1)}} \qquad \textbf{(D5)}$$

It follows that g_1 must be larger than rh_s so that the <u>total</u> fixed cost of N is positive. Note also that the ratio of fixed to variable costs must be:

$$(g_1-rh_s)/[(1+r)h] = (a-b)/b$$

The comparative statics are:

$\partial h/\partial w \ = 0$

$\partial N/\partial w \ = N/w(a-1)$ $\qquad < 0$

$\partial h/\partial r \ = -[b(g_1+h_s)] / [(1+r)^2(a-b)]$ $\qquad < 0$

$\partial N/\partial r \ = [N/(1+r)]\ [(1-b)/(1-a)]\ [((g_1+h_s)/(g_1-h_s))-1/(1-b))]$ $\qquad$ >or<0

$\partial h/\partial g_1 \ = b/[(1+r)(a-b)]$ $\qquad > 0$

$\partial N/\partial g_1 = [(1-b)/(a-1)]\ (N/h)\ [b/[(1+r)(a-b)]]$ $\qquad < 0$

$\partial h/\partial h_s = -\ br/[(1+r)(a-b)] = -(h/h_s)\ [rh_s/(g_1-rh_s)]$ $\qquad < 0$

$\partial H/\partial h_s = -ar/(a-b) = -[H/h_s]\ [arh_s/H(a-b)]$ $\qquad < 0$

$\partial N/\partial h_s = -[N/h]\ [(1-b)/(a-1)]\ (\partial h/\partial h_s)$ $\qquad > 0$

APPENDIX E

Equivalence of Variable Number of Shifts and Overtime

In this Appendix we show the equivalence between a variable number of shifts and a variable number of overtime hours, when considering the effects of reductions in hours of work on employment. In order to be able to compare the two cases assume first that actual hours are a proportion q of standard hours ($h=qh_s$, $q>1$) and s is the number of shifts. Using a Cobb-Douglas production technology, the firm's problem when it can choose employment and overtime (ie q) is:

$$\max_{N,q} P1 = N^a h^b s^d - Nwh_s - Nw(1+r)h_o - Nwg_1$$
$$= A_1 N^a (qh_s)^b - Nw(h_s+g_1) - Nwh_s f_1(q) \quad \textbf{(E1)}$$

where h_o is overtime hours ($h_o=h-h_s$), $A_1=s^d$ and $f_1(q)=(1+r)(q-1)$. Solve for q and N to get:

$$q = (b/(a-b))(1/(1+r))[(g_1/h_s)-r] \quad \textbf{(E2)}$$
$$N = [w(1+r)/(A_1 b)]^{1/(a-1)} (qh_s)^{(1-b)/(a-1)} \quad \textbf{(E3)}$$

A reduction in standard hours decreases employment and increases actual hours, like in the model presented in section <u>4.2</u>.

Assume now that shiftwork is payed at the rate of $(1+r(s))$ and $r(1)=0$, $r'>0$ and the firm chooses s and N (instead of q and N) to maximise profits. To allow for a variable number of shifts write profits as - the level of hours is now exogenous:

$$\begin{aligned} \max_{N,s} P2 &= N^a h_s^b s^d - N s h_s w(1+r(s)) - N w g_1 \\ &= A_2 N^a s^d - N w(h_s+g_1) - N w h_s f_2(s) \qquad \text{(E4)} \end{aligned}$$

where $A_2=h_s^b$ and $f_2(s)= s(1+r(s))$. Inspection of equations (E1) and (E4) shows that the number of shifts (s) in P2 plays the same role as overtime (q) in P1; the results with respect to the effects of reductions in standard hours on employment will therefore be qualitatively the same.

APPENDIX F

Increasing Overtime Premium

The firm's problem and FOCs are - where h_o are overtime hours, $h=h_o+h_s$, $r'(h_o)>0$ and $r(0)=0$:

$$\max_{N,h} P = F^2(Nh) - Nwh_s - Nw(1+r)h_o - Nwg_1 \tag{F1}$$

$$P_N = hF^{2\prime} - w(h_s+g_1) - wh_o(1+r(h_o)) = 0 \tag{F2}$$

$$P_h = NF^{2\prime} - w(1+r(h_o))N - wh_o r'N = 0 \tag{F3}$$

Substitute $F^{2\prime}$ from equation (F2) in (F3) and solve for h to obtain:

$$h^* = (g_1-rh_s)/(re_{rho}) \tag{F4}$$

where e_{rho} is the elasticity of the overtime premium with respect to overtime. Subtract h_s from both sides of equation (F4) to get:

$$h_o^* = (g_1/re_{rho}) - h_s\,[1+(1/e_{rho})] \tag{F5}$$

Assume that e_{rho} is constant and differentiate (F4) to obtain, after some rearrangement:

$$\partial h/\partial h_s = (g_1-rh_o)\,[g_1+(rh_o/e_{rho})]^{-1} \tag{F6}$$

Equation (F6) can be evaluated for various values of the relevant parameters. To ensure consistency, we use first equation (F5) to derive the value of e_{rho} necessary to deliver 8 and 5 hours of overtime, when standard hours of work are 40 and 37 respectively and the premium is 30%, for a range of values of g_1 [24].

The results of this exercise are presented in Table F1 below. The value of e_{rho} is quite low, but this is partly a result of assuming that the output elasticities of employment and hours of work are the same.

TABLE F1

FIXED/TOTAL LABOUR COSTS	g_1	r	h_o	e_{rho}	$\partial h/\partial h_s$
30%	21.6	0.3	8	0.66	+ 0.75
25%	16.8	0.3	8	0.33	+ 0.50
25%	14.5	0.3	5	0.27	+ 0.56

[24] These are broadly consistent with the values for Non-Wage Labour Costs as a Percentage of Total in the 1972-1980 period, as reported in Hart (1984b, Table 1, p. 14); these range from 19.4% for the UK in 1972 to 43.6% for Italy in 1978.

APPENDIX G

Optimal Training Costs

The problem facing the firm is to choose the number of periods it will train its workers ($\underline{t}$) and the training cost per period - by choosing the time spent training per period (h_t) -, to maximise its expected lifetime profits per worker.

We assume that the training time per period can not fall below a minimum efficient level, $h_{t\,min}$. We assume also for simplicity, that revenue per worker per period, is only a linear function of the number of periods spent training [25], $Y_t = k_{tr}\,\underline{t}$, where k_{tr} is a positive constant. If the cost per period spent training is wh_t, the worker retires after R periods and r is the discount rate (r>0), the problem facing the firm is:

$$\max_{\underline{t},h_t} P = \sum_{t=0}^{R} k_{tr}\,\underline{t}\,(1+r)^{-t} - \sum_{t=0}^{\underline{t}} wh_t\,\underline{t}\,(1+r)^{-t} \qquad \textbf{(G1)}$$

By expanding equation (G1) we obtain:

$$\mathbf{max}_{\underline{t},ht}\ \mathbf{P = k_{tr}\ \underline{t}\ A - w\ h_t\ \underline{t}\ f'(\underline{t})} \qquad \textbf{(G2)}$$

---

[25] A rising revenue per worker makes no difference to the result.

where $A=[(1+r)/r]\ [1-(1+r)^{-(R+1)}]$ and $f'(\underline{t})=[(1+r)/r][(1-(1+r)^{-(t+1)}]$.

The FOCs are:

$$\mathbf{P_t = k_{tr}\ A - wh_t\ f' - wh_t\ \underline{t}(df'/dt) = 0} \tag{G3}$$

$$\mathbf{P_{ht} = -\ w\ \underline{t}\ f'} \tag{G4}$$

According to equation (G3) the firm chooses $\underline{t}$ so that the increase in output from training a worker an extra period (k_{tr} A) equals the increase in cost ($wh_t\ f' + wh_t\ \underline{t}(df'/dt)$).

From equation (G4) it follows, that if $\underline{t}$ is positive, P_{ht} will be negative for all $\underline{t}$. The firm would therefore like to set h_t as low as possible and chooses $h_t=h_{t\ min}$.

For any given total amount of training the firm wants to spread training costs as much as possible since this does not affect revenue per worker but minimises the present value of the training cost per worker. It chooses therefore to train the worker the minimum "efficient" amount of time per period at a cost of $wh_{t\ min}$. It follows that if $h_{t\ min}=qh_s$, $0<q<1$, then training costs per period will be linear in standard weekly earnings.

APPENDIX H

The Utility Mark-Up with Positive Overtime

The union now sets w in order to maximize:

$$\max_{w} Z = N\{U(wH, T\text{-}h) - V\} + MV = NDU + MV \qquad \text{(H1)}$$

$$\text{s.t. } h = (b/(a\text{-}b))(1/(1+r))(g_1\text{-}r)\ h_s = \underline{d}\ h_s \text{ and}$$

$$N = (w(1+r)/b)^{1/(a-1)}\ h^{(1-b)/(a-1)}$$

where $H = (1+r)h\text{-}rh_s$. The FOC is:

$$N_w\, DU + NHU_1 = 0 \qquad \text{(H2)}$$

SOC is $Z_{ww} = N_{ww}\, DU + 2HN_w\, U_1 + NH^2 U_{11} < 0$. By rearranging the FOC we obtain:

$$U(wH, T\text{-}h) = [\, e_{Nw} / (\, e_{Nw} + e_{Uc})]\ V \qquad \text{(H3)}$$

where e_{Uc} is the elasticity of utility with respect to wH.

We can therefore look at the effects of changes in h_s on the wage, when e_{Nw} and e_{Uc} are constant. Differentiate the above expression with respect to the wage and standard hours to get:

$$
\begin{aligned}
\partial w/\partial h_s &= \partial w/\partial h_s \big|_{h=\text{const.}} + \partial w/\partial h \; \partial h/\partial h_s \\
&= - U_{hs}/U_w - (U_h/U_w) \; \partial h/\partial h_s \\
&= (rw/H) - [(w(1+r)U_1 - U_2)/(HU_1)] \; \partial h/\partial h_s \\
&= (rw/H) - \underline{A} \; \partial h/\partial h_s \qquad \text{(H4)}
\end{aligned}
$$

where $\underline{A} = [(w(1+r)U_1-U_2)/(HU_1)]$. $\underline{A}$ is larger than, equal to or smaller than zero as the level of hours demanded by the firm is below, at or above the optimal for the individual.

APPENDIX J

Efficient Bargaining with Positive Overtime

The profit (P) and union utility (Z) functions are:

$$\mathbf{P = N^a h^b - Nw\underline{H}} \qquad \mathbf{(J1)}$$

$$\mathbf{Z = N\{U(wH,h)-V] + MV} \qquad \mathbf{(J2)}$$

where $\underline{H}$ = $[(1+r)h + h_s(g-r)]$, H = $[(1+r)h - rh_s]$, $U_1>0$, $U_2<0$, $U_{11}<0$, $U_{22}<0$. The symmetric Nash solution is obtained from maximising:

$$\mathbf{\max_{N,h,w} X = (P-\underline{P})\ (Z-\underline{Z})}$$

Assume that $\underline{P}$ is zero and $\underline{Z}$=MV in which case X becomes:

$$\mathbf{\max_{N,h,w} X = (N^a h^b - Nw\underline{H})\ (NDU)} \qquad \mathbf{(J3)}$$

FOCs are:

$$\mathbf{X_N = P_N\ NDU + P\ DU = 0} \qquad \mathbf{(J4)}$$

$$\mathbf{X_h = P_h\ NDU + P\ NU_h = 0} \qquad \mathbf{(J5)}$$

$$\mathbf{X_w = (-N\underline{H})\ NDU + P\ NU_w = 0} \qquad \mathbf{(J6)}$$

Substitute $P_N = aN^{a-1}h^b - w\underline{H}$ in equation (J4) and divide through by NDU to obtain:

$$(\mathbf{aN^{a-1}h^b - w\underline{H}) + (N^{a-1}h^b - w\underline{H}) = 0} \tag{J7}$$

Divide through equation (J7) by h and rearrange to obtain the solution for N^*_{EB}:

$$\mathbf{N^*_{EB} = \{2w/(1+a)\}^{1/(a-1)}\, h^{(1-b)/(a-1)}\, \{(1+r) + [(h_s/h)(g-r)]\}^{1/(a-1)}} \tag{J8}$$

To obtain the mark-up equation, divide through equation (J6) by NP and multiply by w to get:

$$\mathbf{(-wN\underline{H}/P)DU + U\, e_{Uc} = 0} \tag{J9}$$

Denote $(wN\underline{H}/P)$ by A and rearrange (J9) to get:

$$\mathbf{U^*_{EB}(wH,h) = k_E\, V} \tag{J10}$$

where $k_E = (- A)/(- A + e_{Uc})$, $A = (1+a)/(1-a)$ and $k_E > 1$.

Assume now that the hours solution from equations (J8), (J10) and (J5) is such that $P_h=U_h=0$. We can obtain an explicit solution for hours by using the $P_h=0$ expression. This is:

$$\mathbf{P_h = bN^ah^{b-1} - wN(1+r) = 0} \tag{J11}$$

Multiply through by h, substitute $N^ah^b=[2wN\underline{H}/(1+a)]$ from (J7) and then solve for actual hours to get:

$$h^{*}_{EB} = \{[2b/((1+a)-2b))] (1/(1+r)) (g-r)\} h_s = \underline{d}' h_s \tag{J12}$$

To obtain an explicit solution for hours when P_h is not zero, substitute P_h in equation (J5) and divide through by PDU to obtain:

$$X_h = [\{bN^a h^b - whN(1+r)\} / \{N^a h^b - wN\underline{H}\}] + hU_h/DU = 0 \tag{J13}$$

Substitute $N^a h^b = [2wN\underline{H}/(1+a)]$ from equation (J7), denote (h/h_s) by x and rearrange equation (J13) to obtain:

$$\{[(2b-(1+a))x + 2ba_0]/[(1-a)(x + a_0)]\} + \{hU_h/DU\} = 0 \tag{J14}$$

where $a_0 = (g-r)/(1+r)$. The second term of equation (J14) is the product of $\{hU_h/U\}$ and $\{U/DU\}$. These in turn are:

$$\{hU_h/U\} = \{[(e_{Uc}+\underline{e}_{Uh})a_1 x - \underline{e}_{Uh}] / [a_1 x-1]\} \tag{J15}$$

$$\{U/DU\} = k_E/(k_E-1) = [1+a]/[(1-a)e_{Uc}] \tag{J16}$$

where $a_1=(1+r)/r$, and $\underline{e}_{Uh}$ is the elasticity of utility with respect to hours of work, holding consumption constant. Substituting equations (J15) and (J16) in (J14) and solving we get:

$$\gamma_0 x^2 + \gamma_1 x + \gamma_2 = 0 \tag{J17}$$

where the coefficients are:

$\gamma_0 = a_1 a_2\, e_{Uc} + a_4 \qquad \gamma_1 = a_3 a_1 e_{Uc} - a_2 e_{Uc} - \underline{e}_{Uh} + a_0 a_4$

$\gamma_2 = -a_3 e_{Uc} - a_0 \underline{e}_{Uh}$

$a_0 = (g-r)/(1+r) \qquad a_1 = (1+r)/r \qquad a_2 = \{[2b/(1+a)]-1\}$

$a_3 = 2ba_0/(1+a) \qquad a_4 = (e_{Uc}+\underline{e}_{Uh})a_1$

Equation (J5) is therefore a quadratic in (h/h_s). If $\underline{e}_{Uh}$ is constant, then if a unique solution exists, it will have the form:

$$\mathbf{h}^*_E = f^h\ (e_{Uc}, \underline{e}_{Uh}, a, b, r, g)\ \mathbf{h}_s = \underline{\mathbf{d}}''\ \mathbf{h}_s \qquad \textbf{(J18)}$$

where $\underline{d}''$ ($\underline{d}'' = f^h\ (e_{Uc}, \underline{e}_{Uh}, a, b, r, g)$) will be a constant that must be larger than unity, if firms employ overtime. In the case of simultaneous bargaining between the firm and the union over all relevant variables, the actual hours agreed upon will be linear in standard hours. The necessary conditions for this result are that fixed costs must be linear in standard hours, all the relevant elasticities must be constant and a meaningful solution must exist.

CHAPTER IV

THE DETERMINATION OF HOURS OF WORK AND THE EFFECTS OF MAXIMUM HOURS LEGISLATION

Introduction

In this Chapter we examine the determination of hours of work in a bargaining framework and the effects of maximum hours legislation. The determination of employment and wages in a bargaining framework has been examined extensively but the determination of hours of work is a fairly neglected issue. There are two reasons for this. First, bargaining models become more complicated when hours are introduced, especially when allowing for alternative sequences in the determination of hours, wages and employment - Earle and Pencavel (1990) show that there are 27 possible permutations. For this reason, it is more difficult to obtain clearcut results, unlike in the simple wage-employment bargaining models [1]. Second, empirical evidence on the appropriate model of wage-employment determination is conflicting and there are good reasons for which it might not be possible to discriminate between competing models - see Pencavel (1991, p. 108-114). It is therefore thought that extensions of the model are not likely to clarify the issue.

There are however exceptions in the current literature. Bienefeld (1969) was the first to provide an examination of the determination of hours of work in a bargaining framework, concentrating on the reasons for which hours of work are not changed as frequently as wages. More recently, and following the work of McDonald and Solow (1981) on wages and employment, Johnson (1990) examined the determination of "effort" and hours of work in a bargaining framework. He showed, that under special conditions bargaining over

[1] See however Manning (1992), who offers alternatives to the conventional results by modifying the assumptions of the production process.

effort may not be a substitute for bargaining over employment. The issue of bargaining over effort has also been examined by Bulkley (1992).

Earle and Pencavel (1990) and Pencavel (1991), have provided a detailed analysis of the determination of hours of work in a bargaining framework, allowing for various combinations of variables in the bargaining set and different sequences for the determination of hours, employment and wages.

In this Chapter we use a similar framework to examine the effect of different assumptions about the determination of hours of work on the relationship between hours of work and hourly wages. We show that union bargaining over hours is likely to lead to a level of hours below what a firm would determine unilaterally and present evidence which supports this result. If lower hours increase employment, it follows that, ceteris paribus, a union bargaining over hours of work exerts a positive indirect effect on employment. As a consequence, estimates of the employment effects of unions based solely on union wage differentials are likely to overestimate the employment effects of unions. We then provide a specific example with a Cobb-Douglas production technology and show that the conditions under which bargaining over hours of work will increase employment are realistic.

The analysis of bargaining over hours provides us also with a framework for understanding the conditions under which the level of hours observed may exceed the optimal for the individual or union. Recall that under this assumption, we showed in Chapter II, that reductions in hours of work would not increase the hourly wage and therefore would not have a negative indirect employment effect.

Union demands for reductions in the standard length of the workweek have also been accompanied by demands for a compulsory maximum length of the workweek - or overtime. Such legislation exists in most industrialised countries and is usually fairly comprehensive, specifying maximum hours per day, week, month and year and mechanisms by which firms are penalised when hours worked exceed these limits (see Arrowsmith (1988)). The European Commission has also decided, as part of its Action Programme implementing the Community Charter of Social Rights for Workers, to introduce a directive on the adaptation of working time. This stipulates a number of rules on minimum daily and weekly rest periods, breaks, duration of night work and annual leave. The Directive includes also a provision for a maximum length of work-week of 48 hours including overtime - unless a different agreement is made with unions. The main provisions of the directive including the 48 hours rule must be implemented by November 1996.

The UK has by far the highest percentage of workers working more than 48 hours compared with other European Commission countries, see Table 10. It currently does not have any legislation and has negotiated an opt-out on the 48 hour week but accepted the principle that no-one can be compelled to work more than 48 hours. Still, it intends to challenge the overall procedure of proposing the directive under Health and Safety provisions, at the European Court of Justice.

The framework provided in Chapter II and in section 6.0 of this Chapter, can be used to explain the reasons behind demands for maximum hours legislation (MHL) and the likely effects of the introduction of such legislation on wages, employment, profits and union utility.

If MHL is binding, the effects on employment, wages, utility and profits are very similar to the cases examined in Chapter II. If hours are above the optimal for the individual, employment is likely to increase, the wage is likely to fall, union utility is likely to increase whereas the effect on profits is uncertain. The results are largely independent of whether the firm bargains over employment with the union or has unilateral control of it.

When maximum hours legislation is proposed however, it is likely to be binding for a small minority of workers and firms. In the US for instance, when most states introduced such legislation during the first two decades of this century, the laws applied mainly to the employment of women - see Landes (1980). The strong negative reaction of employers and the strong support of unions for such legislation is therefore difficult to explain. In the last part of this Chapter we provide an explanation for this "curiosity" by examining two different bargaining solutions, showing that even when MHL is not binding it can increase the bargained level of utility and reduce the level of profits. We show that similar arguments can be applied to all legislation that affects the maximum or alternative pay-offs of workers and firms, like legislation on minimum wages.

6.0 THE DETERMINATION OF HOURS OF WORK

6.1 Hours of Work in the Efficient Bargaining Model

Consider the efficient bargaining model - eg McDonald and Solow (1981) -, but assume that the firm bargains over wages, employment and hours of work. Assume there is no overtime and the profit (P) and union utility (Z) functions are - where F and U have the usual properties:

$$\mathbf{P = F(N,h) - whN} \qquad \text{(IV.1)}$$

$$\mathbf{Z = N[U(wh,T\text{-}h)\text{-}V] + MV} \qquad \text{(IV.2)}$$

The symmetric Nash solution is obtained from maximising:

$$\mathbf{\max_{N,h,w} X = (P\text{-}\underline{P})\ (Z\text{-}\underline{Z})} \qquad \text{(IV.3)}$$

$\underline{P}$ and $\underline{Z}$ are the fall-back levels of profits and utility. These are the pay-offs to the firm and the union respectively if no bargaining solution is achieved. Assume that $\underline{P}$ is zero and $\underline{Z}$=MV in which case the FOCs are:

$$\mathbf{X_N = (F_N\text{-}wh)\ NDU + P\ DU = 0} \qquad \text{(IV.4)}$$

$$\mathbf{X_h = (F_h\text{-}wN)\ NDU + P\ N(wU_1\text{-}U_2) = 0} \qquad \text{(IV.5)}$$

$$\mathbf{X_w = (\text{-}hN)\ NDU + P\ NhU_1 = 0} \qquad \text{(IV.6)}$$

where DU=U-V. Divide through equation (IV.6) by NP and multiply by w to obtain:

$$\mathbf{(-whN/P)DU + U\ e_{Uc} = 0} \qquad \mathbf{(IV.7)}$$

where $\mathbf{e_{Uc} = (whU_1/U)}$, is the elasticity of utility with respect to consumption. Denote -whN/P by e_{Pw} (ie the elasticity of profits with respect to the wage) and rearrange equation (IV.7) to obtain bargained utility for the union members as a mark-up over outside utility, like in the models of Chapter II:

$$\mathbf{U_{EB}(wh,T\text{-}h) = k_{EB}\ V} \qquad \mathbf{(IV.8)}$$

where $k_{EB} = (- e_{Pw})/(- e_{Pw} - e_{Uc})$. Note that the labour demand elasticity does not appear directly in equation (IV.8) since the firm now bargains over employment.

The ratio of equations (IV.5) and (IV.6) defines implicitly, for any given level of employment, the relationship between hours of work and wages along the contract curve. After some rearrangement this ratio is:

$$\mathbf{F_h = N(U_2/U_1) = N\ A} \qquad \mathbf{(IV.9)}$$

where A ($A=U_2/U_1$) is the absolute value of the marginal rate of substitution between consumption and leisure. For a given level of employment the slope of the contract curve (CC) is derived by differentiating (IV.9) with respect to hours and the wage:

$$\mathbf{dh/dw}\,\big|_{CC,N\ const} = [NA_w]/[F_{hh} - NA_h] \qquad \textbf{(IV.10)}$$

where $A_w=\partial A/\partial w$ and $A_h=\partial A/\partial h$. If the marginal rate of substitution is diminishing in leisure, then $A_h>0$, which means that the denominator of equation (IV.10) is negative. The numerator will be positive if $U_{12}\geq 0$. It follows that (IV.10) is smaller than zero and the contract curve is negatively sloped in wage-hours space.

The contract curve is illustrated in Figure 6 as CC, and it is the loci of tangency between iso-profit and iso-utility curves in wage-hours space. The iso-profit curves have a maximum at the level of hours that maximises profits for the firm, if it was free to choose hours of work for any given level of wage (ie the w-h combinations that satisfy F_h-wN=0, for given w and N). The curve that connects the maximum points of the iso-profit curve is a conventional demand curve for hours; this is drawn as DD in Figure 6. The further away from the horizontal axis, the lower the level of profits achieved.

