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ABSENCE AND OVERTIME WORK: EMPIRICAL EVIDENCE FROM NORWAY

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Absence and overtime work: Empirical Evidence from Norway*

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Abstract

This paper presents both theoretical and empirical analyses of the relationship between overtime work and absence. Demand for absence is analysed under the assumption that workers in a given firm can be represented by one of two types of workers, denoted overemployed and underemployed. Increased demand for overtime hours has a non-positive effect on absence. If actual overtime pay is higher than the reservation wage, a higher demand for overtime hours will reduce absence. Otherwise absence is unaffected. On the other hand, demand for overtime increases if absence increases. The empirical analysis is carried out on quarterly panel data from 263 firms, covering the time period 1990-96. The empirical results confirm the theoretical predictions except from the effect of overtime hours on absence, where positive elasticities are estimated.

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1 Introduction

Does overtime work affect sickness absenteeism, and does sickness absenteeism affect overtime work? These are the two main questions addressed in this paper, where the aim is to uncover economic factors behind absence, with special focus on the relation between overtime work and absence. The paper contains theoretical models of the relationship between absence and overtime work, and gives empirical evidence on this relationship.

The topic of the paper should be of interest for at least two main reasons. First, most of the studies by economists on absenteeism are biased in the sense that they are almost solely based on supply side models.[1] A main problem by excluding the demand side of the labour market is that interpretations of empirical results are difficult as they may mixture both demand and supply side factors (Barmby and Treble, 1989). In this respect this paper differs from a lot of research on absenteeism as the demand and supply sides are taken simultaneously into account. Second, it is of general interest to obtain empirical estimates of the effects on absenteeism if the amount of overtime work changes, and *vice versa*. Such information is important in relation to for instance discussions on changes in working hours. If a reduction in normal (contract) working hours increases overtime work, which again increases sickness absenteeism, the expected positive welfare effects of reductions in working hours may be reduced. This is directly related to discussions of changes in rules for overtime work. The general rule in Norway is that a worker may work until 200 hours of overtime a year, and until 300 hours if the work is approved by the shop steward. However, this rule has come under pressure as employers wish to extend the 300 hours limit. The employee side is against an extension, arguing that it will increase working pressure. Empirical evidence on the relationship between sickness absenteeism and overtime work may thus add new arguments to the discussion of the length of the normal working day.

The empirical analysis is carried out on firm specific data referring to blue collar workers. In total we have quarterly data from 263 firms from the time period 1990-1996.

[1]For a review of this literature, see Brown and Sessions (1996).

The paper is organised in the following way. The next section presents a theoretical framework which we use to analyse absence and overtime decisions. The empirical model, including data and definitions of variables, and econometric issues, are given in Section 3. Section 4 gives the empirical results. A summary of the main findings is given in Section 5.

2 Theoretical Framework

In this section the relationship between absence and overtime hours is discussed within a standard framework of firm level labour supply and demand. We assume that absence decisions are taken by two types of representative employees but the firm may directly affect the decisions by demanding overtime hours at exogenously given rates of overtime pay. Indirectly the firm may affect absence if for instance overtime hours increase workers' tiredness so they need more hours absent to recover, or in general become more exposed to sickness with a lot of overtime work. Demand for overtime hours is outlined from a representative cost minimizing firm which may choose between normal (contract) working hours and overtime hours in order to satisfy a given level of production. The stock of capital is assumed fixed, given from the firm's long run optimization.

2.1 Absence

The basic model in this section is commonly used in absence research,[2] but the model is extended to discuss overtime work. This extension is to some degree based on Leslie (1982).

A fundamental assumption for this analysis is that workers in a given representative firm can be represented by one of two types of workers, denoted *overemployed* (*oe*) and *underemployed* (*ue*) workers. The working contracts are similar for both types of workers, and specify a fixed number of normal hours, H^C, each worker has to work during a specified period of time. The difference between these two groups is that the *ue-worker* is rationed with respect to working time, *i.e.*, (s)he wishes to work more than the specified number of normal hours, while the *oe-worker* wishes to work less than H^C. We assume that the firm demands overtime hours to which the workers respond voluntarily. Furthermore, it is assumed that conditions securing that

[2] See for instance *ibid.* and Dyrstad and Lysø (1998).

there is always excess supply of overtime work are met, and that those working overtime are hired randomly but they choose the length of overtime by themselves. The utility function of both types of workers is given by

$$V^i = V^i(C_i, L_i; S_i, Z), \quad i = oe,\ ue, \tag{1}$$

where C_i and L_i denote consumption and leisure, respectively. S_i is an index of sickness taking values between 0 and 1. The case $S_i = 0$ indicates that the worker is healthy and able to work efficiently, while $S_i = 1$ indicates that (s)he is completely unable to work. As mentioned above, both types of workers are employed in the same representative firm, so Z is a vector of variables describing working conditions in this firm. Higher values of Z indicate that working conditions worsen. The standard assumption of a strictly quasi-concave utility function is imposed.

The budget restriction for an *underemployed* worker is[3]

$$C = W^C[H^C - (1-k)H^A] + W^O H^O + F - P(H^A, U) \tag{2}$$

The variables W^C and W^O are the real disposable wage rates for normal hours (H^C) and overtime hours (H^O), respectively. H^A is number of hours absent from work, k is degree of economic compensation if absent from work, and F is non-labour income. If $k = 1$ the worker is fully compensated, while $k = 0$ implies no compensation. Non-labour income may range from dividends to disablement benefits.

The penalty function $P(H^A, U)$, which depends on individual absence and the rate of unemployment, U, is included because absence represents costs to the firm. A cost minimizing firm will try to reduce absence, and may for instance do so by holding out expectations of reduced fringe benefits and career opportunities if absence is high. Also, a higher probability of dismissal if the firm has to reduce employment may be important. As penalty in terms of reduced income depends on labour market conditions, penalty is higher when unemployment is high, also at the margin. We therefore assume that penalty is increasing and convex in H^A, *i.e.*, $\partial P/\partial H^A = P' > 0$, $\partial^2 P/(\partial H^A)^2 = P'' > 0$, and that $P(0, U) = 0$, $\partial P/\partial U > 0$ and $\partial^2 P/\partial H^A \partial U > 0$.[4]

[3]Subscript ue is dropped to simplify. We have also dropped subscripts in the following for the same reason.

[4]As long as $\partial^2 P/\partial H^A \partial U$ is non-negative, unambiguous effects of changes in the rate of unemployment are obtained from this model.

More leisure than what follows from working normal hours, L^C, is only possible if $H^A > 0$, which implies $L = L^C + H^A$. Letting total available time be denoted T, the individual time restriction for a *ue-worker* can be written as

$$L = T - H^C - H^O + H^A \tag{3}$$

From this setup we have the following four possible cases to analyse:

i) overemployed and *not* allowed to work overtime

ii) overemployed and allowed to work overtime

iii) underemployed and *not* allowed to work overtime

iv) underemployed and allowed to work overtime

Which of these cases we analyse affects the budget restrictions (2) and (3). In cases i)-iii) $H^O = 0$, *i.e.*, H^O drops out of the budget restrictions and the representative worker maximizes utility function (1) w.r.t. C and H^A. In case iv) $H^A = 0$, implying that the representative worker maximizes utility by choosing C and H^O. In the following we look at cases i)-iii) and iv) separately, and throughout we assume interior solutions.[5]

2.1.1 Overemployed and underemployed but not allowed to work overtime [cases i)-iii)]

Maximizing utility function (1) w.r.t. H^A and C, subject to the budget restrictions (2) and (3) with $H^O = 0$, gives the same marginal conditions for cases i)-iii), *i.e.*,

$$\frac{V_L}{V_C} = W^C(1-k) + P', \tag{4}$$

[5] Even if $k = 1$, this is not a particularly restrictive assumption. In this case the budget restriction is flat close to $H^A = 0$, which is due to the assumption $P(0, U) = 0$. So if the representative worker chooses $H^A = 0$, this implies that the indifference curve is also flat. It is difficult to see why contract hours in the economy, H^C, is chosen so low that the indifference curve of the *representative worker* is flat. In Norway k has been equal to 1 during our estimation period 1990-1996.

