WORKING HOURS AND EMPLOYMENT IN A TRADE UNION
LOCAL WAGE BARGAINING MODEL

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ABSTRACT
The aim of this paper is to measure the effect on employment, and other key economic variables, of work-sharing policies, minimum wage variations and some other measures of flexibility in a special framework, based on Holden (1988) and Moene (1988), where two different levels of negotiations for both wages and hours take place and Capital Operating Time is adopted. Within our framework, hours, wages and employment are determined in a three stage process: in the first a tariff hourly wage and a standard work-week will be unilaterally negotiated by a central union; in the second, firms determine hours and employment prevailing until the next period, and finally in the third stage employers and local unions negotiate local hourly wage drift.

JEL CLASSIFICATION: J20, J22, J50, J51.

KEYWORDS: Working time, Hours reduction, Trade unions, Capital operating Time.

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INTRODUCTION

Although during the last few years some European countries, such as the UK, the Netherlands and Ireland\(^1\), have experienced improvements in labour market performance, unemployment still remains a policy priority of the 2000s. Among economists, since the 1980s, the consensus has been that structural unemployment plays a much more important role than the cyclical one.

An important feature that in some way can explain the contrasting labour market developments of Europe with respect to countries such as US and Japan may be found in the differences in institutional arrangements and rules affecting the labour market. Explanatory factors include differences in the wage-bargaining framework, job protection legislation, flexibility of work arrangements and other forms of labour market regulations. As regards the wage mechanism and the degree of centralisation of the decision process, great differences can be observed among advanced economies. Wage bargaining can take place at different levels (i.e. establishment level, branch, industry or sector-level); the OECD countries occupy quite different positions: the Nordic ones [OECD, 1997], for example, have typically been characterised by centralised bargaining systems, whereas US and Canada are at the more decentralised side. In between are countries with so-called “intermediate bargaining systems” (Belgium, Germany and the Netherlands). In recent years substantial changes have emerged in some countries’ collective bargaining institutions, this mainly being the consequence of different bargaining systems (Katz, 1993, Golden and Wallerstein, 1996; van Ruysseveldt and Visser, 1996; Crouch and Taxler, 1995). A decentralisation wave of collective bargaining occurred in the UK (starting in the 1960s and accelerating in the 1980s), New Zealand (with the passing of the Employment Act in 1991), and finally in Sweden (where the previous system of centralised bargaining has been replaced by agreements at the sectoral level); moves towards more centralised bargaining systems have taken place in Norway and Portugal. Finally the Danish system exhibited the opposite pattern, decentralising in the 1980s and then centralising from 1989 onwards; the same story holds for Italy.

The call for flexibility in the labour market we referred to before, is not only linked to the wage formation process but also to regulations and legislative constraints related to minimum wages and working hours\(^2\). Policies on minimum wages mainly relate to goals such as lifting people out of the poverty threshold and altering the distribution of income in favour of low income households. Research on the economic effect of minimum wages had their boom during the 1990s. Before that date the widely-held belief was that a higher minimum wage had a small negative effect on overall employment. The key mechanism was that a higher minimum wage reduced the incentive of employers to hire low-productivity workers in sectors covered by the minimum level. The wave of consensus about

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\(^1\) These countries have been very successful at getting unemployment down during last decades.

\(^2\) These comprising, amongst others, legislation on the maximum length of the work week, minimum number of holidays, regulation on work at night, on weekends and on official holidays.
employment effects from minimum wages was shattered in the 1990s by the papers of Card (1992a, 1992b) and Card and Krueger (1994); in a series of empirical studies they argued that higher minimum wage rates either had no effect or actually raised employment.

From the middle of the last century, although rather later in some countries, a long term process of working time reduction began. Nobody denies, as stated by Bosch and Lehndorff (2001) amongst others, that reductions in working time are one way of distributing increased prosperity, although Layard, Nickell and Jackman (1991, ch.10) are rather sceptical towards the merits of worksharing policies; some other economists (Drèze, 1986, pag.36) stressed that "...reductions have played an important role in reconciling full employment with productivity gains...". The high and rising rates of unemployment in many countries indicate that full employment cannot be achieved through economic growth alone. John Hicks (1946) too recognised that the reduction in working time was the only tool for avoiding "secular unemployment". According to the widely-held opinion on the state of the art in worksharing, it cannot be argued that the reduction in working time is not in itself an instrument of employment policy simply because researchers have concluded that a particular form of working time reduction in one country has not led to higher employment. The effect may have been produced by certain peripheral conditions, such as excessive wage increases, traditional management styles and labour market shortages. France is currently involved in the transition to a 35-hour work week, with the explicit objective of reducing unemployment, and a similar initiative, although with a different intensity, has been discussed in Italy; German trade unions too motivate their demands for reduced working hours as a means of creating jobs.

The economic literature has been rather controversial on the effects of worksharing policies. Following Freeman (1998), Hunt (1998), De Regt (2002), Contensou and Vranceanu (2000) and Garofalo and Vinci (2003), various factors influence the impact of working time reductions and consequently the effects of worksharing on unemployment are not clear-cut. Layard, Nickell and Jackman (1991) claim that equilibrium unemployment is unaffected by worksharing, although this conclusion seems doubtful since their model does not incorporate working time and leisure as separate elements. Hoel and Vale (1986), however, state that the unemployment rate will increase if working time is reduced, although they also ignore the utility of leisure. Cahuc and Granier (1997) do take this into account and conclude that equilibrium unemployment is unaffected by worksharing policies. De Regt (2002) suggests a U-shaped relation between equilibrium unemployment and working time. FitzRoy, Funke and Nolan (2002), Marimon and Zilibotti (2000), Moselle (1996) and Rocheteau (2002) end up with similar results although in different settings: FitzRoy, Funke and Nolan (2002) use a monopoly union model; Moselle (1996) a moral hazard efficiency wage framework; Marimon and Zilibotti (2000) an equilibrium matching model; finally Rocheteau (2002) combines the equilibrium matching approach with moral hazard issues.

