A NOTE ON THE REDUCTION OF THE WORKWEEK

by

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This note formalizes the discussion about the effects of a reduction of the workweek as has occurred repeatedly in several European countries in the recent past. Some authors and many trade unions claim that such a measure results in higher employment as firms are interested in the total numbers of hours that they pay for. This simple work sharing principle requires though that hourly wages remain unchanged and that there be no fixed costs in resorting to extra workers. But if hourly wages remain unchanged, total take home pay will decline which may, if spending is more highly valued than leisure, reduce the welfare of employed workers. Of course then unemployed workers are likely to benefit and unions which care about both categories may accept some trade-off.

These issues are studied in a very simple model of optimizing trade-union and firms. As expected, the results in terms of employment and welfare are ambiguous, and the roles of some crucial parameters are discussed.
1 - The Model

The individual worker has a utility function:

(1) \[ u = c^\alpha h^{\beta} \]

where \( c \) is consumption and \( h \) hours worked. His budget constraint, assuming no other income than labor income is:

2) \[ c = wh \]

where \( w \) is the hourly wage rate, so that the worker's utility is:

(3) \[ u = w^{\alpha} h^{\alpha-\beta} \]

A reduction in hours worked at given hourly wages may increase the worker's utility if \( \alpha < \beta \), i.e. if leisure is more valued than consumption.

I assume a single trade union which is utilitarian (for a discussion of modelling trade unions' preferences see Oswald (19)). The union cares about the well-being of the representative worker \( u \), but also about total employment. However, because workers already employed are rather indifferent to the situation of the unemployed, the trade union's utility function is separable:

(4) \[ U = c^{\alpha} h^{\beta} + \Theta N^\lambda \]

where \( N \) is total employment.\(^1\)

The trade union will maximize \( U \), setting the hourly wage rate given firms' demand for labor, both employment \( N \) and worked hours \( h \). The representative firm is endowed with a fixed stock of capital, as we focus on the short run. In the long run, whether labor costs rise or fall will influence capital accumulation. If there is no cost in changing the number of workers, all that matters for firms is total hours worked \( Nh \), the breakdown between \( N \) and \( h \) being irrelevant. This does not seem a correct
description of firms behavior. Given existing capital, it is not normally possible to increase freely the number of workers who man it. Going for another shift is a possibility, but this is a major quantum change which does not correspond to the moderate reductions in hours worked of the type studied here. There is, at least, in the short run, a practical technical cost involved in replacing hours by workers. This fact is captured in the following production function:

\[
y = (Nh)^{\mu} N^{-\mu'} = N^{\nu} h^{\mu} \quad \text{with } \nu = \mu - \mu' > 0
\]

where the fixed capital stock is omitted, and will be thereafter, with no loss of generality. The parameter \( \mu' = \mu - \nu \) measures the above mentioned disruption implied by adding additional workers in a plant.

2 - The Institutional Set-Up

It will be assumed that there are three agents who interfere. First, the trade union sets the base wage rate (to be explained shortly), knowing the firm's demand for labor, as represented by \( N \) and \( h \). Second, the firm decides on its optimal employment policy, knowing the trade union's optimal choice of the base wage rate. Thus, the interaction of the trade union and the firm can be described as a Cournot game. The third agent is the government which is concerned with the length of the work-week. It is often the case, in Europe, that governments thus interfere in the labor market. But governments usually do not set a compulsory number for worked hours. They rather specify the normal length of the workweek and determine the premium to be paid for extra hours worked.

[HERE FIGURE 1]

This can be represented by the continuous line on figure 1, where \( \bar{h} \) is the standard number of worked hours. Instead of a progressive increase in \( w \), it may consist of steps. In order to avoid discontinuities, I approximate this regulation by the dotted line:

\[
w = w_o (1 + (h/\bar{h}) \gamma)
\]
where \( w_0 \) is the base wage rate, which is set by the trade union, and \( \gamma \), which measures the steepness of the increase in overtime wage is also decided by the government, with \( \gamma > 1 \).

To summarize, the trade union chooses \( w_0 \) to maximize its utility (4), the firm maximizes its profit by choosing \( N \) and \( h \), and the government decides the levels of \( h \) and \( \gamma \).

3 - The Solution:

As in a Cournot game, each agent optimizes by setting its reaction function according to the other's own reaction function. In order to solve this problem, I assume the functional form of the firm's reaction functions, solve the trade union's problem and then, solving the firm's problem, I compute the parameters of the hypothesized firm's reaction function.