where $V_L = \partial V/\partial L$ and $V_C = \partial V/\partial C$. Equation (4) has the standard interpretation that the marginal rate of substitution between leisure and consumption equals the price of leisure, which is also the price of being absent from work. For all these three cases the relevant budget line is B_0-B_1in Figure 1. The optimal choice of consumption and absence in cases i) and ii) is illustrated by point A in Figure 1. Point B in Figure 1 gives the optimal choice for the rationed worker [case iii)]. From the first order conditions of this maximisation problem the absence relation corresponding to these three cases may be expressed as

$$H^A = f_0(W^C, k, U, S, Z, H^C, F) \tag{5}$$

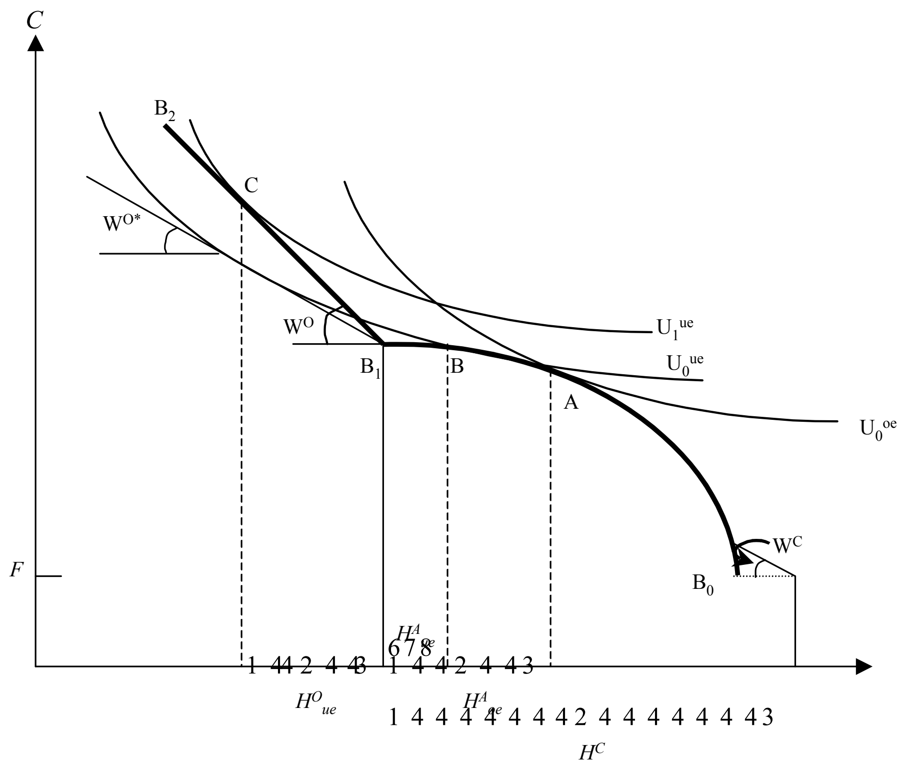

Figure 1: The absence decision

2.1.2 Underemployed and allowed to work overtime [case iv)]

In this case all types of workers are allowed to work overtime, but choosing $H^O > 0$ is only relevant for the *ue-worker*. If overtime pay is higher than

W^{O*}, this worker will choose $H^O > 0$ (and $H^A = 0$), as illustrated by point C in Figure 1. The reservation rate of overtime pay, W^{O*}, is given by indifference between working overtime and being absent from work. The corresponding first order condition is

$$\frac{V_L}{V_C} = W^O, \tag{6}$$

saying that the price of leisure is the rate of overtime pay. If overtime pay is not sufficiently high ($W^O < W^{O*}$), we get the same solution as given by equation (4). Thus the variables affecting absence in cases i)-iii) may also affect the *ue-worker*'s absence decision. The general absence relation for this type of worker could therefore be formulated as equation (5) augmented by H^O and W^O.

2.1.3 Aggregate absence and comparative statics

Based on the analyses in sections 2.1.1 and 2.1.2 we may now formulate an *aggregate* absence relation as:[6]

$$H^{TA} = f(W^C, k, U, S, Z, H^C, F, H^{TO}, W^O), \tag{7}$$

where H^{TA} denotes total absence. In line with the analysis in the preceding section, demand for total overtime work (H^{TO}) and overtime pay (W^O) are included in equation (7) to capture that some workers are underemployed and rationed. However, changes in H^{TO} and W^O will only affect aggregate absence if there is a sufficiently large number of workers with reservation rates of overtime pay higher than the actual rate. This assumption implies that there is always excess supply of overtime work. Furthermore, it is assumed that those who supply overtime work are hired randomly, and that each worker choose by their own how much overtime to work. Under these assumptions we get the following effects on aggregate absence of changes in H^{TO} and W^O.

Increased demand for overtime work reduces absence because there are always some workers who - by assumption - are rationed and willing to switch from being absent to work overtime, *i.e.*, $\partial H^{TA}/\partial H^O < 0$. By the same way of reasoning, if the rate of overtime pay increases, some workers who have

[6] As explained in the preceding section, the absence relation for the *ue-worker* could be fomulated in a similar way.

chosen to be absent because overtime pay is lower than (or equal to) their critical rates, will switch from absence to overtime work. Consequently, the effect on aggregate absence will be negative, and in the following we also refer to this effect as a substitution effect.[7] For those who have already chosen to work overtime before an increase in overtime pay, an increase in W^O will *not* affect absence, so the result $\partial H^{TA}/\partial W^O < 0$ is still valid.[8]

If the actual rate of overtime pay for all workers is lower than their reservation rates, it follows that changes in H^{TO} and W^O will not affect absence. We therefore conclude that more overtime work has a non-increasing effect on aggregate absence, while the effect of a higher rate of overtime pay is ambiguous.

Turning to the other variables in equation (7), we first look at changes in the contract wage (W^C). If all workers are overemployed or rationed, the sign of $\partial H^{TA}/\partial W^C$ is in general ambiguous. This is due to the assumption that leisure (absence) and consumption are normal goods, and the mechanisms are the same as for a change in W^O discussed above: The substitution effects reduce demand for absence because it becomes more expensive. The income effects go in the opposite direction, because a higher wage rate gives higher budgets.

A change in the contract wage rate may also affect demand for absence for non-rationed underemployed workers: If W^C increases, the relevant budget lines[9] will shift positively and parallel. This induces income effects which will reduce overtime work, and for some workers possibly to such an extent that they switch from working overtime to demanding absence. But because the effect of a higher contract wage is ambiguous for overemployed and rationed workers, we are still not able to sign $\partial H^{TA}/\partial W^C$ unambiguously.

The normality assumption gives unambiguous predictions of changes in degree of economic compensation (k) and unemployment (U). For overemployed and rationed workers, increased k means that absence becomes less

[7]The signs of $\partial H^{TA}/\partial H^O$ and $\partial H^{TA}/\partial W^O$ will be the same if we reason on *reductions* in demand for overtime work and overtime pay.

[8]The effect on the amount of overtime work these workers want to work is ambiguous, because we in this case have substitution and income effects operating in opposite directions: A higher rate of overtime pay will partially increase supply of overtime work as the substitution effect makes leisure more expensive. On the other hand, a higher rate of overtime pay increases the workers' budget, so the income effect goes in the opposite direction. The total effect on overtime work is therefore ambiguous.

[9]These budget lines correspond to B_1-B_2 in Figure 1.

expensive at the margin but also that the budgets increase, so in this case both the substitution and income effects contribute to more absence. A higher rate of unemployment gives reduced expected income through the penalty function. Thus the effect on absence is opposite to higher economic compensation, *i.e.*, $\partial H^{TA}/\partial U < 0$. We denote this unemployment effect as a discipline effect. However, only changes in economic compensation may affect the overtime/absence decisions of non-rationed underemployed workers.[10] The reason is that a higher k will increase the budgets and reduce steepness of the budget lines,[11] so that some of these workers may switch to positive absence demand, thus increasing aggregate absence. The total effect is therefore still unambiguously positive, *i.e.*, $\partial H^{TA}/\partial k > 0$.

