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## ABSTRACT

# Employment and Distributional Effects of Restricting Working Time*

We study the employment and distributional effects of regulating (reducing) working time in a general equilibrium model with search-matching frictions. Job creation entails some fixed costs, but existing jobs are subject to diminishing returns. We characterize the equilibrium in the deregulated economy where large firms and individual workers freely negotiate wages and hours. Then, we consider the effects of legislation restricting the maximum working time, while we let wages respond endogenously. In general, this regulation benefits workers, both unemployed and employed (even if wages decrease), but reduces profits and output. Employment effects are sensitive to the representation of preferences. In our benchmark, small reductions in working time, starting from the laissez-faire equilibrium solution, always increase employment, while larger reductions reduce employment. The employment gains from reducing working time are relatively small, however.

JEL Classification: E24, E25, J22, J23, J30, J41
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# NON-TECHNICAL SUMMARY

The policy of reducing working time with the declared aim of reducing unemployment (work-sharing) has recently received renewed support in Continental Europe and is in the process of being implemented in some countries (i.e. the 1998 Aubry's Law in France and the 1998 Italian Government approval of the 35 hours, yet to be legislated). A major appeal of such policy – which has some recent precedents in the 1980s in Germany and France – lies in its implicit promise of enhancing employment without harming the interests of workers, in contrast with other proposed 'labour market liberalization' policies.

Similar to a large number of historical episodes of debate on working time regulation (stretching back to at least the nineteenth-century movement for the ten hour day), this issue is a source of conflict between workers' and employers' organizations, the former supporting and the latter opposing the regulation. Critics have pointed out that, by creating further market frictions and rigidities, these policies might not only reduce output, but also employment. A major argument is that since there are important fixed costs associated with the process of hiring and training new workers, the work-sharing policy will increase unit labour costs and reduce job creation. Many authors question the same rationality of the work-sharing policy from the point of view of its proponents, by arguing that both workers and firms will lose from the introduction of regulation which tightens contractual rigidities. According to this view, the call for working time reduction has its roots in a sort of irrational ideology.

In this paper, we develop a general equilibrium model where unemployment originates from search-matching frictions, to address two questions: i) What are the employment effects of legislation reducing working time? ii) Is the call for working time reduction rational from the point of view of its proponents? Or, alternatively, ii') What are the distributional effects of a policy reducing working time? In our model, diminishing returns to labour input makes work-sharing possible, whereas the presence of fixed cost, associated with the creation of new vacancies, plays against the effectiveness of such policy. We analyse, as benchmark, the case in which firms and workers freely negotiate wages and hours. Then, we consider the effects of legislation restricting the maximum working time, while letting freely negotiated wages respond endogenously. Our main finding is that (some degree of) regulation restricting working time benefits workers, both unemployed and employed, but reduces profits and output. The reason is that the workers' bargaining power is increased by the commitment granted by the law to have a number of hours which is lower than that which would emerge from free negotiation. Although the bargaining

process gives – in the presence of regulation – a socially inefficient outcome, the distributional gains for the workers more than outweigh the efficiency loss. Employment effects are, however, sensitive to how workers value consumption and leisure which, in turn, determines how wages respond to working time reductions. For a general class of preferences, small reductions in working time, starting from the laissez-faire equilibrium solution, always increase employment, while larger reductions reduce employment. The employment gains from reducing working time are relatively small, however. With alternative specifications of preferences (Constant Elasticity of Substitution between consumption and leisure) employment effects might even be negative with 'reasonable parameters'. Finally, we show that work-sharing can only work as an employment policy if firms have some fixed factor of production. If capital and labour are the only factors and capital can freely adjust (small open economy), for instance, restricting working time unambiguously reduces employment.

The quantitative predictions of the benchmark model are consistent with some recent estimates obtained from the German experience in the 1980s.

# 1 Introduction

The persistence of high unemployment levels in most Western European countries is unanimously perceived as a problem. There is, however, much less agreement on which polices should be pursued. Economic theory suggests that certain policies can enhance employment, for instance, reducing unemployment benefits and minimum wages, reducing job protection, curbing union's bargaining power by reforming the legislation on collective agreements, lowering pay-roll taxes, etc. The fact that these policies have not been widely implemented in Continental Europe does not necessarily reflect a lack of understanding of their effectiveness in making labor markets more efficient. These employment policies have redistributional effects and there may be unfeasible, or credible, ways of compensating the losing parties. It is just a sign of rational behavior that some of these liberalization policies would be opposed by the social groups expecting to lose. In particular, there is a widespread notion that firms have much to gain from operating in more flexible labor markets, whereas workers might in fact be hurt not only in relative, but also in absolute terms.

In this context, it is not surprising that the proposal of reducing unemployment through work-sharing is, on the one hand, fairly popular with the general public, but, on the other hand, perceived as almost irrational by many economists and some interested parties. The appeal of this proposal lies in its "solidarity" approach, and its promise to reduce unemployment without touching the Welfare State nor, possibly, reducing workers' welfare. Many economists argue, however, that by imposing further restrictions to the set of contractual relationships, this policy may only induce further inefficiencies and possibly worsen the European unemployment problem.[1]

The objective of this paper is to address the following questions, through a careful analysis based on economic theory: *i)* What are the employment effects of a legislation reducing working time? *ii)* Is the call for working time reduction rational from the point of view of its proponents? or, alternatively, *ii')* What are the redistributional effects of a policy reducing working time? For this purpose, we

[1] For example, Saint-Paul (1999) just captures the opinion of many economists when he argues that "*part of the popularity of this recipe hinges on utopia (a free lunch), misunderstanding and ideology... If it is the case that people want to work shorter hours because they consider that the workweek is too long given the hourly wage, that is, they would prefer to work less in exchange for an equiproportionate reduction in earnings, then this is up to each individual's decision and there is no reason why the government should step in and impose a mandatory reduction in hours worked...*".

construct a general equilibrium model of an imperfectly competitive labor market which we regard as an appropriate tool for answering these questions.

Concerning the first question, *(i),* our analysis provides little ground for optimism. While we show that – as it is argued by the proponents – regulating (restricting) the number of working hours may have positive effects on employment, our quantitative analysis suggests that these effects are, at best, very small. The major effect of reducing working hours is a decrease in output and total number of hours worked. Our predictions are in line with the existing empirical evidence for experiments of working time reduction in Germany in the 1980's (see section 2). As concerns the second question, *(ii),* however, we show that the call for working time reduction, today as in the past, since the beginning of the Industrial Revolution (see, again, section 2), does not necessarily arise from any irrational ideologism. Rather, we find that workers generally prefer the maximum number of hours to be regulated by law, rather than be determined by unfettered agreements between workers and firms. The redistributional effects of such a policy does not only favor the unemployed but, in general, also favor the employed. In fact, the difference between the workers' most preferred regulation and the laissez-faire equilibrium outcome is quite large, even though workers anticipate the wage reduction associated with shorter working hours.

The main argument of the proponents of working time reduction is that this policy will induce firms to substitute some of the labor services provided by their current employees with new hirings. According to Drèze (1987, 1991), this substitution is also beneficial from the standpoint of social efficiency, as employers typically do not properly internalize the social effect of hiring a new worker and have an inefficient bias for asking current employees to work longer hours. The so-called "lump of work" argument has been widely criticized (see Calmfors, 1987, for instance). Some of the firm's labor costs (screening, training, firing, etc.) are fixed per employee and independent of the number of hours worked and, thus, reducing working time tends to increase the costs of production, and reduce the incentive for firms to generate employment. Moreover, hourly wages are likely to rise, although wages per employee may fall, which may further discourage employment creation. Finally, firms may react by adjusting (reducing) capital rather than by increasing the number of employees.

The main forces stressed by advocates and opponents to the work-sharing policy are present in our model. On the one hand, in the tradition of the search-matching literature, we introduce fixed costs in the form of vacancy creation costs associated with hiring new workers. Due to the existence of fixed costs, the simple "lump of work" argument does not apply. On the other hand, we assume diminishing returns to labor, where labor input is measured by the total number of hours worked by the employees in a large firm (workers and hours are assumed to be perfect substitutes). Due to this feature of the model, the marginal product of labor increases, and firms have an incentive to post new vacancies, when firms face a reduction in the maximum hours of labor service per employee. Finally, we allow for an endogenous wage adjustment through a standard bargaining procedure. The presence of forces with opposite signs makes the employment effects of reducing working time a priori ambiguous. Such ambiguity, together with the fact that wage adjust, makes the redistributional effects also *a priori* ambiguous.

Our benchmark will be *laissez faire* economies, where workers freely negotiate wages and hours of work with employers, in a standard Nash-bargaining fashion. Given the outcome of the negotiations, firms decide the number of vacancies to post, which will determine the inflow of workers into employment. Separations occur at an exogenous rate, thus, each firm needs to continuously recruit new workers in order to keep employment constant. After characterizing equilibrium in the laissez-faire environment, we study the behavior of alternative economies where working hours are determined by some exogenous regulation, and workers and firms only bargain for wages. We study the employment and welfare effects of the regulatory policies, by taking laissez-faire as the initial situation, and then introducing regulation which constrains the maximum number of working hours.

The first result of our model is that employers and employees have - endogenous - preferences on working time regulations resulting in a conflict of interests. In general, the employees prefer to restrict statutory hours below the laissez-faire solution, even if they anticipate their wage earnings to be cut. Firms will instead suffer losses from regulations reducing working hours. The distributional effects of restricting working time are therefore clear-cut.

The second result is that the employment effects of regulations are ambiguous, and crucially depend on the response of wages. If hours were reduced keeping the *total* wage per employee constant, employment would unambiguously fall. However, changes of working hours cause endogenous wage adjustments in our general equilibrium model, and the final effect on employment depends on the extent to which the enforcement of restrictions of working hours affect *(i)* the workers' marginal utility of consumption; *(ii)* the marginal productivity of labor. Therefore, the net employment effect will depend on both technology and workers' preferences for consumption and leisure.

While maintaining a standard Cobb-Douglas production technology, we study different specifications of preferences. Our benchmark preferences (GHH), introduced in the real business cycle literature by Greenwood, Hercowitz and Huffman (1988), have the property that the marginal rate of substitution between consumption and leisure is independent of the consumption level within the period. In this case, we prove that the relationship between working time and employment is non-monotonic. Moreover, given a laissez-faire economy, there exists a range of reductions of hours which *increases* employment. In order to assess the quantitative importance of these results, we construct "calibrated economies" and simulate the effects of reductions in working time. The findings are that employment tends to be higher in a *labor-managed* economy, where the government sets hours so as to maximize the workers' welfare, than in a pure laissez-faire economy. The difference in the number of hours worked is quite large: in a labor-managed economy, employees work about two thirds of the time they would work in a pure laissez-faire economy. The employment differences are, however, very small: the unemployment rate decreases by 0.9% at most. Accordingly, output and total hours worked are substantially lower in the labor managed than in the laissez-faire economy. We also simulate the effects of a reduction from 40 to 35 hours. This policy increases the workers' welfare, but has a negligible effect on employment, and a large negative effect on output.

We also study the case of CES preferences. In this case, when the workers' leisure increases due to restrictions on working time, the marginal utility of consumption increases, too, and this makes workers more aggressive in the wage bargaining. Thus, in general, working time reductions cause a less pronounced fall in wage per employee and make favorable employment effects less likely. In particular, we show that the employment effects are always *negative* if the elasticity of substitution between consumption and leisure is less than one. Even when this occurs, however, restrictions in working time tend to increase the workers' welfare.

These results are obtained under the assumption of fixed capital. In contrast, employment effects of restricting working time are always negative, even with GHH preferences, if there are no fixed factors of production and capital can freely adjust.

Although we are, by no means, the first to analyze working time regulations from a positive or normative perspective, the theoretical literature is relatively limited. Most of the existing literature already cautioned that government action in reducing working time may not result in a reduction of unemployment.[2] The main value added of our approach can be summarized in the following points: *(i)* we provide a clear rationale to the observation that workers often lobby for legislative restrictions of working time; *(ii)* in a rather transparent way, we trace back the possible employment effects to basic parameters; *(iii)* we make the analysis in a simple dynamic general equilibrium model which can be suitably calibrated and solved numerically to obtain a quantitative assessment of the effects of policies. From a more theoretical perspective, we regard our work as a complement to the vast theoretical literature which has studied in the recent years a variety of labor market phenomena in the framework of search-matching models.