Let these functions be:

\[
\begin{align*}
N &= A h^{-\sigma} - \tau \\
h &= B h
\end{align*}
\]  

with \( A, B, \sigma \) and \( \tau \) the unknown parameters to be computed. Equations (7) say that firms will change the length of the workweek proportionately to the changes imposed by the government, and the demand for workers will rise when \( h \) declines at a given wage rate while, of course, an increase in \( w \) will reduce both total employment \( N \) and total use of labor \( Nh \). It will be shown that (7) indeed represents the optimal response of the representative firm.

In order to solve the trade union's problem, \( U \) in (4) is maximized with respect to \( w_0 \), subject to (2), (6) and (7). The solution is:

\[
w_0 = D h - \delta
\]

where

\[
D = (1 + B \gamma)^{-1} \left( \tau \lambda \theta \alpha - 1 \right) A^{-1} B^{a - \alpha} 1/(\alpha + \tau \lambda)
\]

\[
\delta = (\alpha - \beta + \sigma \lambda)/(\alpha + \tau \lambda)
\]
When \( h \) is reduced, the trade-union will ask for an increase in the base wage rate so as to avoid too much of a reduction in take-home salaries \( w^2 \). The compensation is likely to be less than complete \( (\delta < 1) \) as the trade union realizes via (7) that there is a cost in total employment. But, it is also possible for \( w_o \) to be lowered \( (\delta < 0) \), for example if \( \alpha - \beta \) is negative and large in absolute value, which is a case where workers value a lot more leisure than consumption. A precise discussion of all this must await until the values of the postulated parameters \( \sigma \) and \( \tau \) are determined by the firm's optimization program.

The firm chooses \( N \) and \( h \) so as to maximize its profit:

\[
\Pi = Nh^\mu - wNh
\]

subject to the wage rule (6) dictated by the government and to the trade union's optimal base wage (8).

Solving this problem yields (7) with:

\[
A = \frac{1}{1-\nu} \left[ \frac{(1+\gamma)\nu - \mu}{\mu - \nu} \right]^{1/1-\nu} \frac{1-\mu}{1-\nu}
\]

\[
B = \frac{1}{(1+\gamma)\nu - \mu}^{\nu}
\]

\[
\tau = 1/(1-\nu) \quad ; \quad \sigma = (1-\mu)/(1-\nu)
\]

Note that for an interior solution to exist we need to have \( (1+\gamma)\nu - \mu > 0 \) i.e. \( \gamma > (\mu-\nu)/\nu = \mu'/\mu \) : the overtime wage rate must increase sufficiently to discourage firms from recruiting too few workers and having them working long hours.
Firms will ask some overtime work \((B > 1)\) as long as
\[\gamma < \frac{2(\mu - \nu)}{\nu} = 2 \frac{\mu'}{\mu - \mu'},\]
i.e. as long as the wage rate does not increase too steeply. Also, if there is no cost in increasing the number of workers
(if \(\mu' = \mu - \nu = 0\) in (5)), the first order condition implies:

\[\gamma \left(\frac{h}{\bar{h}}\right)^\gamma = 0\]

Then, either \(\gamma = 0\) and the firm only chooses \(Nh\), or \(\gamma \neq 0\) and \(h = 0\) (and \(N = \infty\)), which ought to be seen as the limiting case where the firm attempts to take full advantage of the reduced wage when \(h\) declines.

4 - The Effects of Reduced Standard Working Time

It is now possible to derive the effects of a reduction in \(h\), the standard working time set by the government.

As \(h\) is reduced in the same proportion (see (7)), the real wage
\[w = w_0 \left[1 + (h/\bar{h})^\gamma\right]\]
changes as \(w_0\), which gives by (8):

\[\frac{d \log w}{d \log h} = -\delta = -\frac{\alpha - \beta + \sigma \lambda}{\alpha + \tau \lambda}\]

Only if \(\beta > \alpha + \sigma \lambda\) would we expect the hourly wage to rise: this is the case when the representative worker enjoys leisure so much that he would accept a reduction in consumption and the trade union would go along because its employment objective is relatively weak (\(\lambda\) is small).

Take home wage \(wh\) changes as:

\[\frac{d \log wh}{d \log h} = 1 - \delta \geq 0\]
since wages rise by \(\delta\) percent and \(h\) declines by 1 percent (when \(\bar{h}\) is reduced by 1 percent). Unambiguously \(\delta \leq 1\), which means that the trade union will not ask for more than full compensation. The limiting case of full compensation requires either \(\beta < 0\) (the representative worker dislikes
leisure and needs a pay rise to make up for his utility loss) or \( \beta = 0 \) and \( \gamma = 0 \), i.e. the representative worker does not care for leisure and the union has no employment objective.