Concerning the other variables, additional assumptions have to be imposed on the utility function to obtain unambiguous predictions. These predictions and corresponding assumptions will be discussed briefly in the following.[12]

Imposing the reasonable assumptions that marginal utility of leisure is non-decreasing in sickness (S), and that marginal utility of consumption is non-increasing in sickness, a higher degree of sickness gives more absence among overemployed and rationed workers. Graphically this means that the indifference curves become steeper when S increases. The same applies to deteriorating working conditions, *i.e.*, $\partial H^{TA}/\partial Z > 0$. For non-rationed underemployed workers it is not possible to get opposite effects, because higher rates of substitution between leisure and consumption may eventually switch some of these workers from overtime work to demanding absence.

Changes in normal hours (H^C) have in general ambiguous effects on absence for overemployed and rationed workers. However, if marginal utility of leisure is non-decreasing in consumption, an increase in H^Cwill unambiguously increase absence. The effect is also unambiguously positive if there is full economic compensation ($k = 1$) and no penalty $[P(H^A, U) = 0]$. In the case of non-rationed underemployed workers an increase in normal hours may increase absence through negative parallel shifts in the budget lines (income effects): Referring to Figure 1, an increase in H^C shifts point B_1 north-west

[10]A higher rate of unemployment will reduce expected income and make the budget lines steeper. Thus it is not possible that non-rationed underemployed workers will switch from overtime work to demanding absence.

[11]These budget lines correspond to B_0-B_1 in Figure 1.

[12]Formally outlined comparative static results, both of these and those presented above, can be obtained from the authors upon request.

along the ray from point F with angel w^C. Workers with high rates of substitution between leisure and consumption may therefore get higher levels of utility by switching from overtime work to absence.

Throughout this section we have assumed that leisure and consumption are normal goods. In the case of non-rationed underemployed workers an increase in non-labour income (F) may increase absence. The reason is that an increase in F creates both income and substitution effects for overemployed and rationed workers, but only income effects in the case of non-rationed underemployed workers. For non-rationed underemployed workers the mechanism is similar to an increase in contract wages, explained above.

2.2 Demand for overtime hours

Demand for overtime hours is analysed under the assumption that the firm's stock of capital is fixed, so this is a *short run* analysis. The number of *actual working hours per employee*, H, is given by

$$H = H^C - H^A + H^O \tag{8}$$

An important assumption in the following analysis is that an increasing amount of overtime hours relative to employment (normal working hours) yields a less efficient way of organizing production, and *vice versa*. This is a reasonable assumption because such work as clearing of factory halls, repairing and maintenance of machines are more efficiently done after the end of the normal working day.[13] On the other hand, if a large part of work has to be done after the end of normal working time efficiency is lowered, *e.g.*, because other firms are closed. This assumption is captured by the relation

$$H^* = g(NH^C, H^{TO}), \tag{9}$$

where H^* is total number of hours necessary to satisfy a chosen level of production, and $g(.)$ is a strictly quasi-concave function. Since H^C is exogenously given, the firm's choice of number of employees (N) and total overtime hours (H^{TO}) is restricted by (9).

For given total hours of absence (H^{TA}), total costs are given by

$$K = W^C H^C N - W^C(1 - k + d)H^{TA} + W^O H^{TO} + K_0, \tag{10}$$

[13]By "normal working day" we mean work within the spcified number of contract hours.

where d is the fraction of economic compensation not paid by the firm,[14] and K_0 is fixed costs.

Minimising total costs w.r.t. H^{TO} and N given restriction (9), and taking (8) into account, yields the first order condition

$$-\frac{dNH^C}{dH^{TO}} = \frac{g_{H^{TO}}}{g_{NH^C}} = \frac{W^O}{W^C}, \tag{11}$$

where $g_{H^{TO}} = \partial g / \partial H^{TO}$ and $g_{NH^C} = \partial g / \partial NH^C$. This condition states that the firm should combine H^{TO} and NH^C so that the relative productivity of these two types of work equals relative costs. The solution is illustrated by point A in Figure 2.

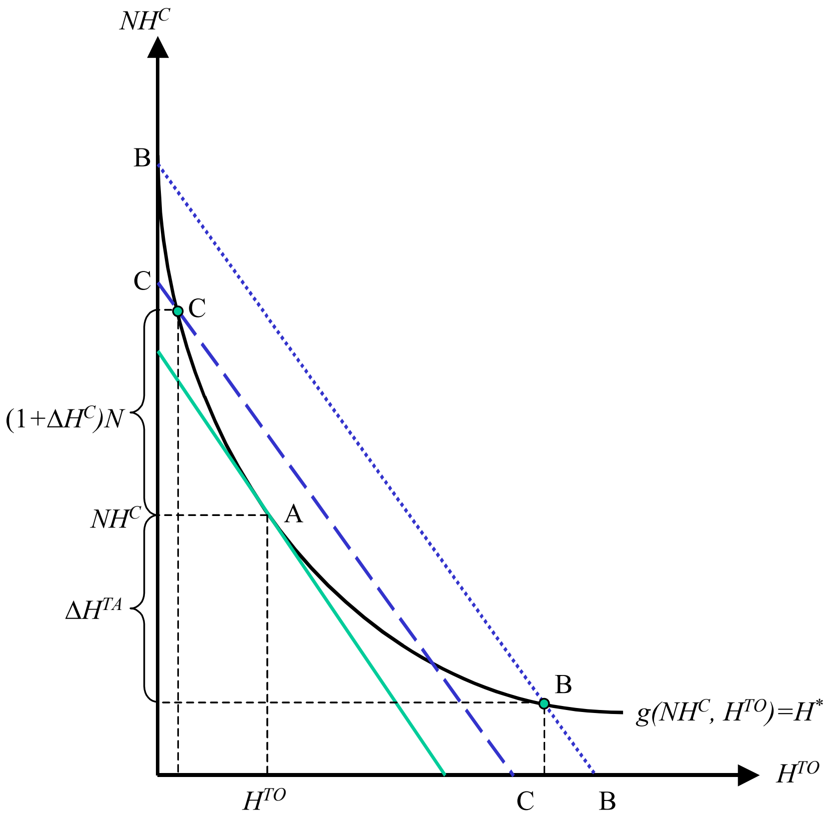

Figure 2: Demand for overtime hours

[14] For instance paid by National Insurance, to which employees also contribute.

The rate of overtime pay, W^O, is higher than the rate for normal working hours, W^C, so $W^O/W^C > 1$. Consequently, to obtain an interior solution to the cost minimising problem the slope of the contours of $g(.)$ has to be sufficiently smaller than -1 for low levels of H^{TO}. Otherwise the firm would use only normal working hours. But as mentioned above, it is not unrealistic to argue that some work is much more efficiently done after the end of the normal working day, implying a slope smaller than -1.

Within this short run set-up, the effect on overtime hours if absence increases is positive. This is illustrated in Figure 2, where an increase in absence by ΔH^{TA} gives solution B, and a corresponding iso-cost line B-B. It also follows directly from Figure 2 that an increase in normal hours by ΔH^C reduces demand for overtime hours, corresponding to point C and iso-cost line C-C.[15] Higher overtime pay increases steepness of the iso-cost lines, implying that demand for overtime hours will be reduced. The opposite applies if the contract wage increases. Assuming that both normal and overtime work are normal factors of production, an increase in H^* will increase H^O. On this background, a general relation for overtime hours can be written as

$$H^{TO} = h(W^O, W^C, H^{TA}, H^C; H^*) \tag{12}$$

3 Data and Empirical Modeling

The aim of this section is twofold. First, in section 3.1, we describe and discuss some features of the data which we use in the econometric analyses. We focus on main variables, and particularly relate the presentation to gender differences and differences w.r.t. the industries included in our sample. Secondly, in section 3.2, the econometric model is presented and issues related to the empirical modelling are discussed.

We use panel data from 263 firms covering the time span 1990-96 (7 years). Data on absence, overtime work, wages and employment refer to blue collar workers, and for most of these firms we have separate observations for both women and men in each firm. In 131 firms only data for one of the groups are available, due to incomplete reporting from the other group. In the other 132 firms we have data for both women and men. Thus we have (132x2+131=) 395 cross-sections, which with quarterly observations in

[15] In these two cases the firm is no longer optimally adjusted, *i.e.*, the iso-cost line is not tangent to the contour of $g(.) = H^*$.

total give 11,060 observations. This is therefore a balanced panel dataset. The firms are selected into this panel if they have continually been reporting absence data to the *Confederation of Norwegian Business and Industry* (NHO) in the time period 1990-96. Hence, to the extent that our empirical results are generalized to the whole population of firms one should be aware of selection biases.