Similarly, the iso-utility curves have a minimum in wage-hours space at the level of hours that would maximise individual utility, if the workers were free to choose hours of work for any given wage (the w-h combinations that satisfy $wU_1-U_2=0$, for given w). The curve that connects the minimum points of the iso-utility curves is the conventional hours (labour) supply curve and it is drawn as SS in Figure 6; this is drawn with a positive slope, assuming a stronger substitution effect. The further away from the origin, the higher the level of utility achieved.

In the special bargaining case of this section, where we assumed that the bargaining power of the two parties is the same, the precise solution on the contract curve will depend on the size of the profit and consumption elasticities which determine the mark-up (ie e_{Pw} and e_{Uc}, see equation (IV.8)). In the general bargaining case, the precise solution along the contract curve will depend also on the bargaining power of the two parties since the mark-up of equation (IV.8) will be increasing in the bargaining power of the union - the generalised wage equation is derived in the next Chapter, see equation (V.7); for a given level of employment, the stronger the union, the higher the wage and the lower the level of hours negotiated.

Note however that as we move up the contract curve, the contract curve itself may shift since its position depends on the level of employment. By differentiating equation (IV.9) with respect to employment and the wage, holding hours of work constant, it is easy to show that $dw/dN\,|_{h\ constant}$ will be negative if $F_{Nh} \leq 0$ or $A > F_{Nh}$ (assuming that A_w is positive - recall that this will hold if $U_{12} \geq 0$). It follows that an increase in employment will shift the contract curve inwards if $A - F_{Nh} > 0$ and A_w is positive. In order to determine whether a movement up the contract curve leads to a higher or lower level of employment we need to totally differentiate equation (IV.4) with respect to employment, the wage and hours of work. After some rearrangement we obtain:

$$[2(F_N - wh) + NF_{NN}]\ dN = 2hN\ dw + [F_h + 2wN - NF_{Nh}]\ dh \qquad \text{(IV.4')}$$

$$\text{or } B\ dN = C\ dw + D\ dh$$

where $B = 2(F_N - wh) + NF_{NN}$, $C = 2hN$ and $D = F_h + 2wN - NF_{Nh}$. B is negative from the FOC. dN/dw holding h constant is therefore negative and dN/dh holding w constant will be negative if $F_{Nh} \leq 0$ or $(F_h+2wN) > NF_{Nh}$. It follows that a movement up the negatively sloped w-h contract curve will have an uncertain effect on employment which means that the contract curve can shift in either direction. More definite results can be obtained by using specific functional forms and we do that in the next section.

The little available empirical evidence for the US supports the view however that stronger unions will achieve higher wages and lower hours. Earle and Pencavel (1991) report a negative union non-union hours differential for annual hours of work using US time-series data and for weekly hours of white males from a cross section of workers from the 1979 Current Population Survey. Perloff and Sickles (1987) also report a significant negative effect of unionisation on hours of work in the construction industry. The evidence suggests therefore that a movement up the contract curve:

- has no effect on employment (ie $C\ dw + D\ dh = 0$), or
- may have an effect on employment but any change in employment does not affect the position of the contract curve (ie $A=F_{Nh}$), or
- increases employment (ie $C\ dw + D\ dh < 0$) and therefore the contract curve shifts inwards - which would suggest that the positive employment effect of lower hours $((D/B)\ dh)$ is larger than the negative employment effect of higher wages $((C/B)\ dw)$, or
- decreases employment ($C\ dw + D\ dh < 0$), but for any given initially negotiated level of hours-wages, the resulting outwards shift of the contract curve is not significant enough to lead to a level of hours above the initial level.

In what follows we examine the implications of the above analysis for:

- the relationship between the bargained level of hours of work and the competitive level,
- the effect of unions on employment and the impact of legislation restraining union power, and
- estimates of labour supply elasticities.

To address the first issue it is useful to distinguish between three possible regimes for the negotiated w-h combinations. By rearranging equation (IV.5) we obtain that at the negotiated employment and wage levels, bargained hours of work (h^*_{EB}) satisfy:

$$\mathbf{P_h = -(P/DU)\ U_h} \qquad \textbf{(IV.11)}$$

It follows from equation (IV.11) that at the bargained level of hours (h^*_{EB}), P_h and U_h will either both be zero or have the opposite sign. The three possible regimes for the level of negotiated hours are - see Figure 6:

	$\mathbf{P_h, U_h}$	$\mathbf{h^*_{EB}}$
(i)	h^*_{EB} is such that $P_h=U_h=0$	$h^*_{EB} = h_e$, $w = w_e$
(ii)	h^*_{EB} is such that $P_h>0$, $U_h<0$ (to the right of the hours supply curve)	$h_e < h^*_{EB} < h_V$ $w_V < w < w_e$
(iii)	h^*_{EB} is such that $P_h<0$, $U_h>0$ (to the left of the hours supply curve)	$h_{min} < h^*_{EB} < h_e$ $w_e < w$

where h_e is the level of hours at the intersection of the demand and supply curve of hours (with a corresponding level of wage of w_e, h_V is the level of hours corresponding to the level of outside utility V - ie at the tangency of the iso-utility curve for V and the corresponding iso-profit curve (with a corresponding level of wage of w_V), and h_{min} is the level of hours corresponding to the zero profits iso-profit curve.

There is no reason, a priori, to expect negotiated hours to be at the intersection of the implicit hours demand (DD) and hours supply (SS) curves (w_e,h_e), ie regime (i). These are also drawn on the figure, with their conventional shapes.

The contract curve is negatively sloped which implies that, if employment does not affect the position of the curve or a movement down the curve has no effect on employment or shifts the curve outwards, h^*_{EB} is higher in regime (ii) than in regime (iii). Regime (ii) describes probably the situation faced by unionised employees, when reductions in hours of work are a persistent union demand. Unlike the simple wage-employment bargaining model therefore, the marginal cost of an hour can now fall short of its marginal product and this is more likely to happen the stronger the firm. The outcomes are all efficient for the assumed bargaining structure. Union demands for lower hours are simply an alternative way of attempting to by-pass a strong bargaining position for the firm, in regime (ii).

If, however, the union is strong and manages to obtain a level of hours in regime (iii), negotiated hours will fall short of the optimal for the individual and union.

The above analysis has also implications for the employment effects of unionism. Studies estimating the effect of unionism on employment by examining the union non-union wage differential and then assuming that a firm with unionised workers will be pushed up a fixed labour demand curve, are likely to overestimate this effect [2].

If employment depends negatively on hours of work and these are bargained over, the conventional result that a union will push wages up a fixed labour demand curve may be misleading. As shown earlier - see equation (IV.4') -, the labour demand curve faced by a unionised firm is likely to shift to the right if unions bargain with firms over hours of work. The available empirical evidence - see subnote 2 in Chapter II - suggests that this is a realistic assumption. In such a case the total effect on employment will need to take into account the size of the union non-union hours differential; given the evidence presented in the introduction on the elasticity of employment with respect to hours of work and the available estimates of the union non-union hours differential, the bias of the effects of unionism on employment can be significant [3].

The other significant implication of the analysis is that a reduction of union power will not necessarily lead to a significant increase in employment. The reason is that firms facing

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[2] See Pencavel (1991, p. 30-45) for a summary.

[3] Pencavel and Hartsog (1984) report an average union non-union wage differential for the 1920-1980 period in the US of +23% and Earle and Pencavel (1990) an average hours union non-union differential of -11%. Furthermore, there is a wide variability depending on the sub-periods considered. In the 1930's for instance, the wage differential is +30% and the hours differential -29%; estimates of the employment effect of unions in such a period, based solely on union wage premiums, are likely to grossly overestimate the true effect. This is true even if the labour demand elasticity with respect to the wage exceeds the labour demand elasticity with respect to hours.

weaker unions will negotiate lower wages but also higher hours - or a smaller reduction in hours than would otherwise be the case - ie they will move down the contract curve. The labour demand curve may therefore shift inwards and any given increase in employment due to lower wages will be restrained by the increase in hours of work. This seems to reflect accurately the path of manufacturing employment, wages and hours in the UK in the 1980s.

Consider now the implications of bargaining over hours of work on the estimates of labour supply elasticities. These are usually estimated to be negative or zero and this is interpreted as evidence of a strong income effect - for a summary see Table 1.19 and Table 1.20 in Pencavel (1986). The wage-hours solutions on the contract curve are off the labour supply curve, as illustrated in Figure 6. This will be valid for individual workers that bargain over hours and wages or, more likely, for unions or representatives of workers bargaining on their behalf. Actual estimates of labour supply elasticities may therefore be biased since they will be picking up the negative effect of unionism on hours of work and its positive effect on the hourly wage, if no variable is included to proxy for union representation or strength. In other words, estimates of labour supply curves may be picking up points along the CC curve rather than the SS curve. The evidence that does exist - Perloff and Sickles (1987, Table 2, p. 188) - suggests that a variable proxying union strength is significant, both on its own and interacting with other worker characteristic variables.

A final note concerns the relation between the above analysis and the assumptions we made in section 2.0 of Chapter II concerning the relation between the initial level of hours and the optimal for the individual. We argued there, that, if the mark-up of union over outside utility is constant, a reduction in hours of work will lead to the same (a lower) hourly wage if hours are at (above) the optimal level for the individual initially. We have shown in this Chapter that efficient bargaining over wages and hours can lead to negotiated hours being at or above the optimal level for the individual, in regimes (i) and (ii) respectively.

6.2 A Reconsideration of the Employment Effects of Unions

In this section we adopt the assumption of a CD production function and a utility function with a constant elasticity of utility with respect to consumption to provide a definite prediction about the implications of bargaining over hours of work on employment. This enables us to obtain an explicit solution for hours of work, employment and wages under two different bargaining regimes. The model is very similar to the model analysed in the last part of section 5.2 but we drop the distinction between actual and standard hours as well as the assumption of a constant elasticity of utility with respect to hours of work - this allows the conventional labour supply function to depend on the wage.

Since we are interested in the effects of introducing bargaining over hours we assume first that the firm sets hours of work - the "right to manage (RM) hours" model - and then that it bargains over them with the union - the "bargaining (B) over hours" model. In both cases employment is set unilaterally by the firm, either simultaneously with hours of work or after it has bargained over wages and hours with the union. We then proceed to derive an explicit expression for the effects of bargaining over hours of work on employment and show that ignoring the "hours effect" of unions can lead to an overestimation of the employment effect of unions.

Consider first the "right to manage hours" model. Assume that the firm's profit and the union's utility functions are:

$$P = N^a h^b - w(h+g_1)N \qquad \text{(IV.12)}$$

$$Z = N\{U(wh,T-h)-V\} + MV = NDU + MV \qquad \text{(IV.13)}$$

The firm is assumed to set employment and hours of work after it has bargained over the wage with the union. The solution for employment and hours therefore is obtained by maximising equation (IV.12), setting $P_N=P_h=0$, for a given wage. The optimal demands are:

$$N^*_{RM} = (w^*_{RM}/a)^{1/(a-1)}\ h^{*\,(1-b)/(a-1)}_{RM}\ \{1+(g_1/h^*_{RM})\}^{\ 1/(a-1)} \qquad \text{(IV.14)}$$

$$h^*_{RM} = \{b/(a-b)\}\ g_1 = q_{RM}\ g_1 \qquad \text{(IV.15)}$$

where q_{RM} = b/(a-b). The bargained wage will maximise the symmetric Nash maximand subject to the factor demand equations (IV.14) and (IV.15):

$$\max_w X = [N^a h^b - w(h+g_1)N]\ [NDU] \text{ s.t. } P_h=P_N=0 \qquad \text{(IV.16)}$$

where we made again the assumption that the fall back level of profits is zero and of union utility MV. We can obtain again union members' utility as a mark-up on outside utility:

$$U^*_{RM} = \{[\ - e_{Pw} - e_{Nw}]/[\ - e_{Pw} - e_{Nw} - e_{Uc}\ ]\}\ \ V = k_{RM}\ V \qquad \text{(IV.17)}$$

This is identical to the mark-up equation obtained when hours were exogenous - equation (II.10) in section 2.1.2. Substituting the relevant elasticities from the functional form assumptions in the mark-up implies that:

$$k_{RM} = [(1+a) / (1-a)] / [\{(1+a) / (1-a)\} - e_{Uc}] \qquad \text{(IV.18)}$$

By substituting h^*_{RM} from equation (IV.15) in (IV.17) we can obtain the solution for w^*_{RM}. We do not need to solve explicitly for the wage however, since as will be seen this is not needed for comparison with the "bargaining over hours" case. This therefore completes the derivation of an explicit solution for employment and hours in the "right to manage hours" case.

Consider now the equivalent "bargaining over hours" case. The problem facing the firm and the union is:

$$\max_{w,h} X = [N^a h^b - w(h+g_1)N] [NDU] \text{ s.t. } P_N=0 \qquad \text{(IV.19)}$$

Employment is set by the firm after it has bargained over the wage and hours with the union. From $P_N=0$ we therefore obtain again:

$$N^*_B = (w^*_B/a)^{1/(a-1)} h^{*\,(1-b)/(a-1)}_B \{1+(g_1/h^*_B)\}^{1/(a-1)} \qquad \text{(IV.20)}$$

This is the same labour demand equation as (IV.14), evaluated at a different level of wage and hours. It is straightforward to derive a mark-up equation for the utility of employed union members. This will be exactly the same as in the case where the firm set hours of work since our profit assumption implies that hours of work are independent of the wage. If the elasticity of utility with respect to consumption is constant and, under the CD assumption, the level of utility achieved under the two bargaining assumptions is the same;

the way hours are set does not affect the wage bargaining outcome. It follows that $U^{*}_{B} = k_{B}\,V$, $U^{*}_{RM} = k_{RM}\,V$ and $k_{B} = k_{RM} = [(1+a)/(1-a)]/[\{(1+a)/(1-a)\}-e_{Uc}]$, so that:

$$U^{*}_{B} = k_{B}\,V = k_{RM}\,V = U^{*}_{RM} \qquad \text{(IV.21)}$$

Consider now the determination of hours. These will satisfy:

$$X_{h} = (bN^{a}h^{b-1} - wN)\;NDU + PN_{h}\;DU + P\;N(wU_{1}-U_{2}) = 0 \qquad \text{(IV.22)}$$

Multiply equation (IV.22) by h/NPDU to get:

$$[(bN^{a}h^{b} - whN)/P] + \underline{e}_{Nh} + [(hwU_{1}-hU_{2})/DU] = 0 \qquad \text{(IV.23)}$$

Assume that $[(bN^{a}h^{b} - whN)/P] + \underline{e}_{Nh} = A1$ and $[(hwU_{1}-hU_{2})/DU] = A2$. Substitute the profit function and the direct elasticity of employment with respect to hours of work - see Table 1 in Chapter I - in A1 to obtain:

$$A1 = [(bN^{a}h^{b}-whN)/(N^{a}h^{b}-w(h+g_{1})N)] + [(1-b-\underline{f})/(a-1)] \qquad \text{(IV.24)}$$

where $\underline{f}$ is the ratio of fixed to total labour costs ($\underline{f}=g_{1}/(g_{1}+h)$). From the solution for employment, equation (IV.20), it follows that:

$$N^{a}h^{b} = [w(h+g_{1})N/a] \qquad \text{(IV.25)}$$

Substitute equation (IV.25) in (IV.24), denote h/g_1 by x and rearrange to obtain:

$$\mathbf{A1 = [2b(1+x)-(1+a)x]/[(1+x)(1-a)]} \tag{IV.26}$$

Multiply now the numerator and denominator of A2 by U to obtain:

$$\mathbf{A2 = [(hwU_1-hU_2)/U]\ [U/DU] = [e_{Uc}+\underline{e}_{Uh}]\ [k_B/(k_B-1)]} \tag{IV.27}$$

where $\underline{e}_{Uh}$ is the elasticity of utility with respect to hours of work, holding consumption constant ($\underline{e}_{Uh} = -(h/U)U_2$, $\underline{e}_{Uh} < 0$). Substitute k_B, which is equal to k_{RM}, from equation (IV.18) and rearrange equation (IV.27) to obtain:

$$\mathbf{A2 = [(1+a)/(1-a)]\ [1 + (\underline{e}_{Uh}/e_{Uc})]} \tag{IV.28}$$

It follows that A2>0 if and only if $e_{Uc} > -\underline{e}_{Uh}$ and $A2 \leq 0$ if and only if $e_{Uc} \leq -\underline{e}_{Uh}$. Denote by b_0 the ratio of the hours to the consumption elasticity, ie $b_0=(\underline{e}_{Uh}/e_{Uc})$, $b_0<0$. If we substitute equations (IV.26) and (IV.28) in (IV.23) and solve for h^*_B we obtain:

$$\mathbf{h^*_B = \{[2b +(1+a)(1+b_0)]/[(a-b)+(1-b)-(1+a)(1+b_0)]\}\ g_1, \text{ or}} \tag{IV.29}$$

$$\mathbf{h^*_B = q_B\ g_1} \tag{IV.30}$$

where $q_B = [2b+(1+a)(1+b_0)]/[(a-b)+(1-b)-(1+a)(1+b_0)]$. In line with our earlier results we will assume first that the union members's utility is decreasing in hours of work at the bargained level of hours. In that case $(wU_1-U_2)<0$, $(1+b_0)<0$ and $e_{Uc} \leq -\underline{e}_{Uh}$. It is then possible to show that $q_B<q_{RM}$ and therefore the level of hours negotiated between the union and the firm will be lower than the level of hours the firm would set unilaterally, if it was free to do so.

To prove this result we assume that q_B is bigger than q_{RM} (which is equal to b/(a-b), see equation (IV.15)) and end up with a contradiction. If we denote $(1+a)(1+b_0)$ by $\underline{z}$ we assume then that $[\{2b+\underline{z}\}/((a-b)+(1-b)-\underline{z})] \geq b/(a-b)$. Note now that it is sufficient to prove that $[\{2b\}/((a-b)+(1-b))]$ can not be bigger or equal to b/(a-b), since $[\{2b+\underline{z}\}/((a-b)+(1-b)-\underline{z})]$ is smaller than $[\{2b\}/((a-b)+(1-b))]$.

After some rearrangement $[\{2b\}/((a-b)+(1-b))] \geq b/(a-b)$ becomes $(a-b)+(a-b) \geq (a-b)+(1-b)$. Note however that since a<1 the LHS will always be smaller than the RHS. It follows that h^*_{RM} is larger than h^*_B.

In order to determine the effect of bargaining over hours on employment, we need to specify whether the bargained wage when firms bargain over hours (w^*_B) is smaller than when hours are set unilaterally by the firm (w^*_{RM}). From (IV.30) and (IV.15) we have that:

$$h^*_B < h^*_{RM} \qquad \textbf{(IV.31)}$$

Under the assumption that U_h is negative at the level of hours negotiated between the firm and the union, utility under the right to manage model will be smaller than utility under the bargaining model, for the same wage [4]. We know from (IV.21) however that $U^*_B=U^*_{RM}$ since the mark-up in both the bargaining and right to manage models is the same. For this equality to hold, the wage when hours are bargained over must be lower than when hours are set by the firm, since utility is increasing in the wage.

Total logarithmic differentiation of equation (IV.14) or (IV.20), for any level of hours h, and wage w, implies that:

$$\mathbf{dlnN = 1/(a\text{-}1)\ dlnw + (1\text{-}b\text{-}\underline{f})/(a\text{-}1)\ dlnh} \qquad \mathbf{(IV.32)}$$

If (1-b-$\underline{f}$) is positive - $\underline{f}$ is the ratio of fixed to total labour costs -, equation (IV.32) will be negative, since (a-1)<0 and, when unions bargain over hours of work, dlnw and dlnh are positive. Employment will therefore be higher when bargaining over hours of work than when hours are set unilaterally by the firm, with a constant consumption elasticity utility function, a constant elasticity production function, under the realistic assumption that 1-b-$\underline{f}$ is positive.

The intuition behind this result is that a lower level of hours when the union can bargain over hours, implies that union members will be better off under the assumption that U_h is negative. This leads the union to negotiate a lower level of wage since the level of utility achieved in the bargaining over hours case is the same. Employment depends negatively both on the wage and hours of work and will therefore be higher. In other words a union

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[4] Note that since $U_{hh} = w^2U_{11} - 2wU_{12} + U_{22}$ is negative, U_h will be negative at h^*_{RM} if it is negative at h^*_B.

bargaining over hours of work will opt for a utility neutral trade-off between hours and wages to increase employment.

If the negotiated level of hours is such that union members are indifferent to small changes in the level of hours (ie U_h=0), then $e_{Uc} = -e_{Uh}$ at the bargained level of hours, $(1+b_0)=0$ and A2=0. From equation (IV.29) it follows that $h^*_B = \{[2b]/[(1+a)-2b]\}\ g_1$. It is possible to show that h^*_B is again smaller than h^*_{RM} (ie $\{[2b]/[(1+a)-2b]\}$ is smaller than $\{b/[a-b]\}$ [5]). U_{hh} is negative for any level of hours so that if U_h is zero at h^*_B it will be negative at h^*_{RM}. The level of utility under the right to manage hours model would be lower than under the bargaining over hours model, for the same wage. The mark-up in both cases is the same however and for equation (IV.21) to hold the wage must be higher in the right to manage hours model. The results are therefore similar to the case just analysed, where U_h was negative at h^*_B and h^*_{RM}.

Note that if the firm bargained also over employment - the "efficient bargaining" model - then the wage and hours outcome would be the same as in the "bargaining over hours" model. Employment would be higher, just like in the simple wage-employment bargaining case. Our main results from the "right to manage hours" model could therefore be compared with the efficient bargaining model. Under our profit assumption, hours are independent of employment and this means that if the firm sets hours unilaterally, the level of hours chosen will be independent of the employment determination assumptions - just like the union utility mark-up is independent of the hours determination assumptions. The

[5] We have already proved this result in the case where U_h was not zero.

main results concerning the effect of bargaining over hours on employment will therefore be qualitatively the same to the comparison of the "right to manage hours" with the "bargaining over hours" models.

We have demonstrated in this section, with an example that allows us to solve explicitly for employment, hours and wages, that a union that bargains over hours of work and wages will negotiate a lower level of hours - and possibly a lower hourly wage -, compared to a union that bargains only over the wage, with the firm having unilateral control over hours of work. This implies that bargaining over hours can have a significant positive effect on employment and confirms the assertion made in the previous section, that studies ignoring the effect of unionisation on hours of work are likely to overestimate the employment effects of unionism.

7.0 MAXIMUM HOURS LEGISLATION

7.1 The Effects of Binding Maximum Hours Legislation (MHL)

7.1.1 MHL when Hours are Exogenous

The effects of Maximum Hours Legislation when hours are exogenous can be derived directly from the models examined in Chapter II. Table 3 in Chapter II summarises the total effect on employment under the different assumptions about the reaction of the hourly wage and the direct employment effect.

We briefly repeat the main results here. Following the evidence presented in Table 2A and Table 2B in Chapter I we assume that a reduction in hours of work is likely to have a positive direct employment effect. Under the assumption of a constant mark-up, if hours are initially below the optimal for the individual and the firm sets employment unilaterally, a reduction in hours will reduce the hourly wage and therefore also have a positive indirect employment effect. It will also increase individual and union utility but will have an uncertain effect on profits.

If hours are at the optimal level for the individual initially, a reduction in hours will have no indirect effect on employment. Individual utility is unaffected, but union utility will increase since the hours reduction leads to a direct positive employment effect. Profits are now more likely to fall, since there is now no reduction in the wage following the reduction in hours.

If employment is determined jointly with wages in a Nash bargain, the qualitative effects of maximum hours legislation on employment and wages are unaffected. If hours are below the optimal level for the individual then the effect on union utility becomes uncertain since a reduction in hours increases individual utility and raises directly and indirectly employment but also leads to a lower wage. If hours are optimal for the individual however, a reduction in hours will lead again to a higher level of union utility. The effect on profits is again uncertain but MHL is more likely to reduce profits, if hours are at the optimal level for the individual initially and the wage remains unaffected.

7.1.2 MHL when Hours are Endogenous

Since our focus in this section and in section 7.2 is the explanation of the strong support of unions for maximum hours legislation and the opposition of employers, we concentrate on the effects of such legislation on profits and union utility. In order to keep the analysis simple we therefore abstract from the employment issue and we take the level of employment to be fixed. The Nash bargain between the union [6] and the firm would then set the wage and hours [7] in order to maximise:

$$\max_{w,h} X = (F(N,h) - whN)\ (NDU) \qquad \text{(IV.33)}$$

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[6] Since employment is fixed by assumption, the terms union and employees-members-workers will be used interchangeably.