A further interesting approach may be that adopted by Huang, Ghang, Lai and Lin (2002) where a shirking-type efficiency wage model is used in order to explain why shorter
working hours cause an ambiguous effect on employment.

Looking at empirical evidence in terms of employment effects, results appear to be once again mixed. Hunt (1999) is rather sceptical since she concludes that the negotiated reductions in working time in Germany have reduced employment. Crépon and Kramarz (2002) referring to France underline how changes in the legal standard workweek led to employment losses, although the initial goals of these policies might have been the contrary. Kapteyn, Kolwijn and Zaidi (2000) do not find evidence for the proposition that work-sharing would promote employment. On the other hand Bosch and Lehn dorff (2001) surveying the literature conclude that most empirical studies confirm that collective working time reductions can be expected to have positive employment effects although an important thing to agree on are the conditions that have to be created in order to make employment policy successful in creating jobs. In this line Freeman (1998) too stresses how from the empirical literature worksharing generated by market forces can increase employment although government legislated policies are likely to have limited or negative effects. In the end, evidence seems to suggest that worksharing might have beneficial employment effects under certain conditions, even though, as underlined by De Regt (2002), the estimates also indicate that the increase in employment is typically less than proportional, reducing total per worker-hours.

Our aim in this paper is to measure the effect on employment and other key economic variables of worksharing policies, minimum wage variations and some other measures of flexibility in a special framework, based on Holden (1988) and Moene (1988), where two different levels of negotiations for both wages and hours take place, and Capital Operating Time (COT) occurs. The reason for COT adoption is that nowadays, more than in the past, production not only requires capital as well as labour, but also depends on varied and complex forms of work organisation, which more or less tie the uses of the two main factors to one another. In industry and services labour needs many allocations of capital for efficient production, some of which are required on a long-term basis, some in the short run. Many production processes, even using the most modern equipment, cannot function properly without constant guidance or control by human labour. The cost of interrupting some industrial processes is so high as to impose continuous operation. Statistical information and economic analysis often neglect, because of its complexity, such an intricate interplay. Indeed, very little is known about capital operating time: the data in question usually concern the volumes of the two main productive factors and the working times of employees. As in Cahuc and d’Autume (1997), we assume that production flows depend on the amount of capital stocks and on the number of the available jobs which set the number of employees in a given instant. In general COT depends directly on work duration; when reorganisation does not occur, the operating time will be proportionate to that of work, namely it decreases when working duration decreases. Under some circumstances the reorganisation can be such that the reduction in the working week duration can be linked to an increase in equipment. Such a phenomenon is likely to occur in those sectors where the utilisation of subsequent workers’ teams is the rule. As already stated, although empirically the relation between work and capital duration is not well known,
econometric analysis has usually found a negative relation between work duration and the number of subsequent workers’ teams, this suggesting the existence of reorganisation when work duration varies (Bourlange et al., 1990; Anxo et al., 1995).

The paper is organised as follows: sections 1 and 2 will be devoted to presenting the theoretical model; in section 3 a numerical simulation is performed while section 4 concludes.

1. Working Time in a Union Local and Central Wage Bargaining Model

In this section we present a model which is basically related to those of Holden (1988) and Moene (1988); this class of models encompasses two levels of wage negotiation: a central and a local one. As a consequence, wages and employment are determined in a three-stage process: in the first, a central union negotiates a tariff wage while in the second firms determine employment; finally, in the third stage, employers and local unions negotiate the wage drift. In these models the scope for wage bargaining at a local level follows directly from the threats of strikes and go-slow actions from employees. In this section our aim consists in modifying Holden’s model by considering hours and workers as different inputs in the production function and where two different levels of negotiations for both wages and hours take place. Hours, wages and employment are determined in a three-stage process: in the first, a tariff hourly wage, which operates as a sort of minimum threshold value for the whole economy, and the standard workweek, will be unilaterally negotiated by a central union; in the second, firms determine hours and the employment level prevailing until the next period; finally, in the third stage, employers and local unions negotiate the local hourly wage drift. In this model we recognise, as in Leslie (1991), the opportunity not only to introduce a labour cost function that explicitly includes the distinction between overtime and standard hours, but also quasi-fixed labour costs (Oi, 1962; Becker, 1962), i.e. those fringe costs which are independent of hours worked, and play a key-role in determining the firm’s labour costs; some examples concerning these latter are: firing, hiring, training and social burden costs. This model has two characteristic features: the first is that the employment level and working hours are set before bargaining about wage drift takes place; the second is related to the assumption that both the central union and the management of firms have full information about each other’s position; therefore the central labour union is assumed to know the firm’s revenue function and can predict what employment and hours will be. In what follows we start by analysing the final stage: the wage drift bargaining process; we derive the wage rate while employment and hours of work are taken as given, namely the bargained wage function, and then we will discuss the determination of employment, hours of work and wages simultaneously.

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3 As suggested by Holden (1988) this follows the monopoly model by Dunlop (1944) and Oswald (1985).
1.1. Determination of the Wage Function at the Local Level

Let us start by assuming that the outcome of a local bargaining process is modelled according to an asymmetric Nash bargaining game where employers strive for maximisation of profits \((\Pi)\) above a threshold value \((\Pi_{\text{min}})\) which is the prevailing one when the tariff wage is paid each worker, and workers maximise the difference between the final hourly wage \((w)\) and the tariff wage bargained at the central level \((q)\). The Nash bargaining function to be maximised is the following:

\[
\max_w \left[ \Pi - \Pi_{\text{min}} \right]^c \left[ w - q \right]^{(1-c)}
\]

(1)

with:

\[
\Pi = R(N, H) - \left[ w \overline{H} + \delta w (H - \overline{H}) \right] N - zN
\]

(2)

\[
\Pi_{\text{min}} = \theta R(N, H) - \left[ q \overline{H} + \delta q (H - \overline{H}) \right] N - zN
\]

(3)

where \(R(N, H)\) represents a strictly concave revenue function with \(R_N > 0, R_H > 0, R_{NN} < 0, R_{HH} < 0\) and, as in Hamermesh (1996), \(R_{HN} > 0\); finally \(R_{NN}R_{HH} - (R_{NH})^2 > 0\). The parameter \(\theta\), which is contained in the interval, \(]0; 1[\) is the fraction of normal productivity prevailing when employees work to rule; \(c\), assumed to be \(0 < c < 1\), measures the bargaining strength of the firm; \(N\) is the number of employees and finally \(H\) stands for the number of weekly hours worked by each worker. Moreover we assume that hours of work \(H\) may be greater than the standard workweek, \(\overline{H}\) in which case overtime hours \((H - \overline{H})\) are positive; each hour up to \(\overline{H}\) is paid \(w\), while overtime hours \((H - \overline{H})\) are paid at a rate \(\delta w\) where \(\delta\), the overtime premium, is greater than unity. Finally \(z\) represents quasi-fixed labour costs (in between the others firing, training and hiring costs)\(^4\).