The following papers – among others – have made valuable contributions to the literature on the effects of regulation of working time. Calmfors (1985) studies how the reduction of working hours impacts on wages and employment in a static model where wages are set by a monopoly union. He finds that the employment effects of reducing working time are, in general, ambiguous, and that – in a monopoly union model – unions will never find it optimal to accept both a hour and a wage reduction in response to a negative supply shock. Booth and Schiantarelli (1987) extend the analysis of Calmfors (1985) and analyze the results under parametrized preferences. Their static model differs from ours in many dimensions, as does their conclusion that unions should not lobby for regulations of working time. Hoel (1986) shows that employment effects need not be positive even if hourly wages are assumed to remain constant when sectoral reallocation is allowed. Hoel and Vale (1986) find a negative relationship between working time and unemployment in a model where firms act as wage setters. The issue of an endogenous response of overtime to a reduction of normal working time (which we analyze in an extension) is analyzed by Calmfors and Hoel (1988), whose conclusions are, once again, pessimistic about the employment effects of reducing working hours.

Formally closer to our model, but less developed in scope, Burdett (1979) and Pissarides (1990, ch.6) discuss the effect of working hours on employment in search-equilibrium models. The latter, in particular, provides a comparison between the Nash solution for hours and the case where workers choose their own working hours,

[2] See Hart (1987), who summarizes the state of the art ten years ago, which has, however, not changed much since.

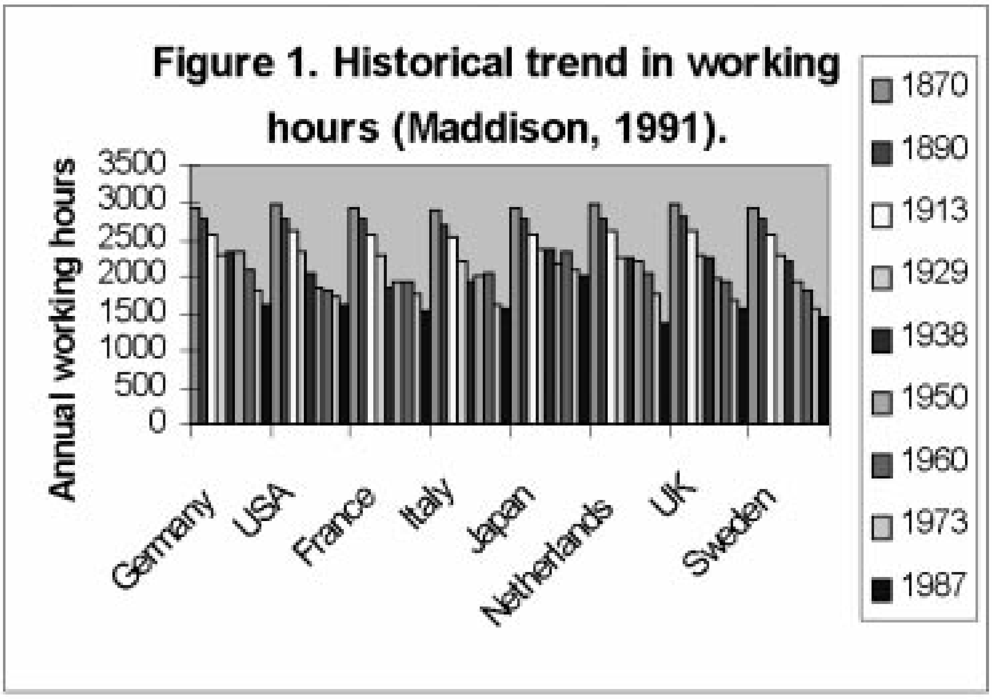
and stresses that in the latter case workers choose to work less hours. This feature is also of importance in our analysis.

Recently, Moselle (1996) shows how, in an efficiency wage model with fixed costs, the relation between a reduction in hours and employment is not monotone, i.e., small reductions may result in higher employment, but further reductions in higher unemployment. While this result agrees with ours, Moselle's work diverge from our conclusions (besides being methodologically very different) by predicting that a reduction in hours increases the utility of a currently unemployed worker, but necessarily makes the employed workers worse off. An extension of Moselle's analysis to a matching, Nash-bargaining, model with moral hazard is provided by Rocheteau (1999). At high unemployment levels Rocheteau's economy behave as Moselle's efficiency wage model. At low levels of unemployment, however, employed workers' share of the surplus is high enough as to make efficient wage considerations not binding. As it follows from our results, in the pure Nash-bargaining regime, with constant returns to labor, reducing working time increases unemployment. Autume and Cahuc (1997) also consider Nash bargained wages with technologies where hours and employment may have different diminishing returns. When the elasticity of output respect to hours is lower than with respect to employment, the productivity gains associated with reducing working time, may result in positive employment effects. Employment effects can also be positive when the output elasticity of hours is higher than the elasticity of employment and a reduction of working time results in a reduction of hourly wages. In a calibrated general equilibrium model, without search-matching frictions, Fitzgerald (1998) obtains large positive employment effects when workers are less than fully employed. In summary, these "contemporaneous" works differ from ours in their choices of technologies and, in some cases (e.g., Fitzgerald), in the predicted employment effects of reducing working time. More fundamentally, however, they differ from ours in that they can not explain, as we do, why all workers -employed and unemployed- may support statutory working time reductions against employers, or how the employment effects of such policies may depend on workers preferences for consumption and leisure, as well as on other assumptions, such as capital mobility or the treatment of overtime.

We proceed as follows. In section 2, we report some motivating empirical evidence. In Section 3, we describe our model. In Section 3, we characterize equilibrium under our benchmark preferences, where consumption and leisure are separable, within the period. In Section 4, we extend the analysis to preferences exhibiting constant elasticity of substitution between consumption and leisure. In Section 5, we study two extension of our model: collective wage bargaining and overtime. Section 6 concludes.

## 2 A perspective on working time

There has been a secular trend towards the reduction in working time. Figure 1 reports Maddison's (1991) estimates of the secular evolution of the average yearly number of hours of labor activity per worker, showing a significant decrease for all countries sampled. Although, these figures reflect, to a large extent, the result of institutional changes (e.g., increasing female participation, the development of part-time work etc.), it is clear that working time has decreased substantially over the last 150 years. In 1815, the working week in textile mills was 76 standard hours, with about 9-10 days off per year (Bienifield, 1972), and the working week was even longer in France (Rigudiat, 1996). In the middle of the 19th Century, a law of 60 hours (from 6am to 6pm, six days a week) was passed in England under the pressure of the union movement, whereas the 60 hours legislation was only introduced, in France, in 1904. Contrary to what is commonly perceived, the legislation about working time is not an "European issue". In fact, the US led the trend of working time reduction in the first half of this Century – from 58 weekly hours in 1901 to 42 weekly hours in 1948 (Owen, 1979, 1988) – and the regulation has for a long time been tighter in the New than in the Old Continent (the situation was only reversed in the period 1960-85).




It might be tempting to interpret this trend as simply the result of an increasing demand for leisure, which naturally accompanied technical progress improving living conditions. In a perfectly competitive economy, this trend of an increasing demand for leisure, whatever its source, should not give rise to conflicts between employers and employees, nor should it require government intervention. However, the history of reduction of working time is not the history of a smooth change in the set of contractual relationships prevailing on the labor market. Rather, it is the history of acrimonious industrial disputes, culminating in legislative interventions and/or direct agreements between workers and firms, where the outcome typically depended on the general political strength of the two parties in conflict. For instance, the French workers obtained, in 1848, an act of 60 hours, which was soon abolished as the fortune of the labor movement was reversed.

As in the past, the regulation of working time remains a conflicting issue, and the social groups which support and oppose further reductions today are the same as they were in the early days of the Industrial Revolution.[3] There is, however, an

[3] Unions support worktime reduction in most European countries, and, in some cases, also in the US (see, for example, the general resolution of the Munich Congress of the European Trade Union Confederation of May 1979), although there are some exceptions (Sweden, for instance).

important novelty in the current call for the 35-hour working week. What was a call for alleviating the poor conditions of the employed workers a century ago, in order to defend them from monopsonistic practices of the employers[4] has, in the last decades, become a call for alleviating the European unemployment problem, for *work sharing*, i.e., a larger number of people being employed, each person working less.

It is not uncommon that trade unions argue in the political debate that working time should be reduced without any wage cut, and that this will benefit employment. It would not be surprising to find that workers would welcome such a free lunch (were it feasible). However, less radical and more realistic advocates of the regulation acknowledge that the reduction in working hours should entail a cut in the employees' wages. When this condition is added, it is no longer clear whether the currently employed workers will gain from the policy change. Nevertheless, as recent EC surveys show (see Robbins, 1980, and Stewart and Swaffield, 1997), a large share of workers – especially blue-collar workers – would like to work less hours at the given *hourly* wage, while only a small share would like to work more hours.[5] Interestingly, a significant proportion of the British workers who would like to work less hours

Many political parties which receive the electoral support of the working-class are also, to various extents, in favor of work-sharing policies. Business and employee organizations, as well as center and right-wing parties are, instead, normally against this.

There are, of course, some partial exceptions. For example, there are many case studies where working time reductions correspond to better working arrangements (new shifts, etc.) and the increases in productivity are welcomed by employers (see, for example, White, 1981, or the Conway Report, 1985).Similarly, Richardson and Rubin (1993) report some survey evidence about the experience of working week reduction for manual worker in the British engineering industry. There, the majority of the managers interviewed were optimistic and believed that labor costs would increase fairly moderately. Such managerial optimism seems, however, to be a relative rare event. Bienefeld's (1972) historical account shows that the employers have always opposed a fiercer resistance to reduce standard working time than to increase wages. This view is echoed by Hart (1984), who argue that unless in the package of measures accompanying reduction of working time there is clear room for improvements of productivity, employers typically oppose these measures.

[4]For example, according to K. Marx, the reduction of working time was a necessary condition for freedom (Capital, Book III, III, sct. VII, ch. XXVIII).

[5]Stewart and Swaffield (1997) report that in 1991 one third of male manual workers in UK would prefer to work fewer hours at the prevailing wage than they do; they also estimate that, on average, desired hours per week are 4.3 hours lower than actual hours. Note that there are important differences between the attitudes of European and North American workers. Bell and Freeman (1994) report that while in Germany, like in Britain, there are more workers surveyed who would rather work less hours at the current hourly wage than workers who would rather do the opposite, in the United States this pattern is reversed. And the response of Canadian workers are similar to those of the US workers (see Kahn and Lang, 1995).

state that they often work overtime.

Concerning the employment effects of shortening working hours, there is only a limited body of empirical work, and the results are rather mixed. A number of papers in the 1980's estimated the elasticity of employment to working hours in different countries (De Regt, 1988; Wadwhani, 1987; Brunello, 1989) to range between 0.34 and 0.5. These estimates would suggest that the effects of reducing working time could be rather large. However, as recently pointed by Hunt (1997), these figures should be treated with great caution, since they are obtained by looking at aggregate trends only, and may well capture the existence of common trends in the variables, rather than causal relationships.

More recent work on two episodes of reduction in working time in the 1980's find significantly smaller employment effects. The case which has been studied in the greatest detail is Germany. Between 1985 and 1989, under the pressure of the Metal Working Industry Union, Germany experienced a series of negotiated reductions in the average weekly hours to 37 hours, where unions accepted – as a counterpart – extended flexibility in the organization of working time. Although some earlier studies based on surveys run by employers and unions found rather optimistic results with employment elasticities ranging between 0.4 and 0.75 (Bosch, 1990), more recent careful microeconometric work by Hunt (1996, 1997) finds the employment effects to be substantially smaller. In response to one standard hour reduction employment rose by 0.3-0.7% (implying an employment elasticity of 0.1) while the total number of hours worked fell (by 2-3%). Interestingly, Hunt's work also shows that, due to an increase in the hourly wage (in addition to the increase in leisure), workers as a group seem to have benefited from working time reduction reforms, while output seems to have decreased.