[7] Although we specify the bargaining set to include hours of work and the basic hourly wage, our results would be unaffected if we assumed that the firm and the union/worker bargained over overtime hours, with standard hours exogenous, and/or the overtime premium, taking the basic wage as given. The latter assumption is probably the least realistic since the overtime premium in most countries is fixed by legislation.

where we assumed that the fall back level of utility is MV and of profits zero. For simplicity, we normalise N to unity and suppress it from the notation. Differentiate equation (IV.33) with respect to hours and the wage to obtain:

$$X_h = (F_h\text{-}w)\ DU + P(wU_1\text{-}U_2) = 0 \qquad \text{(IV.34)}$$

$$X_w = (\text{-}h)DU + PhU_1 = 0 \qquad \text{(IV.35)}$$

The ratio of equations (IV.34) to (IV.35) defines implicitly the contract curve in wage-hours space, like in the case analysed in section 6.1. Since we assume that maximum hours legislation is binding we will only analyse the effects of such legislation on wages, profits and union utility when the initial wage-hours bargaining outcome is such that at the bargained level of hours $P_h>0$ and $U_h<0$; this is regime (ii), see Figure 6.

Rearrange again equation (IV.35), to get members' utility as a mark-up on outside utility:

$$U(wh,T\text{-}h) = \{[\ \text{-}\ e_{Pw}]\ /\ [\ \text{-}\ e_{Pw}\ \text{-}\ e_{Uc}]\}\ V = k_{B1}\ V \qquad \text{(IV.36)}$$

In this framework, the introduction of binding maximum hours legislation introduces an inefficiency since it implies a movement off the contract curve. We can distinguish between two cases, depending on the assumption made about the mark-up:

(a) the mark-up does not depend on hours of work, and

(b) the mark-up is a function of hours of work - and the wage.

In case (a) we assume k_{B1} to be constant. It follows from equation (IV.36) that the level of utility offered after the introduction of maximum hours legislation will be the same. Since MHL is now binding, the solution will be at the intersection of the vertical line passing through h_{max} and the iso-utility locus for U1.

The effects of MHL in this case are depicted in Figure 6. Assume that the initial solution is (w_1,h_1), delivering a utility level of U1 and profits of P1. We can then draw the iso-utility locus, which will be increasing to the right of the hours supply curve (SS) and the iso-profit locus, which will be decreasing to the left of the hours demand curve (DD). If we denote the level of maximum hours by h_{max}, binding MHL which does not imply a change in regime $(h_e<h_{max}<h_1)$, will in this case lead to a lower wage, the same utility [8] and lower profits at a point like B in Figure 6 - iso-profit curves represent lower profits as we move upwards or to the left.

Consider now case (b), where k_{B1} is not constant and depends on hours of work and the wage. The solution will be at the intersection of equation (IV.35) and the vertical line passing through h_{max}. It is easy to show that for constant e_{Uc}, the mark-up will be decreasing in the wage and decreasing in hours, if the average product of an hour is

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[8] Although not modelled explicitly, if employment depends negatively on the wage and hours of work then we would expect MHL, by reducing hours and the wage to have a positive employment effect. This would then increase union utility, although individual utility would remain unchanged. The result is very similar to the CD case presented in section 6.2, where union members are indifferent to the level of hours negotiated.

decreasing in hours [9]. If e_{Pw} is constant on the other hand, the mark-up will be decreasing in the wage and hours if e_{Uc} is decreasing in the wage and hours - eg with a Stone-Geary utility function. In either case it follows that MHL will imply, for a given wage, an increase in both the RHS and the LHS of equation (IV.36). If the mark-up increases by more than union utility, then the wage will have to rise to bring back the equality, and the opposite will be true if union utility increases by more than the mark-up. In this case, individual and union utility are higher after the introduction of maximum hours legislation and profits are lower. Diagrammatically the solution will be at some point on the vertical line passing through h_{max} above B - see Figure 6.

The way MHL has been introduced in practice however, implies, that it is unlikely to be binding for the majority of firms and workers. We turn therefore our attention in the next section to an explanation of why, even in cases where MHL is not binding, it is opposed by employers and supported by unions.

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[9] The mark-up is $[-e_{Pw}]/[-e_{Pw}-e_{Uc}]$ (see equation (IV.36)), where $-e_{Pw} = (whN/P)$ and is positive. The mark-up is increasing in $(-e_{Pw})$. By substituting the expression for profits from equation (IV.33), $(-e_{Pw})$ can be rearranged as follows:

$$(-e_{Pw}) = -whN/P = -(1/(P/whN)) = (1/[1-(F/whN)])$$

If the average product of an hour (ie F/hN) is decreasing in hours, then $(-e_{Pw})$ is also decreasing in hours, since $(-e_{Pw})$ is increasing in the average product of an hour. It follows that the mark-up is decreasing in hours (for constant (e_{Uc})).

$(-e_{Pw})$ is also decreasing in the wage, so that the mark-up is also decreasing in the wage.

7.2 Why do Unions Support and Employers Oppose Non-Binding Maximum Hours Legislation

Consider now the case where maximum hours legislation is not binding. It is easier in this case to demonstrate the effects of maximum hours legislation by expressing the bargaining solution in terms of profits and union/individual utility - see Pencavel (1991, p. 114-120). This will also enable us to examine an alternative solution which allows the bargained outcome to depend on the maximum available pay-offs to the bargaining parties.

In order to derive the solution in P-U space we proceed as follows. We first derive the equation for the contract curve assuming that the firm has to offer a level of utility U0. This defines implicitly wages and hours of work as a function of the level of utility U0. By substituting this back in the profit function we express profits as a function of union utility, such that any combination is on the contract curve. This is the Pay-Off Frontier (PF) and is negatively sloped in profits-utility space, since by derivation, it shows the maximum level of profits attainable by the firm for any given level of utility. We then examine two different bargaining solutions and the implications for utility and profits of maximum hours legislation.

In order to derive the Pay-Off Frontier (PF) assume that the firm has to determine hours and wages in order to maximise [10] (the model is similar to the model presented in section 7.1.2.):

[10] The PF would be the same if the union was setting wages and hours to maximise utility, subject to offering a given level of profits to the firm - ie the dual of (IV.37).

$$\max_{w,h} P = Nf(h) - whN \text{ s.t. } NU \geq NU0 \qquad \textbf{(IV.37)}$$

The Lagrangean for the problem is:

$$\max_{w,h,\lambda} L = F(N,h) - whN + \lambda N \{U0 - U(wh, T-h)\} \qquad \textbf{(IV.38)}$$

where λ is the Lagrangean multiplier, $\lambda \leq 0$. The FOCs with respect to hours, the wage and λ are - normalising again N to unity and suppressing it from the notation:

$$L_h = (F_h - w) - \lambda (wU_1 - U_2) = 0 \qquad \textbf{(IV.39)}$$

$$L_w = -h - \lambda (hU_1) = 0 \qquad \textbf{(IV.40)}$$

$$L_\lambda = U0 - U(wh, T-h) = 0 \qquad \textbf{(IV.41)}$$

By substituting λ from equation (IV.40) in (IV.39) we obtain:

$$(F_h - w) + [(wU_1 - U_2)/U_1] = 0 \qquad \textbf{(IV.42)}$$

Equation (IV.42) defines implicitly the wage as a function of hours of work along the contract curve. It can be rearranged as:

$$F_h = U_2/U_1 \qquad \textbf{(IV.43)}$$

Equation (IV.43) is identical to equation (IV.9) but for the absence of an employment term. If we denote the implicit function of the wage as a function of hours along the contract curve by $w^c = w^c(h)$, then $dw^c/dh<0$. Under the assumption that U_h is negative - ie restricting the bargaining outcomes to regime (ii) -, equation (IV.41) defines implicitly the wage as a positive function of hours and the level of utility U0. If we substitute $w^c = w^c(h)$ in equation (IV.41) and solve for hours of work we can express hours of work as a function of the level of utility U0:

$$\mathbf{h = h^C(U0)} \qquad \textbf{(IV.44)}$$

This is simply the function relating hours of work with the level of utility as we move up the contract curve. As is apparent in Figure 6, bargained utility along the contract curve is decreasing in hours of work and this can be shown by differentiating equation (IV.44) [11] to obtain that $dh/dU0 < 0$. By substituting (IV.44) in the profit function we can obtain the equation for the Pay-Off Frontier (PF), ie the equation relating profits with utility as we move along the contract curve:

$$\mathbf{P^{PF} = f(h^C(U0)) - w^C(h^C(U0))\ h^C(U0)} \qquad \textbf{(IV.45)}$$

It is straightforward to verify that the slope of the PF is negative, whereas its curvature will depend on the shape of the contract curve. We draw in Figure 7 the PF as concave

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[11] If we substitute $w^c(h)$ in equation (IV.41) we obtain $U0 = U(w^c\ h, T\text{-}h)$. By totally differentiating this equation with respect to h and U0 we get after some rearrangement:

$$dh/dU0 = 1/\{[hU_1(dw^c/dh)]+(wU_1-U_2)\}$$

The first term in the denominator of $dh/dU0$ is negative by virtue of the negative slope of the contract curve and the second term is negative by virtue of our assumption that U_h is negative. Note however that $dh/dU0$ would still be negative if U_h was zero.

to the origin but none of the results concerning the effects of MHL would be affected if the PF was convex to the origin [12].

Since the Nash solution maximises the product of the differences between the pay-offs of the two parties and their fall-back levels, it will be at the point of tangency between the PF and the iso-product line X=P(U-V) - where we assume again that the fall back level of profits is zero, the fall back level of utility is MV, we normalised employment to unity and assumed that union and firm have the same bargaining power. If we denote the Nash solutions by U^N and P^N, these will solve:

$$\partial P/\partial U \big|_{\text{Pay-Off}} = \partial P/\partial U \big|_{\text{Iso-product}} \qquad \textbf{(IV.46)}$$

where the LHS of equation (IV.46) is the derivative of equation (IV.45). The RHS of (IV.46) is:

$$\partial P/\partial U \big|_{\text{Iso-product}} = -X(U-V)^{-2} \qquad \textbf{(IV.47)}$$

The initial Nash solution is represented by point N in Figure 7. Consider now the implication of introducing non-binding maximum hours legislation, assume in other words that $h^N_B < h_{max} < h_V$, where h^N_B is the Nash bargaining solution. We can distinguish again between two cases, corresponding to cases (a) and (b) when MHL was binding. Recall that in case (a) the mark-up is constant and the level of utility achieved by workers affected by

[12] Assuming that the shape of the PF does not imply either a multiplicity or no solution in the case of a Nash bargain.

MHL following the introduction of binding MHL remains unchanged. This level of utility achieved under the binding case is the alternative level of utility V in the Nash bargain. The introduction of MHL in case (a) therefore has no impact on the bargained outcome, since none of the parameters affecting equation (IV.46) changes. The intuition is clear; if there is no change in what can be achieved elsewhere in the economy following the introduction of MHL then the Nash bargain between firms that are not affected by the legislation remains unaltered.

In case (b), the introduction of MHL increases the mark-up and therefore the level of utility achieved by workers affected directly by MHL. By differentiating equation (IV.47) with respect to V we obtain:

$$\partial(\partial P/\partial U)/\partial V = -2X(U-V)^{-3} < 0 \qquad \textbf{(IV.48)}$$

This means that the slope of the iso-product line becomes steeper and it is easy to confirm that the slope of the PF remains unaffected. It follows that the new Nash solution will deliver a higher level of utility and a lower level of profits. The Nash solution depends on the fall-back levels of the two parties; although MHL is not binding, it increases what union members expect to obtain elsewhere in the economy and therefore increases their demands and share of the rents in the bargain. The new outcome is depicted in Figure 7 by P^N_{max} and U^N_{max}.

The key issue when considering the impact of the introduction of MHL is the extent to which employers will be able to maintain workers on their pre-MHL level of utility, ie the extent of the reduction in the hourly wage. If they are successful in doing so, MHL leads to lower profits without any change in the level of utility. This is true of workers affected directly by MHL and those that are not, but bargain with their employers about the wage and hours of work in a Nash bargain. If employers can not maintain the pre-MHL level of utility which will be the case for example if workers do not accept cuts in their hourly wages, then the introduction of MHL will increase utility for workers affected directly and those involved in bargains over the wage and hours of work in a Nash bargain.

In practice, it would seem unlikely that MHL would be accompanied by a reduction in the hourly wage (or the overtime premium), especially if such legislation is introduced on the grounds of health and safety. It is quite likely therefore that case (b) would describe more accurately the impact of introducing MHL.

The key link in the above results about the transmission mechanism of MHL is the dependency of the bargained outcome in the Nash-solution on the fall-back levels of utility and profits. If MHL does not affect the fall-back level of utility and profits, it will have no impact on the bargaining outcome in a Nash bargain. Kalai and Smorodinsky (1974) and Raiffa (1953) [13], by replacing Nash's "independence of irrelevant alternatives" property with a "monotonicity" property, have proposed a solution which allows changes in the set of feasible outcomes - in addition to the fall-back levels - to affect the solution.

The monotonicity principle implies that, if the maximum available pay-off to one of the parties in the bargain increases, the bargaining solution will also lead to a higher pay-off

[13] See also Roth (1979, p.98-107) for a summary of the different solutions.

for that party. Formally, the Kalai-Smorodinsky solution (P^{KS}, U^{KS}) is obtained in the model of this section by solving equation (IV.45) and P = [Pmax/Umax] (U-V), where we make the same assumptions concerning the fall-back levels of utility and profits as in the Nash bargain. It follows that Pmax=P^{PF}(V) and Zmax is obtained from solving P^{PF}=0.

Within the current model, the introduction of MHL will always reduce the maximum level of profits attainable, ie Pmax with MHL is lower in both cases (a) and (b). Because of the monotonicity property, this will also decrease the bargained level of profits and increase the level of utility. The situation is depicted in Figure 8, with a movement from P^{KS}, U^{KS} to $P^{KS}_{max}1$ and $U^{KS}_{max}1$ (corresponding to case (a)) and $P^{KS}_{max}2$ and $U^{KS}_{max}2$ (corresponding to case (b)). The reaction of utility and profits to maximum hours or other legislation under the Kalai-Smorodinsky solution will therefore differ from the Nash one, if such legislation affects the maximum level of utility and/or profits but does not affect the alternative available elsewhere in the economy. In such a case the Nash solution pre- and post- change is the same whereas the Kalai-Smorodinsky solution would increase the pay-off to the workers and reduce the pay-off to the firm.

This framework can also be used to examine the strong support of unions and the equally strong opposition of employers to minimum wage legislation (MWL). The introduction of a minimum wage, to the extent that it affected some workers, would increase the alternative level of utility and thus decrease the maximum level of profits attainable by the firm. With either a Nash or a Kalai-Smorodinsky solution, MWL would therefore lead to a decrease in profits of firms and an increase in utility of workers not affected by the legislation. If MWL does not affect the alternative level of utility, it will lead under KS to a higher level of utility and a lower level of profits if it decreases the maximum level of profits attainable.

The above model is also consistent with the effects of maximum hours legislation in the US. Such legislation was introduced at the beginning of this century in most US states and concerned predominantly the employment of women. Landes (1980), concluded that such legislation reduced significantly hours worked per week, but also, by making female employment more unattractive relative to male, it reduced the share of females in the employment of the manufacturing sector, the major sector covered.

Goldin (1988) re-examined the evidence and asserted that maximum hours did reduce hours of work but affected equally male and female weekly hours of work; she says " ...maximum hours legislation served to reduce scheduled hours in 1920,... Curiously, the legislation appears to have operated equally for men". She concluded therefore that MHL had no impact on the composition of employment in the manufacturing sector. This is what our model would predict if we assumed that male hours and wages were determined in either a Nash or a Kalai-Smorodinsky bargain and specified V as the alternative household level of utility. Note finally that any legislation which affects the alternative or "fall-back" level of utility for Nash bargains, and/or the maximum pay-off available to the bargaining parties for Kalai-Smorodinsky bargains will have an impact on the negotiated outcome. It is possible therefore for groups of workers to benefit from legislation that is not directly targeted at them, to the extent that it affects what that group can get elsewhere in the economy.

Conclusions

The aim of this Chapter was to examine in more detail the hours determination process. We showed that negotiated hours can be off the conventional hours supply and hours demand curves when firms bargain with unions over hours of work. This implies that the negative employment effect of unionism, which assumes that a union pushes a firm up a fixed labour demand curve may be misleading. The labour demand curve is likely to shift to the right as unions negotiate wages above the competitive level, since they are also likely to negotiate lower hours of work. We showed that this will definitely be the case with a Cobb-Douglas production technology and a utility function with a constant elasticity of utility with respect to consumption.

We also concluded that legislation affecting a minority of workers, like maximum hours or minimum wages, can have an impact on the outcome of bargains between parties that are not directly affected. The reason is that such legislation is likely to affect the alternative pay-offs of one or either of the bargaining parties (Nash) or the maximum pay-offs of the parties (Kalai-Smorodinsky); it will thus affect the negotiated outcome in favour of one or other of the parties. We showed that the analysis could be used to explain the US paradox of introduction of maximum hours legislation covering female workers, not affecting their relative attractiveness compared to males; this would be the outcome if the fall-back or minimum level of utility corresponded to the household rather than the individual.

TABLE 10

Percentage of Workers Working More Than 48 Hours in 1990

	48-50	**51-59**	**>60**	**More Than 48 Hours**
Belgium	0.9	0.3	1.1	2.3
Denmark	2.8	0.6	1.1	4.5
France	2.6	0.9	1.8	5.3
Germany	1.9	0.7	2.2	4.8
Greece	1.1	1.6	2.0	4.7
Holland	0.5	0.3	0.9	1.7
Ireland	3.7	1.1	3.5	8.3
Italy	1.9	0.5	1.1	3.5
Portugal	1.7	0.8	2.2	4.7
Spain	2.1	0.8	2.0	4.9
UK	4.8	6.3	4.9	16.0
EUROPE 12	**2.5**	**1.9**	**2.4**	**6.8**