By maximising equation (1) with respect to equations (2) and (3), and holding \(N\) and \(H\) constant, we may obtain:

\[
w = q + \frac{(1-c)(1-\theta)R}{N[H + \delta (H - \overline{H})]}
\]

(4)

\(^4\) As underlined in Erbas and Sayers (1999) it is worth noting that \(z\) is likely to be interpreted as a flow; besides some items qualified as fixed costs of hiring and firing (to quote some: search and training costs, risks concerning the quality of new hires, severance pay etc.) do not match a flow as such since these types, of course, decrease only once, namely when hiring and firing occur. Phelps (1994) too in a dynamic model suggests treating these costs as stocks (the present value of flows of such costs over a time horizon). However some costs associated with hiring can be treated as flows; an example of this concerns the firm’s regular contributions to unemployment insurance and social security for each period wages are paid.
If we consider the case in which firms have all the bargaining power \((c = 1)\) we see from equation (4) that the wage is set at a level such that:

\[
w = q
\]  
\[
(5)
\]

When, by contrast, workers enjoy full bargaining power and \(c = 0\), the wage rate will be the value corresponding to \(\Pi = \Pi_{min}\), that is:

\[
w = q + \frac{(1 - \theta)R}{N[H + \delta (H - \overline{H})]}
\]  
\[
(6)
\]

Looking back at equations (4), (5) and (6) it can be easily shown that wage rates are equal to the minimum value (the tariff one) \(q\) plus a mark-up which is proportional to the difference between the revenue when a wage \(w\) will be paid to workers, and the revenue associated to the minimum value \(q\); further, it will increase as workers enjoy more bargaining power (a decreasing value of \(c\)).

1.2. Determination of employment, hours and wages

Before the local wage bargaining process takes place, firms will set unilaterally hours and workers to be employed in order to maximise profits, this being done always considering the possible consequences on the wage rates. The employers’ maximisation problem can be written as follows:

\[
\begin{align*}
\text{Max}_{N,H} & \quad R(N, H) - wN[H + \delta (H - \overline{H})] - zN \\
\text{s.t.} & \quad H \geq \overline{H}; \quad N, H > 0
\end{align*}
\]  
\[
(7)
\]

From equation (4), for \(H > 0\) and \(N > 0\) the first order conditions are:

\[
\begin{align*}
[c + \theta(1 - c)]R_H - \delta qN + l & = 0 \\
\{c + \theta(1 - c)\}R_N - q[H + \delta (H - \overline{H})] - z & = 0 \\
l(H - \overline{H}) & = 0 \quad \text{with : } l \geq 0
\end{align*}
\]  
\[
(8a, 8b, 8c)
\]

where \(l\) is the Lagrange multiplier. The case in which the possibility for firms to employ overtime is ruled out (\(H = \overline{H}\)) has a positive \(l\) equal to \(\delta qN - [c + \theta(1 - c)]R_H\), and by equation (8b) that may be rewritten in the following way:

\[
R_N = \frac{q\overline{H} + z}{c + \theta(1 - c)}
\]  
\[
(9)
\]
Equation (9) operates as a demand curve for labour. Joining this latter with equation (4) yields the optimal combination of wages and employment respectively. As in the previous section if we consider the case with firms having all the bargaining power \((c = 1)\), we might combine equation (5) with the following:

\[
R_N = q \bar{H} + z
\]

(10)

so doing we can determine the optimal values for both wages and employment. Otherwise when workers enjoy all the bargaining power (and \(c\) is equal to zero) the amount of workers and wages will be easily derived by combining equation (6) and:

\[
R_N = \frac{q \bar{H} + z}{\theta}
\]

(11)

Inspection of the three above situations suggests that the employment levels will decrease with employers’ bargaining power.

From the above results there emerges a typical Insider- Outsider market structure; it is interesting to note that once firms lose their bargaining power there will be a joint effect on hourly wage rates and the employment levels. On the one hand, wages will tend to increase, on the other employee numbers will end up decreasing. Besides, as a matter of fact, such a state is the rule when the insiders’ market power prevails.

Let us turn our attention now to the effects of variations in some policy instruments on the optimal values of both employment level and wage rate. As regards employment, by totally differentiating equation (9) we can easily sign the partial derivatives of \(N\) with respect to \(q, \bar{H}\) and \(z\):

\[
\frac{dN}{d\bar{H}} = \frac{q - [c + \theta (1 - c)]R_{NH}}{[c + \theta (1 - c)]R_{NN}} < 0
\]

(12)

\[
\frac{dN}{dq} = \frac{\bar{H}}{[c + \theta (1 - c)]R_{NN}} < 0
\]

(13)

\[
\frac{dN}{dz} = \frac{1}{[c + \theta (1 - c)]R_{NN}} < 0
\]

(14)

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\(^1\) Profits too, as for the revenue function, are concave in \(H, N\) space. As a consequence \(\Pi_N, \Pi_H > 0\) \(\Pi_{NN}, \Pi_{HH} < 0\); and also \(\Pi_{NN} \Pi_{HH} - (\Pi_{NH})^2 > 0\). Since it is usually assumed in the literature (Andrews and Simmons, 1994, 1997) that \(R_{HN} = -\frac{R_{HN}}{N} \leq 0\) where \(R_{HN} = \frac{q}{c + \theta (1 - c)}\) it will follow that \([c + \theta (1 - c)]R_{HN} - q < 0\).
What emerges from eqs. (12-14) is that the adoption of worksharing policies, as well as policies aiming to get a higher degree of flexibility such as those operating on quasi-fixed labour costs and on tariff wages (the minimum values) will have a positive impact on employment.