The effect on employment follows from (7) and (9):

\[
\frac{d \log N}{d \log h} = -\sigma - \tau \frac{d \log w}{d \log h} = -\sigma + \tau \delta 
\]

Not surprisingly, two forces are at work: first given the total demand for hours worked \( N_h \), a reduction in \( h \) indeed tends to create some work sharing. But, as hourly wages rise (see (10)), total demand for hours worked decline, reducing employment.

The condition for an increase in employment can be shown to be:

\[
\alpha \mu < \beta 
\]

which would require the representative worker to have a strong taste for leisure, yet not necessarily a preference for leisure over consumption as \( \mu < 1 \). In order to interpret (13) consider the border case where employment remained unchanged because \( \beta = \alpha \mu \). In this case \( \frac{d \log (wh) }{d \log (h)} = \mu = \frac{d \log (y) }{d \log (h)} \) : both the income of the firm and its cost decline by the same proportion so that the labor share of income remains unchanged at the initial employment level. With Cobb-Douglas technology, this implies that the initial level of employment remains optimal from the point of view of the firm (although its profit also declines in the same proportion \( \mu \)). This shows that the present result depends on the unit elasticity of substitution assumption.

Finally, I consider the employed worker's individual welfare:

\[
\frac{d \log u}{d \log h} = \frac{\lambda}{\alpha + \tau \lambda} \cdot \frac{\omega \mu - \beta}{1 - \nu} 
\]

The condition for improving his welfare is exactly the same (13) as the condition for an increase in employment. When \( \omega \mu = \beta \), his consumption and
his income both decline by $u$ which creates a welfare loss $\omega u$ exactly offset by the welfare gain in leisure $\beta$.

From (14) we can also see that when the union does not care for employment, i.e., when $\lambda = 0$, it manages to fully insulate the employed worker's utility from the change in worked hours. This is achieved by setting the real wage so that $d \log c / d \log h = \beta / \alpha$ (from (11) with $c = wh$ and $\delta = (\alpha - \beta) / \alpha$ from (8)): consumption (which declines) and leisure (which increases) exactly offset each other in the worker's utility function.

5 - Concluding Remarks:

When firms and trade unions optimally react to a reduction in the workweek imposed by the government, the expected work sharing effect depends on the amount of compensation for reduced income that the union will achieve by raising the hourly wage rate. If this compensation is moderate, because the representative worker enjoys leisure enough to accept a drop in consumption, employment will rise. On the other hand, if the workers insist for full compensation, there is an unambiguous adverse effect on unemployment.

These results have been obtained in a very simple framework and are subject to numerous caveats. The wage equation (6) is a simplified representation which has a strong effect: alternative versions do lead to different results. The trade union objective function is ad-hoc and the separability assumption is not innocuous. Also, there is no unemployment compensation and corresponding taxes which would enforce the solidarity between employed and unemployed workers. Finally, the model is entirely static and, in particular, the effect of a reduced workweek on capital accumulation is ignored. All these effects are important and should be kept in mind when interpreting the results. Yet, for a reduction in the workweek to result in an increase in employment, not only the representative worker must exhibit a rather strong taste for leisure, but also the trade union must be willing to defend the unemployed to the point of reducing the utility level of the employed worker.
Footnotes

1. The union might be concerned by the total utility level of employed workers as in $U = Nu + \Theta N^\lambda$. It can be shown that none of the qualitative results would be affected. Simply the optimal wage elasticity to worked hours would be increased (parameter $\delta$ in equation (8) below). A more satisfactory formulation would allow for unemployment compensation paid for by the employed workers.

2. Note that if the trade union does not care about employment, so that $\Theta$ or $\lambda$ are zero, we have a degenerate case.

3. As long as $\mu' < \mu/2$, $\mu'/(\mu-\mu') < 1$ and the condition is satisfied as $\gamma > 1$. Also, I have not introduced an upper bound on $h$ (below 24 hours) which would lead to a corner solution when the condition is not satisfied.

4. From (8) and (9c) $1 - \delta = [\beta + (\tau-\sigma) \lambda]/(\alpha + \tau\lambda)$, with $\tau > \sigma > 0$.

5. $-\sigma + \tau\delta = [\alpha(\tau-\sigma) - \beta\tau]/(\alpha + \tau\lambda)$. The denominator is always positive and the numerator is, by (9c), $(\alpha\mu - \beta)/(1 - \nu)$.

6. For example, with a constant elasticity $w = w_0 (h/h)^\gamma$, the solution is degenerate, requiring $\gamma = (\mu - \nu)/\nu$ and the firm is indifferent between various combinations of $N$ and $h$. 
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