While reductions in working time in Germany did not receive any stimulus from the authorities, in France, it was the government which, in January 1982, introduced a generalized reduction of statutory working time to 39 hours, intended to be the first step towards 35 hours. The experiment raised substantial controversy, and was essentially abandoned shortly afterwards. Only survey evidence is available about this episode, and different sources report different results. A study by INSEE found relatively low employment effects, with elasticities (0.1-0.15) rather close to those estimated by Hunt (1997) for Germany. Cette and Taddei (1994) report more optimistic figures (with elasticities between 0.15-0.3).[6]

# 3 The model.

## 3.1 Set-up: technology and preferences.

A unique consumption good is produced by a measure one of competitive firms. The production function for the representative firm, $i$, is:

$$Y_i = \tilde{A}\left(N_i l_i\right)^{\alpha} K_i^{1-\alpha}$$

where $\tilde{A}$ is a parameter, $N_i$ denotes the set of firm $i$'s employees and $l_i$ is the hours worked by each employee. $K_i$ as a productive factor with which firm $i$ is endowed, and can be interpreted as capital, as well as managerial talent, land, etc.. For most of our analysis, we will treat $K_i$ as a fixed factor which firm $i$ is endowed with. In section 4.3 we will discuss how the results change when $K_i$ can be costlessly adjusted. We assume that all firms in the economy have an identical endowment of the fixed factor, i.e., $K_i = K$. Then we will write the production function as:

$$Y_i = A\left(N_i l_i\right)^{\alpha},$$

where $A \equiv \tilde{A}K^{1-\alpha}$.

We normalize hours such that each worker has a unit time endowment. Workers' preferences are defined over consumption and leisure $(1-l)$. Throughout our analysis, we will assume that workers can neither save nor borrow, thus $w$ will denote both the current wage and consumption. We will denote by $\tilde{u}\left(w,(1-l)\right)$ the instantaneous utility function of a representative worker, and assume that the rate of time preferences is equal to the interest rate, $r$.

The labor market is characterized by search frictions. We assume a standard isoelastic constant returns to scale matching function, $\frac{m}{v} = \theta^{-\zeta}$ where $m$ denotes matches, $v$ denotes vacancies and $\theta \equiv \frac{v}{u}$ is the tightness of the labor market, $u$ being the mass of unemployed agents.

[6] In the United Kingdom, the only European country with virtually no regulation of working time, two important industrial disputes exploded in 1979 and 1989, both involving manual engineering workers, where the workers' main request was the reduction of the working week. The former started with the demand of 35 hours and ended with an agreement based on 39 hours. The latter led to a further cut in the working week to 37 hours. While the first episode had very marginal effects, since firms mainly replaced normal hours with overtime (Roche, 1996), some authors argue favorably about the consequences of the second episode (see Richardson and Rubin, 1997).

## 3.2 Bellman equations.

We assume that a firm has to pay a flow cost of $c$ units of output in order to hold an open vacancy. This, together with search frictions, makes labor adjustments costly for each firm. The presence of frictions turns the number of employed workers into a state variable for each firm.[7] Jobs are terminated at the exogenous rate $s$. Then, the net flow of employment into firm $i$ is given by:

$$\dot{N}_i = \theta^{-\zeta} V_i - sN_i \tag{1}$$

where $V_i$ denotes the number of vacancies, and $\theta$ is the tightness of the labor market (so, $\theta^{-\alpha}$ is the rate at which firms fill vacancies).

Each firm chooses the sequence$\{N_{i,t}, V_{i,t}\}_{t=0}^{\infty}$ so as to maximize the PDV of expected profits (cfr. Pissarides, 1990, ch.2), i.e.:

$$\begin{aligned}\Pi_i &= \textstyle\int_0^\infty e^{-rt} \left(A \left(N_i l_i\right)^\alpha - wN_i - cV_i\right) dt = \\ &= \textstyle\int_0^\infty e^{-rt} \left(A \left(N_i l_i\right)^\alpha - wN_i - c\theta^\zeta \left(\dot{N}_i + sN_i\right)\right) dt,\end{aligned} \tag{2}$$

subject to (1) and given $N_0$. The optimality condition for $N_i$ requires that:

$$e^{-rt} \left(\alpha \frac{A \left(N_i l_i\right)^\alpha}{N_i} - w - cs\theta^\zeta\right) - \frac{d}{dt} \left(e^{-rt} c\theta^\zeta\right) = 0. \tag{3}$$

We will restrict attention to steady-state equilibrium. In steady-state, $\theta$ is constant, hence $\frac{d}{dt}\left(e^{-rt} c\theta^\zeta\right) = e^{-rt} rc\theta^\zeta$. Using the fact that all firms are equal and the total measure of firms is one (i.e., $N_i = n$), we can write the resulting steady-state labor demand condition as

$$pl - w - c(r+s)\theta^\zeta = 0, \tag{4}$$

[7]Hiring costs can be regarded as a proxy for a number of fixed costs which we do not explicitly model, like training costs, etc.. The main difference is that these other costs are normally paid by firms after a worker is hired. We believe that extending the model to take this difference into account would not alter the major results of the paper.

Also, we implicitly assume that the hiring/training technology has the same capital intensity as the production activity. If one assumed, instead, that hiring technology is more labor-intensive than production technology, restrictions on working time would have the additional effect of increasing the importance of fixed costs. Employment effects would therefore tend to be less positive under this alternative assumption than in the case which we analyze.

where, $p$, the marginal product of labor is defined as:

$$p = \alpha A (nl)^{\alpha - 1}, \tag{5}$$

and decreases with the total labor input $(nl)$ in the firm. We assume that since the number of firms in the economy is large, each firm take the tightness of the labor market, $\theta$, as given. Furthermore, since we assume that each firm employs a large number of workers (i.e., $K$ is large), we ignore the impact of changes in the number of hours worked by the *marginal* employee on the marginal product of labor (thus, for instance, if we let $l_j$ denote the hours worked by the marginal worker $j$, the revenue generated by this worker will be $pl_j$).

Denote by $J$ the value of the marginal position filled by the firm. In a steady-state, $J$ must be such that:

$$(r + s)J = pl - w. \tag{6}$$

Then, (4) can be re-expressed as follows:

$$\theta^{-\zeta} J = c, \tag{7}$$

which says that the firm will open vacancies until the point where the cost of holding a vacant position, $c$, equals the expected value of a filled vacancy (note that $\theta^{-\zeta}$ is the instantaneous probability that a vacancy gives rise to a match).

The value of employment to a worker is:

$$(r + s)W = \tilde{u}\,(w, (1 - l)) + sU, \tag{8}$$

where $U$ is the value of being unemployed. $U$, in turn, is given by:

$$rU = \tilde{u}\,(0, 1) + \theta^{1-\zeta}(W - U), \tag{9}$$

where $\tilde{u}\,(0, 1)$ is the instantaneous utility of an unemployed agent who earns no wage and does not work $(w = l = 0)$. From (8) and (9) it follows that;

$$(r + s + \theta^{1-\zeta})\,(W - U) = \tilde{u}\,(w, (1 - l)) - \tilde{u}(0, 1). \tag{10}$$

We assume that each worker bargains individually over his wage and (in some cases) over his hours with the firm he is matched with, and that these are determined by the Nash solution. The analysis of collective bargaining is deferred to section 7.1. The Nash solution is given by the solution to the following program:

$$\max_{\{w,l\}} \quad (W-U)^{\beta}(J-V)^{1-\beta}, \tag{11}$$

where $\beta$ is the bargaining strength of the workers, and $V$ is the value of a vacancy. Since firms have no restriction to the number of vacancies which they can open, $V$ will be zero in equilibrium. The First Order Conditions, using (4)-(6)-(7) and (10), can be written as:

$$\frac{\beta}{\tilde{u}\left(w,(1-l)\right)-\tilde{u}(0,1)}\tilde{u}_w = \frac{1-\beta}{(pl-w+c\theta)}, \tag{12}$$

$$-\frac{\beta}{\tilde{u}\left(w,(1-l)\right)-\tilde{u}(0,1)}\tilde{u}_l = \frac{1-\beta}{(pl-w+c\theta)}p, \tag{13}$$

which, jointly, imply that $p=\frac{-\tilde{u}_l}{\tilde{u}_w}$, yielding an implicit relationship between wages and hours worked.

We will also study the case where the number hours is fixed by legal regulation, and workers and firms only bargain on wages. In this case, the bargaining problem is equivalent to (11), except that the maximization is now defined over $w$ only. The resulting First Order Condition is (12), with the restriction that $l=l_r$, where $l_r$ denotes the statutory working time.

The model is closed by a steady-state flow condition. Steady-state employment is the level $n$ which equates transition rates into and out of employment, and is given by:

$$n=\frac{\theta^{1-\zeta}}{s+\theta^{1-\zeta}}. \tag{14}$$

The laissez-faire equilibrium will be determined by equations (4)- (5)-(12)-(13)-(14) the endogenous variables being $n,\theta,l,p,w$. In contrast, when working time is determined by legislation, the equilibrium will be determined by equations (4), (5), (12) and (14), the endogenous variables being $n,\theta,p,w$, while $l_r$ will be exogenous.

We will consider two classes of preferences. In section 4, we will consider a generalized version of Quasi-linear utility, which was first introduced in the macro-RBC literature by Greenwood, Hercowitz and Huffman (1988), where consumption and leisure are additively separable within each period. This class of preferences (from now on, GHH preferences) is very convenient for our purposes, since it allow us to analytically obtain all major results.[8] In section 5 we extend the analysis to preferences exhibiting Constant Elasticity of Substitution (CES) between consumption and leisure.

# 4 GHH Preferences

In this section, we parameterize preferences as follows:

$$\tilde{u}\left(w,(1-l)\right)=\nu\left(w-\frac{l^{\chi}}{\chi}\right)^{\frac{1}{\nu}}, \tag{15}$$

where we assume that $\chi>1$ and $\nu>1$. The value of $\frac{1}{\nu}$ corresponds to what is known in the literature as the intertemporal elasticity of substitution in labor supply, while $\frac{\nu-1}{\nu}$ is the coefficient of relative risk aversion. Note that in the risk-neutrality case ($\nu=1$) they reduce to the Quasi-linear utility specification. In this particular case, utility is linear in consumption and we do not need to rely on the assumption that agents cannot save.[9]

The restriction that $\nu>1$ means that one is the upper bound to relative risk aversion. With relative risk aversion equal or larger than one, the outcome of the bargaining process always gives the workers their reservation utility. Since the only effect of risk aversion is to reduce the workers' bargaining power, and we allow, as a limit case (i.e., when $\nu\rightarrow\infty$), for unit relative risk aversion, this assumption entails no loss of generality.

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[8] See Greenwood *et al.* (1988) for an RBC model of capacity utilization, and Correia *et al.* (1995) for an RBC model of a small open economy. A property of these preferences is that the choice of the number of hours supplied does not directly depend on the intertemporal consumption-saving decision. This property (i.e., the absence of intertemporal substitution in labor effort) has proved useful for explaining some business cycles regularity – such as fluctuations of working hours, consumption and investments – better than with the standard CES specification.

[9] A drawback of GHH preferences is the prediction that technical progress – which we do not explicitly introduce in our model – induces workers to increase continuously the number of hours supplied. This contradicts the evidence of a secular trend towards a reduction in working time discussed in the Section 2. As Correia *et al.* (1995) noted, however, a simple modification to the utility function (15) would rule out this counterfactual feature. In particular, it must be assumed that as labor productivity grows, so does the value of not working (i.e., due to ongoing technical progress in home production). Formally, the modified utility function would be: $\tilde{u}\left(w,(1-l)\right)=\nu\left(w-X_t\frac{l^{\chi}}{\chi}\right)^{\frac{1}{\nu}}$, where $X_t$ grows at the same rate of labor productivity. With this modification, (15) becomes consistent with the absence of positive trends in working time.

## 4.1 Laissez-faire equilibrium

The First Order Conditions for the laissez-faire economy, (12)-(13), are:

$$\frac{\beta}{\nu\left(w - \frac{1}{\chi}l^{\chi}\right)} = \frac{1-\beta}{pl - w + c\theta}, \tag{16}$$

$$\frac{\beta l^{\chi-1}}{\nu\left(w - \frac{1}{\chi}l^{\chi}\right)} = \frac{(1-\beta)p}{pl - w + c\theta}, \tag{17}$$

which, after rearranging terms, give the following laissez-faire (*unrestricted*) solutions:

$$l_u = p^{\frac{1}{\chi-1}}; \tag{18}$$

$$w_u = \gamma \left[\left(\frac{(1-\beta)\nu}{\chi} + \beta\right) p^{\frac{\chi}{\chi-1}} + \beta c\theta\right], \tag{19}$$

where $\gamma \equiv [(1-\beta)\nu + \beta]^{-1}$ □ 1. Two features of (18)-(19) are worth noting:

1. Working time only depends on the marginal product of labor and the disutility of labor (and not on the workers' risk aversion nor on their bargaining strength). In particular, (18) implies that the marginal cost of foregone leisure equals the marginal product of labor. In other terms, given $p$, hours are set so as to maximize the size of the surplus, and the wage is used to split this surplus between workers and firms.