Source : Eurostat and UK Labour Force Survey

FIGURE 6

The wage-hours contract curve

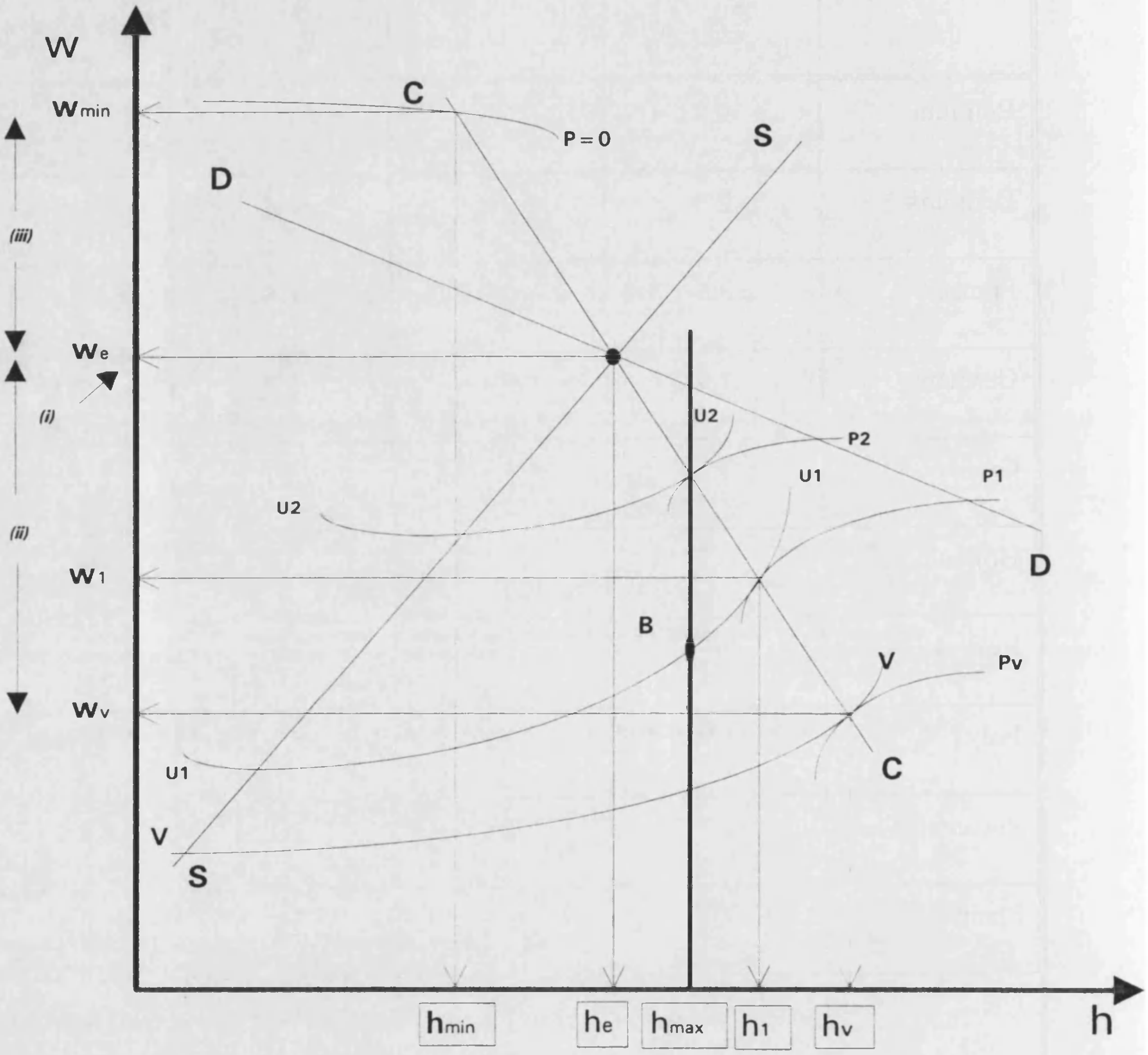


FIGURE 7

The Nash Bargaining solution and MHL

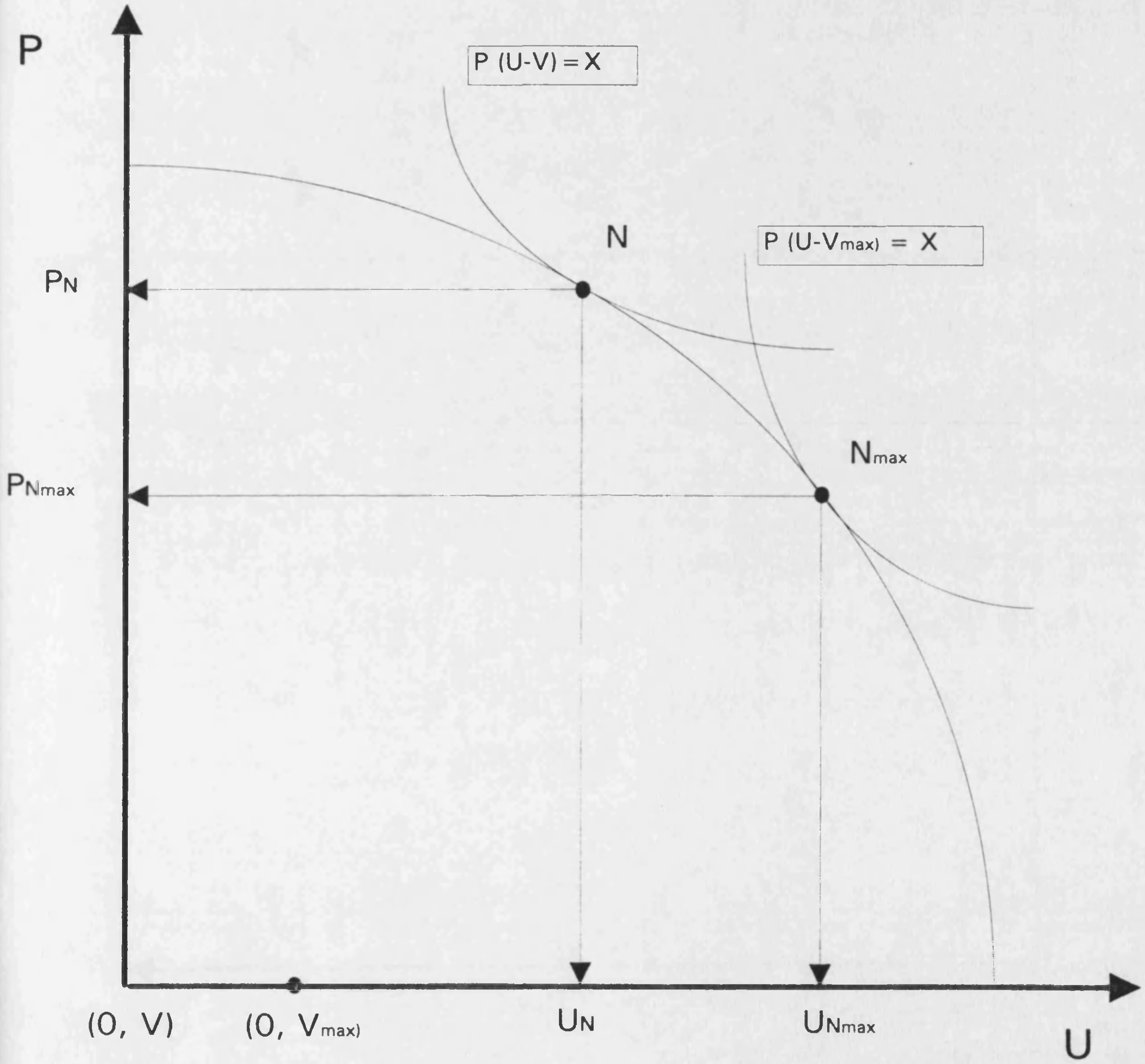
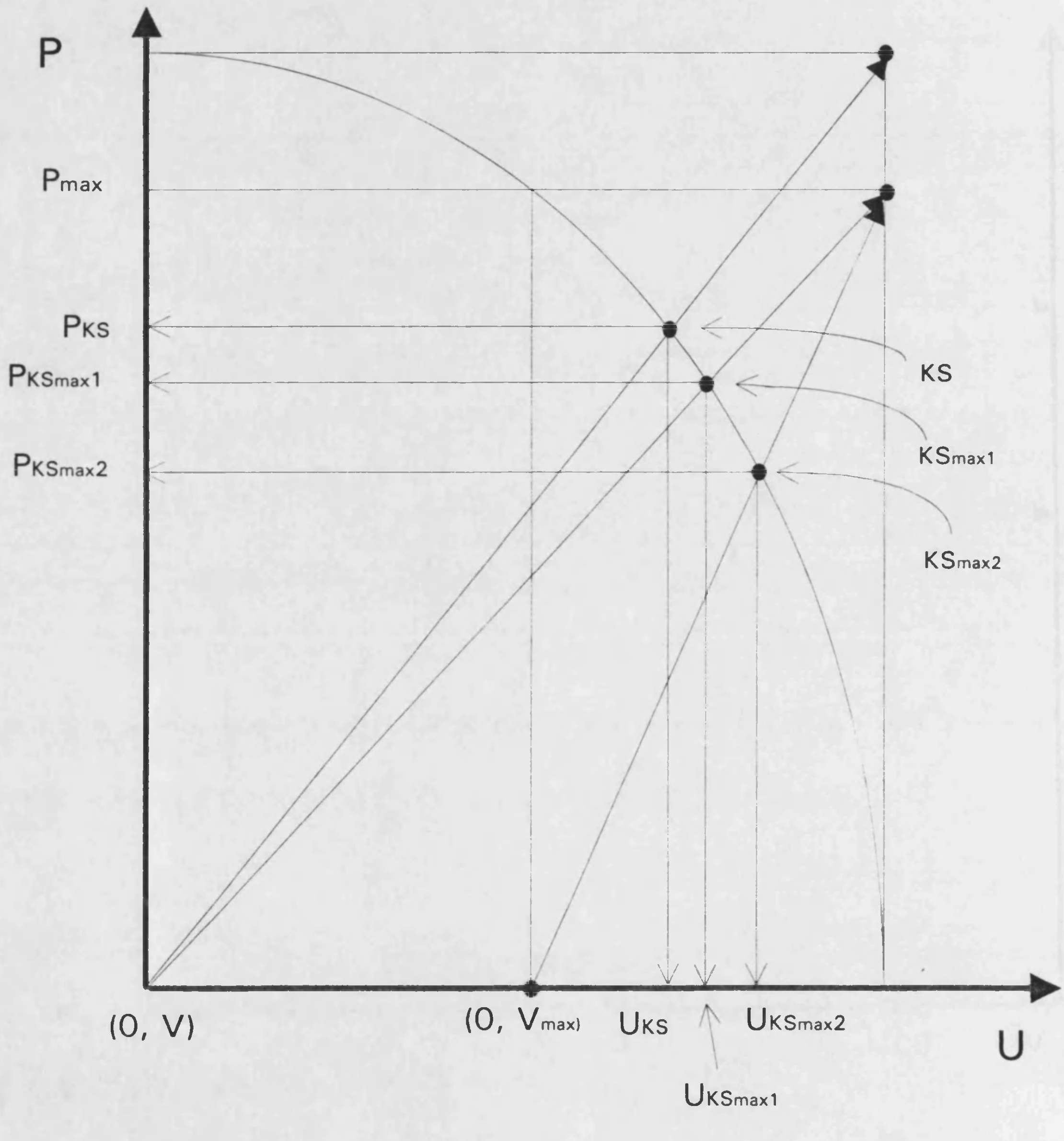


FIGURE 8

The Kalai-Smorodinsky Bargaining solution and MHL



CHAPTER V

EMPIRICAL EVIDENCE ON THE EFFECTS OF LOWER HOURS OF WORK ON WAGES IN THE UK: 1950-1990

Introduction

The growth and persistence of unemployment in the UK and Europe has triggered demands for reductions in hours of work to "spread more widely the available work". We have shown in Chapter II that reductions in hours of work are likely to have a direct positive employment effect, and an indirect uncertain effect through the wage. The sign and size of this indirect effect is therefore crucial for the proper evaluation of the merits of reductions in hours of work as an employment promotion policy.

We have argued in Chapters II, III and IV that, when hours of work are integrated properly into union models, such models do not provide, ceteris paribus, a justification for increases in the hourly wage accompanying reductions in hours of work. On the contrary, it is possible that unions would be prepared to forego wage increases for lower hours of work, because they are likely to have a beneficial effect on the utility of union members and employment. The aim of this Chapter is to use a generalised version of the union models of the previous Chapters to derive an estimable wage equation and test the income sharing hypothesis with annual UK data.

It should be noted that a number of authors and policy makers have been unfavourable to hours reductions because of their presumed adverse indirect effect. Such views have been strengthened by findings of macroeconometric models that the effects on employment from a reduction in weekly hours of work, would be reduced significantly if the hourly wage increased to maintain weekly income unchanged - section 1.4.1 in Chapter I.

The empirical evidence on which such assertions are based is however weak. As mentioned in the introduction, survey evidence finds typically, that when hours reductions are negotiated, unions do not accept a proportional reduction in their weekly income. Most hours reductions are usually associated however with other cost reducing and productivity enhancing measures. This explains why employers are prepared to accept eventually the introduction of such reductions - see for instance the Volkswagen deal as described in Bosch (1990).

Within this type of analysis, it is therefore in general difficult to calculate the precise effect of reductions in hours of work on labour costs, and probably impossible to calculate the effect on unit labour costs. When such a task has been undertaken - eg Richardson and Rubin (1993) -, a 5% reduction in hours of work was estimated to have added ***less than 1%*** to labour costs. This is not what one would expect if the reduction in hours of work was associated with compensating increases in the hourly wage.

Further evidence on the relationship between hours reductions and the hourly wage comes from the Engineering Employers Federation (EEF) enquiries, as reported in Knowles and Robinson (1969). This is reproduced in Figure 9. The relationship is interesting because the engineering industry has initiated and negotiated most reductions in hours of work in the UK, the data covers the two major hours reductions in the post war period and is not available elsewhere [1]. As can be seen from the figure, the hourly wage in the whole of the UK - bottom line -, seems to have followed its long-run trend in both periods of significant reductions in hours of work (1946-47 and 1959-60), and the years following

[1] I am grateful to Marcus Rubin for providing me with this information.

them. There is therefore no evidence from this figure of a compensating increase in the hourly wage following reductions in hours [2].

Although the recent wage bargaining literature has prompted a number of authors to estimate real wage equations both for the UK and other countries [3] the role of hours of work has not been examined in detail. Pissarides (1991), after allowing for an independent effect from hours of work, found that reductions in average hours of work through the growth of part-time employment, resulted in equilibrium unemployment increasing only to 6% rather than more than 9% - from 1970/73 to 1976/79; this is due to a direct positive employment effect - since Pissarides's employment variable is manhours -, more than counterbalancing an indirect negative effect. The elasticity of the hourly wage with respect to hours was however estimated to be, absolutely, much smaller than unity (-0.4). Also, the possibility that the hours variable is simply capturing an accounting effect or a productivity effect is not explored.

Nymoen (1989) has used a simplified version of the union models developed in this thesis to examine the issue of the effects of lower hours on hourly wages in the Norwegian manufacturing sector. He first estimates the long-run version of a wage equation and reports that hours have no long-run effect on hourly wages. He then estimates a short-run equation with an error correction mechanism, where he finds a contemporaneous elasticity of hourly wages with respect to hours of work of -0.28. This implies, in line with our

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2 Graphs for the manufacturing sector and the engineering industry based on Department of Employment Gazette data are very similar.

3 Andrews and Nickell (1983), Bean et al (1986), Layard and Nickell (1986), Pissarides (1991).

earlier theoretical results, that even in the short-run, changes in hours of work have a very small negative effect on the hourly wage.

Nymoen (1989) calls this low elasticity result "intriguing", and suggests replacing the actual hours variable with a normal hours variable; this leads to an absolutely higher coefficient. The derivation of the hourly wage does ***not*** take into account overtime hours however and the coefficient of the normal hours variable could be capturing simply an accounting effect, which has nothing to do with income compensation demands by workers or unions. This "accounting" elasticity is, for realistic values of overtime, normal hours and the premium [4], approximately -0.45. If we add to that the elasticity of the wage with respect to actual hours, which does capture the economic effect, we get an elasticity of -0.73; this is very close to Nymoen's reported elasticity of the hourly wage with respect to normal hours of -0.83.

A test of the effects of lower hours on wages and employment was also done with Japanese data. Brunello (1989) uses a two sector model, which follows closely Bernanke (1986), with primary sector firms choosing the level of employment and actual hours subject to offering the secondary's sector level of earnings to their employees. This constraint allows earnings to be determined endogenously. In this context, a reduction in standard [5] hours increases - for given or increased actual hours worked -, the earnings per period available in the secondary sector and therefore implies an increase in the earnings per period that

[4] The values used are time and a half for the overtime premium, a 40 hours standard week and 5 hours of overtime.

[5] We use the terms "normal" and "standard" interchangeably, to denote the number of hours per week payed at a non-overtime hourly wage rate.

firms of the primary sector must offer; this results in an unambiguous fall in employment of that sector. Brunello's assumptions are broadly consistent with the movement of actual hours in Japan - see Table 7 in Chapter III - and since these have not changed much, it is not surprising that he does not find a significant employment effect from reductions in standard hours. Even so, he warns that the long-run solution of his system might not be stationary, so that his results should be treated with caution.

The available survey and econometric evidence does not seem to support the assertion of an unchanged weekly income, following reductions in the length of the workweek, when other variables affecting the hourly wage are taken into account. In this Chapter we investigate further the issue, by examining whether hours reductions have resulted in compensating or other hourly wage increases in the UK.

Our data covers the manufacturing sector in the 1948-91 period. During this period large reductions in "normal" or "standard" hours took place in 1960-1962 and 1965-1967 (-4.8% and -4.1% respectively), and then again in 1982-1984 when standard hours decreased by 1.3%. The annual rate of fall for standard hours is 0.30% (for the 1951-1990 period). Actual hours have followed this decline one for one - average rate of fall in the 1951-90 period was 0.26% -, with the exception of the 1980's when there has been a moderate increase in the average hours of overtime, due mainly to the mid-80's boom.

Our findings suggest that, controlling for other variables that might influence the hourly wage and for the possible endogeneity of hours of work, the effect of reductions in standard and actual hours of work on the hourly wage was insignificant or even positive, in line with theoretical predictions. This does not mean that an ad hoc reduction in the length of the workweek in the future will have no effect on the hourly wage, since, as the theoretical analysis makes clear. this will only be true under specific conditions. The results cast doubt however on the claims that reductions in hours of work have a negative indirect effect on employment, and provide support to the income sharing hypothesis.

8.0 THE EFFECTS OF LOWER HOURS OF WORK ON WAGES IN THE UK: 1950-1990

8.1 A Generalised Bargaining Model

Given that our empirical work covers male manual workers in UK industries, the most appropriate theoretical framework to study the effects of a reduction in hours of work is the union-firm bargaining framework, which was presented and analysed in Chapters II-IV[6]. Our procedure will be to derive a wage equation under the most general and realistic assumptions about the bargaining process and then discuss the effects of alternative assumptions on the form of the equation to be estimated.

The basic structure of the model is similar to the one analysed in section 5.2 of Chapter III. The union bargains with the employer over the wage and then the employer sets employment and hours of work unilaterally. The justification for the hours determination assumption is based on the costs of monitoring and enforcing an hours agreement on the part of the union, especially when hours are made contingent on the state of demand. We assume also that demand for hours of work does not depend on the wage. The justification for this is based on the small and insignificant estimates of the elasticity of hours demand with respect to the wage, when one controls for fixed employment costs and standard hours. The implication of this assumption is that the determination of hours of work does

[6] The percentage of manual workers who's pay was determined as a result of collective bargaining agreements in the private manufacturing industries was 70% in 1990 and 79 % in 1984 according to the 1990 WIRS - Millward, Stevens, Smart and Hawes (1992), Table 7.3 - and 84 % in 1980, according to the 1984 WIRS - Millward and Stevens (1986), table 9.3. It was 78 % in 1978 for males, according to the 1978 NES.

not affect the wage bargain. Even if hours depended negatively on the wage however, the derivation of the wage equation would be unaffected if hours were bargained over simultaneously with the wage.

The assumption of employment being set unilaterally by the firm is based on the mixed empirical results on this issue as well as on the available survey evidence. MaCurdy and Pencavel (1986) and Brown and Ashenfelter (1986) with US data and Bean and Turnbull (1988) with UK data find evidence against a neoclassical labour demand function but do not necessarily support the case for efficient bargaining. Alogoskoufis and Manning (1991), using more aggregate data end up with the same conclusion but Machin et al (1991), estimating an Euler equation using UK micro-data, conclude that a dynamic labour demand -right to manage - function best fits the data; the same is true of Symons and Layard (1984). Survey evidence for the UK on the other hand seems to support also the view that unions do not bargain directly over employment (Clark and Oswald (1991)). Farber (1986), Oswald (1985) and Layard et al (1991) have provided possible explanations. Although some ambiguity about the proper model of employment determination remains, in the theoretical model that follows we will assume that the firm sets employment unilaterally and comment on the effects of assuming that employment is bargained over.

In the most general case we can write firm profits, union utility and the Nash maximand as:

$$\mathbf{P = F(N, h, Z1) - w(h+g_l)N} \qquad \mathbf{(V.1)}$$

$$\mathbf{Z = N\{U(w(1-t_{inc})h, T-h)-V\} + MV = NDU + MV} \qquad \mathbf{(V.2)}$$

$$X = (Z-\underline{Z})^{\beta}(P-\underline{P})^{(1-\beta)} \qquad \text{(V.3)}$$

where we denote $\{U(w(1-t_{inc})h,\ T-h)-V\}$ by DU. We assume that F and U have the usual properties, and that the fall back level of profits is zero and of union utility MV. Z1 includes variables like the capital stock and technical progress, t_{inc} is the income tax rate and β denotes the relative power of the union in the bargain. Following our discussion and results in section 4.3 of Chapter III, we make no distinction between actual and standard hours of work in our theoretical derivation of the wage equation. We take into account however the existence of overtime in our estimation. All other variables have already been defined - see Notation.

The problem then facing the union and the firm is to maximise equation (V.3) with respect to the wage, subject to the factor demand functions derived from maximising (V.1) with respect to employment and hours of work. Formally, N, h and w solve:

$$P_N = F_N(N,h,Z1) - w(h+g_1) = 0 \qquad \text{(V.4)}$$

$$P_h = F_h(N,h,Z1) - wN = 0 \qquad \text{(V.5)}$$

$$X_w = \beta(NDU)^{\beta-1}\, P^{1-\beta}\, (N_w DU + NhU_1) - (NDU)^{\beta}\, (1-\beta)P^{-\beta}\, (h+g_1)N = 0 \qquad \text{(V.6)}$$

By rearranging equation (V.6) we can obtain again the familiar mark-up equation of union members' utility over outside utility:

$$U\,(w(1-t_{inc})h,\ T-h) = [\theta e_{Pw} + e_{Nw}]\ /\ [\theta e_{Pw} + e_{Nw} + e_{Uc}]\ V = k_{PE}\ V \qquad \text{(V.7)}$$

where $\theta=(1-\beta)/\beta$. Note that e_{Nw} and e_{Pw} are both negative. It is easy to show that the mark-up will be:

(a) increasing in e_{Uc}, since the union will push for a higher wage if the value of any given wage increase is higher,

(b) increasing in β, the bargaining power of the union,

(c) increasing in e_{Pw}, since a higher elasticity of profits with respect to the wage implies a smaller reduction in profits for any given wage increase, and

(d) increasing in e_{Nw}, since a higher labour demand elasticity - ie absolutely smaller elasticity - leads to a smaller fall in employment for any given increase in the wage.

If the firm bargained with the union over employment or if the union was indifferent to the level of employment. k_{PE} would be independent of the labour demand elasticity. If on the other hand the wage was set by a monopoly union, k_{PE} would be independent of e_{Pw}.

Equation (V.7) could be approximated with a log-linear transformation and estimated as a wage equation if we assume that V is constant. This is essentially the equation estimated by Nymoen (1989). with a number of additional restrictions. Since however our data covers manual workers in manufacturing, the mobility between this and other sectors in the economy is limited. The expected level of outside utility available is therefore a function of utility when unemployed and utility when employed in the manufacturing sector. We can write V as:

$$\mathbf{V = \eta\ U(\underline{b},\ T\text{-}h^{SE}) + (1\text{-}\eta)\ U(w(1\text{-}t_{inc})h,\ T\text{-}h) = \eta\ U^{u} + (1\text{-}\eta)\ U^{e}} \qquad \mathbf{(V.8)}$$

where we denote by U^u utility when unemployed ($U(\underline{b}, T\text{-}h^{SE})$) and by U^e utility when employed ($U(w(1\text{-}t_{inc})h, T\text{-}h)$) . η is the probability of being unemployed, in which case the worker obtains unemployment benefit ($\underline{b}$) and has to search h^{SE} hours per period for a job. $(1\text{-}\eta)$ is the probability of obtaining employment with another firm in the manufacturing sector, in which case the worker will obtain utility $U(w(1\text{-}t_{inc})h, T\text{-}h)$. In our empirical work we use unemployment and other variables to proxy this probability.

By substituting equation (V.8) in (V.7) we obtain:

$$\mathbf{U^{e}\ =\ [k_{PE}\ \eta]\ [1\text{-}k_{PE}(1\text{-}\eta)]^{-1}\ \ U^{u}\ =\ k_{GE}\ U^{u}} \qquad \mathbf{(V.9)}$$

Assume now that the elasticity of utility with respect to consumption is constant - denote it by α_0 - and $\underline{b}$ is partially indexed to weekly earnings ($\underline{b}=\rho(wh)^{\gamma}$, $0<\gamma<1$). Utility when employed is therefore $U^e = (w(1\text{-}t_{inc})h)^{\alpha o}\ l(T\text{-}h)$ and utility when unemployed is $U^u = (\rho(wh)^{\gamma})^{\alpha o}\ l(T\text{-}h^{SE})$, where l is the utility of leisure. If we denote by l_0 leisure when unemployed ($l_0=l(T\text{-}h^{SE})$) and substitute l_0, U^e and U^u in equation (V.9) we obtain, after some rearrangement:

$$\mathbf{(w(1\text{-}t_{inc}))^{\alpha o(1-\gamma)}\ \ h^{\alpha o(1-\gamma)} = k_{GE}\ [(l_0\ \rho^{\alpha o})/l)]} \qquad \mathbf{(V.10)}$$

If we take logs on both sides of equation (V.10) and then solve for the wage we obtain:

$$\mathbf{lnw = d_0ln(1\text{-}t_{inc}) + d_1lnh + d_2ln(l) + d_3ln(l_0) + d_4ln\ k_{GE} + d_5ln\ (\rho)} \qquad \textbf{(V.11)}$$

where $d_0=d_1=-1$, $d_2=-1/\alpha_0(1-\gamma)<0$, $d_3=d_4=1/\alpha_0(1-\gamma)>0$ and $d_5=1/1-\gamma>0$. If k_{PE} is constant - which will be true if the production technology is Cobb-Douglas -, then one could proxy ln k_{GE} with the unemployment rate and test the income sharing hypothesis by testing whether the coefficient of hours of work in an equation like (V.11) is significantly different from zero. The coefficient will be capturing two effects. First, if leisure matters and hours are initially at or above the optimal level for the individual/union, the direct effect from a reduction in hours of work on the wage should be zero or positive. Second, in general equilibrium, a reduction in hours of work will reduce utility from unemployment and therefore the bargained wage, ***if*** the unemployment benefit is partially indexed to weekly rather than hourly earnings.

If the unemployment benefit is fully indexed to the hourly wage, then the wage would disappear from equation (V.11), which would essentially become an unemployment - or hours - equation. If that is the case however, γ would be close to unity and the coefficient of the replacement ratio (ie the ratio of income when unemployed to income when employed or ρ in this case) or variables proxying it, in conventional wage equations, should be "very" large. Furthermore, if the mark-up is not a constant, it is likely to depend on the wage, in which case one could solve again equation (V.10) for the wage. We therefore keep the general version of the model and test whether the assumption of full indexation of the unemployment benefit is supported by the data.

If the mark-up is not constant then equation (V.11) must be amended to include the variables that determine it. First, increases in the probability of being unemployed reduce the mark-up as can be easily confirmed from equation (V.9); it follows that $\partial k_{GE}/\partial \eta<0$. It can also be confirmed from the same equation that an increase in k_{PE}, the mark-up in partial equilibrium, increases k_{GE}, the mark-up in general equilibrium. The effects of the variables determining k_{PE} on k_{GE} therefore are: $\partial k_{GE}/\partial e_{Nw} >0$, $\partial k_{GE}/\partial e_{Pw} >0$, $\partial k_{GE}/\partial e_{Uc} >0$, $\partial k_{GE}/\partial \beta >0$.

All three elasticities may depend on the level of the wage and hours of work. If we assume that none is increasing in the wage [7], then a higher wage will either decrease or leave the mark-up unchanged. Even if one of them is increasing in the wage - as could happen with e_{Pw} -, the total effect on k_{GE} from an increase in the wage is likely to be negative and we therefore adopt $\partial k_{GE}/\partial w <0$. We discuss the effects of hours below.

Note that e_{Pw} is :

$$\mathbf{e_{Pw} = -[w(h+g_1)N] \ / \ [F(N,h,Z1) - w(h+g_1)N]} \qquad \textbf{(V.12)}$$

Dividing numerator and denominator by $-N(h+g_1)$ and rearranging we obtain:

$$\mathbf{e_{Pw} = w/[\underline{pr}(1-\underline{f}) - w]} \qquad \textbf{(V.13)}$$

[7] This will hold for e_{Uc} if the utility function is Stone-Geary and will be true for e_{Nw} if $F_{NNN}\leq 0$. The elasticity of profits with respect to the wage can be rearranged as $e_{Pw}=(-(h+g_1)Nw)/P$. Differentiate e_{Pw} with respect to w (noting that $P_N=0$) to obtain, after some rearrangement $\partial e_{Pw}/\partial w= -([(h+g1)(1+e_{Nw}+e_{Pw})]/P^2)$. The elasticity will not be increasing in the wage if $(1+e_{Nw}+e_{Pw}) \geq 0$.

where we denote by pr hourly productivity (pr=F/Nh) and by f the ratio of fixed to total costs ($f=g_1/(h+g_1)$). It is easy to see that e_{Pw} is increasing in pr and decreasing in f, so that the mark-up also increases in productivity and decreases in the ratio of fixed to total costs; it follows that $\partial k_{GE}/\partial pr > 0$ and $\partial k_{GE}/\partial f < 0$. This is simply saying that, ceteris paribus, an increase in productivity or a decrease in fixed employment costs, increases profits, and therefore leads to a higher mark-up through a higher e_{Pw} [8].