Shifting our attention to the optimal wage rates, by totally differentiating equation (4) together with the total differential of equation (9) we get:

\[
\frac{dW}{dH} = \frac{(1-c)(1-\theta)}{NH} \left[ R_N - \frac{R}{N} \right] \left[ q - \frac{(c + \theta (1-c))R_{NH}}{(c + \theta (1-c))R_{NN}} \right] + \left[ \frac{R_H}{H} - \frac{R}{H} \right] \geq 0
\]  

(15)

\[
\frac{dW}{dz} = \frac{(1-c)(1-\theta)}{NH} \left[ R_N - \frac{R}{N} \right] \frac{1}{c + \theta (1-c)R_{NN}} > 0
\]

(16)

\[
\frac{dW}{dq} = 1 + \frac{(1-c)(1-\theta)}{NH} \left[ R_N - \frac{R}{N} \right] \frac{\bar{H}}{c + \theta (1-c)R_{NN}} > 0
\]

(17)

Inspection of equation (15) shows that the effect of a policy aimed to favour an increase in the employment level through a reduction in contractual hours is ambiguous. This ambiguity derives from the co-existence of two forces moving towards opposite directions: on the one hand, a working hours reduction will imply an increase in wage rates since,

\[
\frac{R_H}{H} - \frac{R}{H} < 0
\]

on the other it will induce an increase in the optimal employment levels and consequently a reduction in wages since

\[
\left( R_N - \frac{R}{N} \right) \left( \frac{dN}{dH} \right) > 0
\]

From the analysis of equations (16) and (17) it clearly emerges that policies adopted in order to guarantee a higher degree of flexibility, such as those operating on quasi-fixed labour costs and on tariff values, have a negative impact on wage rates.

If we consider the two extreme cases, where firms and workers have respectively all the bargaining power, we get the same results as before, in the sense that the signs of the partial derivatives on \( N \) and \( w \) are similar to those of equations (12), (13), (14), (15), (16) and (17), with only one exception given by the case in which since it will hold that

\[
\frac{dW}{dz} = \frac{dW}{dH} = 0
\]

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Let us now go back to the case in which the use of overtime hours is allowed \( H - \bar{H} > 0 \). As we stated above, in this case each hour up to the threshold \( \bar{H} \) will be paid \( w \), while overtime hours will be paid at the rate \( \delta w \) which is an overtime premium assumed to be greater than one since it has been estimated to be approximately in between and 1,3 and 1,5\(^6\). In this case the first order conditions of the previous maximisation problem —equation (7)— will be given by:

\[
[c + \theta(1-c)]R_H = \delta q N
\]

\[
[c + \theta(1-c)]R_N = q[\bar{H} + \delta (H - \bar{H})] + z
\]

(18a)

(18b)

where, as we can see, the parameter \( l \), interpreted as the shadow cost of standard hours, is equal to zero. Once again, combining these latter with equation (4) will yield the optimal values of wages, employment and working hours.

As in the previous case, if we assume employers have all the bargaining power, the first order conditions will be:

\[
R_H = \delta q N
\]

\[
R_N = q[\bar{H} + \delta (H - \bar{H})] + z
\]

(19a)

(19b)

which together with equation (5) will give the optimal values of working hours, employment and wage drift. If, instead, firms lose all of their bargaining power (or in other words, if parameter \( c \) is equal to zero) in order to determine hours, workers and wage drift, we need to combine equation (6) with the following:

\[
\theta R_H = \delta q N
\]

\[
\theta R_N = q[\bar{H} + \delta (H - \bar{H})] + z
\]

(20a)

(20b)

The next step is to get some insights, if possible, on the possible effects of changes in contractual hours, minimum wages, quasi-fixed labour costs and other parameters as for example the overtime premium on working hours and employment; by totally differentiating the above first order conditions (equations 18a and 18b), we can sign the following partial derivatives\(^7\):

\[
\frac{dN}{dH} > 0; \quad \frac{dN}{dq} \geq 0; \quad \frac{dN}{dz} < 0; \quad \frac{dN}{d\delta} \leq 0; \quad \frac{dH}{dq} < 0; \quad \frac{dH}{dz} \leq 0; \quad \frac{dH}{d\delta} > 0 \quad \frac{d\delta}{dz} \leq 0
\]

(21)


\(^7\) A detailed proof is provided in Appendix 1.
It can be easily shown that in the case of a firm employing overtime hours the effect of a reduction in standard hours is that of reducing employment: worksharing does not work. Further the relation between $\overline{H}$ and $H$ ends up out being negative, this suggesting that the substitution effect dominates and consequently that a reduction in the standard contractual hours is compensated by an increase in overtime hours. Concerning the other partial derivatives, corresponding to an increase in $z$ there will be a lower employment level while the opposite holds true if we refer to working hours. In the case of policies using as instruments either the tariff wage or the overtime premium, we will observe an ambiguous effect respectively on both working hours and employment levels.

Let us focus now on the optimal hourly wage drifts; unfortunately we cannot, at least in this case, shed some further insights on the signs of $\frac{dw}{dH}$, $\frac{dw}{dq}$, $\frac{dw}{d\delta}$ and $\frac{dw}{dz}$ since the results are ambiguous. As in the case when overtime hours are ruled out, let us shift our attention to the two extreme cases, namely when firms and workers respectively have all the bargaining power. Results resemble what we analysed above: the signs of the partial derivatives respect those of equation (21) and what was stated concerning the signs of $\frac{dw}{dH}$, $\frac{dw}{dq}$, $\frac{dw}{d\delta}$ and $\frac{dw}{dz}$.

The only exception, confirming the previous result, is represented when $c = 1$, since in this case we had $\frac{dw}{dz} = \frac{dw}{dH} = \frac{dw}{d\delta} = 0$.