2. Wages decrease with risk aversion. In particular, as $\nu \to \infty$ (unit RRA), then $w_u \to \frac{l^{\chi}}{\chi}$, namely workers are paid their reservation wage, whereas, when $\nu = 1$ (risk neutrality) then $w_u = \frac{l^{\chi}}{\chi} + \beta\left(pl + c\theta - \frac{l^{\chi}}{\chi}\right)$, namely workers receive their reservation wage plus a share $\beta$ of the surplus generated by the match.

To find employment, substitute the equilibrium values of $l_u$ and $w_u$ as given by (18) and (19) into equation (4):

$$\gamma\nu(1-\beta)\frac{\chi-1}{\chi}p^{\frac{\chi}{\chi-1}} - c\left[(r+s)\theta^{\zeta} + \beta\gamma\theta\right] = 0. \tag{20}$$

Next, substitute $n$ and $l$ as given by (14) and (18), respectively, into the expression of the marginal product of labor, (5):

$$p = \left( (\alpha A)^{\frac{1}{1-\alpha}} \left(1 + s\theta^{\zeta - 1}\right) \right)^{\frac{(1-\alpha)(\chi-1)}{\chi-\alpha}}. \tag{21}$$

Equations (20)-(21) jointly determine the equilibrium solution in the endogenous variables $p, \theta$. Once $p$ and $\theta$ are determined, (14) and (18) yield the equilibrium employment and hours. The system (20)-(21) identify two loci in the plane $(p, \theta)$ which are, respectively, positively and negatively sloped, and whose intersection yields the unique equilibrium, $(p_u, \theta_u)$ – see Figure 2. Recall that, from (18), a higher $p$ implies a higher $l$, whereas, from (14), a higher $\theta$ implies a higher $n$. The comparative statics are standard. Unemployment, for instance, depends positively on $\beta$ and $c$, and negatively on $\nu$.

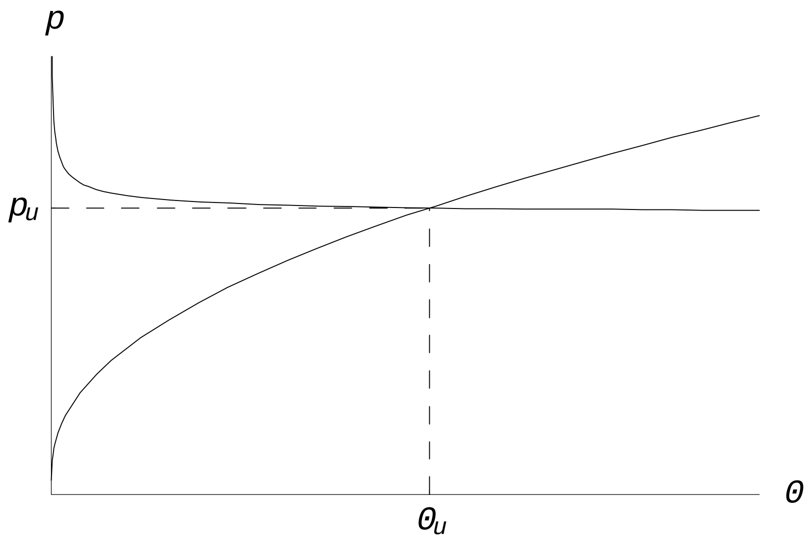


Figure 2: Laissez-faire equilibrium

## 4.2 Equilibrium with hours regulation.

We now characterize equilibrium when agents bargain on wages only, and hours are exogenous. The First Order Condition, (12), yields:

$$w = \gamma \left[ (1-\beta)\nu \frac{l_r^\chi}{\chi} + \beta \left( pl_r + c\theta \right) \right], \tag{22}$$

which can be substituted into (4) to obtain the following demand condition:

$$(1-\beta\gamma)\left( pl_r - \frac{l_r^\chi}{\chi} \right) = c\left[ \beta\gamma\theta + (r+s)\theta^\zeta \right]. \tag{23}$$

Next, using sequentially (5) and (14) to eliminate $p$ and $n$ we obtain:

$$\tau(\theta, l_r) \equiv (1-\beta\gamma)\left(\alpha A\left(s\theta^{\varsigma-1}+1\right)^{1-\alpha} l_r^{\alpha} - \frac{l_r^{\chi}}{\chi}\right) - c\left[\beta\gamma\theta + (r+s)\theta^{\varsigma}\right] = 0. \quad (24)$$

By totally differentiating $\tau(\theta, l_r)$, we have that $\frac{d\theta}{dl_r} = -\frac{\tau_{l_r}(\theta,l_r)}{\tau_\theta(\theta,l_r)}$. This expression can be used for studying the employment effect of a change in the regulation of working time. Since $\tau_\theta(\theta, l_r)$ is unambiguously negative, then $\frac{d\theta}{dl_r}$ is positive (negative) if and only if $\tau_{l_r}(\theta, l_r)$ is positive (negative). The sign of $\tau_{l_r}(\theta, l_r)$ is, however, in general ambiguous. Some simple algebra establishes that

$$\tau_{l_r}(\theta, l_r) \gtreqless 0 \Leftrightarrow \alpha p - l_r^{\chi-1} \gtreqless 0. \quad (25)$$

An interesting local result can then be established. Consider economies in the neighborhood of a laissez-faire equilibrium. For these economies, *small* reductions of working time increase employment. More formally, if we denote the equilibrium employment level as a function of statutory hours by $n(l_r)$, the following Proposition holds.

**Proposition 1** *(A) If $\alpha < 1$, then $\exists\epsilon > 0$ such that: $0 < l_u - l_s < \epsilon \Rightarrow n(l_s) > n(l_u)$. (B) If $\alpha = 1$, then: $0 < l_u - l_s \Rightarrow n(l_s) < n(l_u)$.*

**Proof.** By condition (25), $\frac{d\theta}{dl_r} < 0 \Leftrightarrow l_r^{\chi-1} > \alpha p$. But, from (18), $l_u = p^{\frac{1}{\chi-1}}$. Then, if $\alpha < 1$, in a neighborhood of $l_u$, it must be that $\frac{d\theta}{dl_r} < 0$. Thus, by (14), $n(l_s) > n(l_u)$ and (A) is proved. When $\alpha = 1$, then $\tau_{l_r} = 0$ and changing hours has no first-order effects. However, it is easily checked that, if $l_s < l_u$ ($l_s > l_u$), then $\frac{d\theta}{dl_r} > 0$ ($\frac{d\theta}{dl_r} < 0$). Thus, (B) follows. QED

Proposition 1 establishes that, generically, the laissez-faire solution does not maximize employment. While, under laissez-faire, $l = p^{\frac{1}{\chi-1}}$, employment is maximized when $l = (\alpha p)^{\frac{1}{\chi-1}}$. The two conditions only coincide under constant returns to labor, while if returns to labor are diminishing, unfettered bargaining will yield overwork and underemployment.

The result of Proposition 1 is illustrated by Figure 3, which geometrically represents the implicit function given by equation (24). When $\alpha < 1$ (Case A), the laissez-faire solution ($l_u$) lies to the right of the employment maximizing working time. Note that the result has a local nature. While *small* reductions of working time increase employment, large reduction may have the opposite effects. Finally, when $\alpha = 1$, $l = l_u$ maximizes employment (Case B), and no regulation in working time might reduce unemployment.

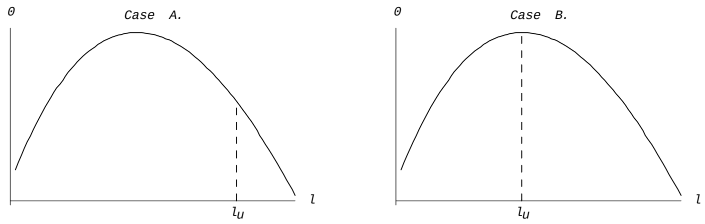


Figure 3: Rationship between $\theta$ (tightness of the labor market) and $l_r$ (hours). Case A: $\alpha < 1$. Case B: $\alpha = 1$.

A corollary establishes that restricting hours reduces total wages.

**Corollary 1** *Let $\alpha, l_s$ be as in Proposition 1, part (A). Then, $w(l_s) < w(l_u)$.*

**Proof.** By (4), $w = \alpha A n^{\alpha-1} l_r^{\alpha} - c(r+s)\theta^{\zeta}$. Since $l_s < l_u$ and, by Proposition 1, $n(l_s) > n(l_u)$ (given that $\alpha < 1$), and this, in turn, implies that $\theta(l_s) > \theta(l_u)$), then $w(l_s) < w(l_u)$. QED

We will now analyze the welfare implications of policies reducing statutory working time.

**Proposition 2** *If $\alpha < 1$, then $\exists \bar{\epsilon} > 0$ such that:* $0 < l_u - l_s < \epsilon \Rightarrow$ (i) $W(l_s) > W(l_u)$; (ii) $U(l_s) > U(l_u)$ *and* (iii) $\Pi(l_s) < \Pi(l_u)$

**Proof.** To establish (i) and (ii), observe that, since $\tilde{u}(0,1) = 0$, from (8)-(9)-(10)-(22), and given that ũ(0,1)=0 :

$$W = \frac{r+\theta^{1-\zeta}}{r\left(r+s+\theta^{1-\zeta}\right)}\left(w - \frac{l^{\chi}}{\chi}\right) = \\ \Box \frac{r+\theta^{1-\zeta}}{r\left(r+s+\theta^{1-\zeta}\right)} \beta\left(\alpha A n^{\alpha-1} l^{\alpha} - \frac{l^{\chi}}{\chi}\right) - (1-\gamma\nu)\frac{l^{\chi}}{\chi} + \beta\gamma c\theta\Big] \tag{26}$$

and

$$U = \frac{\theta^{1-\zeta}}{r\left(r+s+\theta^{1-\zeta}\right)}\left(w - \frac{l^{\chi}}{\chi}\right) = \\ \Box \frac{r+\theta^{1-\zeta}}{r\left(r+s+\theta^{1-\zeta}\right)} \beta\left(\alpha A n^{\alpha-1} l^{\alpha} - \frac{l^{\chi}}{\chi}\right) - (1-\gamma\nu)\frac{l^{\chi}}{\chi} + \beta\gamma c\theta\Big]. \tag{27}$$

Consider, first, the direct effect of changes in $l_r$ on $W$ and $U$ (given $\theta$ and $n$). The term $\beta\left(\alpha A n^{\alpha-1} l^{\alpha} - \frac{l^{\chi}}{\chi}\right)$ is a decreasing function of $l$ if $\alpha p < l^{\chi-1}$ and this condition is always satisfied when $l_r$ □ $l_u$. The term $-(1-\gamma\nu)\frac{l^\chi}{\chi}$ is also a decreasing function of $l$ (recall that $\gamma\nu$ □ $1$). Thus, all direct effects of increasing (decreasing) $l_r$ are negative (positive) on both $W$ and $U$. Consider, next, the indirect effects. Both $W$ and $U$ are increasing with both $\theta$ and $n$. Furthermore, by Proposition 1, both $\theta$ and $n$ are decreasing with $l_r$ in a left-hand neighborhood of $l_u$, provided that $\alpha < 1$. Therefore, the indirect effects of increasing (decreasing) $l_r$ are also negative (positive) in this case. Parts (i) and (ii) of the Proposition are then established.