3.1 Descriptive Statistics

Two tables will be presented in this section. Unweighted means and coefficients of variation (CV)[16] of absence rates, overtime hours, wages, employment and rates of unemployment for each of the years 1990-96 are given in Table 1. Separate calculations for men and women are presented. In Table 2 we present unweighted means and coefficients of variation of the absence rates and overtime hours by industry. As the specification of the econometric model in section 3.2 will show, we use *total* number of absence days and overtime hours in each firm in the econometric analysis, while we in Table 1 and 2 use absence days and overtime hours *per employee*.

About 63% of the cross-section units refer to male workers. On average each firm in our dataset employs 135 male and 44 female workers, which illustrates that the industries represented are traditionally dominated by male workers. Measured by employment, *iron and metal* is the largest industry in the sample (See Table 2). Those employed in the iron and metal industry do heavy physical work, so it is not surprising that only 30% of the cross-sections in this industry refer to women. On average there are 33 female and 186 male workers per firm. Another large industry in the sample is *food products, beverages and tobacco*, but in this industry 56% of the cross-section units are women. However, on average the industry has about 113 male workers and 76 female workers in each firm.

From Table 1 it is seen that we are using two categories of absence. *Short term absence* (*STA*) is defined as spells of absence due to sickness lasting until 3 days plus absence registered as shirking, whereas *long term absence* (*LTA*) is spells of absence due to sickness lasting 4 days or more.

Absence is generally higher among women than among men. On average the rate of LTA for women is about 50% higher than for men. However, the

[16]The coefficient of variation is defined as a variable's standard deviation divided by it's mean.

Table 1: Descriptive Statistics: Absence, Overtime Hours, Unemployment, Pay and Employment, by Gender

Variable	1990 mean *CV*	1991 mean *CV*	1992 mean *CV*	1993 mean *CV*	1994 mean *CV*	1995 mean *CV*	1996 mean *CV*	Total balanced sample mean *CV*	Total NHO sample mean *CV*
Rate of LTA men	3.80 *0.74*	3.65 *0.74*	3.41 *0.71*	3.22 *0.78*	2.98 *0.66*	3.17 *0.67*	3.41 *0.68*	3.38 *0.72*	3.27 *0.83*
Rate of LTA women	6.02 *0.72*	5.46 *0.71*	4.87 *0.81*	4.50 *0.81*	4.48 *0.81*	4.79 *0.77*	5.52 *0.78*	5.09 *0.78*	5.04 *1.09*
Rate of STA men	0.70 *0.56*	0.69 *0.59*	0.67 *0.60*	0.71 *0.58*	0.67 *0.57*	0.73 *0.56*	0.73 *0.54*	0.70 0.57	0.66 0.68
Rate of STA women	0.75 *0.70*	0.71 *0.68*	0.73 *0.67*	0.76 *0.72*	0.71 *0.64*	0.82 *0.70*	0.79 *0.89*	0.75 *0.73*	0.73 *0.99*
Overtime hours per employee, men	20.29 *0.82*	20.22 *1.00*	21.27 *1.60*	21.95 *1.50*	24.84 *1.97*	25.00 *2.01*	29.68 *3.28*	23.32 *2.14*	21.54 *1.83*
Overtime hours per employee, women	9.75 *1.50*	10.13 *1.40*	9.60 *1.48*	10.05 *1.60*	12.05 *1.75*	11.99 *1.94*	11.85 *1.67*	10.77 *1.67*	10.20 *1.62*
Rate of unemployment men	4.08 *0.27*	4.44 *0.26*	4.97 *0.27*	5.18 *0.26*	4.57 *0.29*	4.06 *0.30*	3.57 *0.32*	4.41 *0.30*	4.43 *0.32*
Rate of unemployment women	2.62 *0.33*	2.80 *0.30*	3.14 *0.29*	3.28 *0.29*	3.27 *0.27*	3.26 *0.27*	2.98 *0.27*	3.05 *0.30*	3.03 *0.32*
Overtime premium men	57.07 *0.35*	59.63 *0.34*	62.70 *0.35*	63.96 *0.34*	66.76 *0.36*	70.37 *0.39*	72.83 *0.38*	64.76 *0.37*	63.91 *0.41*
Overtime premium women	52.49 0.46	57.09 0.76	58.38 0.40	61.32 0.52	62.27 0.42	65.46 0.39	67.20 0.34	60.60 *0.48*	61.21 *0.71*
Normal wage rate men	82.10 *0.14*	86.10 *0.13*	88.47 *0.12*	90.58 *0.12*	93.32 *0.12*	95.90 *0.12*	99.67 *0.12*	90.88 *0.14*	90.22 *0.14*
Normal wage rate women	77.89 *0.13*	82.06 *0.11*	84.66 *0.11*	87.07 *0.11*	89.43 *0.11*	92.13 *0.11*	95.43 *0.11*	86.95 *0.13*	85.62 *0.14*
Number of workers men	141.78 *1.46*	138.20 *1.50*	134.23 *1.54*	132.54 *1.56*	131.90 *1.52*	133.42 *1.49*	133.71 *1.47*	135.11 *1.50*	104.63 *1.64*
Number of workers women	49.58 *1.32*	46.08 *1.29*	44.63 *1.28*	43.17 *1.26*	41.87 *1.20*	40.77 *1.19*	40.96 *1.16*	43.87 *1.25*	30.76 *1.48*

Notes: Rates of short (STA) and long term absence (LTA) are given by total absence days per employee per quarter. Rates of unemployment are given by number of persons registered as unemployed in per cent of the working force in each municipality. Overtime is defined as number of overtime hours worked per employee per quarter. The overtime premium is additional nominal earnings per hour of overtime work and normal wage rate is nominal hourly earnings for work within normal working day. Number of workers is number of persons working in the firm per quarter.

corresponding difference for STA is only 7%. There are several explanations to these differences, *e.g.*, pregnancies and child care. In physically demanding industries, differences in physical constitution between men and women could also be an important factor.

The lowest means are observed in 1994 for both STA and LTA (women and men). For STA the rates stay rather constant, varying in the intervals 0.67-0.73 (men) and 0.71-0.82 (women). On the other hand, there is more variation in the rates of LTA. The two highest observed means (in 1990) are about 22-25% higher than the means in 1994. There is also a clear pattern of falling LTA-rates until 1994, but from then on they increase. Concerning variation between the firms, the changes seem too small and not systematic w.r.t. time.

We define *overtime work* in Table 1 as number of overtime hours worked per worker. A striking but not surprising feature concerning overtime work is that men on average work more than twice as much overtime as women. It is reasonable that more household work and child care among women may explain this difference. Overtime work is relatively stable for both women and men from 1990 to 1993. From 1993 to 1994 the increase was 13% for men and 20% for women. For men there was also a sharp increase from 1995 to 1996 (19%), whereas overtime work among women stayed relatively stable after 1994.

Both absence and overtime work have break points around 1993/94, as is also the case for the *rates of unemployment*.[17] Both male and female unemployment rates increased gradually and approximately equally from 1990 to the peak in 1993. Unemployment among men increased by 27%, while the female rate of unemployment increased by 25% in this period. However, the drops in unemployment after 1993 differ between women and men. From 1993 to 1996 the male rate of unemployment is reduced by 31% but only by 9% for women.

It is not unreasonable that unemployment affects absence and overtime work. In the period of increasing unemployment (1990-93) we see from Table 1 that LTA is reduced but increases in the period of decreasing unemployment (1993-96), indicating an inverse relationship between unemployment and absence. Overtime work increases slightly during the period of increas-

[17]We use municipality specific rates of unemployment, so the unemployment variation is due both to differences between municipalities and between the quarters in the given year.

ing unemployment. During the period of decreasing unemployment overtime work increases more, particularly among men. A possible explanation to this picture is that firms during a recession substitute hiring of additional workers with more overtime due to uncertainty about the future. Hence, the relatively sharp increase in overtime work in the recovering period has to be explained by recruiting problems because the labour market tightens. In relation to this it is interesting to note that there is an increase over time in the variation between firms regarding overtime work, which may indicate differences regarding recruiting possibilities and uncertainty.