2. INTRODUCING CAPITAL OPERATING TIME

In this section we present a modified version of the previous model where, in order to study the relation between working time, employment and wages, we will explicitly consider in the revenue production function hours of work, employment in physical units and capital as inputs; so doing, we will examine more closely the link between working time, employees and wages in a context with two levels of wages’ negotiations as before: a local and a central one. Following Cahuc and d’Autume (1997) we introduce in the revenue production function Capital Operating Time which depends directly on work-duration; when reorganisation does not occur, the operating time is proportionate to that of work; it decreases with working duration. Nevertheless, a working time reduction will imply a working reorganisation in the sense that it can induce an increase in equipment. Such a case is likely to occur in those sectors where the use of subsequent worker teams is possible. A working hours reduction may favour an increase in the number of teams and in the duration of machine use.
The revenue production function we are going to adopt is the following:

\[ R = R[n\lambda H, TK] \]

with: \( R_H, R_n, R_K > 0; \) \( R_{HH}, R_{nn}, R_{KK} < 0; \) \( R_{HK}, R_{HN}, R_{KN} > 0 \)  \( (22)^8 \)

where:
\( \lambda = \) number of successive teams;
\( n = \) number of workers per team;
\( K = \) capital stock;
\( N = \lambda n = \) number of employed workers;
\( T = \lambda H = \) capital operating time (COT).

As stated, we will consider the case in which the reduction of working time is accompanied by a certain extent of hours reorganisation. Therefore, we will assume the existence of a decreasing relation for \( \lambda \) between working hours and the number of teams. We will consider the following:

\[ \lambda = \lambda(H) \]

with \( \lambda_H < 0; \) \( \lambda_{HH} > 0, \) and \( -1 < \varepsilon_\lambda < 0 \)  \( (23)^9 \)

where the parameter \( \varepsilon_\lambda \) measures the elasticity of the reorganisation function \( \lambda \) with respect to the hours of work. Moreover, following Cahuc and d’Autume (1997) we suppose it is contained within the interval \( ]-1; 0[ \).

As in the previous section we will begin with the analysis of the final stage: the wage drift bargaining process; we will determine wage rates taken employment and working hours as given, and then proceed to discuss the determination of employment, working time and wage drifts simultaneously with the related policy implications.

\[ \text{Max} \left[ \Pi - \Pi_{min} \right]^c \left[ w - q \right]^{(1-c)} \]  \( (1) \)

\( ^8 \) A revenue function encompassing the above characteristics should be \( R = [n\lambda H]^p[k\lambda H]^{(1-p)} \).

\( ^9 \) A reorganisation function with the above characteristics should be the following: \( \lambda = H^{-\beta} \) with \( 0 < \beta < 1 \).
with:

\[ \Pi = R - n\lambda w \left[ H + \delta(H - \bar{H}) \right] - zn\lambda - cuK \]  
(24)

\[ \Pi_{\text{min}} = R - n\lambda q \left[ H + \delta(H - \bar{H}) \right] - zn\lambda - cuK \]  
(25)

where \( cu \) represents capital user's cost and the fraction of normal productivity prevailing when each employee works to rule.

The first order condition section of the above maximisation problem—equation (1)—with respect to conditions (24) and (25), will end up giving results similar to those of the previous section:

\[ w = q + \frac{R(1 - \theta)(1 - c)}{n\lambda[H + \delta(H - \bar{H})]} \quad \text{if} \quad 0 < c < 1 \]  
(26)

\[ w = q + \frac{R(1 - \theta)}{n\lambda[H + \delta(H - \bar{H})]} \quad \text{if} \quad c = 0 \]  
(27)

\[ w = q \quad \text{if} \quad c = 1 \]  
(28)

Even in the presence of a working hours reorganisation function it can be easily shown (eqs. 26, 27 and 28) that wage rates increase as employees enjoy more bargaining power.

### 2.2. Determination of Employment Levels, Hours and Wages

Before entering the local bargaining process on wages, firms will unilaterally set working hours and employment so as to maximise profits, always keeping in mind the possible repercussions on the wage rate according to equation (26) if the parameter \( c \) belongs to the interval \([0, 1] \), while reference is made to equations (27) or (28) if we consider the special cases in which \( c \) is equal respectively to zero and one. The firm maximisation problem is the following:

\[ \text{Max}_{n, H} \quad R - wn\lambda \left[ H + \delta(H - \bar{H}) \right] - zn\lambda - cuK \]  
(29)

s.t. \( H \geq \bar{H}, \quad H, n > 0 \)

For \( H > 0 \) and \( n > 0 \) first order conditions are:

\[ [c + \theta(1 - c)]R_H - qn\frac{\lambda_H}{\bar{H} + \delta(H - \bar{H})} + \delta\lambda = zn\lambda_H + l = 0 \]  
(30a)

\[ [c + \theta(1 - c)]R_n - q\lambda[H + \delta(H - \bar{H})] - z\lambda = 0 \]  
(30b)

\[ l(H - \bar{H}) \quad \text{with} \quad l \geq 0 \]  
(30c)
where \( l \) is the Lagrange multiplier. Again let us start by considering the case in which the opportunity for firms to employ overtime hours is floated out \((H = \overline{H})\) and consequently \( l \) is a positive parameter equal to:

\[
q n \left\{ \lambda_{H} \left[ H + \delta \left( H - \overline{H} \right) \right] + \lambda \delta \right\} + z n \lambda_{H} - \left[ c + \theta (1 - c) \right] R_{H}
\]

From equation (30.b) we have that:

\[
R_{n} = \frac{q \lambda H + z \lambda}{[c + \theta (1 - c)]} \quad \text{if} \quad 0 < c < 1
\]

(31)\\n
which operates as a demand curve for labour. Combining equation (31) with equation (26) we may derive the optimal mix of wage drift and employment level.