To establish (iii), write:

$$\begin{aligned}\Pi &= \frac{n}{r}\left(An^{\alpha-1}l_r^\alpha - w - cs\theta^\zeta\right) = \\ &\frac{n}{r}\left(\left(An^{\alpha-1}l_r^\alpha - \frac{l_r^\chi}{\chi}\right) - \left(w - \frac{l_r^\chi}{\chi}\right) - cs\theta^\zeta\right)\end{aligned}$$

First, consider the term $\Delta(l_r) \equiv \left(An^{\alpha-1}l_r^\alpha - \frac{l_r^\chi}{\chi}\right)$. From the definition of $p$, $\Delta'(l_r) \gtreqqless 0 \Leftrightarrow p \lesseqqgtr l_r^{\chi-1}$. Thus, $\Delta'(l_u) = 0$. Second, the proof of the first part of this Proposition establishes that the term $-\left(w - \frac{l_r^\chi}{\chi}\right)$ is increasing with $l_r$. Third, Proposition 1 establishes that $\theta$ is decreasing with $l_r$ in a neighborhood of $l_u$. Therefore, the term $-cs\theta^\zeta$ is increasing with $l_r$ in that neighborhood. Finally, by the envelope theorem, $\frac{\partial\Pi}{\partial n} = 0$. Hence, part (iii) follows. QED

Proposition 2 establishes that, starting from a laissez-faire equilibrium, all workers, both employed and unemployed, benefit from the reduction of working time when $\alpha < 1$. Firms lose, however. While the value of the marginal filled position ($J$) increases, the value of the firm ($\Pi$), which also includes rents associated with the fixed factor $K$ is reduced.

So far, we have discussed the employment and distributional effect of working time regulation. It seems natural to ask what the effects on efficiency are. Answering this question is relatively simple, when agents' preferences are linear in income ($\nu = 1$). In this case, the planner chooses the allocation which maximizes the present discounted value of aggregate output net of the effort cost suffered by employed agents and of job creation costs. This allocation is *efficient,* in the sense that it corresponds to the choice of a planner who has access to lump-sum redistribution (or no distributional concern) but is subject to search frictions.

**Proposition 3** *Assume $\nu = 1$. If $\beta = \zeta$, the laissez-faire allocation is efficient.*

This Proposition establishes that the Hosios-Pissarides condition (see Pissarides, 1990) is necessary and sufficient for the laissez-faire outcome to be efficient. The proof uses standard arguments and is, therefore, omitted. Extending the analysis to the case of risk aversion is possible, although more complicated.

## 4.3 Capital adjustments.

As we have seen (Proposition 1, part B), under constant returns to labor, reducing working time below the laisse-faire equilibrium results in lower employment. The same result holds if capital is allowed adjust when policies change, although returns to labor are diminishing. To analyze this case, we recover the original formulation $Y_i = \tilde{A}\,(N_i l_i)^{\alpha}\, K_i^{1-\alpha}$ and, for simplicity, consider a small open economy where capital is perfectly mobile and there are no capital adjustment costs. Then, the representative firm's optimal capital-labor ratio satisfies

$$\frac{K}{nl} = \left(\frac{r}{(1-\alpha)\tilde{A}}\right)^{1/\alpha}. \tag{28}$$

In this case, the marginal product of labor is uniquely determined by the interest rate, i.e.,

$$p = p(r) \equiv \alpha\tilde{A}\left(\frac{r}{(1-\alpha)\tilde{A}}\right)^{\frac{1-\alpha}{\alpha}}.$$

Therefore, the equilibrium condition (20) becomes

$$(\gamma\nu)\frac{\chi-1}{\chi}(1-\beta)\,(p(r))^{\frac{\chi}{\chi-1}} - c\left[(r+s)\theta^{\zeta} + \beta\theta\right] = 0, \tag{29}$$

and the interest rate, $r$, uniquely determines the *laissez-faire* market tightness: $\theta_u = \theta(r)$.

**Proposition 4** *If* $Y = \tilde{A}\,(Nl)^{\alpha}\, K^{1-\alpha}$ *and firms can costlessly adjust capital, then* $l_r < l_u \Rightarrow n(l_r) < n(l_u)$.

**Proof.** The argument is the same as in the proof of Proposition 1, part B. Just notice that, $\tau_{l_r}(\theta, l_r) = \frac{1}{\gamma}p(r) - l^{\chi-1}$.

The employment effects of reducing working time are negative when capital is perfectly mobile, and there is no fixed factor of production, thus, no pure rents accrue to the firms. This finding suggests that at least part of the positive employment effects which may materialize in the short-run are likely to vanish as firms start adjusting their productive capacity.

# 5 Constant Elasticity of Substitution.

In this section, we will consider preferences characterized by Constant Elasticity of Substitution (CES) between consumption and leisure. Formally, we assume:

$$\tilde{u}\left(w,(1-l)\right)=\begin{cases}\left(\frac{w^{\xi}}{2}+\frac{(1-l)^{\xi}}{2}\right)^{\frac{1}{\xi}} & if \quad -\infty<\xi \leq 1 \quad and \quad \xi\neq 0; \\ \sqrt{w(1-l)} & if \quad \xi=0\end{cases} \tag{30}$$

where $\frac{1}{1-\xi}$ is the elasticity of substitution between labor and leisure. Note that this specification encompasses Cobb-Douglas preferences, $\tilde{u}=\sqrt{w(1-l)}$, as the limit of $\left(\frac{w^{\xi}}{2}+\frac{(1-l)^{\xi}}{2}\right)^{\frac{1}{\xi}}$ when $\xi$ tends to zero.[10]

## 5.1 Laissez-faire equilibrium.

Under CES utility, the First Order Conditions of the bargaining problem, (12) and (13), can be written as:

$$\Gamma(w,l,\xi)\frac{\beta w^{\xi}}{w\left(w^{\xi}+(1-l)^{\xi}\right)}=\frac{(1-\beta)}{pl-w+c\theta}; \tag{31}$$

$$\Gamma(w,l,\xi)\frac{\beta(1-l)^{\xi}}{(1-l)\left(w^{\xi}+(1-l)^{\xi}\right)}=\frac{(1-\beta)p}{pl-w+c\theta}, \tag{32}$$

where

$$\Gamma(w,l,\xi)\equiv\begin{cases}\dfrac{\left(\frac{w^{\xi}}{2}+\frac{(1-l)^{\xi}}{2}\right)^{\frac{1}{\xi}}}{\left(\frac{w^{\xi}}{2}+\frac{(1-l)^{\xi}}{2}\right)^{\frac{1}{\xi}}-\frac{1}{2}} & if \quad \xi>0 \\ 1 & if \quad \xi \leq 0.\end{cases}$$

The two conditions jointly imply that $w=p^{\frac{1}{1-\xi}}(1-l)$. All points belonging to the Pareto frontier of the bargaining set satisfy this restriction. In Figure 1, the Pareto

[10] Some technical remarks are in order, in this respect. First, the utility function (30) is not well-defined at $(0,1)$ when $\xi<0$. However, it is easily proved that, in this case, $\lim_{\{w\to 0,l\to 1\}}\tilde{u}(w,1-l)=0$. Using this fact, throughout the analysis, we will omit limits and, with some abuse of notation, write that $\tilde{u}(0,1)=0$ when $\xi \leq 0$. Second, observe that under the CES representation (30), $\tilde{u}(0,1)=\frac{1}{2}$ when $\xi>0$. Since the utility of consumption-leisure during unemployment determines the workers' outside option when bargaining with firms over wages and employment conditions, this discontinuous behavior will create some technical complications, which will be discussed as we proceed.

frontier – for a given $p$ – is represented as a negatively sloped segment in the plane $(w, l)$ (Figure 4). In contrast with the case of GHH preferences, the equilibrium working time depends on $\beta$. The larger the power of workers, the higher the wage and the lower the number of hours. In the extreme case of $\beta = 0$, the solution features $w = 0$ and $l = 1$ (the workers receive their reservation utility), whereas in the opposite extreme of $\beta = 1$ workers work the minimum number of hours, $l_{\min}$, and earn the highest wage, $w = w_{\max}$ along the bargaining frontier.

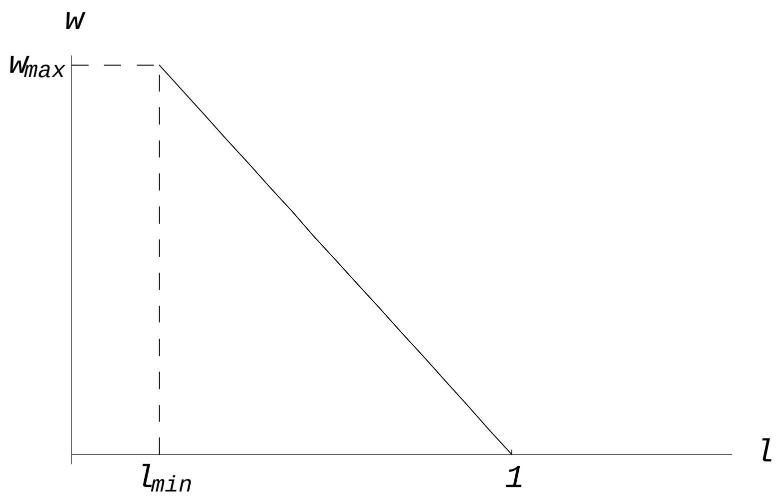

Figure 4: Frontier of the bargaining set, CES utility.

Given the First Order Conditions, we proceed to derive the solutions for wages and hours worked. It is, unfortunately, impossible to analytically characterize the case where the elasticity of substitution between consumption and leisure is larger than one ($\xi > 0$). Quasi closed-form solutions can instead be derived when $\xi$ □ 0.[11] In this case, the expressions for consumption and leisure are:

$$l_u = 1 - \frac{\beta\left(p + c\theta\right)}{p\left(1 + p^{\frac{\xi}{1-\xi}}\right)}; \tag{33}$$

$$w_u = \frac{\beta(p + c\theta)}{1 + p^{-\frac{\xi}{1-\xi}}}. \tag{34}$$

[11] The source of complication is the term $\Gamma(w, l, \xi)$. The case in which $\xi > 0$ can be dealt with only numerically (see section 6).

To find the equilibrium employment level in this economy, plug in $l_u$ and $w_u$ into equation (4) and rearrange terms, to obtain:

$$p(1-\beta) - c\left[(r+s)\theta^{\zeta} + \beta\theta\right] = 0. \tag{35}$$

Next, substitute $n$ and $l$ as given by (14) and (33), respectively, into the expression of the marginal product of labor, (5), to get:

$$p = \alpha A \left( \frac{\left(1 + p^{\frac{\xi}{\xi-1}}\right)\left(1 + s\theta^{\zeta-1}\right)}{1 + p^{\frac{\xi}{\xi-1}}(1-\beta) - p^{\frac{1}{\xi-1}} c\beta\theta} \right)^{1-\alpha}. \tag{36}$$

(35)-(36) jointly determine the equilibrium solution with respect to the endogenous variables $p, \theta$. Once $p$ and $\theta$ are determined, (14)-(33)-(34) can be used to obtain solutions for the equilibrium employment, hours worked and wages.

## 5.2 Equilibrium with hours regulation.

Let us turn now to the bargaining problem with exogenous working time. The unique First Order Condition is given by (31), with the restriction that $l = l_r$.

Using (4) to substitute away $(pl_r - w)$, we can rewrite (31) as follows:

$$\mu(w, l_r) \equiv \frac{(1-\beta)}{\beta} \frac{w^{\xi} + (1-l_r)^{\xi}}{\Gamma(w,l,\xi)} w^{1-\xi} = c\theta + (r+s)c\theta^{\zeta}. \tag{37}$$

Standard differentiation shows that, irrespective of parameters, $\mu_w > 0$, while the sign of the partial derivative $\mu_l$ depends on the elasticity of substitution between consumption and leisure. In particular, it can be shown that $\xi \gtreqless 0 \Leftrightarrow \mu_l \lesseqgtr 0$.

Next, we use (5) and (14) to substitute away $p$ and $n$, respectively, and rewrite the steady-state employment demand condition, (4), as:

$$w = \alpha A l_r^{\alpha} \left(s\theta^{\zeta-1} + 1\right)^{1-\alpha} - (r+s)c\theta^{\zeta}. \tag{38}$$

The equilibrium is characterized by the pair of equation (37)-(38), where $w$ and $\theta$ are the endogenous variables. Figure 5 provides a geometrical representation of the equilibrium in the plane $(w, \theta)$. Equation (37) is described by the upward sloping curve $WW$, while equation (38) is described by the downward sloping curve $DD$. Consider now the effect of an exogenous increase in the hours worked by employee, $l_r$. The increase in $l_r$ shifts the $DD$ curve to the right, while its effect on the $WW$

curve depends on the sign of $\xi$. In particular, if $\xi < 0$ (implying $\mu_{l_r} > 0$), the $WW$ curve shifts to the right, as in the case represented by Figure 5. If $\xi > 0$, however, (implying $\mu_{l_r} < 0$), the $WW$ curve shifts to the left. In the case of unit elasticity ($\xi = 0$), the $WW$ curve does not move. This simple geometrical argument establishes the following Proposition.