Hours of work now can, in theory, affect the mark-up through all the elasticities that may appear in it. The total effect on the mark-up can be split into three components:

$$\begin{aligned} \mathbf{dk_{GE}/dh} \quad &= \partial k_{GE}/\partial e_{Nw}\ \partial e_{Nw}/\partial h + \partial k_{GE}\ \partial e_{Pw}\ \partial e_{Pw}/\partial h + \partial k_{GE}/\partial e_{Uc}\ \partial e_{Uc}/\partial h \\ &= A1 + A2 + A3 \qquad \textbf{(V.14)} \end{aligned}$$

If lower hours have a positive direct employment effect then they are equivalent to a wage fall and will, under the assumptions made earlier, increase the labour demand elasticity - or leave it unchanged of course, if it is constant. A1 may therefore be negative or zero.

If we assume that the utility function is Stone-Geary then e_{Uc} will be decreasing in hours and A3 is also negative. Note that in that case the log-linearisation we did earlier - see equation (V.11) - will only be approximate with respect to the wage.

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8 Changes in pr may also affect the mark-up through e_{Nw} ($e_{Nw} = (F_N/(NF_{NN}))$), if it is not constant. An increase in productivity should increase F_N and, if F_{NN} is unaffected or if it increases, the labour demand elasticity and the mark-up will be reduced. If on the other hand F_{NN} falls following an increase in pr, the effect becomes uncertain.

The effect of hours through e_{Pw} can be separated into an effect through $\underline{pr}$ and an effect through $\underline{f}$. If productivity is decreasing in hours, which is a consistent finding of all survey evidence on hours reductions (White (1983), Bosch (1986), Richardson and Rubin (1993) and references therein), then lower hours will increase e_{Pw}. On the other hand, $\underline{f}$ is likely to be decreasing in hours of work [9], which means that lower hours reduce $(1-\underline{f})$ and therefore reduce the mark-up. Given the evidence cited earlier and the possibility of $\underline{f}$ not being affected by changes in hours of work we believe that the productivity effect of lower hours will dominate the fixed costs effect; it follows that A2 is also likely to be negative so that we can assume that $\partial k_{GE}/\partial h < 0$. In practice now, if we control properly for productivity and fixed costs, we would expect the effect of lower hours on the mark-up to come mainly through changes in e_{Uc}. By taking a log-linear approximation of the mark-up we therefore obtain [10]:

$$\mathbf{\ln k_{GE} = j_0 + j_1 \ln \eta + j_2 \ln \beta + j_3 \ln \underline{pr}(h) + j_4 \ln \underline{f}(h) + j_5 \ln h + j_6 \ln w} \qquad \textbf{(V.15)}$$

We have written $\underline{pr}(h)$ and $\underline{f}(h)$ to highlight the fact that both variables are likely to depend on hours of work and we have also included an hours variable independently, to capture the effects of changes in hours through e_{Uc} and possibly e_{Nw}.

Following our discussion above the expected signs of the j_i's are; $j_1 < 0$, $j_2 > 0$, $j_3 > 0$, $j_4 < 0$, $j_5 < 0$, $j_6 < 0$. Substituting (V.15) back in (V.11) and solving for the wage we obtain:

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[9] $\underline{f}$ will be constant if fixed costs are indexed to weekly rather than hourly earnings.

[10] For expositional purposes we express the mark-up as a linear function of the logarithms of all the variables on the right-hand side. This is of course only an approximation and different specifications are used at the estimation stage.

$$\ln w = n_0 + \underset{-}{n_1 \ln (1-t_{inc})} + \underset{+}{n_2 \ln l_0} + \underset{-}{n_3 \ln \rho} + \underset{+}{n_4 \ln \eta} + \underset{+}{n_5 \ln \beta}$$

$$+ \underset{+}{n_6 \ln \underline{pr}(h)} + \underset{-}{n_7 \ln \underline{f}(h)} + \underset{+/0/-}{n_8 \ln h} \qquad \text{(V.16)}$$

where the n_is are functions of the parameters of the j_is and the d_is - see equations (V.11) and (V.15). Equation (V.16) forms the basis for our estimation, and the second row of the equation shows the expected signs of the coefficients under the employment, hours and wage determination assumptions made earlier. If k_{PE} is constant - Cobb-Douglas production function -, then $n_6 = n_7 = 0$. If k_{PE} is constant and $\underline{b}$ is fully indexed to the wage, then n_3 should be "large".

The coefficient of the hours variable can not be signed definitely a priori. If the productivity and fixed costs variables included capture the effects of changes in hours on the wage through e_{Pw}, then the coefficient on hours of work will be capturing three effects. The first and second effects operate through the utility function when leisure matters and through utility when unemployed, if the unemployment benefit ($\underline{b}$) is indexed to weekly hours of work. As mentioned already, this should be zero or positive if hours are at or above the optimal level for the individual/union initially and $\underline{b}$ is indexed to hours. The third effect operates through the change in the mark-up, excluding e_{Pw}; this is likely to be negative or zero, if a reduction in hours of work increases or leaves e_{Uc} unchanged. Unless this latter effect is therefore very significant, we would expect a reduction in hours of work not to affect the hourly wage or even reduce it, if we account properly for changes in productivity and the ratio of fixed to total costs.

8.2 Estimation and Results

Before proceeding with the presentation of our results we discuss briefly the identification problem and the variables used in the regressions. The identification problem with the estimation of wage equations arises from the fact that, in principle, all the variables affecting employment through $P_N=0$ [11] - ie the variables shifting the labour demand curve - are likely to be the same variables that affect productivity. This, as we mentioned earlier, is expected to have a positive effect on the wage. In such a case it will not be possible, in general, to include both a productivity per worker/hour variable, and find suitable instruments for the endogenous variables, unemployment and hours of work, in an equation like (V.16). The practical but relatively arbitrary solution, is to use exclusion restrictions and assume that some variables that affect unemployment in the reduced form, possibly only in the short run, do not have an effect on productivity. This is also one of the methods used here.

Alternatively, as noted by Bean (1992), one can proceed and estimate equation (V.16) with OLS if employment from the labour demand function does not depend on the wage and the error terms of the labour demand equation and an equation like (V.16) are uncorrelated. Bean argues that these are not unrealistic assumptions and we have already argued that these are also reasonable assumptions with respect to demand for hours of work. We therefore report also the OLS estimates of (V.16).

---

[11] If unions bargain also over employment and hours of work then in principle, none of the three structural employment, hours and wage equations is identifiable.

As noted earlier the main problem arises from the inclusion of an employment productivity variable in the wage equation. A simple solution is therefore to exclude it from the equation and try to proxy productivity with some other variable. The problem is that there is no economic explanation for the presence of such an alternative variable. This is rather unsatisfactory when the point of the exercise is to identify a structural economic relationship. We present therefore in the next section an intertemporal version of the wage bargaining model analysed earlier which enables us to derive an estimable dynamic wage equation and replace the productivity variable, as well as provide an economic rationale for such a solution.

Several variables in Equation (V.16) are not directly observable and therefore need to be proxied. Starting with l_0, leisure when unemployed, this will be affected negatively from the time spent searching. This in turn will be increasing in unemployment (the variable used is male unemployment rate, **U** - Figure 14) so that we can expect the unemployment rate to exert a negative influence on the hourly wage. We would also expect that, for any given unemployment rate, time spent searching is likely to be higher the larger the increase in unemployment or alternatively, the lower the unemployment rate of the last period. We therefore included **DU** with an interactive dummy, taking the value of 1 when DU>0, as well as the lagged unemployment rate (**UL**). Since η is positively related with h^{SE}, it will also be proxied by the same variables.

The logarithm of $(1\text{-}t_{inc})$ is approximated by the average income tax (**INCTAX** - see Figure 16). ρ is proxied by the log of the replacement ratio, ie the ratio of unemployment benefits to average weekly earnings (**LRER** - Figure 20), and β by the log of the union density (**LDEN** - Figure 15). The ratio of fixed to total costs is proxied by the ratio of employers' contributions to wages and salaries (**FIXCOST** - Figure 16). This does not capture variations in training costs, which will be operating through the hours variable, if training costs are indexed to weekly earnings. To the extent that firms can borrow freely in the capital markets, training costs and the hourly wage should also be correlated negatively with the real interest rate (**RSTR** - Figure 18) [12].

Other variables used include indirect taxes (**INDTAX** - Figure 17) and an indication of the mismatch in the economy (**MM**). An increase in indirect taxes reduces consumption in partial equilibrium and leads to a higher wage demand on the part of the union; if it reduces also the price received by producers then it would lead to a stronger opposition from employers to any given wage increase. In general equilibrium an increase in indirect taxes will also lead to a reduction in V. The effect on the hourly wage is therefore uncertain. The mismatch has also opposing effects on the wage; the higher the mismatch the longer the period any unemployed person will be expected to search for a job and this exerts downwards pressure on the wage. Andrews and Nickell (1983) on the other hand argue, that the higher the mismatch, the smaller the wage restraint any given aggregate unemployment rate will exert. Since variables capturing the length of search are already included, we should probably expect the mismatch variable to have a positive effect on the wage.

[12] The real interest rate will also have a positive effect on the current wage since it proxies the - inverse of the - discount factor of the workers; the higher the interest rate, the smaller the value of future utility and the higher current union wage demands - see next section. The net effect is therefore uncertain but is likely to be positive, the smaller training costs as a share of total and the more binding the capital market constraints faced by the firm.

We used three real pre-tax wage variables, based on October weekly male earnings in manufacturing, see Figure 10. First, we use the log of a basic hourly wage variable which takes into account the distinction between normal and overtime hours and corresponds to the wage in our theoretical derivation (**LWAG1**). We also use the log of an average hourly wage variable which does not take into account the distinction between normal and overtime hours (**LWAG2**). The results using LWAG1 and LWAG2 may be affected by an accounting effect, since actual and/or normal hours are used on the RHS as well as to derive the dependent variable. We report therefore also the results with the log of weekly rather than hourly earnings as a dependent variable (**LWAG3**).

The productivity variable appearing in equation (V.16) is defined as output per employeehour, and we report results using both the log of output per manhour in manufacturing (**LYMEMH,**) and economy wide capital per manhour (**LKEMPH**). Since this will be obviously correlated with the hours variable, we use also the log of productivity per worker (**LYMEM** - Figure 12) and capital per worker (**LKEMP** - Figure 13). When the productivity variables are per person rather than per hour, the hours variable will be capturing the effects of reductions in hours of work on the wage through increased productivity and we should therefore expect a smaller coefficient.

In Chapter III we argued that actual hours can be modelled as a positive function of normal hours, which could be unit elastic. This implies that the inclusion of either the log of actual (**LH**) or normal (**LNH**) hours on their own - see Figure 11 -, should be enough to capture the effect of changes in hours of work on the wage, with the overtime premium and the other parameters determining the relationship between standard and actual hours "going in" the constant of the equation. This is however a long-run relationship and in the short-run the two variables could have different effects. We therefore examine the effects of replacing the actual with the normal hours variable in section 8.3, where we estimate the dynamic version of the model presented earlier.

The results of the estimation of the static model are presented in Tables 10 to 12. Table 10 reports the OLS results with the basic hourly wage, Table 11 with weekly earnings and Table 12 the IV estimates; t-statistics are in parentheses under the estimated coefficients and we report for our preferred equations a Chow test, a Lagrange multiplier test for first and second order autocorrelation and an Augmented Dickey-Fuller test for the stationarity of the residuals. We use annual observations and the full sample period is 1950-1990, but some regressions run over a shorter time period due to lags and lack of observations for some of the RHS variables. Data definitions and sources can be found in Appendix K, and the actual dataset used in Appendix L.

Starting with Table 10, column (i) uses as a productivity variable output per manhour in manufacturing and column (ii), economy wide capital per manhour. The equations are well determined and most variables are significant and with the expected signs. Although the size of the coefficients varies from column (i) to (ii), their sign and significance is largely unaffected. The only significant difference between the two columns is the interchange in the significance of the log of the replacement ratio lagged (LRERL) and log of the union density lagged (LDENL) in the two equations.

Concerning the other variables used, we did experiment with the fixed costs variable but it was either insignificant or wrongly signed so we included only the interest rate (RSTR). This was found to have a small but well determined positive effect, suggesting that the discount effect on the union side counterbalances the fixed cost effect on the firm side, if such an effect exists. We also found no role for the positive changes in unemployment so we dropped it in favour of the lagged unemployment rate (UL). Although its coefficient is not very well determined, its relative stability across the static and dynamic OLS equations suggests that this is due to its correlation with the unemployment rate (U).

The indirect tax variable (INDTAX) has a negative effect on the hourly wage and the income tax variable (INCTAX) a positive effect. The unemployment rate has a significant negative effect, and the lagged unemployment rate a positive effect, both as expected and in line with other similar studies - see footnote 3 in this Chapter and Blanchflower and Oswald (1989) for a summary of findings using different datasets.

The lagged replacement ratio (LRERL) has a significant positive effect when used with the capital per manhour productivity variable but although its coefficient is positive, it is insignificant when used with the manufacturing output per manhour productivity variable. The opposite is true of union density lagged (LDENL). This could be explained by the fact that the replacement ratio is an economy wide variable which might not be correlated with the hourly manufacturing wage when the effects of changes in manufacturing productivity are controlled for. When however we control only for changes in aggregate productivity by using capital per manhour, the manufacturing hourly wage is more likely to reflect changes in the aggregate hourly wage, in which case the replacement ratio has a role in explaining its variability. A similar argument can be made for the union density variable.

The MM variable is positive and significant across all the equations, but its effect is small. The productivity variables, as is usually the case, are very significant and their coefficients are smaller than unity.

Turning now to the variable of interest, the coefficient of the hours variable is positive when either productivity variable is used. The coefficient is larger as well as very significant when the economy wide productivity variable is used (column (ii)). A possible explanation is that to the extent that the equation of column (i) describes better the unionised manufacturing sector, any given reduction in hours is likely to lead to a smaller reduction of the hourly wage, compared to the whole economy.

When the productivity variables reflect output/capital per person rather than per hour - columns (iii) and (iv) -, the coefficient of the hours variable is lower, as expected, since it captures the positive effect on the mark-up from an increase in productivity. The coefficients are still positive however, although insignificant in the manufacturing productivity equation, which suggests that even when the hours variable incorporates the productivity effect, lower hours still lead to a lower or an unchanged hourly wage.

The last column of Table 10 - column (v) -, reports the "best" equation within the static framework, using the basic hourly wage, economy-wide productivity per person and dropping the insignificant union density. We used also the average hourly wage and the results were unaffected so we do not report them separately. Since an accounting effect may be operating with both of these variables we also used the weekly earnings variable, unadjusted for overtime. The results are reported in Table 11 and are very similar to the hourly wage case. In fact the coefficient of the weekly hours variable is now significantly larger than unity in all equations.

All the results from the simple OLS estimation of the wage equation suggest therefore that, unlike what has been suggested from casual observation and survey results, reductions in hours of work have led in the past to a lower hourly wage and thus to a more than proportional reduction in weekly earnings. This is perfectly consistent with the union model presented in the earlier section.

Returning to the identification issue recall that OLS will provide consistent estimates of the structural coefficients of the wage equation if the labour demand curve is nearly vertical in wage-employment space. If this is not the case however then the appropriate estimation technique is instrumental variables. The results of estimating the wage equation with instrumental variables, treating unemployment (**UHAT**), the replacement ratio (**LRERLHAT**) and hours (**LHHAT**) as endogenous variables are reported in Table 12. The instruments used include two lags of the dependent variables (ie unemployment, the wage, hours and the replacement ratio), the interest rate, taxes (fixed costs, indirect and income taxes), mismatch, union density as well as prices of raw materials and government spending.

We report only the results using the economy wide productivity variable since these are typical of the general findings. The coefficient of the hours variable is now significantly higher in all columns. The same is true of the productivity variable and the replacement ratio variable but, more importantly, the unemployment coefficient. This now becomes significantly smaller (absolutely) and as a result the coefficient on unemployment lagged becomes significantly negative. The IV results therefore strengthen the support for the income sharing hypothesis, despite the changes on the effects of the other variables on the hourly wage.

8.3 A Dynamic Wage Equation

In order to derive a dynamic wage equation, we use the intertemporal version of the model analysed in section 8.1. We will assume that the firm maximises again per period profits by setting employment and hours of work. The union however is interested in the present value of the utility of its members. The structure of the model we present is an extended version of Layard and Nickell (1990) and Manning (1993) so we only highlight its main features. The present value for an employed union member in period t is W^e_t and of an unemployed union member W^u_t. These are given by [13]:

$$W^e_t = U^e_t + \delta\, E\, \{(1-\eta)\, W^e_{t+1} + \eta\, W^u_{t+1}\} \tag{V.17}$$

$$W^u_t = U^u_t + \delta\, E\, \{(1-q)\, W^e_{t+1} + q\, W^u_{t+1}\} \tag{V.18}$$

where δ is a discount factor ($0<\delta<1$), E is the expectations operator and $(1-\eta)$ is the probability of an employed union member remaining employed in the following period. $(1-q)$ is the probability of an unemployed union member becoming employed in the next period.

Utility when employed and utility when unemployed are the same as in section 8.1; we do not write these explicitly here for notational convenience. The value of alternative utility (W^a), if not employed with the firm in period t is:

[13] For expositional reasons we will only index union objectives with time.

$$W^a_t = \eta\ W^e_t + (1-\eta)\ W^u_t \qquad \textbf{(V.19)}$$

This is simply the dynamic equivalent of V - see equation (V.8). It is also useful at this stage to derive the difference between the present value of the utility of an employed and an unemployed union member ($Y_t = W^e_t - W^u_t$). Subtract (V.18) from (V.17) to get:

$$Y_t = U^e_t - U^u_t + \delta\ E\{(q-\eta)\ Y_{t+1}\} \qquad \textbf{(V.20)}$$

Note that if the transition probabilitiy from employment to employment (η) and from unemployment to employment (q) are the same, then Y_t will only depend on the same period levels of utility when employed and unemployed. The model would therefore degenerate to the static model presented in section 8.1. Union utility and the Nash Maximand can now be written as:

$$Z_t = N\ \{W^e_t - W^a_t\} + MW^a_t = N\ DW_t + MW^a_t \qquad \textbf{(V.21)}$$

$$X_t = (Z_t - \underline{Z})^{\beta}(P-\underline{P})^{(1-\beta)} \qquad \textbf{(V.22)}$$

where $DW_t = \{W^e_t - W^a_t\}$. Under the assumptions of $\underline{P}=0$ and $\underline{Z}=MW^a_t$ we can again maximise (V.22) with respect to the wage and solve for union utility when employed which will now be a function of DW_t:

$$U^e_t = K_{PE}\ DW_t \qquad \textbf{(V.23)}$$

where the mark-up, K_{PE}, will depend on the same parameters as in the static case. By substituting W^{*}_{t} from equation (V.19) we can express utility of an employed union member in period t as a function of Y_t:

$$U^{e}_{t} = K_{GE}\, Y_{t} \qquad \text{(V.24)}$$

where K_{GE} depends on K_{PE} and (1-η). By using equation (V.24) to solve for Y_t, and then forwarding it one period to solve for Y_{t+1} we obtain:

$$Y_{i} = U^{e}_{i}/K_{GE} \qquad \text{(V.25)}$$

where i=t, t+1. Substituting equation (V.25) in equation (V.20) and then solving for U^{e}_{t} we obtain:

$$U^{e}_{t} = K\, U^{u}_{t} + K\, \delta\, E\, \{(q-\eta)\, (U^{e}_{t+1}/K_{GE})\} \qquad \text{(V.26)}$$

where $K=(1-(1/K_{GE}))$. Under rational expectations the second term on the right can be replaced by the actual value plus a white noise error. This will then produce an equation of the form:

$$w_{t} = f^{d}\, (w_{t-1}, h_{t}, h_{t-1}, \delta, Z2_{t}, Z2_{t-1}) \qquad \text{(V.27)}$$

where Z2 includes all the variables affecting the mark-up and the transition probabilities q and η. These are the same variables as in the static equation. The inclusion of the dependent lagged on the RHS however can now act as a trend. This means that we can drop the productivity variable from the RHS variables and/or use proxies for productivity that do not include employment or employeehours.

Equation (V.27) can then be approximated loglinearly and the results of the estimation of such an equation with OLS are reported in Table 13. The results using different wage variables are very similar so we only report the results using the basic hourly wage, LWAG1. Unlike the static equation the coefficients on unemployment suggest that there is no level effect on wages, in line with other studies for the UK (see Manning (1993) and references therein). We therefore use the first difference in unemployment in columns (ii) to (iv). The other variables have the expected signs and are well determined although the size of the coefficients of the tax variables and their significance is reduced compared to the static equations. As can be seen from columns (iii) and (iv), we were unable to establish a significant role for the productivity variables excluding employment - the log of the economy wide output per unit of capital variable (LYK, column (iii)) or the log of the manufacturing output per unit of capital variable (LYMK, column (iv)).

The coefficient of the current and lagged hours variables are now positive again but insignificant. This may be due however to the correlation between the lagged dependent variable and the hours variables. The long-run elasticity of the hourly wage with respect to hours estimated from these regressions is in the region of 1.6-2.7. Despite being large, such estimates are consistent with the coefficients of the static equations, see col. (ii) in Table 10.

The dynamic estimation allows us to examine also the role of normal hours. The last two columns report the results using normal instead of actual hours. The results are very similar with the exception of the coefficients of normal hours. These are found to have a positive contemporaneous effect but a negative effect in the following year which is unlikely and counter-intuitive. Given the relatively poor determination of these coefficients our tentative conclusion would be that variations in normal hours do not affect the level of hourly wages.

In summary, the results of the dynamic estimation confirm the findings of the static regressions, where we found no evidence of a negative link between the hourly wage and weekly hours of work. Empirical analysis at a more disaggregate level is clearly needed however, to capture properly the link and direction of causation between hours of work and the hourly wage.

Conclusions

In this Chapter we provided a test of the income sharing hypothesis with aggregate annual post-war UK data. We found that, under a most general specification of a wage equation and controlling for a number of factors that can affect the hourly wage, there was no evidence of the hourly wage compensating for the hours reductions that have occurred in the past.

This was true when estimating both static and dynamic versions of the wage equation, when using different variables to proxy productivity, when using ordinary least squares or instrumental variable estimation and when using actual or normal hours. It seems therefore that hours reductions that have occurred in the past were not accompanied by arbitrary compensating or otherwise increases in the hourly wage, as is the conventional view. It is therefore quite likely that productivity increases accounted for any observed increases in the hourly wage.