If we consider the case in which firms enjoy all the bargaining power \((c = 1)\) equation (31) will become:

\[
R_{n} = q \overline{\lambda} H + z \overline{\lambda}
\]

(32)

from which, taking into account that \( w = q \) from equation (28), we derive the optimal amount of employees. Besides, when parameter \( c = 0 \), equation (31) may be rearranged as follows:

\[
R_{n} = \frac{q \overline{\lambda} H + z \overline{\lambda}}{\theta}
\]

(33)

From equations (33) and (27) we obtain wages and employment levels.

Once again there emerges, as in the previous case when \( H = \overline{H} \), a typical Insider- Outsider labour market structure since, as workers increase their bargaining power, wage rates will tend to rise and the number of workers per team will decrease (as will obviously total employment, working hours being fixed at the central level).

In order to evaluate the effects of some policy instrument variations by differentiating equation (31) we get:

\[
\frac{dn}{dH} = \frac{\overline{\lambda} H + \overline{\lambda}}{[c + \theta (1 - c)] R_{nn}} < 0
\]

(34)

\[
\frac{dn}{dz} = \frac{\overline{\lambda}}{[c + \theta (1 - c)] R_{nn}} < 0
\]

(35)

---

\(^{10}\) Where \( \overline{\lambda} \) stands for \( \lambda(H) \)
\[
\frac{dn}{dz} = \frac{\bar{\lambda}}{[c + \Theta(1 - c)]R_m} < 0 \tag{36}
\]

Equations (34), (35) and (36) suggest how both worksharing policies and those operating on quasi-fixed labour costs and tariff wages, will increase the per team number of workers and also total employment\(^{11}\). By totally differentiating equation (26) with some simple algebraic manipulations, we can sign the following partial derivatives:

\[
\frac{dw}{dH} = \frac{(1 - c)(1 - \Theta)}{nH\bar{\lambda}} \left\{ \lambda H [R_n n - R] \left[ \lambda (H\bar{\lambda} + \bar{\lambda}) + z\lambda_{H} - R_{nh} [c + \Theta (1 - c)] \right] + \frac{\bar{\lambda} H - R(H\bar{\lambda} + \bar{\lambda})}{c + \Theta (1 - c)} \right\} > 0 \tag{37}
\]

\[
\frac{dw}{dq} = \left\{ 1 + \frac{(1 - c)(1 - \Theta)H\bar{\lambda}[R_n n - R]}{[nH\lambda]^2[c + \Theta(1 - c)]R_m} \right\} > 0 \tag{38}
\]

\[
\frac{dw}{dz} = \left\{ \frac{(1 - c)(1 - \Theta)H\bar{\lambda}[R_n n - R]}{[nH\lambda]^2[c + \Theta(1 - c)]R_m} \right\} > 0 \tag{39}
\]

Analysis of the above partial derivatives' signs clearly shows at the same time an ambiguous effect on wage drift in case of worksharing policies, and a negative one when policies aimed to guarantee a higher degree of flexibility operating on quasi-fixed labour costs or on tariff values are adopted.

The signs of the partial derivatives on \(n\) and \(w\) are similar to the above if we consider the case in which \(c = 0\) and \(c = 1\), exception made for this latter since it will be as above

\[
\frac{dw}{dz} = \frac{dw}{dH} = 0
\]

Shifting our attention to the case in which overtime hours are allowed to employers \((H > \bar{H})\), the first order conditions of the above maximisation problem –equation (29)– will give:

\[
[c + \Theta(1 - c)]R_n = q\lambda[H + \delta(H - \bar{H})] + z\lambda \tag{40a}
\]

\[
[c + \Theta(1 - c)]R_H = nq\left\{ \lambda_{H} [H + \delta(H - \bar{H})] + \delta \lambda \right\} + zn\lambda_{H} \tag{40b}\]

\(^{11}\) We recall that total employment \(N = n\lambda(H)\).

\(^{12}\) We recall that in this case the Lagrangian multiplier, interpreted as the shadow cost of standard hours, is equal to zero.
if parameter $c$ belongs to the interval $]-1;0[$. Even in this context, combining these latter equations with equation (26) will yield the optimal value of wage drift, working hours and the number of workers per team. To evaluate the effects of changes in contractual hours, minimum tariff wages, quasi-fixed costs and other parameters such as the overtime premium, in what follows by totally differentiating equations (40.a) and (40.b) with simple algebraic manipulations we will obtain the following partial derivatives\footnote{For a detailed proof see Appendix 2.}:

\[
\frac{dn}{dq} \leq 0; \quad \frac{dH}{dq} \leq 0; \quad \frac{dn}{d\delta} \leq 0; \quad \frac{dH}{d\delta} \leq 0; \quad \frac{dn}{dH} > 0; \quad \frac{dH}{dH} \leq 0; \quad \frac{dn}{dz} < 0; \quad \frac{dH}{dz} > 0
\]  

(41)

Inspection of equations (41) will show results similar to those of the previous section; worksharing does not occur, while a reduction in quasi-fixed costs will favour an increase in the number of workers per team and consequently in total employment level. Other policies, aimed to modify the overtime premium and the tariff wage, will have an ambiguous effect on both team’s workers and working hours. Once again we cannot give any further insight on the signs of $\frac{dw}{dH}$, $\frac{dw}{dq}$, $\frac{dw}{d\delta}$ and $\frac{dw}{dz}$ since the results are ambiguous.

3. A Numerical Simulation

In order to better represent the response of the economy to the policies we considered in our model, and since it was impossible in some cases to get any insights on the effect of the measures considered above, we will carry out a numerical simulation. In so doing we will merely refer to the second case where, as shown, most of the time it was impossible to have any understandable and interpretable outcome.

The first step to be followed for the proposed aim is the specification of the revenue function; as seen above, the specification encompassing the main characteristics of eq.(22), should be $R = [n\lambda H]^\alpha [K\lambda H]^{(1-\alpha)}$ which, once we assume the following reorganisation function $\lambda = H^{-\beta}$ may be rewritten as: $R = n^\alpha H^{(1-\beta)} K^{(1-\alpha)}$ with $0 < \beta < 1$ and $0 < \alpha < 1$.