Two wage variables are important in this paper, in Table 1 denoted *overtime premium* and *normal wage rate*. The overtime premium is additional average *nominal* earnings per hour of overtime work, and the normal wage rate is *nominal* hourly earnings for work within the normal working day. These wage variables are the same as the ones used in the econometric analyses, except that they are deflated by consumer prices. For the period 1990-96, the average overtime premia are approximately NOK 65 and NOK 61 for men and women, respectively. This difference between women and men may reflect that men work more overtime hours than women and/or that men often are more able to work during hours with high overtime pay, for instance late nights and long hours. The overtime premia increased by 28% for both women and men during this period, while normal wage rates increased by 21% for male workers and 22.5% for female workers from 1990 to 1996. From Table 1 we see that the variation between firms regarding normal wage rates is very stable. Due to the changes in overtime work mentioned above it is not surprising that there is more variation in overtime premia.

Number of workers is the last variable in Table 1, and as already mentioned, on average there are 135 male and 44 female workers in each firm in our sample in this period.

The last column in Table 1 (*Total NHO sample*) shows averages of the variables for the period 1990-96 if we use the total NHO sample, and not only the balanced panel which we are using in this paper. The total NHO sample referred to in Table 1 is a representative sample of the firms which are members of NHO. Dyrstad and Skramstad (1998) find that the development in employment in all NHO firms and the total population of firms in eleven main industries from National Accounting is very similar over the time period 1970-1996. This is an indication that the total NHO sample is representative. It is therefore interesting to note that averages of the variables in Table 1 are very similar in the total balanced sample (second last column in Table

1) and the total NHO sample. The only exception is employment, where the averages from the total balanced sample are higher than the averages from the total NHO sample, indicating that large firms are overrepresented in the sample which we are using[18]. However, the ratio between women and men is exactly the same.

Table 2 gives means and coefficients of variation (CV) of absence and overtime hours by industries. The first column shows the distribution of industries in the sample. Iron and metal counts for more than 20% of the sample closely followed by food products, beverage and tobacco. The petrochemical industry is only represented by one firm, and data for both women and men are reported for this firm. Also transport is represented by only one firm, and here only data for men are available because of missing data for women. Textile and clothing, chemicals and chemical products, electrochemicals, and building and construction are each reported by 10% of the sample. The distribution of industries in the total NHO sample is given in the second column, and we see that the distributions are very similar in the two samples.

Both the rates of LTA and STA show that there are important differences between the industries regarding absence. On average (both women and men) the rate of LTA is 4.1 and the rate of STA 0.75. Both STA and LTA are highest in mining, quarrying and oil extraction, and food products, beverages and tobacco. LTA is also high in production of pulp, paper and paper products. Petrochemicals and transport have the lowest rates of LTA, but one have to keep in mind that only one firm in each of these two industries is included in the sample. Except from these two industries, building and construction, and publishing and printing have the lowest rates of LTA. These two industries also have the lowest rates of STA.

Concerning overtime work there is also a lot of variation between industries. In transport the average number of overtime hours per worker is nearly 45. It is reasonable that this is an industry with a large number of overtime hours but again it should be remembered that this figure refers to only one firm. Otherwise, workers in iron and metal, petrochemicals, and food products, beverages and tobacco work a lot of overtime. We calculate the lowest number of overtime hours in textiles and clothing, and wood and wood products.

[18] This is not strange as large firms often have better routines on reporting data than smaller firms which may not have special staff or divisions for these tasks.

Table 2: Descriptive Statistics: Industry Differences

Industry	**% of Total balanced sample**	**% of Total NHO sample**	**Rates of LTA** Mean *CV*	**Rates of STA** Mean *CV*	**Overtime hours** Mean *CV*
Mining, quarrying and oil extraction	1.56	1.22	5.03 *0.72*	0.89 *0.56*	16.12 *0.71*
Food products, beverages and taobacco	19.96	24.51	4.53 *0.65*	0.83 *0.61*	22.47 *1.18*
Textiles and clothing	10.19	7.42	3.76 *0.93*	0.63 *0.81*	10.48 *1.15*
Wood and wood products	4.56	7.10	3.57 *1.06*	0.69 *0.76*	12.58 *0.74*
Pulp, paper and paper products	6.84	6.12	4.84 *0.68*	0.65 *0.52*	17.25 *0.75*
Publishing and printing	2.78	2.93	3.46 *0.89*	0.52 *0.70*	14.29 *0.80*
Chemicals and chemical products	9.81	8.54	4.25 *0.76*	0.77 *0.55*	13.00 *0.96*
Non-metallic mineral production	4.75	4.43	4.30 *0.91*	0.70 *0.64*	15.15 *0.91*
Electrochemicals	8.67	6.42	3.87 *0.71*	0.69 *0.55*	15.37 *0.72*
Petrochemicals	0.51	0.23	1.63 *0.65*	0.49 *0.37*	22.81 *0.72*
Iron and metal	20.76	21.74	3.66 *0.80*	0.76 *0.62*	28.58 *2.93*
Building and construction work	9.37	8.52	3.44 *0.94*	0.60 *0.67*	13.24 *0.97*
Transport	0.25	0.44	2.72 *0.53*	0.94 *0.39*	44.46 *0.36*
Total mean of industries			4.10	0.75	19.89

3.2 Empirical Modeling

The empirical analysis is based on the following error correction model:

$$\begin{aligned} h^{TA}_{ijst} &= \alpha_{i0} + \alpha_{i1} h^{TA}_{ijst-1} + \alpha_{i2} w^{N}_{jst} + \alpha_{i3} w^{O}_{jst} + \alpha_{i4} u_{mst} \\ &\quad + \alpha_{i5} n_{jst} + \alpha_{i6} h^{TO}_{jst} + dummies + error\ term \end{aligned} \tag{13}$$

$$\begin{aligned} h^{TO}_{jst} &= \beta_0 + \beta_1 h^{TO}_{jst-1} + \beta_2 w^{N}_{jst} + \beta_3 w^{O}_{jst} + \beta_4 u_{mst} \\ &\quad + \beta_5 h^{TA}_{3jst} + \beta_6 h^{TA}_{4jst} + \beta_7 n_{jst} + dummies + error\ term \end{aligned} \tag{14}$$

Subscript i refers to duration of absence spells, with duration divided into the two categories mentioned in the preceding section: i=3 refers to absence spells lasting until 3 days plus absence registered as shirking, while i=4 refers to sickness spells lasting 4 days or more. As in Section 3.1, the first category will be referred to as short term absence (*STA*) and the second as long term absence (*LTA*).[19] Subscript j is the firm index, and s and t refer to gender and time, respectively.

The variables in equations (13) and (14) are defined as follows:

h^{TA}_{ijst} :Total number of days of absence, log-transformed. *Source:* Confederation of Norwegian Business and Industry.

w^{N}_{jst} :Average wage rate for normal working hours deflated by the national consumer price index. The average wage rate is defined as total earnings from work within the normal working day divided by the total number of normal working hours, log-transformed. *Source:* Confederation of Norwegian Business and Industry and Statistics Norway.

w^{O}_{jst} :Average overtime premium deflated by the national consumer price index, log-transformed. Overtime premium is pay in excess of the normal wage rate due to overtime work, which is calculated by dividing total overtime allowances by total number of overtime hours. *Source:* Confederation of Norwegian Business and Industry and Statistics Norway.

[19]But now we are using total number of absence days, not rates of absence.

u_{mst} :Aggregate municipality and gender specific unemployment rate, log-transformed, where m refers to municipality. *Source:* Statistics Norway.

n_{jst} :Number of workers, log-transformed. *Source:* Confederation of Norwegian Business and Industry.

h_{jst}^{TO} :Total number of overtime hours worked, log-transformed. *Source:* Confederation of Norwegian Business and Industry.

The term *dummies* both in equation (13) and (14) comprises one dummy for *gender* (taking the value 1 if referring to men, otherwise 0), one set of *time dummies* each corresponding to the years 1990-1995, and one set of *seasonal dummies* (quarters).