TABLE 10

OLS of Static Real Wage Equation
Dependent Variable: Log of Basic Real Hourly Wage (LWAG1)
t-stats in parentheses

	(i)	(ii)	(iii) ident. to(i) see text	(iv) ident. to(ii) see text	(v)
RSTR	.0081	.0066			.0063
	(4.89)	*(4.02)*			*(4.53)*
INDTAX	-1.36	-1.71			-1.73
	(-3.51)	*(-4.36)*			*(-4.57)*
INCTAX	3.54	2.35			2.27
	(5.51)	*(3.15)*			*(3.33)*
U	-.016	-.029			-.029
	(-1.64)	*(-3.91)*			*(-3.99)*
UL	.0097	.014			.013
	(.92)	*(1.59)*			*(1.60)*
MM	.073	.069			.068
	(3.80)	*(3.79)*			*(3.89)*
LRERL	.054	.212			.213
	(.56)	*(2.09)*			*(2.14)*
LDENL	.306	.024			
	(3.43)	*(.279)*			
LYMEMH	.527				
	(6.23)				
LKEMPH		.672			
		(6.75)			
LYMEM			.527		
			(6.23)		
LKEMP				.672	.68
				(6.75)	*(7.27)*
LH	.81	1.74	.28	1.08	1.01
	(1.49)	*(3.00)*	*(.54)*	*(2.02)*	*2.13)*
R^2	.991945	.992697	.991945	.992697	.992938
DW	1.76	1.71	1.76	1.71	1.68
CHOW (6,30)					.96
LM1/LM2					.68/4.22
ADF					-4.94

TABLE 11

OLS of Static Real Wage Equation
Dependent Variable: Log of Weekly Earnings (LWAG3)
t-stats in parentheses

	(i)	(ii)	(iii) ident. to(i) see text	(iv) ident. to(ii) see text
RSTR	.0082	.0067		
	(4.76)	*(3.89)*		
INDTAX	-1.33	-1.68		
	(-3.27)	*(-4.09)*		
INCTAX	3.67	2.44		
	(5.45)	*(3.12)*		
U	-.016	-.030		
	(-1.59)	*(-3.81)*		
UL	.0089	.014		
	(.80)	*(1.46)*		
MM	.074	.070		
	(3.68)	*(3.66)*		
LRERL	.080	.243		
	(.80)	*(2.28)*		
LDENL	.294	.0029		
	(3.15)	*(.032)*		
LYMEMH	.545			
	(6.15)			
LKEMPH		.694		
		(6.63)		
LYMEM			.545	
			(6.15)	
LKEMP				.694
				(6.63)
LH	1.99	2.96	1.45	2.26
	(3.50)	*(4.84)*	*(2.67)*	*(4.05)*
R^2	.988211	.989218	.988211	.989218
DW	1.72	1.65	1.72	1.65
CHOW (6,30)			.98	2.23
LM1/LM2			.75/3.61	.84/5.07
ADF			-5.07	-4.86

TABLE 12

Instrumental Variables Estimation of Static Real Wage Equation
Dependent Variable: Log of Basic Hourly (LWAG1) - Weekly Earnings (LWAG3)
t-stats in parentheses

	LWAG1	LWAG1	LWAG3	LWAG3
	(i)	(ii)	(iii)	(iv)
RSTR	.0024	.0032	.0011	.0021
	(1.39)	*(1.96)*	*(.54)*	*(1.11)*
INDTAX	-2.29	-2.18	-2.19	-2.05
	(-5.86)	*(-5.65)*	*(-4.83)*	*(-4.58)*
INCTAX	.067	.38	-.092	.32
	(.10)	*(.67)*	*(-.12)*	*(.48)*
UHAT	-.0096	-.0084	-.0071	-.0056
	(-1.54)	*(-1.36)*	*(-.98)*	*(-.77)*
UL	-.011	-.011	-.015	-.014
	(-2.32)	*(-2.18)*	*(-2.60)*	*(-2.42)*
MM	.029	.031	.024	.027
	(1.92)	*(2.08)*	*(1.38)*	*(1.54)*
LRERLHAT	.50	.49	.55	.54
	(4.88)	*(4.76)*	*(4.66)*	*(4.50)*
LDENL	-.124		-.16	
	(-1.19)		*(-1.34)*	
LKEMP	.96	.95	1.01	1.01
	(12.26)	*(12.14)*	*(11.19)*	*(10.99)*
LHHAT	1.57	2.19	2.92	3.73
	(1.86)	*(3.26)*	*(2.98)*	*(4.76)*
R^2	.990510	.990361	.982648	.982127
DW	1.79	1.87	1.68	1.83

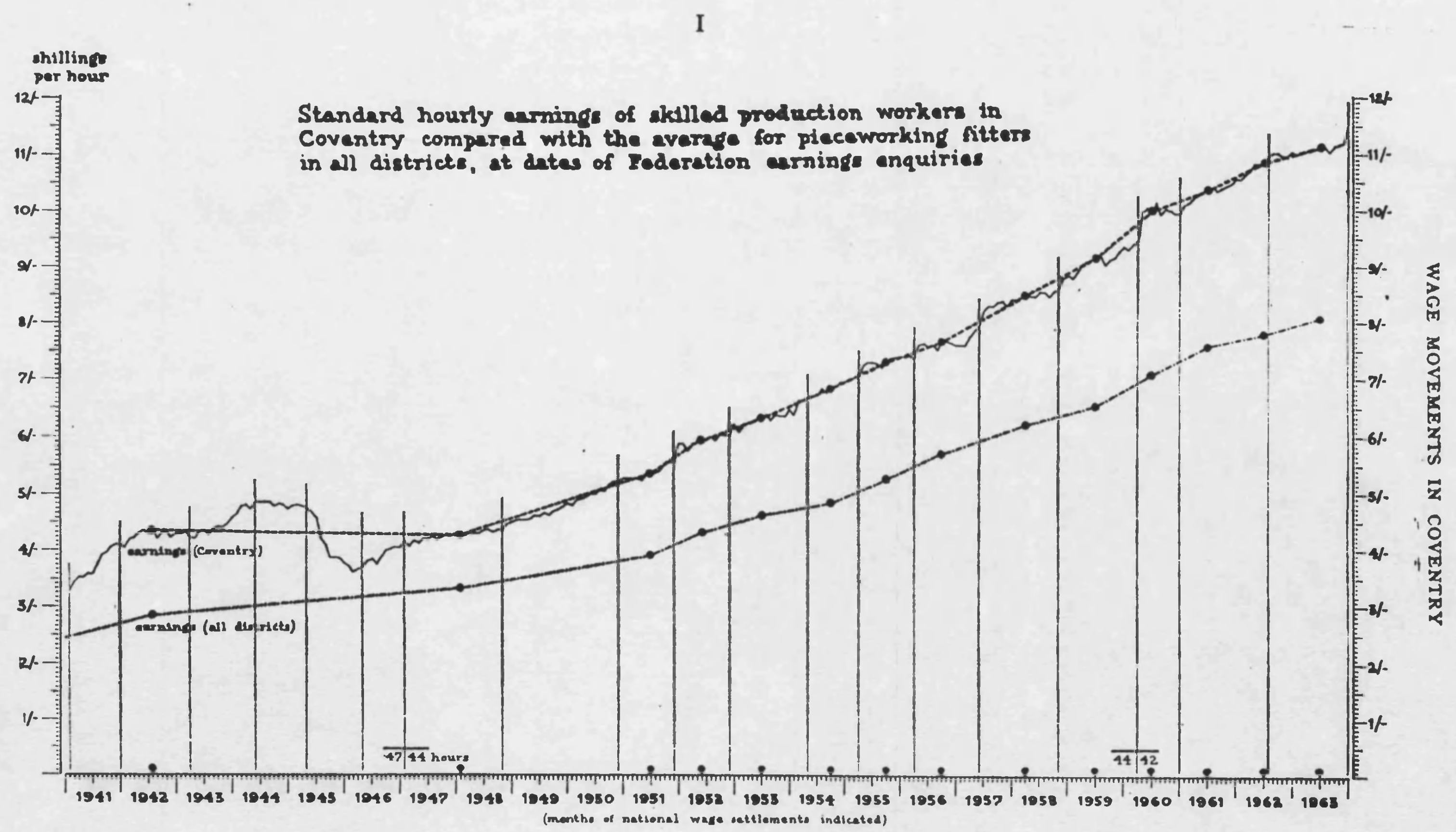
TABLE 13

OLS of Dynamic Real Wage Equation
Dependent Variable: Log of Basic Real Hourly Wage (LWAG1)
t-stats in parentheses

	(i)	(ii)	(iii)	(iv)	(v)	(vi)
LWAG1L	.82	.82	.83	.83	.84	.82
	(10.57)	*(10.77)*	*(8.04)*	*(10.62)*	*(7.14)*	*(8.26)*
RSTR	.0053	.0053	.0052	.0052	.0053	.0052
	(4.30)	*(4.40)*	*(4.23)*	*(4.29)*	*(4.47)*	*(4.36)*
INDTAX	-.34	-.35	-.33	-.26	-.39	-.35
	(-1.44)	*(-1.56)*	*(-1.26)*	*(-.99)*	*(-1.42)*	*(-1.19)*
INCTAX	.87	.88	.87	.80	.65	.65
	(1.42)	*(1.47)*	*(1.39)*	*(1.29)*	*(1.02)*	*(1.03)*
U / DU	-.019	/ -.019	/ -.018	/ -.018	-.016	-.016
	(-3.45)	*/ (-3.53)*	*/ (-2.76)*	*/ (-3.31)*	*(-2.24)*	*(-2.24)*
UL	.019				.014	.016
	(3.32)				*(2.03)*	*(2.55)*
MM	.064	.063	.063	.064	.061	.062
	(4.75)	*(4.83)*	*(4.71)*	*(4.79)*	*(4.65)*	*(4.75)*
LRERL	.15	.15	.15	.12	.13	.098
	(2.17)	*(2.33)*	*(2.29)*	*(1.60)*	*(1.54)*	*(.95)*
LDENL	.13	.13	.14	.13	.088	.092
	(2.15)	*(2.38)*	*(2.23)*	*(2.21)*	*(1.22)*	*(1.43)*
LYK			.039		.091	
			(.16)		*(.39)*	
LYMK				.041		.062
				(.68)		*(.64)*
LH	.14	.16	.13	.019		
	(.36)	*(.43)*	*(.31)*	*(.042)*		
LHL	.30	.34	.33	.26		
	(.83)	*(1.10)*	*(1.03)*	*(.78)*		
LNH					.55	.43
					(1.00)	*(.73)*
LNHL					-.68	-.59
					(-1.42)	*(-1.17)*
R^2	.996230	.996361	.996225	.996288	.996206	.996245
DW	2.63	2.62	2.64	2.69	2.71	2.76
CH (6,30)	.54	.57	.55	.59	.52	.55
LM1/LM2	4.9/4.6	4.8/4.4	5.1/4.8	5.5/5.4	7.3/9.0	8.3/10

FIGURE 9

Hourly Wages and Weekly Hours of Work in the UK Engineering Industry: 1940-1963



3

FIGURE 10

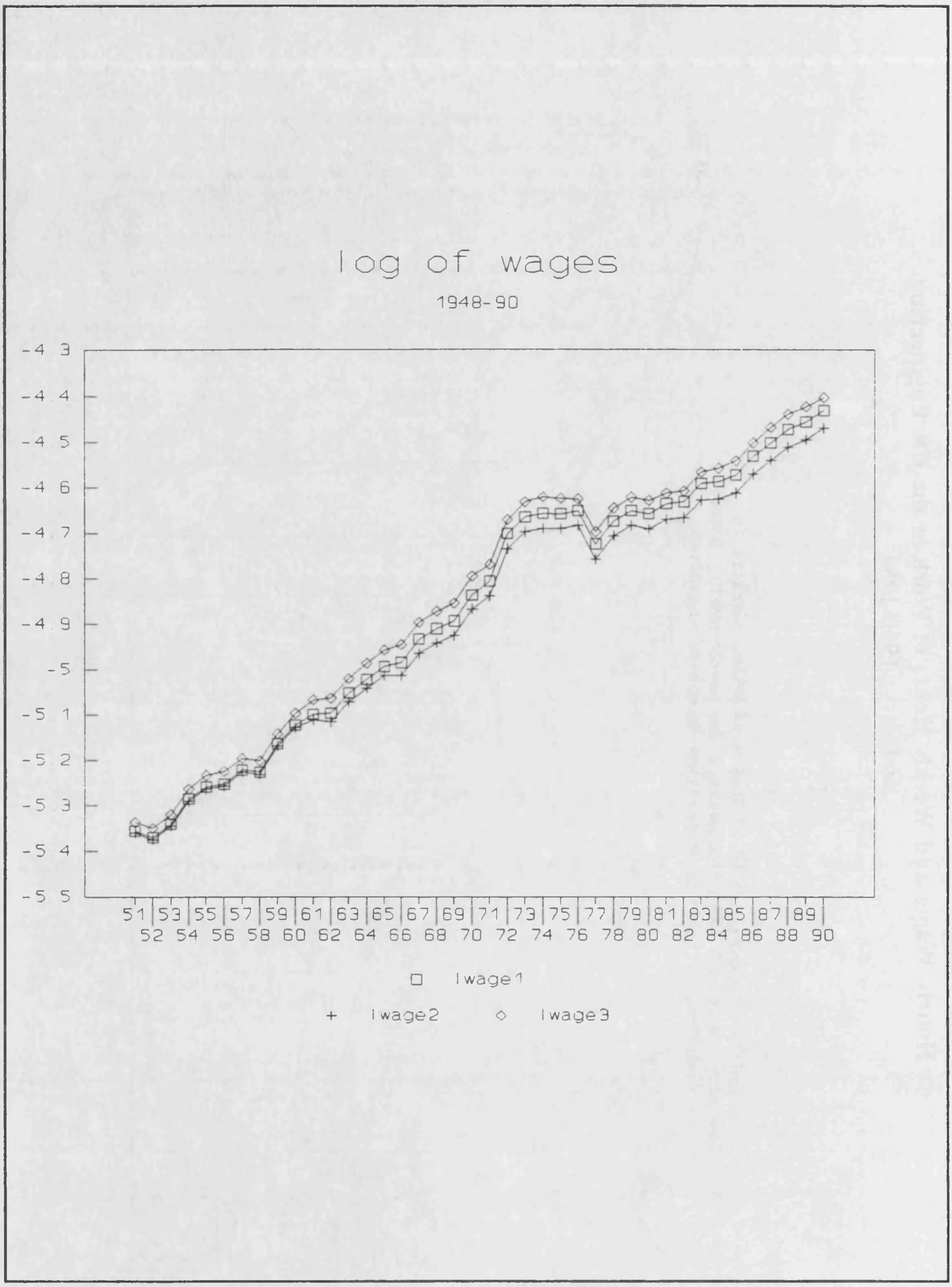
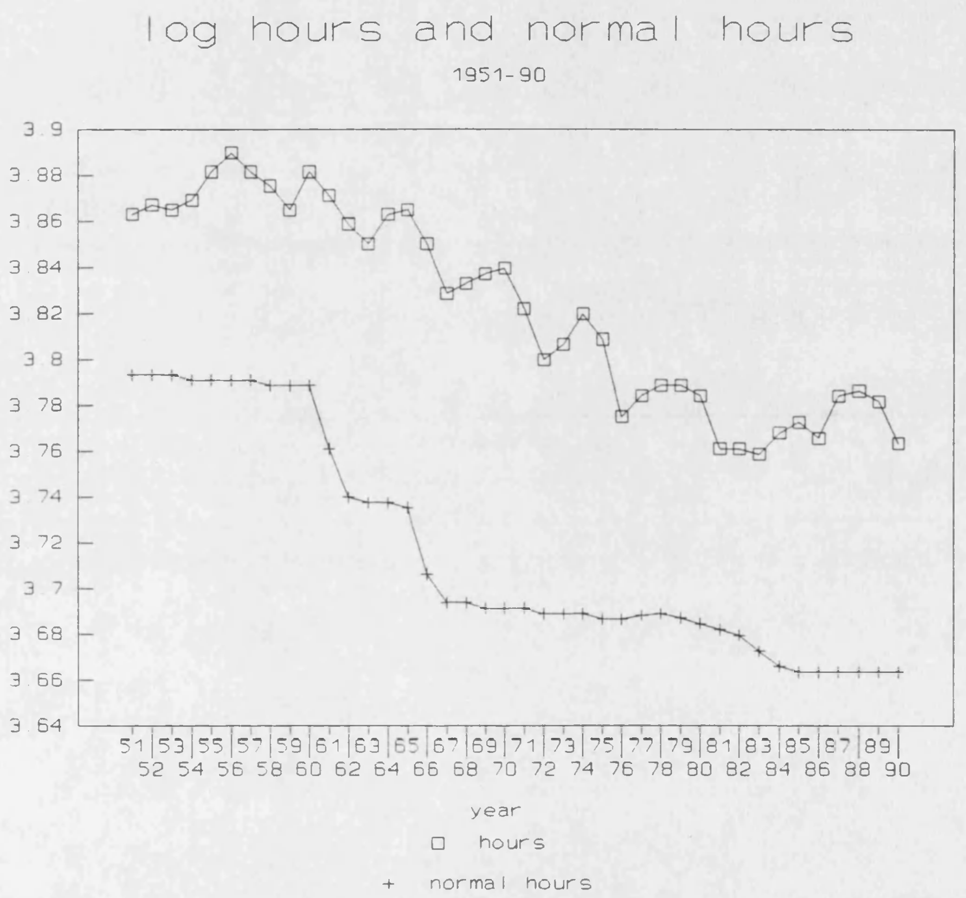
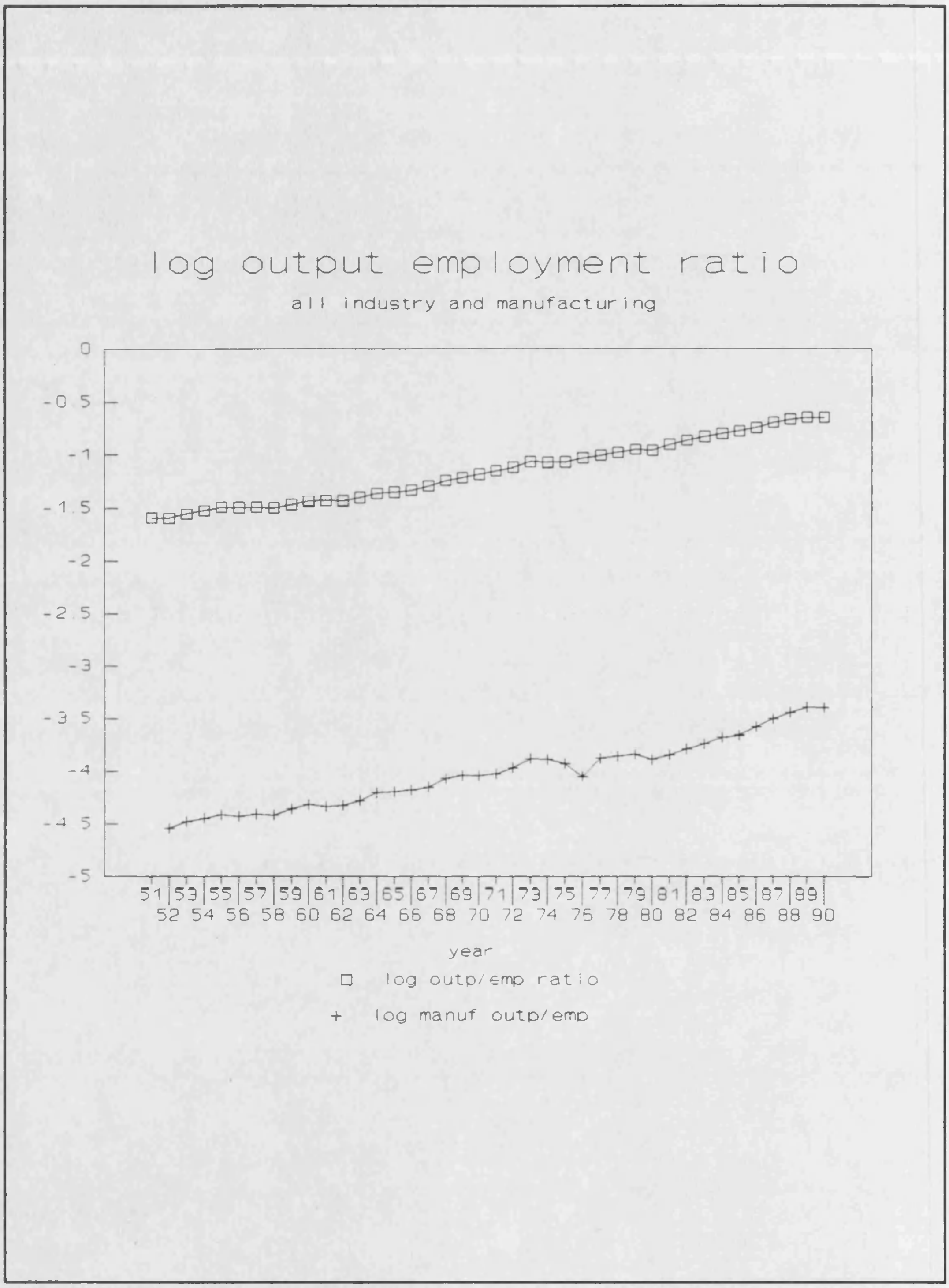

log of wages
1948-90
-4.3
-4.4
-4.5
-4.6
-4.7
-4.8
-4.9
-5
-5.1
-5.2
-5.3
-5.4
-5.5
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
lwage1
lwage2
lwage3

FIGURE 11



log hours and normal hours
1951-90
3.9
3.88
3.86
3.84
3.82
3.8
3.78
3.76
3.74
3.72
3.7
3.68
3.66
3.64
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
hours
normal hours

FIGURE 12



log output employment ratio
all industry and manufacturing
0
-0.5
-1
-1.5
-2
-2.5
-3
-3.5
-4
-4.5
-5
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
log outp/emp ratio
log manuf outp/emp

FIGURE 13

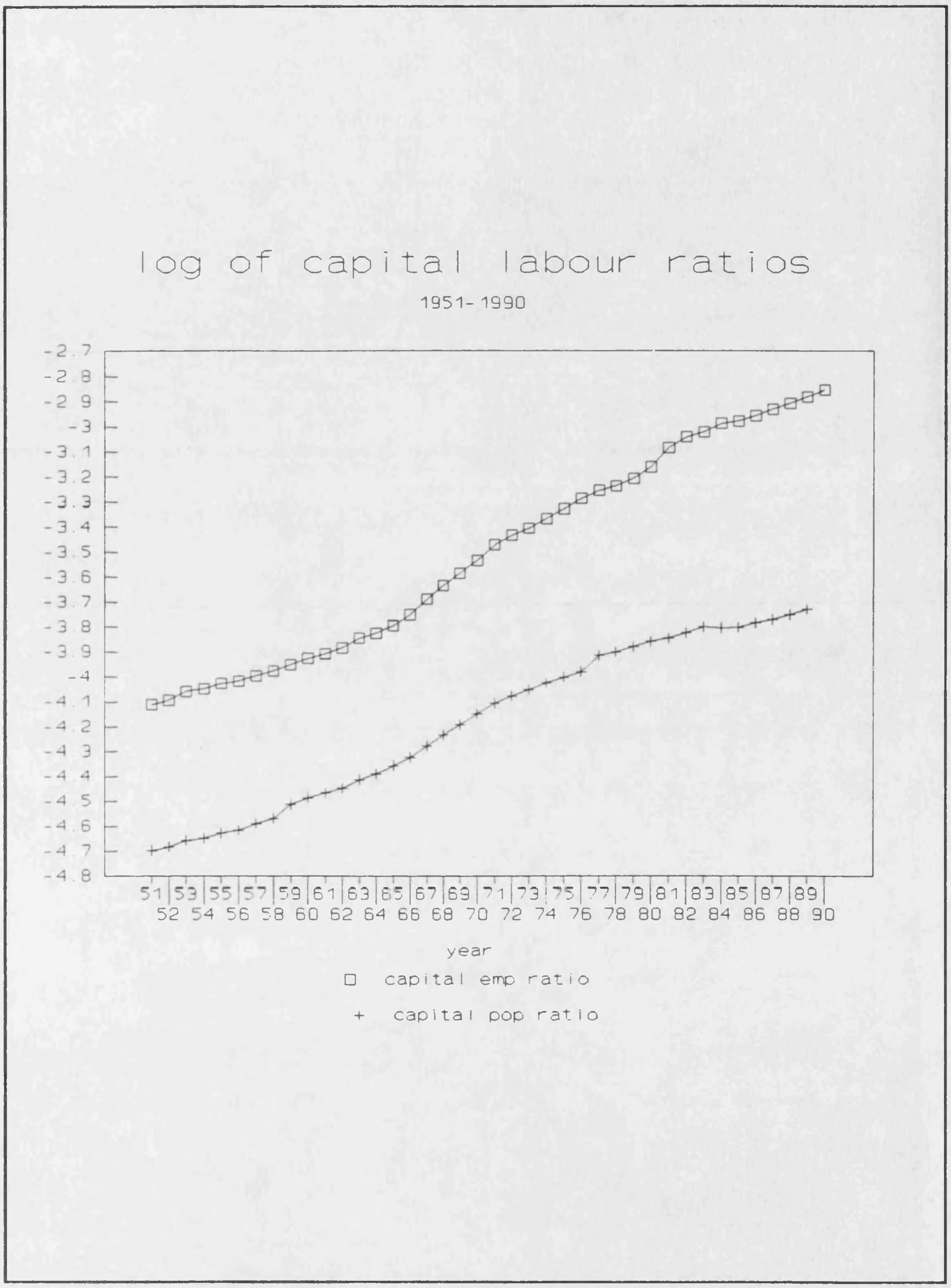

log of capital labour ratios
1951-1990
-2.7
-2.8
-2.9
-3
-3.1
-3.2
-3.3
-3.4
-3.5
-3.6
-3.7
-3.8
-3.9
-4
-4.1
-4.2
-4.3
-4.4
-4.5
-4.6
-4.7
-4.8
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
capital emp ratio
capital pop ratio