The relevant parameters may be specified as follows:

$\alpha = 0.75; \quad \beta = 0.3; \quad \gamma = 1.5; \quad \theta = 0.8; \quad K = 10; \quad c = 0.5; \quad \delta = 1.4.$

As regards parameter $\alpha$, which measures the output elasticity with respect to labour services, following most of the estimates (amongst others Maddison, 1982) in which $\alpha$ is found to be more or less equal to 0.7, we will assume a value for the relevant parameter equal to 0.75. Finally $\theta, \gamma, q$ and $K$ representing respectively the fraction of the normal productivity prevailing when employees work to rule($\theta$), quasi-fixed labour costs ($z$), the tariff wage
bargained at central level (the minimum one) \((q)\) and the capital stock \((K)\) were chosen in order to obtain a reasonable outcome. The assumption of \(c = 0.5\) suggests an equal bargaining distributed power for both workers and entrepreneurs; the choice of the above mean value comes from the need to handle with cases which do not represent extreme situations; parameter \(-\beta\), standing for the elasticity of reorganisation function \((\lambda)\) with respect to the hours of work, following Cahuc and d’Autume (1997), and in line with most of the available estimates (Bourlangé et al. 1990, and Anxo et al., 1995)\(^{14}\), is assumed to be equal to \(-0.3\). Finally, the overtime premium, will be hypothesised as equal to 1.4 as underlined in most of the economic literature on worksharing (Andrews and Simmons, 1994, 1997).

What will be done in the following paragraphs concerns a numerical simulation of the effect produced by a gradual standard working time reduction from a starting value of forty hours per week to the final thirty-five, on normal hours (Table 1), total employment (Table 2)\(^{15}\) and hourly wages (Table 3) and this for different values of quasi-fixed labour costs \(z\), minimum wages \(q\) and overtime premiums \(\delta\). Since the absolute values are meaningless from an economic point of view, in order to capture the trends of the variables which are of interest for our purpose, we consider the ratio between effective values and those corresponding to the initial one.

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\(^{14}\) Which suggest for this parameter a value contained within the interval \([-1, 0]\).  

\(^{15}\) Remind that \(N = \lambda n\) .
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As regards the effect of standard hours reduction on normal hours (Table 1), for different values of $z$, $q$ and $\delta$, it emerges that normal hours will follow the standard ones, the latter recalling a result already stressed by Bodo and Giannini (1995). Shifting our attention to the effect of the standard hours reduction on total employment (Table 2), no matter the variations involved in $z$, $q$ and $\delta$, there will be increasing employment behaviour suggesting a positive outcome for worksharing policies once they are adopted in a framework in which COT occurs.
Table 4

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Table 3 encompasses the trend obtained once we focus on hourly wages; as clearly emerges once we allow for working time reductions, an increasing trend in will follow. Finally (Table 4) we report the effect of variations in the tariff wage bargained at central level and the overtime premium for a given value of the standard hours ($H = 40$). This exercise has the aim of considering exclusively the effect of variations in $q$ and $\delta$. As regards normal hours, both a reduction in $q$ and in $\delta$ will yield a decreasing behaviour for $H$ and an increasing trend for total employment. As far as the hourly wage is concerned, a reduction in $q$ will end up with a decreasing trend in $w$, while on the other hand allowing for lower values of the overtime premium ($\delta$) will entail an increasing behaviour for the hourly wage.

5. CONCLUDING REMARKS

From the analysis made so far, what emerges is that the burden imposed by European unemployment calls for intervention on the part of politicians to do something about labour market performance in many European countries. The aim of this paper was to measure the effect on employment and other key economic variables of worksharing policies, minimum wage variations and other measures of flexibility in a special framework in which local and central wage bargaining take place, and COT occurs.

As underlined throughout this paper, policies need to be designed with due consideration for the institutional features of the labour market in which they are adopted. Most European countries are characterised to different extents by the weight of influential trade unions in the bargaining process; several empirical surveys (OECD 1997) confirm that along with wages, working hours too are a major bargaining issue.

Bearing this in mind, we built a model based on those by Holden (1988) and Moene (1988), in which COT occurs, hours and workers operate as different inputs in the production function and where two different levels of negotiations for both wages and hours occur. In our framework hours, wages and employment are determined in a three stage process: in the first a tariff hourly wage and a standard workweek will be unilaterally negotiated by a central union; in the second, firms determine hours and employment prevailing until the next period, and finally in the third stage employers and local unions negotiate the local hourly wage drift.
Once overtime hours occur, a reduction in the working time duration will yield a reduction in employment. As regards the other partial derivatives, they mainly preserve the right sign, namely an increase in $z$ will lower employment and increase working time hours, while for the effects of policies which use as instruments either the tariff wage or the overtime premium, an ambiguous effect emerges on both working hours and employment levels. On the optimal hourly wage drifts there are some ambiguities emerging concerning the effect of $\bar{H}, q, \delta$ and $z$ on $w$. Subsequently, shifting our attention to the case in which Capital Operating Time a lâ Cahuc and d’Autume (1997) occurs, the results emerging from the maximisation process, when overtime hours are ruled out, show that both worksharing policies and those operating on quasi-fixed labour costs and tariff wages, will have a positive impact on the per team number of workers and consequently employment. The effect of standard hours on $w$ proves uncertain, while that on $q$ and $z$ is in both cases positive.

If overtime hours are allowed, the effect on $n$ of variations in $q, \delta, \bar{H}$, and $z$ are in the first two cases uncertain, while, in terms of the effect on $\bar{H}$ and $z$ we will have a positive value for $\frac{dn}{dH}$ and a negative one for $\frac{dn}{dz}$.

These two results seem to suggest that in the overtime region worksharing policies are definitely compromised, while a reduction in $z$ will achieve the hoped-for results. On the effect of $H$ on $q, \delta, \bar{H}$ and $z$ the outcome is even more ambiguous: the only result taken for granted is the one which links variations in $z$ to variations in $H$ through a positive relation.

Once again we underline how cautious economists should be before believing that in a context characterised by high unemployment the only remedies may be found in either a generalised reduction in standard working time hours or in other policies aimed to influence the minimum wage or to grant a higher degree of flexibility without giving due consideration to the economic setting in which these policies are implemented.
REFERENCES

Andrews M. and R. Simmons, 1994. “Friday may never be the same again: towards a union-firm bargaining model over hours, the workweek, wages and employment”, Mimeo, The University of Manchester.