Comparing the empirical and theoretical models, we see that they differ w.r.t. right hand side variables. Variables measuring degree of economic compensation (k), sickness (S), working conditions (Z), normal working hours (H^C), non-labour income (F) and production level (H^*) are not included in the empirical model. The reason for this is partly that it is not possible to obtain data corresponding to our units of observation, and partly because there have not been any changes in some of these variables. For instance, normal working hours have stayed constant in the period 1990-96. There have been some changes in degree of economic compensation in the estimation period, and possible effects of these changes are assumed to be captured by the time dummies. To this it should also be added that the seasonal dummies may represent important external factors affecting sickness, and consequently sickness absenteeism: During winter time there is more flu and respiratory related sickness. Finally, overtime hours in the absence relation may not only be interpreted as a pure demand factor as in the theoretical model. Overtime hours may also capture working pressure, so more overtime hours increases absence.[20]

The rate of unemployment is included in equation (14) to pick up possible effects mentioned in connection to Table 1. It is obvious that large firms have more days of absence and more overtime hours than small firms. We control for this by including employment in both equations.

[20]Future projects involve collecting data on changes in working conditions at the firm level so it becomes possible to analyse empirically to what extent working conditions may affect sickness absenteeism.

The model consists of three equations; two absence relations corresponding to short and long term absence, and one equation for overtime. The parameters in these equations are estimated by ordinary least squares (OLS), and the fixed effects (FE) and random effects (RE) estimators are also applied. To discriminate between the OLS and FE versions of the model we have used standard F tests. Based on Leamer's (1978) critical values for these tests we cannot reject none of the OLS versions which have been estimated.[21] Testing the RE versions against FE the Hausman tests reject the RE models. From this sequence it follows that the modeling should be based on the OLS estimator.

The FE results are given in Appendix 1. Explanatory power is higher in these models than the OLS models (See Tables 3 and 4), but absence and overtime work in the FE models are mainly explained by the varying intercepts and the time dummies. Most of the economically interpretable variables are statistically not different from zero. The firms in our sample are all members of NHO, and it is reasonable to assume that all these firms are covered - directly and indirectly - by central and local tariff agreements which first and foremost regulate pay for different forms of work. This system of tariff agreements creates work and pay structures which seem stable over time, c.f. the discussion of wages and overtime work related to Table 1. On this background it is not surprising that the OLS models are not rejected against the FE models, because main parts of this structure is captured by the varying intercepts.

In order to apply the OLS, FE and RE estimators all the right hand side variables have to be exogenous, which they are not according to the theoretical model. The equations are therefore estimated by the instrumental variables method (IV). The parameters in the absence equations are both overidentified, while the parameters of the overtime relation are exactly identified. However, overidentifying restrictions are imposed on all three equations, and the Sargan tests[22] of overidentifying restrictions cannot reject the null hypotheses of valid instruments. In the STA and LTA equations we use Δh_{t-1}^{TO} and h_{t-1}^{TO} as instruments.[23] The variables Δh_{3t-1}^{TA}, h_{3t-1}^{TA}, Δh_{4t-1}^{TA}

[21]By conventional critical values the OLS models are rejected. The reason for using Learmer's critical values is that the null hypothesis is too often rejected when the sample size is large. Leamer's critical values are implemented in the TSP version 4.4, which has been used when estimating til OLS, RE and FE models.

[22]Sargan (1988).

[23]Δ denotes first difference.

and h^{TA}_{4t-1} are instruments in the overtime relation.[24] The next section gives the OLS and IV estimates, and there are only minor differences between these two sets of estimators. Hence, the sequence for model selection seems consistent.

4 Empirical Results

Parameter estimates of the absence relations are given in Table 3. In addition to the full sample OLS and IV versions, we have also estimated the models on sub-samples. All these models explain about 50% of the variation in absence, and the Durbin-Watson statistics indicate no first order serial correlation in the error terms. The reported t-values are based on heteroskedastic consistent standard errors (White, 1980). The estimated parameters of the lagged endogenous variables indicate short periods of adjustment, which correspond to rather small differences between short and long run estimates. In the following we first comment on the full sample results.

Before turning to the parameters which are most directly related to the topic of this paper, we note that absence among women is estimated to be significantly higher as compared to men. Absence during winter time (first and fourth quarter) is significantly higher than during summer time (second and third quarter), which is according to expectations. The year dummies affect absence statistically more significant in the IV version than the OLS version of the STA equation, but the parameter estimates are very similar in both versions. Concerning LTA both levels of significance and estimates are similar.

The estimated *unemployment* elasticities are small and highly insignificant. Dyrstad and Lysø (1998), using aggregate time series data from the period 1970-96, estimate long run unemployment elasticities close to -0.2 for short term absence, and close to -0.05 for long term absence. If we estimate the models without year dummies and/or quarter dummies the unemployment elasticities become larger in absolute value and also much more significant. Except from the unemployment elasticity, the other parameters are not affected at all.[25] Concerning STA, the unemployment elasticity is close to

[24]The IV versions of the model are estimated by the GMM estimator implemented in DPD (GAUSS), see Arrelano and Bond (1998).

[25]Only the elasticity w.r.t. w^N_{jst} is affected, and varies betweeen -0.36 and -0.45.

-0.1 if we exclude both sets of time dummies or the quarter dummies.[26] For LTA the unemployment elasticities are in the interval -0.15 - -0.09. These estimates differ from those obtained by Dyrstad and Lysø, as the effect on STA is smaller than they estimate, while the effect on LTA is larger. From this it is clear that the small and insignificant unemployment elasticities in the OLS and IV versions presented in Table 3 are due to the inclusion of time dummies.

The estimated elasticities w.r.t. *firm specific employment* are larger than one, saying that an increase in employment by one per cent increases the number of days absent from work relatively more.[27] These results may simply be interpreted as firm size effects, *i.e.*, large firms have relatively more absence than smaller firms. However, as the elasticities are greater than one this could be interpreted as composition effects; when number of employees increases firms hire more and more "marginal" labour so that absence increases more than proportionally. It is interesting to note that this effect is stronger for STA than LTA.

Higher wages, both higher *normal wage rates* (w^N_{jst}) and *overtime premia* (w^O_{jst}) are significantly negative in the STA relation. The elasticity w.r.t. the normal wage rate is also significantly negative in the LTA relation. According to the theoretical model these results should be interpreted as dominating substitution effects. Looking only at the elasticity w.r.t. normal wages, it seems as the substitution effects are stronger for long term than for short term absence.[28] However, the differences are not statistically different

These results could alternatively be interpreted as composition effects. We are using firm specific data, and if low-wage firms attract the least productive workers, including workers with the highest rates of absence, we expect a negative relation between absence and wages. However, the fact that Dyrstad and Lysø (1998) on time series data also estimate negative elasticities for LTA support the interpretation of dominating substitution

[26] If we include only the quarter dummies the estimate is -0.6.

[27] It is only the estimate of the OLS version of the STA equation which is statistically larger than one. Imposing the restriction that this parameter equals one does not change the other parameter estimates.

[28] This result is in line with the results obtained by Dyrstad and Lysø (1998), in the sense that the direction of the difference between these wage elasticities in the STA and LTA relations is the same. They estimate negative wage elasticities for LTA but positive for STA. Their explanation to this is that it is more likely that income effects dominate for short absence spells than for long spells because the budget restriction is flatter in the former cases.

effects.

Changes in overtime premia (w^O_{jst}) affect STA significantly negative, which again and consistently have to be interpreted as substitution effects. The corresponding elasticities for LTA are not significantly different from zero. According to the theoretical model we thus expect that more overtime will reduce STA and not affect LTA, but this is not the case. The estimated effects of more *overtime work* are significantly positive for both STA and LTA, *i.e.*, contrary to the theoretical predictions.

The estimated model is not a real test of the theoretical predictions of overtime on absence because more overtime work may increase working pressure so that sickness and absence among workers increase, c.f. our comments to the model specification in the preceding section. Consequently, the positive estimates may be due to dominating pressure effects. The estimated effect on LTA is larger than on STA, which give some support to this interpretation. Because the adjustment period is longer for LTA than for STA, the long run elasticities based on the OLS estimates underline such a difference. If we assume that there is more serious sickness among those on long term absence spells we would expect that the effect on LTA is larger than the effect on STA.