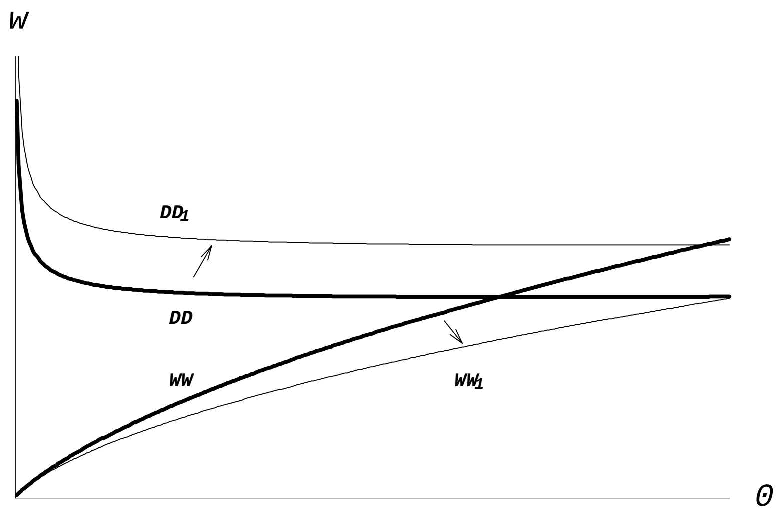


Figure 5: Equilibrium with restricted hours and effect of increasing hours $(\xi < 0)$.

**Proposition 5** *If* $\xi$ □ 0, *then reducing working time necessarily decreases the steady-state employment level. If* $\xi > 0$, *then reducing working time necessarily decreases the steady-state wage.*

Under CES, this model yields the following prediction: unless consumption and leisure are better substitutes than in Cobb-Dougals, reductions of working time cannot increase employment. Note that when $\xi$ □ 0, the effect of a reduction of hours on the total wage is ambiguous. If, however, $\xi < 0$, reducing hours pushes down wages and *possibly* reduces unemployment. In this case, reducing hours originating from two opposite effects on employment. An inspection of the equilibrium conditions (37)-(38) suggests that the range of parameters for which work-sharing has beneficial effects on aggregate employment when $\xi < 0$ increases as we take larger $\alpha'$s. When $\alpha$ is small, the $DD$ curve shifts only a little after a reduction in $l_r$ and the effect of the shift to the right of the $WW$ curve dominates. The more diminishing the returns to labor, the larger the subset of the parameter space for which a reduction in hours promotes employment. Figure 6 represents a case in which consumption and leisure are substitutes, and a reduction in hours increases employment.

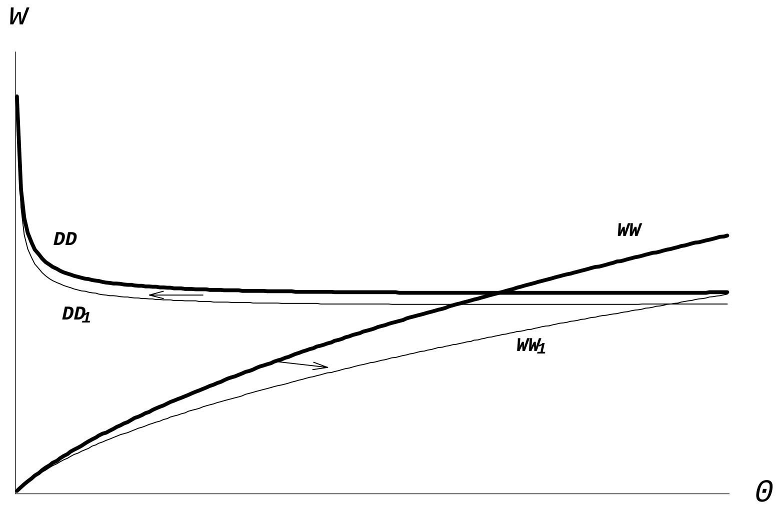


Figure 6: As case where a reduction of hours increase employment, $\xi > 0$.

The intuition for the above result is the following. If consumption and leisure are highly complementary, workers the marginal value of consumption becomes very high when workers have a greta deal of sparetime. Thus, cutting hours only generates small (if any) wage reductions. The *fixed cost effect* on job creation then dominates, and employment decreases. The opposite occurs if workers regard consumption and leisure as sufficiently close substitutes. In this case, workers are prepared to substitute consumption for leisure. Wages decrease more significantly, and the *decreasing returns effect* dominate, thus inducing firms to hire more workers.

Analytically establishing the welfare implications of reducing hours under CES utility is more problematic. Although it can be shown that – for a range of restrictions – reducing working hours in a laissez-faire equilibrium increases the instantaneous utility of employed workers, workers may suffer a loss due to increased unemployment. Nevertheless, our calibrations in section 6 will show that workers typically gain (while firms lose) from policies restricting working time. Thus, the distributional implications are the same under both GHH and CES preferences.

# 6 Calibration.

In this section we provide the results of some numerical simulations, the aim of which is to provide a quantitative assessment of the importance of the effects identified in sections 4 and 5.

We calibrate the parameters as follows. We interpret a time period of unit length to be one quarter, and set the annual interest rate at 4.5%. The separation rate is fixed at $s = 0.04$, implying an average duration of a match of about six years. The bargaining strength parameter is set equal to $\beta = 0.5$ (symmetric Nash solution), and the elasticity of the matching function is $\zeta = 0.5$. Note that $\beta = \zeta$ is the standard Hosios-Pissarides condition. The elasticity of output to labor, $\alpha$, is set equal to 0.65, a standard value in both the growth and business cycle literature, where the output elasticity of labor is the competitive labor share. The two remaining parameters, $c$ (the hiring cost) and $A$ (the TFP in the production function), are calibrated so as to keep the steady-state unemployment rate to 8% and $l = 0.55$ in the laissez-faire equilibrium across the different experiments. Also, to fix ideas, we assume that the $l = 1$ corresponds to 80 hours per week, implying that the laissez-faire solution yields 44 weekly working hours. Note that the average duration of unemployment implied by these parameters is approximately 9 months.

## 6.1 GHH preferences.

Following the studies of Greenwood *et al.* (1988) and Correia *et al.* (1995), based on micro-evidence, we assume the intertemporal elasticity of substitution in labor supply to be 0.6, i.e., we set $\chi = 1.7$. We present the results for three different risk aversion parameters, ranging between the case of risk-neutrality ($\nu = 1$) and (almost) unit relative risk aversion ($\nu = 10000$). As mentioned before, given our extreme assumption about market incompleteness, the latter represents the upper bound to the effects of risk aversion in this model.

The results are summarized in Table 3. For each of the different cases analyzed, we report – together with the parameters used– two series of statistics. The first column (*Free*) corresponds to the equilibrium solution given unrestricted bargaining between firms over both wages and hours. The second column (*Restr*) corresponds to the equilibrium solution under the assumption that the government imposes regulations on working time so as to maximize the welfare of the employed. In the latter case (which will be referred to as a *labor-managed economy*), workers and firms only bargain on wages. For each economy we report the solutions for the steady-state working time ($l$), unemployment ($u$), wage ($w$), total hours ($w \cdot n$) and output ($y$).

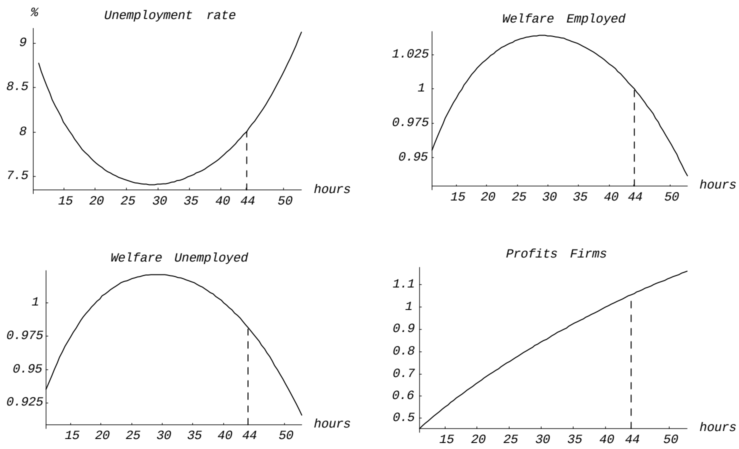


Figure 7: Steady-state equilibrium conditions under alternative worktime regulations.

The length of the working week maximizing workers' utility is approximately 29 hours, corresponding to about two-thirds of the equilibrium working time under unconstrained bargaining. The size of the differences between a laissez-faire and a labor-managed economy changes with risk aversion, since this affects the wage response. In all cases, there is less unemployment in the labor-managed than in the laissez-faire economy, with the decrease in the unemployment rate ranging between 0.5 and 0.9 points. Small employment effects imply that the total number of working hours in the economy is reduced by almost the full amount of the reduction in hours per worker. GDP (net of recruitment costs) falls by about a fourth.[12]

Figure 7 plots, respectively, the unemployment rate ($u$), the welfare of the employed workers ($W$), the welfare of the unemployed workers ($U$) and the firms' profits ($\Pi$) as functions of the number of hours ($l_r$) for the case where $\nu = 5$. The dashed line correponds to the laissez-faire equilibrium (44 hours). As discussed in section 4, the relationship between employment and working time is non-monotonic (top left panel), with employment being maximized for a working time level which is below the free-market agreement .Workers' welfare is maximized at $l_r = 29$ (top right

[12]It may be interesting to check whether the relative size of the "recruitment costs" implied by these experiments is realistic. Recall that, since $A$ and $c$ are chosen to determine $u$ and $l_u$, recruitment costs are not calibrated to real observations. Under risk neutrality, each firm's expenditure on recruitment is about 1.9% of the value of its gross GDP. In the other two cases ($\nu = 5; \nu = 10^3$), this percentage increases to 7% and 21%, respectively. Since recruitment costs in this model are meant to capture a variety of quasi-fixed cost, like training, etc., we think that both 1.9% and 7% are in the range of "reasonable" values.

panel). Firms' profits, finally, increase motonically with working time (bottom right panel).

| $RRA$ | 0 ($\nu = 1$) | | 0.8 ($\nu = 5$) | | 1.0 ($\nu = 10^3$) | |
|---|---|---|---|---|---|---|
| $A$ | 0.798 | | 0.798 | | 0.798 | |
| $c$ | 0.58 | | 2.12 | | 6.32 | |
| regime | Free | Restr | Free | Restr | Free | Restr |
| hours | 44 | 29 | 44 | 29 | 44 | 29 |
| un. rate | 0.080 | 0.075 | 0.080 | 0.074 | 0.080 | 0.071 |
| wage | 0.348 | 0.261 | 0.312 | 0.222 | 0.213 | 0.105 |
| total hours | 40.5 | 26.8 | 40.5 | 26.9 | 40.5 | 26.9 |
| GDP | 0.503 | 0.382 | 0.477 | 0.354 | 0.406 | 0.270 |

Table 3. Simulations: GHH preferences.

An interesting experiment related to the ongoing policy debate in a number of European countries is to compare two regulated economies, with working weeks of 40 and 35 hours, respectively. We restrict our attention to $\nu = 1$ and $\nu = 5$. As Table 4 shows, the differences in employment are very small. If we compare the predictions of our model with the empirical estimates of Hunt (1997), we find that one standard hour reduction causes a reduction of total hours of about 2.4%, which is in the range of Hunt's estimates. The employment elasticity predicted by our model are actually even smaller than that estimated by Hunt. A reduction of standard hours of 12.5% causes an employment increase of the order of 0.23%, with an implied elasticity of 0.02 (whereas Hunt estimated an elasticity of 0.1). Also, steady-state GDP falls by about 9%, a rather large amount. Figure 7 shows, however, that workers are better off with 35 than with 40 hours. Note that the results would not change significantly if we considered economies with a higher structural unemployment rate. If, for instance, we set parameters so that the unemployment rate in the 40 hours economy is 11% (about the average unemployment rate in Continental Western Europe), the unemployment rate of the 35 hours economy would be 10.7%.

| *RRA* | 0 ($\nu = 1$) | | 0.8 ($\nu = 5$) | |
|---|---|---|---|---|
| *A* | 0.798 | | 0.798 | |
| *c* | 0.58 | | 2.12 | |
| hours | 40 | 35 | 40 | 35 |
| un. rate | 0.078 | 0.076 | 0.077 | 0.075 |
| wage | 0.326 | 0.296 | 0.288 | 0.257 |
| total hours | 36.9 | 32.4 | 36.9 | 32.4 |
| GDP | 0.473 | 0.431 | 0.446 | 0.403 |

Table 4. From 40 to 35 hours.