FIGURE 14

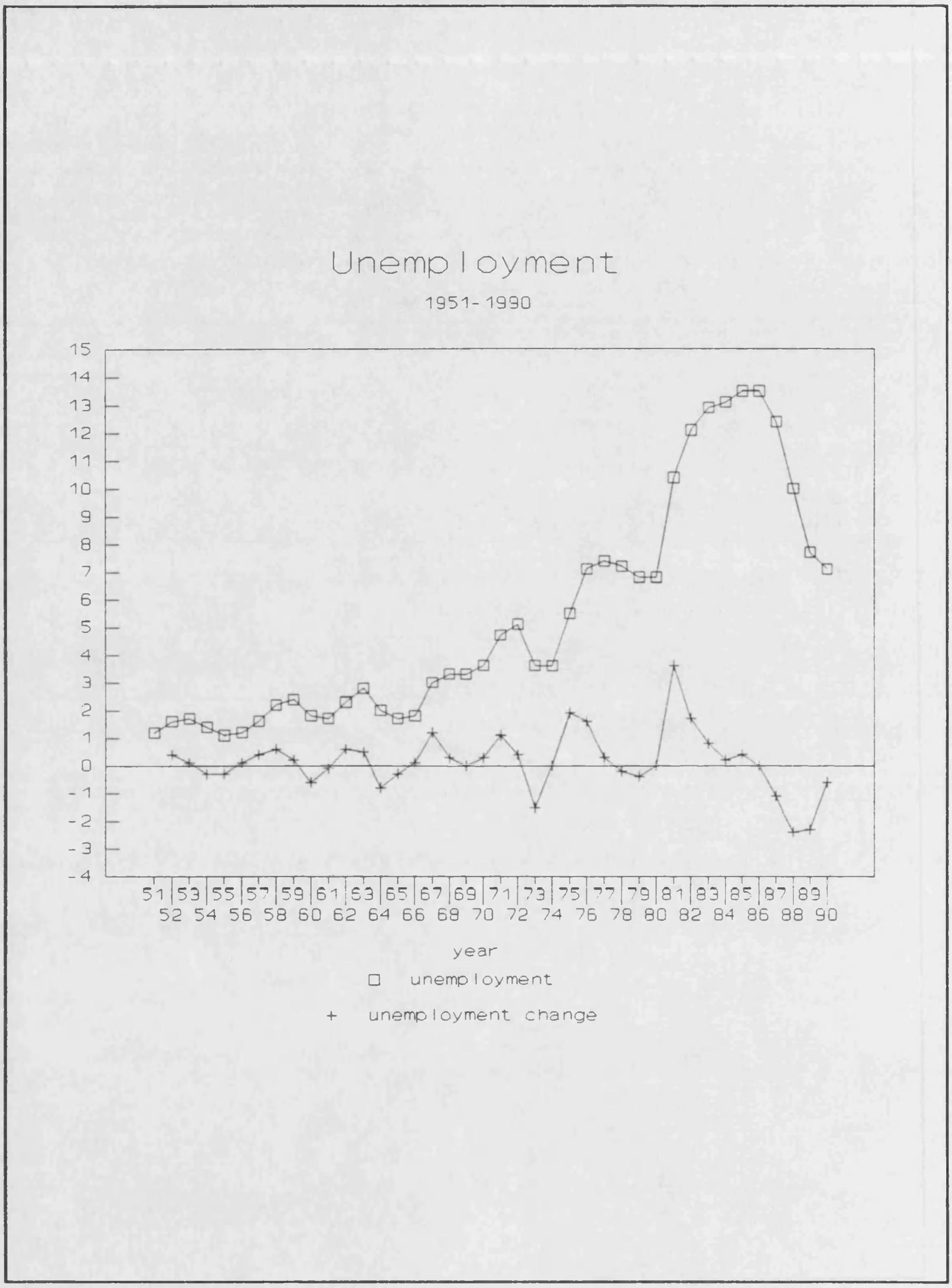
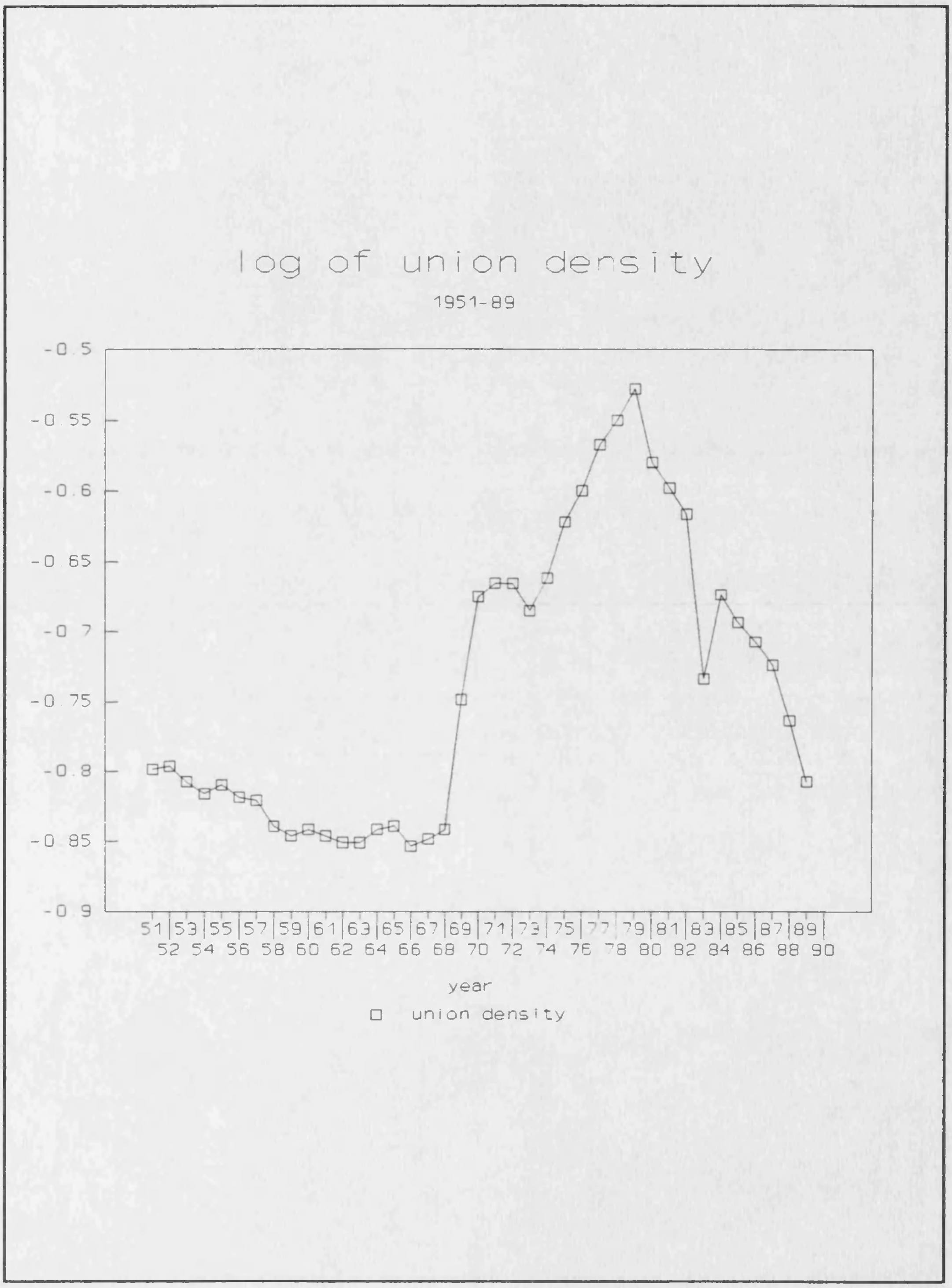

Unemployment
1951-1990
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
-1
-2
-3
-4
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
unemployment
unemployment change

FIGURE 15



log of union density
1951-89
-0.5
-0.55
-0.6
-0.65
-0.7
-0.75
-0.8
-0.85
-0.9
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
union density

FIGURE 16

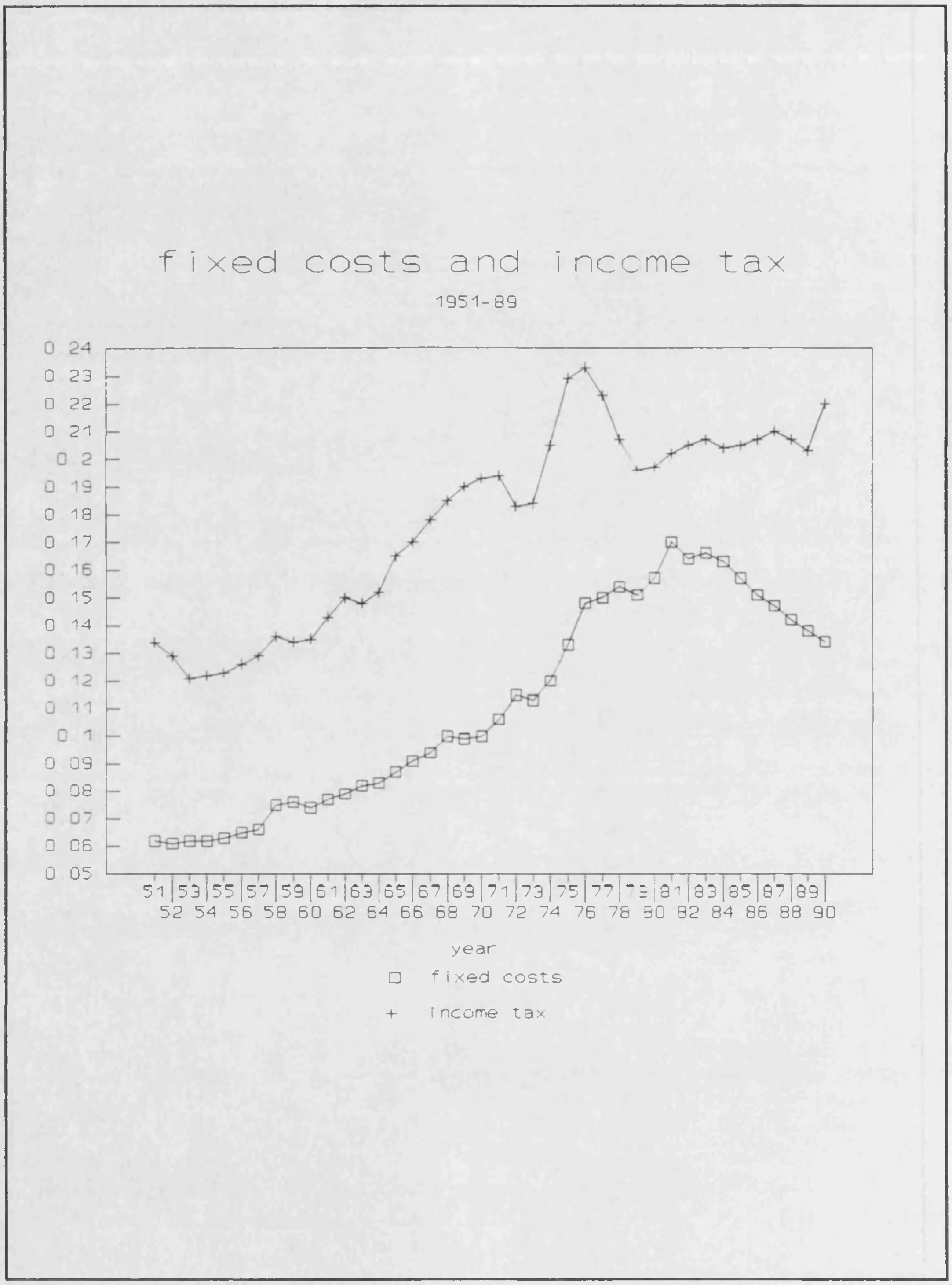
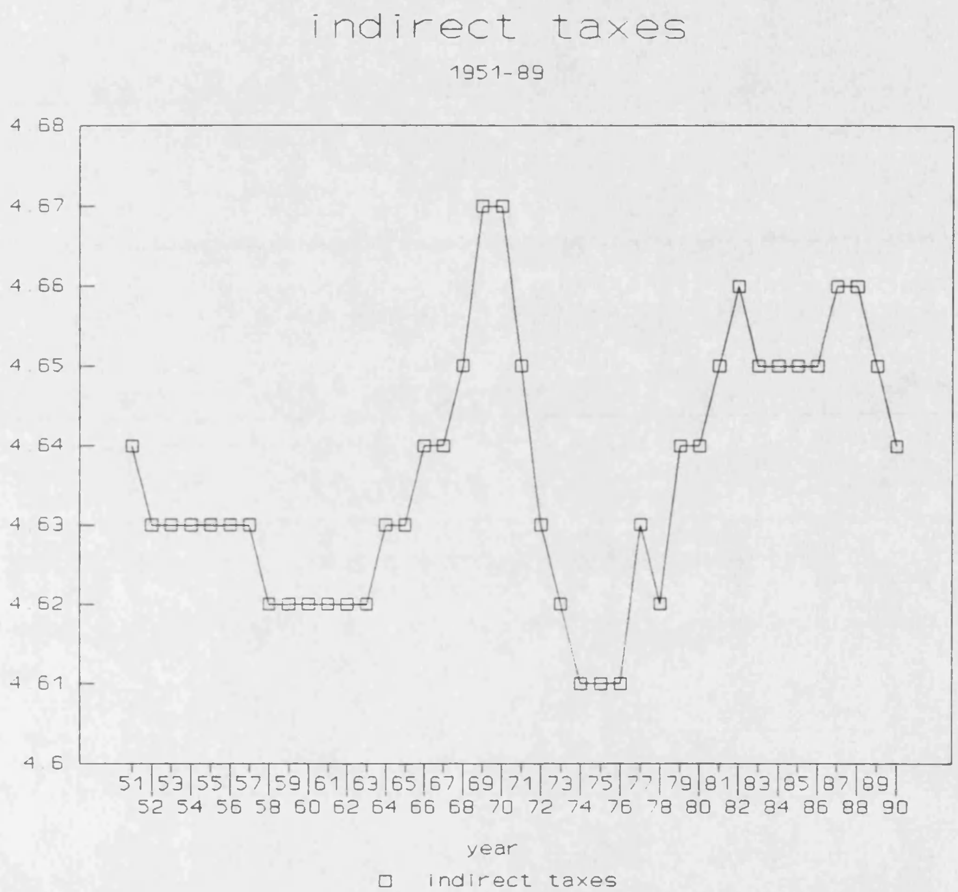
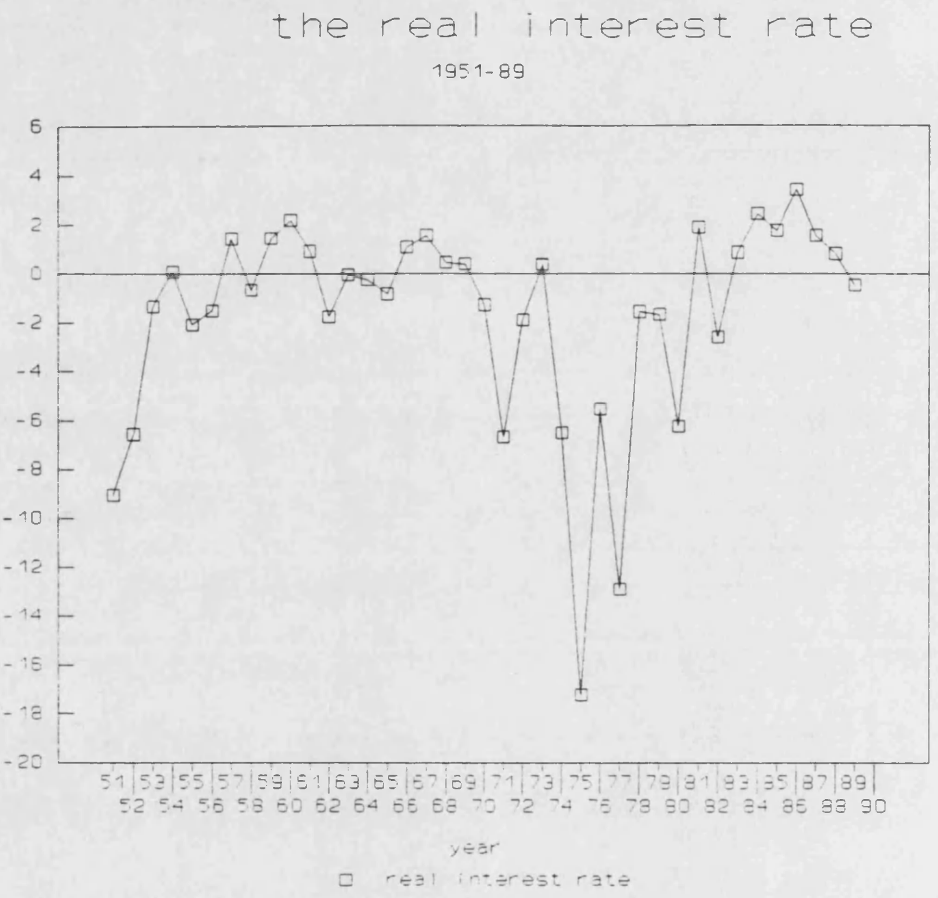

fixed costs and income tax
1951-89
0.24
0.23
0.22
0.21
0.2
0.19
0.18
0.17
0.16
0.15
0.14
0.13
0.12
0.11
0.1
0.09
0.08
0.07
0.06
0.05
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
fixed costs
income tax

FIGURE 17



indirect taxes
1951-89
4.68
4.67
4.66
4.65
4.64
4.63
4.62
4.61
4.6
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
indirect taxes

FIGURE 18



the real interest rate
1951-89
6
4
2
0
-2
-4
-6
-8
-10
-12
-14
-16
-18
-20
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
real interest rate

FIGURE 19

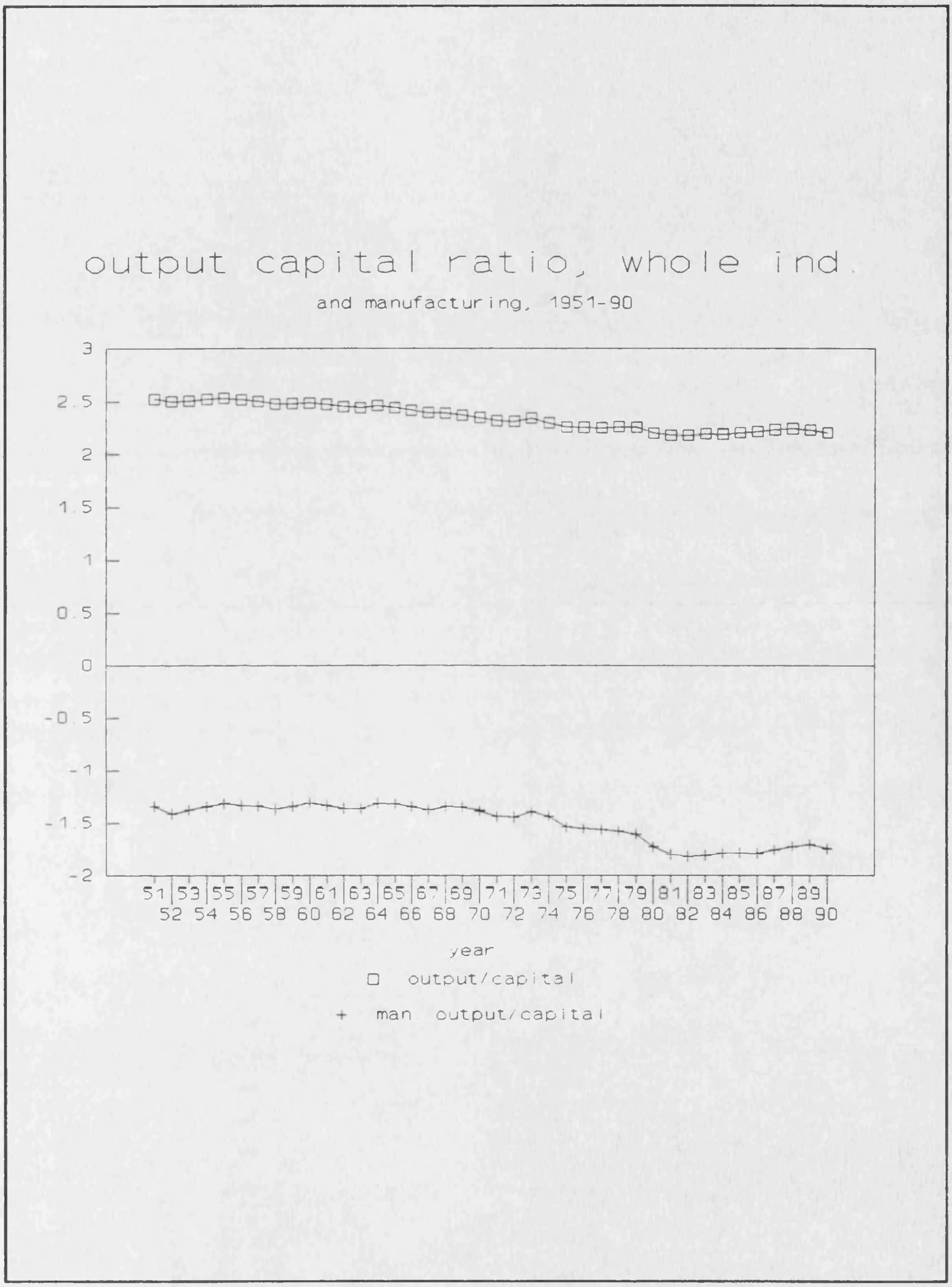
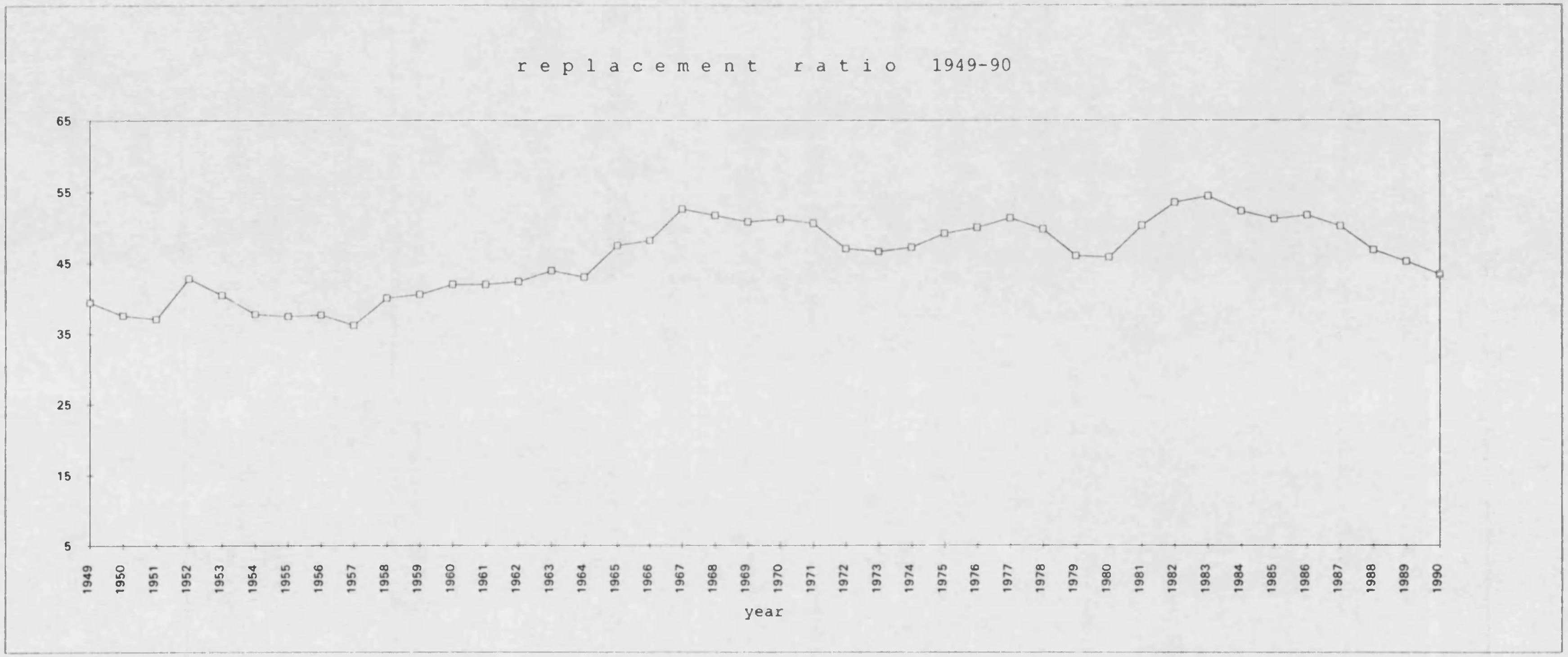

output capital ratio, whole ind.
and manufacturing, 1951-90
3
2.5
2
1.5
1
0.5
0
-0.5
-1
-1.5
-2
51 53 55 57 59 61 63 65 67 69 71 73 75 77 79 81 83 85 87 89
52 54 56 58 60 62 64 66 68 70 72 74 76 78 80 82 84 86 88 90
year
output/capital
man output/capital

FIGURE 20


replacement ratio 1949-90
65
55
45
35
25
15
5
1949
1950
1951
1952
1953
1954
1955
1956
1957
1958
1959
1960
1961
1962
1963
1964
1965
1966
1967
1968
1969
1970
1971
1972
1973
1974
1975
1976
1977
1978
1979
1980
1981
1982
1983
1984
1985
1986
1987
1988
1989
1990
year

APPENDIX K - Variable Definitions and Data Sources

The dataset we used is the Layard-Nickell (1986) dataset updated using the same sources, where available. We comment in detail when other methods or sources are used. All variables preceded by L in the tables are natural logarithms.