Table 4 gives the estimates of the overtime equation, and it should be noted that the differences between the OLS and IV estimates are small with the exception of the parameter in front of LTA (h^A_{4jst}). Explanatory power measured by R^2 is slightly above 60 per cent and there is no indication of serious first order serial correlation in the error terms. Also in Table 4 heteroskedastic consistent standard errors are used. Most of the year dummies are not significantly different from zero but there are significant seasonal variations in overtime work. It should also be noted that the period of adjustment is longer for overtime work as compared to absence, implying larger differences between short and long run effects.

The *gender* effect is estimated to approximately 0.4. This result is according to the picture given in Table 1 of more overtime work among men than among women. The estimated effect of the *employment* variable (n_{jst}) could be interpreted as a firm size effect saying that larger firms use more overtime work than smaller firms. However, the result could also be interpreted as a scale effect, because if firms hire more workers in order to increase production, this can be done by both increasing employment and overtime work. This explanation is consistent with the theoretical model. The argument that more workers are hired at the cost of getting more "marginal"

Table 3: Parameter Estimates - Absence

Explanatory Variables	***Short term absence***				***Long term absence***			
	OLS	***IV***	***OLS 1990-1993***	***OLS 1993-1996***	***OLS***	***IV***	***OLS 1990-1993***	***OLS 1993-1996***
h^{TA}_{isjt-1}	0.22	0.21	0.23	0.23	0.38	0.37	0.41	0.35
	9.93	*6.82*	*7.85*	*7.65*	*19.22*	*13.67*	*14.98*	*14.09*
w^{N}_{jst}	-0.48	-0.54	-0.40	-0.76	-0.61	-0.70	-0.85	-0.50
	2.41	*1.59*	*1.53*	*2.73*	*2.44*	*1.76*	*2.75*	*1.30*
w^{O}_{jst}	-0.32	-0.33	-0.30	-0.35	0.03	0.04	0.16	-0.11
	4.51	*3.50*	*3.02*	*3.65*	*0.32*	*0.31*	*1.47*	*0.83*
u_{mst}	-0.03	-0.01	-0.13	0.10	-0.04	-0.01	-0.02	-0.03
	0.65	*0.14*	*1.78*	*1.57*	*0.57*	*0.12*	*0.25*	*0.39*
h^{TO}_{jst}	0.04	0.06	0.04	0.04	0.05	0.09	0.04	0.06
	3.43	*2.33*	*2.76*	*2.58*	*3.82*	*2.84*	*2.43*	*3.02*
n_{jst}	1.14	1.12	1.12	1.14	1.08	1.05	1.02	1.15
	30.08	*15.90*	*22.35*	*21.90*	*25.98*	*14.26*	*18.24*	*20.07*
Gender	-0.13	-0.16	-0.06	-0.20	-0.51	-0.54	-0.50	-0.49
	2.86	*1.93*	*0.80*	*3.36*	*7.71*	*4.98*	*5.27*	*5.60*
Y1990	-0.11	-0.13	0.02	—	-0.02	0.04	0.15	—
	1.57	*2.02*	*0.24*		*0.25*	*0.45*	*1.57*	
Y1991	-0.17	-0.17	-0.07	—	-0.02	-0.02	0.16	—
	2.60	*3.09*	*1.01*		*0.23*	*0.20*	*1.80*	
Y1992	-0.10	-0.10	0.01	—	-0.08	-0.08	0.09	—
	1.50	*2.01*	*0.21*		*0.97*	*1.26*	*1.07*	
Y1993	-0.12	-0.12	—	—	-0.18	-0.18	—	—
	1.69	*2.14*			*2.01*	*2.02*		
Y1994	-0.12	-0.13	—	0.04	-0.21	-0.22	—	-0.01
	1.88	*2.44*		*0.58*	*2.34*	*3.32*		*0.12*
Y1995	0.04	0.04	—	0.22	-0.12	-0.12	—	0.09
	0.70	*0.84*		*2.89*	*1.34*	*1.62*		*0.84*
Y1996	—	—	—	0.20	—	—	—	0.21
				2.48				*2.01*
Q2	-0.54	-0.54	-0.73	-0.36	-0.32	-0.30	-0.29	-0.33
	10.49	*10.96*	*10.22*	*5.13*	*4.52*	*4.66*	*3.17*	*3.23*
Q3	-0.51	-0.52	-0.62	-0.41	-0.31	-0.32	-0.30	-0.37
	10.04	*9.77*	*8.97*	*5.72*	*4.59*	*5.23*	*3.23*	*3.77*
Q4	0.05	0.05	-0.07	0.28	0.17	0.16	0.15	0.24
	1.09	*0.88*	*1.12*	*3.94*	*2.63*	*2.35*	*1.71*	*2.50*
Constant	1.61	1.97	0.77	3.16	1.37	1.83	1.88	1.06
	1.95	*1.31*	*0.72*	*2.68*	*1.28*	*1.08*	*1.46*	*0.66*
R^2	0.53	0.53	0.53	0.54	0.50	0.50	0.51	0.50
SEE	1.81	1.82	1.86	1.82	2.41	2.42	2.35	2.51
DW	2.01	—	1.96	1.91	2.06	—	1.98	1.98
Sargan	—	0.84	—	—	—	0.32	—	—
Number of observations	10665	10270	5925	5925	10665	10270	5925	5925

Notes: t-values based on robust standard errors are reported below the coefficients (White, 1980). R^2 is adjusted for degrees of freedom. The Durbin-Watson statistics (DW) are computed within individual units (Bhargava, Franzini and Narendanantham, 1982). Sargan is the Sargan-Hansen test of the overidentifying restrictions, where the p-values are reported (Sargan1988). SEE is standard error of regression. Instruments used in the instrumental variables method (IV) are first differenced lagged values and lagged levels of overtime.

labour also implies more overtime work.

The estimated *wage elasticities* are in accordance with the theoretical predictions: A higher normal wage rate increases overtime work whereas a higher overtime premium has the opposite effect. The estimated effects are unreasonably large and highly significant. Based on these estimates, the long run elasticities w.r.t. normal wages and overtime premia are approximately 3.8 and -1.8, respectively. This means that if both the normal wage rate and the overtime premium increase by one per cent overtime work increases by 2 per cent in the long run.

Unemployment affects overtime work negatively, which to some extent is according to the picture in Table 1. The estimated long run elasticity is approximately -0.4, so if the rate of unemployment doubles, overtime work is reduced by 40 per cent. As mentioned in connection to the discussion of data in Section 3.1, there are at least two explanations to this inverse relationship. First, high unemployment corresponds to low production, which directly reduces demand for overtime work. Secondly, in periods with low unemployment it is in general more difficult to get workers, so that overtime work has to be increased.

Short term *absence* does not affect overtime significantly in the IV model, whereas the OLS estimate is different from zero at the 7 per cent level of significance (one tail test). LTA has a statistically significant effect in the OLS model, and the estimate is much larger but not significant when the IV estimator is applied. The IV estimate implies a long run elasticity of 0.19. In order to illustrate this effect we can use overtime and absence data from the "average firm" in our dataset. This firm has about 2,200 overtime hours and 370 days of long term absence per quarter. If long term absence increases by one day, overtime hours increase by 1.4 hours in such a firm, which sounds reasonable. As illustrated in Table 1 there have been large changes in overtime work, both over time and between firms, and based on our estimates absence changes may count for a large part of these changes.