## 6.2 CES preferences.

In the CES case, we need to parameterize the elasticity of substitution between consumption and leisure. We consider values of elasticities ranging between 0.2 ($\xi = -4$), and 2 ($\xi = 0.5$). The lower bound corresponds to the time series estimation of Alogoskoufis (1987a) with UK data. Cross-sectional analysis, in particular, finds that individuals earning higher hourly wages work more hours in the market than workers with low wages. This is consistent with consumption and leisure being substitutes rather than complements (as well as being consistent with GHH preferences). The elasticity of working hours to wages is estimated to be around 0.2 by Zabel (1993) using PSID, while earlier studies where direct and participation effects were compounded had found even large estimates of this elasticity. Since the existing evidence is mixed, we consider a wide range of elasticities.

| *elast.* | 0.2 ($\xi = -4$) | | 0.5 ($\xi = -1$) | | 1.0 ($\xi = 0$) | | 2.0 ($\xi = 0.5$) | |
|---|---|---|---|---|---|---|---|---|
| $A$ | 1.18 | | 1.16 | | 1.2 | | 1.53 | |
| $c$ | 3.80 | | 3.70 | | 3.85 | | 0.553 | |
| case | Free | Restr | Free | Restr | Free | Restr | Free | Restr |
| $l$ | 44 | 32.9 | 44 | 32.6 | 44 | 34 | 44 | 30.4 |
| $u$ | 0.080 | 0.110 | 0.080 | 0.097 | 0.080 | 0.087 | 0.080 | 0.076 |
| $w$ | 0.447 | 0.385 | 0.440 | 0.365 | 0.451 | 0.379 | 0.682 | 0.531 |
| $y$ | 0.758 | 0.613 | 0.746 | 0.606 | 0.767 | 0.649 | 0.984 | 0.775 |

Table 5. Simulations: *CES* preferences.

Table 5 summarizes the results. Coherently with the theoretical results of section 5, when $\xi$ □ 0, the unemployment rate is higher in the labor managed than in the laissez-faire economy. The more complementary are consumption and leisure, the more negative are the employment effects of restrictions on working hours. With

Cobb-Douglas preferences ($\xi = 0$), for instance, the unemployment rate in the labor-managed economy is 0.7% higher than in the laissez-faire economy, while the difference increases to 3% when the elasticity is 0.2 ($\xi = -4$). Yet, even when this causes higher unemployment, employed workers' welfare is maximized when a relatively large restriction on working time is imposed. Furthermore, the welfare of the unemployed is also increased by reducing working time. That is, the patterns described in Figure 7 generalize to the CES case, even when $\xi$ □ 0 (in Table 5) and unemployment increases.

The analysis showed that, when $\xi \geq 0$, employment effects are ambiguous. As is shown by the last two column in Table 5, when the elasticity of substitution equals 2 the solution resembles that under GHH preference. In particular, it turns out that unemployment is a U-shaped function of working time, decreasing at the laissez-faire solution, $l_u$. Unemployment is lower in the labor managed than in the laissez-faire economy.

# 7 Extensions

To better understand the robustness of the results of Section 4, we will analyze in this section two extensions of our model. We show that the employment effects are also present when wages are collective bargained. In contrast, reducing standard hours when firms can use overtime may, in some cases, reduce employment.

## 7.1 Collective Bargaining

When wages and hours are bargained by a firm-level Union, instead of individual workers, employees receive, under Nash bargaining, a share of the total surplus of the firm, rather than of the surplus generated by the marginal match. In this case, the general analysis becomes complicated, in particular, due to the firm's outside option. With individual bargaining, the firm's outside option is, simply, the value of the marginal vacancy which, in equilibrium, equals zero. With collective bargaining, however, the firm's outside option is the value of retaining the capital stock while having no employees, and with the perspective of hiring an entirely new workforce. The calculation of this outside option is quite complicated. In order to keep the model tractable, we therefore introduce the simplifying assumption that, if negotiations break down, the firm is liquidated at a value equal to a fraction $\phi$ of the value of the firm (where $0 \,\square\, \phi < 1$).[13]

The bargaining problem is modified as follows (note that we express the problem in per worker terms):

$$\max_{\{w,l\}} \quad (nW - nU)^{\beta} \left(\Pi(1-\phi)\right)^{1-\beta}, \tag{39}$$

where $\beta$ is the bargaining strength of the Union, and $\Pi = A\,(nl)^{\alpha} - wn - cs\theta^{\zeta} n = \left(pl/\alpha - w - cs\theta^{\zeta}\right) n$. We only analyze the case of GHH preferences. The First Order Conditions are:

$$\frac{\beta(r+s+\theta^{1-\zeta})}{\nu\left(w - \frac{l^{\chi}}{\chi}\right)} = \frac{(1-\beta)r}{(pl/\alpha - w - cs\theta^{\zeta})}; \tag{40}$$

$$\frac{\beta l^{\chi-1}}{\nu\left(w - \frac{l^{\chi}}{\chi}\right)} = \frac{1-\beta}{(pl/\alpha - w - cs\theta^{\zeta})} p, \tag{41}$$

which, jointly, imply that in the laissez-faire environment, $l_u = p^{\frac{1}{\chi-1}}$. Thus, the presence of Unions does not alter the equality between the marginal product of labor and the marginal cost of effort. The main result of this section will be stated conditional on the following mild assumption.

**Assumption** Parameters are such that $n > \sqrt{r+s}\left(\sqrt{r+s} - \sqrt{s}\right)/r$.

This assumption is sufficient (not necessary) to guarantee that the equilibrium wage increases as the labor market becomes tighter (a natural feature of the equilibrium). Any economy with reasonable parameters satisfies this assumption.[14] Under this condition, the main result of this section follows (see the Appendix for its proof).

**Proposition 6** *If Assumption 7.1 is satisfied, then: (A) If* $\alpha < 1$*, then* $\exists \epsilon > 0$ *such that:* $0 < l_u - l_s < \epsilon \Rightarrow n(l_s) > n(l_u)$*. (B) If* $\alpha = 1$*, then:* $0 < l_u - l_s \Rightarrow n(l_s) < n(l_u)$.

[13] Alternatively, one could assume that the firm is liquidated at a constant value $\Omega$ (e.g., capital is turned into consumption good) rather than a fraction of the value of the firm before the breakdown of the negotiations. The results are identical, although the algebra is more complicated.

[14] For instance, if $s = 0.04$ as in our simulations, Assumption 7.1 is satisfied for any $r \in (0, 0.1)$ provided that the equilibrium unemployment rate is lower than 34.8%.

Proposition 6 extends the result of Proposition 1 to the case where Unions bargain for wages with firms on the workers' behalf. Some range of reductions of working time, in the neighborhood of the laissez-faire solution, increase employment. It can also be shown that the other main results of Section 4 carry over unchanged to the case of collective bargaining. In particular, starting from a laissez-faire equilibrium, all workers, both employed and unemployed, benefit from reducing working hours when $\alpha < 1$, whereas firms lose.

## 7.2 Overtime

So far, we have restricted our attention to an extreme form of regulation, where an employee can only work a given number of hours as set by the legislation. It is common practice, however, to allow overtime, although firms are, in many countries, subject to pecuniary penalties as well as various types of constraints on their use. In this section we extend the model to introduce this feature. We assume that firms can employ workers for longer time than statutory hours, but must pay an extra-cost proportional to the number of extra hours employed. Workers and firms bargain on wages and hours subject to such regulations. We define $\tau$ as the fee paid by the firm on each extra hour of work and $\bar{w}$ as the normal hourly wage. We still denote statutory hours by $l_r$, but, in this case, the actual working time needs not be equal to $l_r$.[15] For simplicity, we only study the case of GHH preferences.

The profit maximization problem of a representative firm is modified as follows.

$$\Pi_i = \int_0^\infty e^{-rt} \left( A \left( N_i l_i \right)^\alpha - \left[ \bar{w} l + \tau \left( l - l_r \right) \right] N_i - c\theta^\zeta \left( \dot{N} + sN \right) \right) dt, \tag{42}$$

subject to (1), and given $N_0$. Solving this problem and restricting attention to steady-state (we let, as usual, $N_i = n$), we obtain:

$$pl - (\bar{w} + \tau)l + \tau l_r - c(r+s)\theta^\zeta = 0 \tag{43}$$

where, $p$ is the marginal product of labor as defined in equation (5).

[15] The choice of modeling the extra cost as an absolute fee, $\tau$, on each extraordinary hour worked, rather than, more realistically, as a percentage of the normal hourly wage is motivated by tractability. No major result would change in the alternative set-up, but it becomes impossible to obtain closed-form solutions. The choice of having hourly rather than total wages is instead purely expositional. The results would be identical if we let agents bargain on total instead of hourly normal wages.

We first consider the case where the additional costs suffered by firms are transferred to the workers as a premium on the extraordinary hours worked. This implies that the total wage of an individual worker can be decomposed into two parts: $\bar{w}l$, which defines the normal compensation, and $\tau(l - l_0)$ which defines the premium for extraordinary hours. Workers and firms are assumed to bargain $\bar{w}$ and $l$, taking $\tau$ and $l_0$ as given. However, since agents, when bargaining, understand that only total payments matter, the following neutrality result follows (it is also proved in the Appendix):

**Proposition 7** *If the fees paid by firms on overtime are transferred to the workers as extra compensation, then the equilibrium solution is identical to the laissez-faire equilibrium, irrespective of* $\tau$ *and* $l_r$*.*

In many countries – see the recent proposal of 35 hours regulation in Italy, for instance – firms must pay additional *sunk* costs which are not transferred to the workers (e.g, higher taxes) for the use of extra hours of work. In this case, regulations have real effects, as will now be shown. When workers only receive the normal wage, although firms must pay fees on extra hours, the FOC's of the bargaining problem (cfr. (16)-(17)) become – restricting attention to interior solutions where a positive number of extraordinary hours are worked– :

$$\frac{\beta}{\nu\left(\bar{w}l - \frac{1}{\chi}l^{\chi}\right)} = \frac{(1-\beta)}{pl - \bar{w}l - \tau\left(l - l_r\right) + c\theta}; \tag{44}$$

$$\frac{\beta}{\nu\left(\bar{w}l - \frac{1}{\chi}l^{\chi}\right)}\left(\bar{w} - l^{\chi-1}\right) = \frac{1-\beta}{pl - \bar{w}l - \tau\left(l - l_r\right) + c\theta}\left(p - \bar{w} - \tau\right). \tag{45}$$

Hence,

$$l^* = Max[(p-\tau)^{\frac{1}{\chi-1}}, l_r] \tag{46}$$

$$w^* = \bar{w}^* l^* = \begin{cases} \gamma\left[\left(\frac{(1-\beta)\nu}{\chi} + \beta\right)(p-\tau)^{\frac{\chi}{\chi-1}} + \beta\left(c\theta + \tau l_r\right)\right] & if \quad l^* > l_r; \\ \gamma\left[(1-\beta)\nu\frac{l_r^{\chi}}{\chi} + \beta\left(pl_r + c\theta\right)\right] & if \quad l^* = l_r, \end{cases} \tag{47}$$

where $\gamma$ is as defined as in section 4. Consider the range of interior solutions, where $l^* > l_r$. Substituting the values of $l^*$ and $\bar{w}^*$into (43), and rearranging terms, we obtain:

$$\Lambda\left(p,\theta,l_r,\tau\right) \equiv \gamma\nu(1-\beta)\ \Box\ \frac{\chi-1}{\chi}\left(p-\tau\right)^{\frac{\chi}{\chi-1}} + \tau l_r \Big] - c\left[(r+s)\theta^{\zeta} + \beta\gamma\theta\right] = 0, \tag{48}$$

where standard differentiation shows that $\Lambda_p > 0$, $\Lambda_\theta < 0$, $\Lambda_{l_r} > 0$ and $\Lambda_\tau \ \Box\ 0$. In particular, note that $\Lambda_\tau = -\gamma\nu(1-\beta)\left(l - l_r\right)$.