Andrews M. and R. Simmons, 1997. “Friday may never be the same again: some results on worksharing from union-firm bargaining models”, Mimeo, The University of Manchester.


APPENDIX

APPENDIX 1

By totally differentiating the f.o.c. (equations 18.a and 18.b) we get:

\[
\begin{align*}
\{c + \theta(1-c)\}R_{HH} - \delta q \}dN + \{c + \theta(1-c)\}R_{NH} \}dH = \delta Ndq + qN\delta \\
\{c + \theta(1-c)\}R_{NN} \}dN + \{c + \theta(1-c)\}R_{NH} - \delta q \}dH = q(1-\delta)\dH + dq + \{c + \theta(1-c)\}dq + q(H - H)\dH \\
\end{align*}
\]

that in matrix form may be rewritten as:

\[
\begin{bmatrix}
\{c + \theta(1-c)\}R_{HH} - \delta q & \{c + \theta(1-c)\}R_{NH} \\
\{c + \theta(1-c)\}R_{NH} - \delta q & \{c + \theta(1-c)\}R_{NN}
\end{bmatrix}
\begin{bmatrix}
dH \\
dN
\end{bmatrix}
\]

\[
\begin{bmatrix}
0 \\
1 \dH + q(1-\delta)\dN + \delta N \dH + \delta \dN \dH = qn \dH + q(H - H)\dH
\end{bmatrix}
\]

By rearranging the above terms we can sign the following partial derivatives:

\[
\frac{dN}{dH} = \frac{\{c + \theta(1-c)\}R_{HH}q(1-\delta)}{D} > 0
\]

\[
\frac{dN}{dq} = \frac{\{c + \theta(1-c)\}R_{HH}[H + \delta(H - H)] - \delta N \{c + \theta(1-c)\}R_{NH} - \delta q}{D} \leq 0
\]

\[
\frac{dN}{dz} = \frac{\{c + \theta(1-c)\}R_{HH}q(H - H)}{D} < 0
\]

\[
\frac{dN}{d\delta} = \frac{\{c + \theta(1-c)\}R_{HH}q(H - H) - qN \{c + \theta(1-c)\}R_{NH} - \delta q}{D} \leq 0
\]

\[
\frac{dH}{dH} = \frac{\{c + \theta(1-c)\}R_{HH} - \delta q} {q(1-\delta)} < 0
\]

\[
\frac{dH}{dq} = \frac{\delta N \{c + \theta(1-c)\}R_{NH} - \{c + \theta(1-c)\}R_{HH} - \delta q}{D} \leq 0
\]

\[
\frac{dH}{dz} = -\frac{\{c + \theta(1-c)\}R_{HH}}{D} > 0
\]

\[
\frac{dH}{d\delta} = \frac{qN \{c + \theta(1-c)\}R_{NH} - q(H - H) \{c + \theta(1-c)\}R_{HH} - \delta q}{D} \leq 0
\]

where \(D = \{c + \theta(1-c)\}^2R_{HH}R_{HH} - \{c + \theta(1-c)\}R_{HH} - \delta q\) > 0
APPENDIX 2

Taking the differential of equations (40.a) and (40.b) will yield:

\[ A_4 dn + A_5 dH = A_4 dq + A_6 d\delta - A_5 d\bar{H} + A_6 dz \]
\[ B_4 dn + B_5 dH = B_4 dq + B_6 d\delta - B_5 d\bar{H} + B_6 dz \]

with

\[ A_1 = [ c + \theta (1 - c) ] R_{1n} < 0 \]
\[ A_2 = [ c + \theta (1 - c) ] R_{1H} - q [ \lambda_{1H} \bar{H} + \delta (H - \bar{H}) + \delta \lambda - z \lambda_{1n} ] < 0 \]
\[ A_3 = [ \lambda \bar{H} + \delta (H - \bar{H}) ] > 0 \]
\[ A_4 = q \lambda (H - \bar{H}) > 0 \]
\[ A_5 = q \lambda (\delta - 1) > 0 \]
\[ A_6 = \lambda > 1 \]

and

\[ B_1 = A_2 \]
\[ B_2 = [ c + \theta (1 - c) ] R_{1H} - q [ \lambda_{1H} \bar{H} + \delta (H - \bar{H}) + \delta \lambda - z \lambda_{1n} ] - z n \lambda_{1n} < 0 \]
\[ B_3 = n [ \lambda_{1H} \bar{H} + \delta (H - \bar{H}) + \lambda \delta ] > 0 \]
\[ B_4 = n q [ \lambda_{1H} (H - \bar{H}) ] > 0 \]
\[ B_5 = n q \lambda_{1H} (\delta - 1) < 0 \]
\[ B_6 = n \lambda_{1H} < 0 \]

Rearranging the above we will obtain the following partial derivatives:

\[ \frac{dn}{dq} = \frac{A_4 B_2 - A_2 B_4}{D} \lneq 0 \]
\[ \frac{dH}{dq} = \frac{A_4 B_2 - A_2 B_4}{D} \lneq 0 \]
\[ \frac{dn}{d\delta} = \frac{A_4 B_2 - A_2 B_4}{D} \lneq 0 \]
\[ \frac{dH}{d\delta} = \frac{A_4 B_2 - A_2 B_4}{D} \lneq 0 \]
\[ \frac{dn}{dH} = \frac{- A_5 B_2 + A_2 B_5}{D} > 0 \]
\[ \frac{dH}{dH} = \frac{- A_5 B_2 + A_2 B_5}{D} \lneq 0 \]
\[ \frac{dn}{dz} = \frac{A_4 B_2 - A_2 B_4}{D} < 0 \]
\[ \frac{dH}{dz} = \frac{A_4 B_2 - A_2 B_4}{D} > 0 \]

Where \( D = A_4 B_2 - A_2 B_4 > 0 \)

\[ ^{16} \text{Through the concavity of the profit function we have .} \]