As shown in Table 3 and Table 4, the absence and overtime relations have also been estimated on the sub-periods 1990-93 and 1993-96. The first period corresponds to the period of increasing unemployment, while the second corresponds to decreasing unemployment, c.f. the discussion in relation to Table 1. Most of the estimates are similar irrespective of estimation period, but there are some important differences, particularly regarding STA: Seasonal variation seems to be more important in the period of increasing unemployment. The estimated parameters indicate that STA is considerably

Table 4: Parameter estimates - Overtime

Explanatory Variables	Overtime Hours			
	OLS	***IV***	***OLS 1990-1993***	***OLS 1993-1996***
h^{TO}_{isjt-1}	0.63 *33.10*	0.63 *13.72*	0.62 *24.50*	0.64 *24.56*
w^{N}_{jst}	1.39 *5.30*	1.44 *2.95*	1.69 *4.44*	1.23 *3.85*
w^{O}_{jst}	-0.67 *8.76*	-0.68 *3.94*	-0.78 *7.14*	-0.61 *6.20*
u_{mst}	-0.16 *2.65*	-0.15 *2.04*	-0.16 *1.72*	-0.20 *3.24*
h^{TA}_{3jst}	0.03 *1.47*	0.02 *0.20*	0.03 *1.13*	0.03 *0.97*
h^{TA}_{4jst}	0.03 *2.40*	0.07 *1.74*	0.04 *2.10*	0.03 *1.36*
n_{jst}	0.50 *11.24*	0.46 *3.75*	0.53 *8.97*	0.50 *8.46*
Gender	0.36 *6.14*	0.38 *3.40*	0.42 *4.65*	0.33 *4.46*
Y1990	-0.08 *0.93*	-0.07 *0.75*	-0.05 *0.55*	—
Y1991	-0.13 *1.75*	-0.13 *2.14*	-0.08 *0.96*	—
Y1992	-0.03 *0.45*	-0.03 *0.61*	0.02 *0.30*	—
Y1993	-0.06 *0.73*	-0.05 *0.84*	—	—
Y1994	0.07 *1.02*	0.08 *1.75*	—	0.03 *0.32*
Y1995	-0.04 *0.53*	-0.03 *0.57*	—	-0.09 *0.98*
Y1996	—	—	—	-0.05 *0.56*
Q2	0.27 *4.16*	0.28 *3.20*	0.33 *3.46*	0.17 *2.04*
Q3	0.23 *3.72*	0.23 *2.75*	0.36 *4.05*	0.12 *1.43*
Q4	0.37 *5.99*	0.37 *4.53*	0.46 *5.22*	0.27 *3.18*
Constant	-4.53 *4.42*	-4.63 *2.59*	-5.72 *3.85*	-4.03 *3.24*
R^2	0.64	0.64	0.63	0.65
SEE	2.15	2.15	2.21	2.12
DW	2.27	—	2.11	2.23
Sargan	—	0.98	—	—
Number of observations	10665	10270	5925	5925

Notes: See Table 3. Instruments used in the instrumental variables method (IV) are first differenced lagged values and lagged levels of both absence variables.

lower during summer time than in the period of decreasing unemployment. The unemployment elasticity is larger in absolute value and more significant in the period 1990-93. In fact, the estimated unemployment elasticity in the period 1993-96 is positive but not significantly different from zero. The estimated gender effects imply that STA among women is higher during a period where labour markets improve: Statistically there is no gender difference in the period of increasing unemployment.

These results are reasonably interpreted in the context of discipline mechanisms. This interpretation is underlined if we look at the sub-sample estimates for LTA and if we have in mind that it is reasonable to assume that there is more serious sickness among those on long term absence spells than among those on short term spells, and consequently that it is more difficult to discipline LTA. The sub-sample estimates of the LTA relations indicate no differences w.r.t. unemployment and gender effects, and the seasonal differences are much smaller.

There are also some differences between the sub-sample estimates w.r.t. the wage variables. However, it is difficult to give plausible interpretations to these differences, and they seem to be of minor importance.

Concerning the sub-sample estimates of the overtime relation, the two most important differences are related to the wage and unemployment effects. The wage effects are stronger in the period of increasing unemployment, while changes in unemployment seem to be more important in the period of decreasing unemployment. However, none of these differences are statistically significant.

5 Concluding Remarks

The topic of this paper has been to analyse theoretically and empirically the relationship between overtime work and absence. Theoretically the effects on absence of changes in demand for overtime hours depend on the reservation wage for overtime work. If the actual rate of overtime pay is higher than the reservation wage, more overtime work will reduce absence. In this case an increase in the overtime premium will also reduce absence. If the actual rate of overtime pay is less or equal to the reservation wage, changes in demand for overtime work will not affect absence. Concerning overtime work, the theoretical prediction is unambiguously that more absence increases overtime work.

The empirical analyses confirm that more days of absence increase overtime work, but it seems as long term absence is more important than short term absence in this respect. The size of the effects are plausible. Also the theoretical prediction of a negative impact on absence of higher overtime premia is confirmed empirically for short term absence. However, the estimation results show that more overtime work increases both short and long term absence, which is contrary to the theoretical prediction. This result is reasonably interpreted as a pressure effect, as overtime work may generate pressure on workers and consequently more sickness absenteeism. The fact that the effect is larger for long term than for short term absence support this explanation. The estimated relationships between overtime work and absence are rather similar in the two sub-periods 1990-93 (increasing unemployment) and 1993-96 (decreasing unemployment), so it seems as they do not depend on conditions in the labour market.

Higher rates of unemployment reduce absence but statistical significance depends on specification w.r.t. time dummies and estimation period. Most of the specifications without time dummies give statistically significant estimates of reasonable size. Contrary to the results in Dyrstad and Lysø (1998), long term absence is more affected than short term absence with these specifications. This relation between short and long term absence is in line with the picture seen in Table 1 of this paper. However, when we estimate the relation for short term absence on data from the sub-period 1990-93, including both year and quarter dummies, we obtain a statistically significant estimate which is close to the corresponding estimate in *ibid*.

More unemployment reduce overtime work, which could be explained by production cuts in downturns and/or binding recruiting restrictions in periods of low unemployment.

The estimated wage effects in the absence relations are negative, and in the context of our theoretical model they have to be explained by dominating substitution effects. Higher rates of overtime allowances reduce the amount of overtime work, while higher normal wage rates increase such work. These effects are highly significant and according to expectations. However, the size of the estimated elasticities is larger than we expected.

We estimate a positive relationship between absence and employment, and between overtime work and employment. As the estimated elasticities in the absence relations are larger than one, this indicate presence of composition effects. However, positive estimates could simply be interpreted as firm size effects. The positive relationship between overtime hours and employment could also be interpreted as firm size effects, saying that larger firms use more overtime work than smaller firms. Another explanation is that it is due to scale effects.

As noted above, the models are estimated separately on the sub-periods of increasing (1990-93) and decreasing (1993-96) unemployment. The most important differences are related to short term absence: The gender effect becomes less important and disappears statistically in the period of increasing unemployment, while unemployment and seasonal variation become more important.

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Appendix 1. Fixed Effects Results

Explanatory Variables	*Short Term Absece*	*Long Term Absence*	*Explanatory Variables*	*Overtime*
h^{TA}_{isjt-1}	0.00 *0.04*	0.17 *7.89*	h^{O}_{jst-1}	0.29 *11.21*
w^{N}_{jst}	0.06 *0.11*	-0.17 *0.27*	w^{N}_{jst}	-0.57 *0.84*
w^{O}_{jst}	-0.09 *0.60*	-0.01 *0.04*	w^{O}_{jst}	-2.01 *9.97*
u_{mst}	0.00 *0.05*	-0.10 *0.91*	u_{mst}	0.07 *0.64*
h^{TO}_{jst}	0.02 *1.23*	-0.01 *0.31*	h^{TA}_{3jst}	0.02 *0.83*
			h^{TA}_{4jst}	0.00 *0.20*
n_{jst}	1.75 *14.51*	1.49 *10.68*	n_{jst}	1.05 *9.70*
Y1990	-0.10 *1.34*	0.03 *0.27*	*Y1990*	-0.48 *4.94*
Y1991	-0.17 *2.38*	0.00 *0.05*	*Y1991*	-0.47 *5.69*
Y1992	-0.11 *1.57*	-0.08 *0.88*	*Y1992*	-0.36 *4.41*
Y1993	-0.14 *1.90*	-0.23 *2.44*	*Y1993*	-0.42 *4.82*
Y1994	-0.12 *1.81*	-0.25 *2.93*	*Y1994*	-0.11 *1.58*
Y1995	0.05 *0.77*	-0.16 *1.98*	*Y1995*	-0.16 *2.21*
Q2	-0.54 *11.20*	-0.34 *4.99*	*Q2*	0.19 *3.20*
Q3	-0.64 *13.60*	-0.40 *6.15*	*Q3*	0.14 *2.59*
Q4	-0.06 *1.20*	0.08 *1.21*	*Q4*	0.39 *6.72*
R^2	0.62	0.56	R^2	0.72
SEE	1.67	2.26	*SEE*	1.91
DW	1.96	1.96	*DW*	1.96
N of obs	10665	10665	*N of obs*	10665
Notes: See Table 3.				