BASIC VARIABLES: Wages, Prices, Hours, Employment, Output.

FTME Average weekly earnings of full-time male manual workers 21+, in October of each year, all industries covered. Sources: Various Issues of the Department of Employment Gazette (DEG). British Labour Statistics Historical Abstract (BLSHA).

RPIO General Index of Retail Prices, October, all Items, 1975=100. Source: Economic Trends Annual Supplement (ETAS), 1990.

STR Short-term nominal interest rate. Selected Retail Banks short-term money rates, October each year. Source: ETAS.

FTMH Average weekly hours of full-time male manual workers, 21+, in October of each year, all industries covered. Source: DEG, BLSHA.

LH Natural logarithm of FTMH

FTMNH Average weekly normal hours of full-time male manual workers, 21+, all industries covered, October figure. Source: DEG, BLSHA. From 1984 onwards the figure is for April. Source: New Earnings Survey (NES).

LNH Natural logarithm of FTMNH

FTMN Full time male employment (GB) at mid-year, all industries and services. Source: DEG.

FTMNM Full time male manual employment (GB) at mid-year, manufacturing. Source: DEG.

POP Workforce in employment. Source: Annual Abstract of Statistics (AAS).

OUTP GDP at factor cost at 1985 prices. Source: ETAS

OUTPM Index of Output: Total Manufacturing Industries. Source: ETAS

K Gross capital stock at 1975 replacement cost in bn pounds. For interpolation technique for the 1950-58 period see Layard and Nickell (1986). Source: The Blue Book, National Income and Expenditure.

DERIVED VARIABLES: Wage, Real Interest Rate, Productivity.

A. Real Basic Hourly Wage: this is the weekly wage divided by average hours worked, taking into account overtime hours payed at a premium of 30%.

WAG1 = FTME / {[1.3 FTMH - 0.3 FTMNH] * RPIO}

B. Real Average Hourly Wage: This is the average hourly wage without any correction for overtime.

WAG2 = FTME / [FTMH * RPIO]

C. Real Weekly Earnings:

WAG3 = FTME / RPIO

D. Real Interest Rate.

RSTR = STR - $[\{(RPI_t / RPI_{t-1}) - 1\}*100]$

E. Capital Stock per Male Employee.

KEMP = K/FTMN

F. Capital Stock per Male Employee-hour.

KEMP = K/(FTMN * FTMH)

G. Manufacturing Output per Male Manual Employee

YMEM = OUTPM/FTMNM

H. Manufacturing Output per Male Manual Employee-hour

YMEMH = OUTPM/(FTMNM * FTMH)

I. GDP per Unit of Capital

LYK = OUTP/K

J. Manufacturing Output per Unit of Capital

LYMK = OUTPM/K

OTHER VARIABLES USED / INSTRUMENTS:

U Male Unemployment Rate: males wholly unemployed as a percentage of the number of employees (employed and unemployed) at the appropriate mid-year for the UK. Source: DEG.

DU Change in unemployment (U_t-U_{t-1}).

MM Index of Mismatch: one year absolute change in the percentage ratio of employees in employment , males and females, in production industries at each mid-year, GB, to total employees in employment, males and females at each mid-year, GB. Source: DEG.

RER The Replacement Ratio: a weighted average (for five family types) of annual income on benefit which is then related to mid-year earnings from Layard and Nickell (1986). The variable was updated according to the ratio of benefits to basic weekly earnings for a family with two children. Source: Department of Social Security, Statistics 1990.

FIXCOST Fixed Employment Costs; The ratio of Employment Contributions to Wages and Salaries. Source: ETAS.

INCTAX Average Rate of Income Tax: (1-INCTAX) is the ratio of total personal disposable income, mn pounds, current prices, to total income before tax, mn pounds, current prices. Source: ETAS.

INDTAX Indirect Taxes: the ratio of GDP deflator at market prices, 1975=100 to GDP deflator at factor cost, 1975=100. INDTAX is the logarithm of the series, which is an index. Source: ETAS.

DEN Union Density: union membership as a proportion of employees in employment. Source: ETAS/AAS.

LG Natural logarithm of real government spending: general government expenditure on goods and services, mn pounds, to GDP deflator at factor cost. Updated using government expenditure at 1985 prices. Source: ETAS.

INP The price of materials and fuels: wholesale price index of materials and fuel purchased by manufacturing industry, 1975=100. Source: ETAS.

APPENDIX L - THE DATA

YEAR	LWAGE1	LWAG2	LWAG3
51	-5.35585	-5.35984	-1.47305
52	-5.37008	-5.37407	-1.48194
53	-5.34010	-5.34409	-1.45462
54	-5.28524	-5.28989	-1.39382
55	-5.25869	-5.26335	-1.35148
56	-5.25276	-5.25742	-1.33516
57	-5.22190	-5.22656	-1.31469
58	-5.22607	-5.23139	-1.32612
59	-5.16380	-5.16912	-1.27709
60	-5.12334	-5.12866	-1.21552
61	-5.09834	-5.11159	-1.19637
62	-5.09622	-5.11537	-1.20460
63	-5.05172	-5.07153	-1.17016
64	-5.02152	-5.04132	-1.12400
65	-4.99338	-5.01384	-1.09262
66	-4.98501	-5.01327	-1.09544
67	-4.93394	-4.96544	-1.06817
68	-4.91032	-4.94182	-1.03912
69	-4.89418	-4.92632	-1.01695
70	-4.83578	-4.86793	-0.95587
71	-4.80626	-4.83840	-0.94806
72	-4.70231	-4.73510	-0.87128
73	-4.66490	-4.69769	-0.82544
74	-4.65729	-4.69008	-0.80120
75	-4.65792	-4.69135	-0.81503
76	-4.65103	-4.68446	-0.85083
77	-4.72480	-4.75778	-0.91350
78	-4.67414	-4.70693	-0.85731
79	-4.65123	-4.68454	-0.83387
80	-4.65762	-4.69158	-0.84533
81	-4.63622	-4.67081	-0.85239
82	-4.63186	-4.66710	-0.84735
83	-4.59160	-4.62858	-0.80821
84	-4.58736	-4.62594	-0.79053
85	-4.57323	-4.61245	-0.76990
86	-4.53208	-4.57130	-0.73749
87	-4.50226	-4.54148	-0.68454
88	-4.47309	-4.51231	-0.65252
89	-4.45607	-4.49529	-0.64122
90	-4.43090	-4.47012	-0.63924

YEAR	U	DU
51	1.20000	.
52	1.60000	0.40000
53	1.70000	0.10000
54	1.40000	-0.30000
55	1.10000	-0.30000
56	1.20000	0.10000
57	1.60000	0.40000
58	2.20000	0.60000
59	2.40000	0.20000
60	1.80000	-0.60000
61	1.70000	-0.100000
62	2.30000	0.60000
63	2.80000	0.50000
64	2.00000	-0.80000
65	1.70000	-0.30000
66	1.80000	0.100000
67	3.00000	1.20000
68	3.30000	0.30000
69	3.30000	0.00000
70	3.60000	0.30000
71	4.70000	1.10000
72	5.10000	0.40000
73	3.60000	-1.50000
74	3.60000	0.00000
75	5.50000	1.90000
76	7.10000	1.60000
77	7.40000	0.30000
78	7.20000	-0.20000
79	6.80000	-0.40000
80	6.80000	0.00000
81	10.40000	3.60000
82	12.10000	1.70000
83	12.90000	0.80000
84	13.10000	0.20000
85	13.50000	0.40000
86	13.50000	0.00000
87	12.40000	-1.10000
88	10.00000	-2.40000
89	7.70000	-2.30000
90	7.10000	-0.60000

YEAR	MM	LDEN	LRER
51	0.56400	-0.79851	3.61362
52	0.11800	-0.79629	3.75654
53	0.10700	-0.80744	3.70130
54	0.16000	-0.81645	3.63231
55	0.48700	-0.80968	3.62434
56	0.16100	-0.81871	3.62966
57	0.27500	-0.82098	3.58906
58	0.24400	-0.83933	3.69138
59	0.53500	-0.84630	3.70377
60	0.35900	-0.84165	3.73767
61	0.065000	-0.84630	3.73767
62	0.72900	-0.85097	3.74715
63	0.66800	-0.85097	3.78191
64	0.15900	-0.84165	3.76120
65	0.061000	-0.83933	3.86073
66	0.18100	-0.85332	3.87536
67	0.58600	-0.84863	3.96272
68	0.53400	-0.84165	3.94546
69	0.031000	-0.74866	3.92790
70	0.48700	-0.67531	3.93574
71	0.99900	-0.66553	3.92395
72	1.27000	-0.66553	3.85015
73	0.60300	-0.68518	3.84160
74	0.31100	-0.66165	3.85439
75	1.54200	-0.62176	3.89589
76	0.79300	-0.59966	3.91202
77	0.095000	-0.56740	3.93769
78	0.43200	-0.54991	3.90802
79	0.51800	-0.52763	3.82864
80	1.01200	-0.57982	3.82428
81	1.80700	-0.59784	3.91800
82	1.07600	-0.61619	3.97968
83	0.98600	-0.73397	3.99636
84	0.91000	-0.67334	3.95700
85	0.70000	-0.69315	3.93574
86	0.80000	-0.70725	3.94546
87	0.80000	-0.72361	3.91602
88	0.70000	-0.76357	3.84588
89	0.60000	-0.80744	3.81110
90	0.50000	.	3.77046

YEAR	FIXCOST	INCTAX	INDTAX
51	0.062000	0.13400	4.64000
52	0.061000	0.12900	4.63000
53	0.062000	0.12100	4.63000
54	0.062000	0.12200	4.63000
55	0.063000	0.12300	4.63000
56	0.065000	0.12600	4.63000
57	0.066000	0.12900	4.63000
58	0.075000	0.13600	4.62000
59	0.076000	0.13400	4.62000
60	0.074000	0.13500	4.62000
61	0.077000	0.14300	4.62000
62	0.079000	0.15000	4.62000
63	0.082000	0.14800	4.62000
64	0.083000	0.15200	4.63000
65	0.087000	0.16500	4.63000
66	0.091000	0.17000	4.64000
67	0.094000	0.17800	4.64000
68	0.10000	0.18500	4.65000
69	0.099000	0.19000	4.67000
70	0.10000	0.19300	4.67000
71	0.10600	0.19400	4.65000
72	0.11500	0.18300	4.63000
73	0.11300	0.18400	4.62000
74	0.12000	0.20500	4.61000
75	0.13300	0.22900	4.61000
76	0.14800	0.23300	4.61000
77	0.15000	0.22300	4.63000
78	0.15400	0.20700	4.62000
79	0.15100	0.19600	4.64000
80	0.15700	0.19700	4.64000
81	0.17000	0.20200	4.65000
82	0.16400	0.20500	4.66000
83	0.16600	0.20700	4.65000
84	0.16300	0.20400	4.65000
85	0.15700	0.20500	4.65000
86	0.15100	0.20700	4.65000
87	0.14700	0.21000	4.66000
88	0.14200	0.20700	4.66000
89	0.13800	0.20300	4.65000
90	0.13400	0.22000	4.64000

YEAR	RSTR	LINP	LYMEM
51	-9.04744	2.81241	-4.48418
52	-6.55036	2.63620	-4.54128
53	-1.33102	2.53052	-4.47895
54	0.088926	2.51447	-4.44777
55	-2.07647	2.54318	-4.41463
56	-1.49837	2.58022	-4.42904
57	1.42692	2.58626	-4.40990
58	-0.65950	2.52092	-4.41941
59	1.44127	2.53052	-4.35952
60	2.17066	2.53052	-4.32230
61	0.92828	2.52092	-4.33708
62	-1.74467	2.52092	-4.32950
63	-0.035916	2.54318	-4.28105
64	-0.24212	2.58324	-4.20770
65	-0.83068	2.59824	-4.19873
66	1.08346	2.62177	-4.18104
67	1.56042	2.61593	-4.15189
68	0.45411	2.70002	-4.06760
69	0.41051	2.73955	-4.04601
70	-1.27394	2.78994	-4.04545
71	-6.65977	2.83321	-4.02672
72	-1.87123	2.87695	-3.97141
73	0.38063	3.15785	-3.88298
74	-6.49512	3.54674	-3.89369
75	-17.22341	3.68888	-3.92921
76	-5.50000	3.91002	-4.05170
77	-12.87976	4.05178	-3.87923
78	-1.54582	4.08766	-3.85894
79	-1.65647	4.20916	-3.84485
80	-6.22371	4.29046	-3.89302
81	1.88927	4.37827	-3.84609
82	-2.59238	4.44852	-3.79278
83	0.87024	4.51525	-3.74491
84	2.43245	4.59411	-3.67962
85	1.75579	4.60517	-3.66279
86	3.41780	4.52613	-3.57725
87	1.55190	4.55703	-3.50252
88	0.83284	4.58904	-3.44465
89	-0.46421	4.64439	-3.39168
90	.	4.64247	-3.39894

YEAR	LKEMP
51	-4.11160
52	-4.09364
53	-4.05911
54	-4.04770
55	-4.02673
56	-4.01790
57	-3.99522
58	-3.97690
59	-3.95076
60	-3.92560
61	-3.90768
62	-3.88521
63	-3.84669
64	-3.82575
65	-3.79610
66	-3.75204
67	-3.68860
68	-3.63438
69	-3.58561
70	-3.53223
71	-3.47144
72	-3.43356
73	-3.40540
74	-3.36680
75	-3.32759
76	-3.28670
77	-3.25455
78	-3.23578
79	-3.20547
80	-3.15962
81	-3.08291
82	-3.04144
83	-3.02016
84	-2.98833
85	-2.97786
86	-2.95666
87	-2.93074
88	-2.90726
89	-2.88059
90	-2.85382

YEAR	LKEMPH	LYMEMH
51	-7.97443	-8.34701
52	-7.96066	-8.40830
53	-7.92404	-8.34388
54	-7.91681	-8.31689
55	-7.90830	-8.29619
56	-7.90768	-8.31882
57	-7.87679	-8.29146
58	-7.85226	-8.29477
59	-7.81569	-8.22446
60	-7.80716	-8.20387
61	-7.77888	-8.20828
62	-7.74384	-8.18813
63	-7.69683	-8.13120
64	-7.68858	-8.07053
65	-7.66103	-8.06366
66	-7.60219	-8.03119
67	-7.51724	-7.98053
68	-7.46736	-7.90058
69	-7.42291	-7.88331
70	-7.37168	-7.88491
71	-7.29354	-7.84882
72	-7.23354	-7.77139
73	-7.21206	-7.68964
74	-7.18670	-7.71360
75	-7.13648	-7.73810
76	-7.06175	-7.82676
77	-7.03874	-7.66342
78	-7.02450	-7.64767
79	-6.99419	-7.63357
80	-6.94381	-7.67721
81	-6.84411	-7.60729
82	-6.80264	-7.55398
83	-6.77903	-7.50378
84	-6.75648	-7.44777
85	-6.75062	-7.43555
86	-6.72250	-7.34309
87	-6.71493	-7.28671
88	-6.69372	-7.23110
89	-6.66250	-7.17359
90	-6.61734	-7.16247

YEAR	LYK	LYMK
51	2.52138	-1.34399
52	2.50064	-1.41473
53	2.50630	-1.37648
54	2.52350	-1.34406
55	2.53169	-1.31333
56	2.52093	-1.33489
57	2.50269	-1.34186
58	2.47584	-1.37101
59	2.47959	-1.34445
60	2.48682	-1.30786
61	2.47474	-1.33518
62	2.44976	-1.36251
63	2.44223	-1.36714
64	2.45958	-1.31088
65	2.44191	-1.32294
66	2.41538	-1.34474
67	2.39178	-1.37912
68	2.38978	-1.34565
69	2.36947	-1.34884
70	2.34663	-1.38583
71	2.31806	-1.43589
72	2.31263	-1.44488
73	2.34118	-1.39589
74	2.29595	-1.43865
75	2.25782	-1.53994
76	2.25376	-1.55139
77	2.24905	-1.56224
78	2.25862	-1.57656
79	2.25496	-1.60750
80	2.20208	-1.72839
81	2.18044	-1.80024
82	2.17876	-1.81804
83	2.19345	-1.80990
84	2.18891	-1.78912
85	2.20452	-1.78483
86	2.21353	-1.79191
87	2.23458	-1.76092
88	2.24450	-1.72292
89	2.23209	-1.70585
90	2.20551	-1.74593

YEAR	LH	LNH
51	3.86283	3.79324
52	3.86703	3.79324
53	3.86493	3.79324
54	3.86912	3.79098
55	3.88156	3.79098
56	3.88978	3.79098
57	3.88156	3.79098
58	3.87536	3.78872
59	3.86493	3.78872
60	3.88156	3.78872
61	3.87120	3.76120
62	3.85862	3.74005
63	3.85015	3.73767
64	3.86283	3.73767
65	3.86493	3.73529
66	3.85015	3.70623
67	3.82864	3.69387
68	3.83298	3.69387
69	3.83730	3.69138
70	3.83945	3.69138
71	3.82210	3.69138
72	3.79997	3.68888
73	3.80666	3.68888
74	3.81991	3.68888
75	3.80888	3.68638
76	3.77506	3.68638
77	3.78419	3.68813
78	3.78872	3.68888
79	3.78872	3.68688
80	3.78419	3.68437
81	3.76120	3.68185
82	3.76120	3.67933
83	3.75887	3.67250
84	3.76815	3.66612
85	3.77276	3.66356
86	3.76584	3.66356
87	3.78419	3.66356
88	3.78646	3.66356
89	3.78191	3.66356
90	3.76352	3.66356

CHAPTER VI

CONCLUSIONS AND FUTURE RESEARCH

9.0 CONCLUSIONS AND AREAS FOR FUTURE RESEARCH

9.1 Conclusions

We examined in this thesis the theory on the determination of hours of work in a bargaining framework and empirical evidence related to reductions in hours of work. When hours are taken as exogenously given, we found that the impact of reductions in hours of work on employment through changes in the hourly wage depended crucially on the initial level of hours compared to the optimal for the individual. If hours exceeded initially the optimal level for the individual, then any reduction would lead to a lower hourly wage and therefore higher, rather than lower employment.

We found this proposition to hold true in both union and efficiency wage models under the assumption that the elasticity of utility with respect to consumption is constant. The proposition was also valid when we allowed for an endogenous determination of the level of alternative utility, under the additional assumption that the unemployment benefit is partially or fully indexed to weekly rather than hourly earnings.

When we relaxed the assumption of an exogenously fixed level of hours by allowing firms to choose the level of actual hours for a given level of normal hours, we found that the proposition would again be true under the assumption that fixed costs of employment were indexed to standard hours of work.

We then examined in detail the process of determination of hours of work, in order to provide an economic rationale for reductions in hours of work. We demonstrated that inefficiencies arising from the hours determination process or the structure of labour costs can give rise to efficiency gains through hours reductions. We also showed that, under efficient bargaining, hours can be off the conventional hours supply and demand curves.

We used the model with an endogenous determination of hours to assess also the impact of union bargaining over hours of work on wages and employment. We found that, under a CD production function and a constant consumption elasticity utility function, bargaining over hours of work could lead to a lower level of hours and a higher level of employment. This implies that the assessment of the employment effect of unions through a movement up a fixed labour demand curve because of a union wage mark-up over the competitive level could be exaggerated; the available evidence suggests that unions will negotiate also lower hours which would lead to an outwards shift of the labour demand curve and a higher level of employment, for any given wage.

The endogenous determination of hours of work enabled us to examine also the impact of Maximum Hours Legislation (MHL). We showed in particular, that even when MHL is not binding it can affect favourably the union in a union-firm bargain, if it increases the alternative pay-off for union members in a Nash bargain or the minimum pay-off in a Kalai-Smorodinsky bargain. We showed that this will be true in general for any type of legislation that can affect the alternative or minimum levels of utility available to workers, like minimum wage legislation.

We provided finally a test of the income sharing hypothesis - ie the proposition that hours reductions are not accompanied by compensating or other increases in the hourly wage - by deriving a generalised wage equation from a firm-union bargain and estimating it with annual aggregate data. We used a number of productivity variables, simple least squares and instrumental variables estimation, actual and normal hours variables and estimated both static and dynamic versions of the wage equation. The evidence suggested that reductions in hours of work were associated, if anything, with a lower level of the hourly wage.

9.2 Future research

There are a few areas where this thesis has provided some findings but where more research is needed. Starting with our test of the income sharing hypothesis, aggregate annual data cannot provide a sufficient test of such a hypothesis because of its very nature. In order to examine in more detail the degree to which hours reductions are accompanied by increases in the hourly wage we need more disaggregated, firm level data for a number of years to capture also dynamic effects.

The estimation of the potential bias in the employment effects of unionism can be achieved in two ways. First, estimate at a disaggregate level a three equation system for wages, hours and employment, including variables that capture the potential impact of unionism. Pencavel and Holmlund (1988) have already estimated such a system with aggregate Swedish data, but imposed the monopoly union assumptions and did not account explicitly for union strength. The weakness of such an approach is the possible inability to identify separately the three equations, because of the lack of appropriate instruments. An alternative method would be to use micro-data to estimate union non-union hours differential and then assess the combined impact of the union wage mark-up and hours mark-down on employment, through labour demand equations.

A number of authors have tested for the appropriate model of employment determination, primarily by testing the form of an employment equation resulting from a union-firm bargain, as those derived in Chapter II and Chapter V. It would be very interesting to expand these tests to assess the appropriate model of hours determination. Unfortunately the mark-up equations are more complicated when hours are accounted for explicitly - see Chapter V - so that a straightforward test seems unlikely. We have shown however that the hours contract curve can lie between the conventional hours supply and demand curves, so a possible test of the hours determination models presented would be a comparison of the hours-wage equations of unionised v non-unionised employees.

Another implication of the hours determination model presented, is that the introduction of MHL would affect the wage-hours bargain, if it affected the alternative or minimum pay-offs available to workers. We also showed however that, under a Nash bargain, a firm with significant bargaining strength can maintain an unchanged level of utility following the introduction of maximum hours legislation by negotiating a lower hourly wage. This is an inefficient outcome, in the sense that the firm's profits following the introduction of MHL are lower, with the utility for the workers unchanged. To the extent that MHL is introduced for health and safety reasons however, the key issue would be to determine whether the characteristics of the sectors in which it is binding would lead to significant or negligible increases in the level of utility achieved. Recall that the extent of change in the sectors where MHL is binding will determine the degree to which negotiated outcomes in the remaining sectors will be affected. Similar arguments hold true with mimimum wage legislation.

Finally, the models of Chapters III indicated that the extent to which reductions in normal hours of work have a beneficial indirect employment effect will depend crucially on the extent to which so called fixed costs of employment - training, employment taxes, holidays, etc - are really fixed or depend, possibly in the medium term, on weekly hours of work. We provided some evidence which supported the view that fixed employment costs were indexed to weekly hours of work, but more research at a more disaggregate level could provide further insights into the structure, nature and dynamic path of fixed employment costs.

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