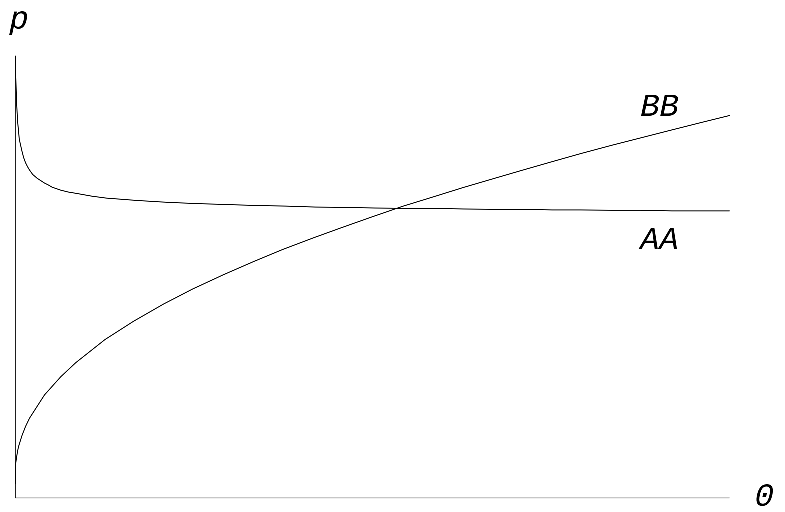


Figure 8: Equilibrium with overtime.

Next, substitute $n$ and $l$ as given by (14) and (46) into the expression of the marginal product of labor, (5) (in the case when $l^* > l_r$) to obtain:

$$\Gamma\left(p,\theta,\tau\right) = p - \alpha A\left(1 + s\theta^{\zeta-1}\right)^{1-\alpha}\left(p-\tau\right)^{\frac{\alpha-1}{\chi-1}} = 0, \tag{49}$$

where $\Gamma_p > 0$, $\Gamma_\theta > 0$, $\Gamma_\tau < 0$. (48)-(49) determine the equilibrium solution with respect to the endogenous variables $p, \theta$. The effects of legal restrictions on hours can be seen by looking at Figure 8. The positively sloped curve, BB, represents equation (48), while the negatively sloped curve, AA, represents equation (49). Consider the (steady-state) effect of increasing statutory hours, while keeping $\tau$ fixed. Since $\Lambda_{l_r} > 0$ (while $\Gamma$ is independent of $l_r$), increasing $l_r$ shifts the BB curve to the right, while the AA curve remains unchanged. Thus, it increases $\theta$ and decreases $p$. Therefore, an increase of statutory hours – when overtime is allowed and in the range where it is used – always reduces unemployment. Reducing statutory hours, on the other hand, increases unemployment in the same case.

Consider, now, the effect of changes in $\tau$. Since $\Gamma_\tau < 0$ and $\Lambda_\tau$ □ 0, increasing $\tau$ shifts the BB curve to the left and the AA curve to the right, with ambiguous effects on $\theta$ and employment. Nevertheless, an interesting *local* result can be established. Consider an economy where – for given $l_r$ – fees are sufficiently high to deter firms from using extra hours, i.e., $l^* = l_r$. Then, decrease progressively $\tau$ to the level where firms start using overtime. At this level of taxes, we know that $l^* = l_r$, hence $\Lambda_\tau = -\gamma\nu(1-\beta)(l - l_r) = 0$. Therefore, the BB curve does not move, while the AA curve shifts to the left, causing a fall in $\theta$. More in general, starting from sufficiently large values of $\tau$, increaseas in the price of overtime cause unemployment to fall.

The main results of this section are summarized by the following Proposition.

**Proposition 8** *(A) Let $(\tau^0, l_r^0)$ be such that $l^* > l_r^0$. Then, keeping $\tau^0$ constant, $\frac{\partial n}{dl_r} > 0$. (B) For any given $l_r$, there exists $\hat{\tau} < \infty$ such that $\forall \tau > \hat{\tau}$, $\frac{\partial n}{d\tau} \geq 0$ (with $>$ for some $\tau > \hat{\tau}$).*

Proposition 8 has interesting normative implications. If the government wants to restrict working time with the objective of promoting employment, it should discourage the use of extraordinary hours either by legislation or by enforcing severe fees, but not by decreasing the number of statutory hours while keeping penalties on the use of extra hours moderate.

# 8 Conclusions.

There is widespread agreement that the high level and persistency of unemployment is the main current economic and social problem in Europe. There is, however, much less agreement on which policies European governments should follow to increase employment. This disagreement often reflects, more or less openly, the fact that employment policies usually have redistributional effects. The proposal of reducing working time is one of these policies that generates controversy. This is not surprising, since, as we have argued in this paper, regulating working time has important distributional implications.

Two aspects have been discussed in the paper. One is based on purely redistributional grounds. We find that almost independently of whether there is "work sharing" or not, workers may prefer regulation restricting working time. The other is about whether restricting working time can be effective in increasing employment. As a positive conclusion, our theory suggests that there may be nothing irrational behind the fact that, when the balance of political equilibrium shifts in favor of the workers (as it seems to have been recently the case in several European countries), the old call for reducing working time by decree emerges again. It is a different matter, however, to assess whether the policy will mitigate the European unemployment problem. To this respect, our paper broadly agrees with the past literature, both theoretical (Calmfors, 1985; Hoel and Vale, 1986, etc. ) and empirical (Hunt, 1997) in *calling for caution*. The conditions for obtaining even small employment effects are rather restrictive. In particular, input factors -such as, capital in our model - should not be able to adjust to the policy intervention (this might explain, why some proponents would like these policies to be implemented at the largest scale possible, e.g., the EU). Moreover, the output loss which this policy would cause may be quite large. Although we have not addressed this issue explicitly, one expects that reducing working time will have a negative impact on the government budget of the countries which choose to adopt this policy.

Several important aspects and extensions are left open for future research. For example, we have only discussed wage setting through bargaining, but not other regimes, such as "wage posting." Similarly, we have not considered other mechanisms that may rationalize "working time regulations." Our model does not consider possible "social coordination" problems, nor the possibility that workers like restrictions on working time to avoid that employers exploit some type of yardstick competition mechanism to induce them to overwork. Nor do we consider the possible role of downward nominal rigidities, implying that total wages adjusting with a delay to the reduction of hours. In this case, the short-run employment effects of the policy may be worse than those predicted by our model (where we restrict attention to steady-states). Finally, regarding our assumptions, one can generalize the model in different directions. For example, by introducing heterogeneity among workers or by not having hours and workers as perfect substitutes. Although important for a more accurate quantitative assessment of the policy, most of these generalizations are unlikely to substantially change our main results.

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# Appendix

**Proposition** 6

**Proof.** In the economy with regulation, the first order condition is given by (40) under the constraint that $l = l_r$. By inserting the labor demand condition, (4), into (40), we obtain:

$$\frac{\beta(r+s+\theta^{1-\zeta})}{\gamma\left(w-\frac{l_r^{\chi}}{\chi}\right)} = \frac{(1-\beta)r}{\left(rc\theta^{\zeta}+pl_r\frac{1-\alpha}{\alpha}\right)} \tag{50}$$

(cfr. the individual bargaining condition, (16)). Since (4) implies $c\theta^{\zeta} = \frac{pl_r - w + c\theta}{r+s+\theta^{1-\zeta}}$, then wages are given by

$$w = \gamma\left((1-\beta)\frac{l_r^{\chi}}{\chi} + \beta\left(pl_r + c\theta\right) + \beta\frac{(r+s+\theta^{1-\zeta})}{r}pl_r\frac{1-\alpha}{\alpha}\right) \tag{51}$$

The expression (51) differs from the expression for individual bargaining wages (22) by the presence of the last positive term on the right hand-side (since workers also share the rents generated by inframarginal workers, their wage, given $\beta$, is higher). By substituting (51) into the labor demand equation we obtain:

$$(1-\beta\gamma)\left(pl_r - \frac{l_r^{\chi}}{\chi}\right) = c\left[\beta\gamma\theta + (r+s)\theta^{\zeta}\right] + \gamma\frac{\beta(r+s+\theta^{1-\zeta})}{r}pl_r\frac{1-\alpha}{\alpha}, \tag{52}$$

>From (52), recalling that $n = \left(1+s\theta^{\zeta-1}\right)^{-1}$, it follows that $\tilde{\tau}(n, l_r) = 0$, where:

$$\tilde{\tau}(\theta, l_r) \equiv (1-\beta\gamma)\left(\alpha A\left(1+s\theta^{\zeta-1}\right)^{1-\alpha} l_r^{\alpha} - \frac{l_r^{\chi}}{\chi}\right) - c\left[\beta\gamma\theta + (r+s)\theta^{\zeta}\right] - \tag{53}$$
$$\frac{\beta\gamma}{r}(r+s+\theta^{1-\zeta})\left(1+s\theta^{\zeta-1}\right)^{(1-\alpha)} Al_r^{\alpha}(1-\alpha).$$

Then, $\frac{dn}{dl_r} = -\frac{\tilde{\tau}_{l_r}(\theta,l_r)}{\tilde{\tau}_n(\theta,l_r)}$. To sign the effect of a change of $l_r$, we proceed to sign each of the partial derivatives. First, by the same argument used in the proof of Proposition 1,

$$\tilde{\tau}_{l_r}(n, l_r) = (1-\beta\gamma)\left(\alpha p - l_r^{\chi-1}\right) - \frac{\beta\gamma}{r}(1-\alpha)\left(\frac{r+s+\theta^{1-\zeta}}{r}\right)p,$$

is negative, provided that $l_r$ □ $l_u$. In order to determine the sign of $\tilde{\tau}_\theta(\theta, l_r)$, observe that *(i)* the term $(1-\beta\gamma)\left(\alpha A\left(1+s\theta^{\zeta-1}\right)^{1-\alpha} l_r^{\alpha} - \frac{l_r^{\chi}}{\chi}\right) - c(r+s)\theta^{\zeta}$ is decreasing with $\theta$; *(ii)* the term $(r+s+\theta^{1-\zeta})\left(1+s\theta^{\zeta-1}\right)^{(1-\alpha)}$ is increasing with $\theta$ if and only if $\frac{\theta^{1-\zeta}}{r+s+\theta^{1-\zeta}} > \frac{s}{s+\theta^{1-\zeta}}(1-\alpha)$. This condition holds true necessarily if Assumption 7.1 is satisfied (observe that $\theta^{1-\zeta} = s/(1-n)$). QED

**Proposition** 7

**Proof.** The value of a filled job for a worker and a firm are, respectively:

$$(r+s)W = \tilde{u}\left(\bar{w}l + \tau\left(l - l_r\right), (1-l)\right) + sU, \tag{54}$$

and:

$$(r+s)J = pl - \bar{w}l - \tau(l - l_r) \tag{55}$$

Then, solving the bargaining problem yields the following FOC's

$$\frac{\beta}{\nu\left(\bar{w}l + \tau\left(l - l_r\right) - \frac{1}{\chi}l^{\chi}\right)} = \frac{(1-\beta)}{pl - \bar{w}(1+\tau)l + \bar{w}\tau l_r + c\theta}; \tag{56}$$

$$\frac{\beta}{\nu\left(\bar{w}l + \tau\left(l - l_r\right) - \frac{1}{\chi}l^{\chi}\right)}\left(\bar{w} + \tau - l^{\chi-1}\right) = \frac{1-\beta}{pl - \bar{w}(1+\tau)l + \bar{w}\tau l_r + c\theta}\left(p - \bar{w} - \tau\right). \tag{57}$$

whose solution is:

$$l^* = p^{\frac{1}{\chi-1}} \tag{58}$$

$$w^* = \bar{w}l + \tau\left(l - l_r\right) = \gamma \,\square\left(\frac{(1-\beta)\nu}{\chi} + \beta\right)p^{\frac{\chi}{\chi-1}} + \beta c\theta\Bigg], \tag{59}$$

where $\gamma$ is as defined in section (4). Since $w^* = w_u$ (as given by (19)) and $l^* = l_u$ (as given by (18) ), the result is established. **QED.**