Just-in-time Production, Work Organisation and Absence Control

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February 2004

Abstract

Studies of sick pay and absenteeism have traditionally treated absence as a worker-related phenomenon. There are good reasons to suppose, though, that firms' incentives to control absenteeism are not uniform. This paper presents what we believe to be the first evidence for relationships between the nature of a firm's production method) and its personnel policies, particularly as they are directed towards absence control. Such evidence is hard to assemble because data sources containing information about both technology and monitoring and incentive schemes are rare. Indeed, as far as we know the French data we use here are unique in this respect.

The results suggest strongly that firms' choices of personnel policy are driven in a significant way by reliability considerations. Firms who might be expected to value reliability particularly highly, which we characterise as those adopting Just-In-Time (JIT) methods, are more likely to monitor absence and tend to be more concerned to provide appropriate incentives, in the form of additional and/or more generous sick pay. However, firms are confronted with a variety of ways to handle the extra rigidities introduced by JIT. We show that our results are robust to firms' choices of methods, so that for instance, firms that have flexible teams, enabling substitution of absent workers, can be more generous with sick pay, *ceteris paribus*, than one without. Despite these complications, our basic hypothesis, that absence control is on average more severe in firms using JIT, survives. It is also true that JIT firms have a different demographic profile from others, employing fewer women and having younger workforces.

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1 Introduction

Studies of sick pay and absenteeism have traditionally treated absence as a worker-related phenomenon. There are good reasons to suppose, though, that firms' incentives to control absenteeism are not uniform. In particular, it has been shown[1] in the context of a formal model that the presence of complementarities in production increases the costs of absence to a firm. Thus absence by a worker who works as part of an interdependent team may be more expensive than for one whose work is more individualistic because for a team worker, absence is detrimental to the productive effort of other team members. Another source of complementarity has to do with the maintenance of stocks of semi-finished goods. If stocks are held, absence will be less expensive than if not, since without stocks, production downstream of a missing worker will be unable to continue, while if stocks can be held, production downstream of a missing worker can continue until the stocks are exhausted.

There are, of course, many ways in which costs of absence can be handled. One is by using buffer stocks of workers, either employing more than are strictly necessary for the operation of the production process, using supply arrangements (perhaps through agency suppliers, or through a register of supply workers), or by ensuring that workers are sufficiently flexibly-skilled to enable the missing worker place to be temporarily filled. Firms can also, of course, manage the incidence of absenteeism itself. Again, there exist many ways in which this can be done. They include hiring workers with known reliability characteristics, monitoring attendance, and providing financial (or other) incentives often through a sick pay scheme.

The point made and documented empirically in the present paper, is that just as firms are likely to differ in their attitudes to absenteeism, so are they likely to differ in their modes of absenteeism control. Furthermore, these differences have a clear connection with the production

[1] By Xxx(1996).

methods adopted by firms. In particular, we show that the adoption of just-in-time production (JIT) methods is robustly associated with lowered levels of generosity of sick pay provision. This relationship survives the inclusion in our statistical analysis of variables capturing the use of a number of buffering techniques.

Our work belongs to a now large strain of the literature that has focused on the relationships between technological and organizational changes and new practices in human resources management. Among the initially influential work, Womack and Ali (1990) emphasised the trend towards the reduction of buffers in production techniques summarised in the term of 'lean production'. Following this line of research, McDuffie (1995) focused on the increased value of problem-solving capabilities in the workforce when inventories of semi-finished goods are not available to mitigate production problems. Using his words, *"dealing with the problems raised by the new flexible production systems requires motivated, skilled and adaptable workers"*. Consequently, we propose to add 'reliable' to this list of required qualities, reliability being indeed a component of workers' effort [2,3]

Our statistical evidence is from France. The data used are, as far as we know, the only extant data broad enough in coverage to enable us to identify the effects that we seek. They provide information about firms' production methods, their labour force management (including absence-related incentive schemes), and the workers' characteristics including their recorded absence rate.

Using the same dataset, a few French studies have investigated the link between organizational changes towards the adoption of flexible production systems and the prevalence of new human resources methods oriented towards workforce commitment. In a report for the French Planning Office, Arai, Lanfranchi, Meurs and Skalli (1997) found a close association between enlargement and decentralization of responsibilities on the one hand and employment guarantees,

[2] Note that we do not deal with the patterns of productive and organizational changes on firms' productivity. For an empirical evaluation of the efficient association of practices, see for example McDuffie (1995), Ichniowski and al. (1997), Cappelli an Neumark (2001).

[3] The case for reliability, and specifically, attendance being a component of worker effort is made by Flabbi and Ichino(2001), and by Audas et al.(2004)

internal careers based upon the acquisition of versatile skills and introduction of pay based on firm and/or individual performance on the other hand. Furthermore, Caroli and Van Reenen (2001) show the complementarity between the use of Just-in-Time and delayering and the demand for skilled workers. Finally, Coutrot (1996) report the association between new organisational practices and the increase of internal vocational training of the workforce.

The conjecture that there are patterns in the human resources policies of firms related to specific characteristics of their production methods is also broadly confirmed by the empirical evidence presented here. For reasons that are made clear in the next section of the paper, the analysis focuses on the adoption of just-in-time (JIT) production methods. We show that firms who adopt JIT, also display employment patterns that are concentrated on those demographic groups (the male, the young) that typically have lower absence rates than others. Furthermore, the generosity of the sick pay regimes offered by JIT firms is less than for their non-JIT counterparts, even when buffering measures are in place. The buffering measures that we consider tend to have the predicted effect on generosity: that is, adopting a policy that buffers production from absence shocks tends to raise the generosity of sick pay..

Note that we do not suggest that the main driver of these relationships is an overwhelming concern with absenteeism on the part of management. The theory proposes an equilibrium generated by workers making choices in a manner that they see as benefiting themselves, or their households, and firms making choices that will generate profit. So, for instance, when we speak of 'buffering measures', we do not imply that these measures have been introduced specifically with the intention of buffering absence. It is rather that whatever reasons may have caused the firm to introduce the measures, and whatever other effects they may have on firms' operations, they have an absence buffering effect.

The paper opens with a theoretical discussion about the hypothesized link between absenteeism control and methods of production. It then continues with a detailed description of our

data source and measure of the generosity of the sick pay scheme. Finally, we present our statistical analysis and discuss our main results.

2 Theory

The main idea of the theory of absence described by Xxx(1996) is that the observed rate of absence is not a simple consequence of a labour supply function, but a more complex equilibrium outcome generated by market interaction between the interests of workers and their households on the one hand, and the interests of firms on the other. The main features of the equilibrium are:

1. *Heterogeneous workers*. For this theory, the relevant aspect of worker heterogeneity is the value for them and their households of flexibility in the work contract.
2. *Heterogeneous firms*. For firms, the key aspect of heterogeneity is the cross-firm variation in absence costs.
3. *Sorting of workers between firms*. In the equilibrium, workers are not assigned at random to firms. Rather they sort themselves between the firms, so that workers who value the ability to be absent most highly (e.g. workers with children requiring care) contract with firms for whom absence is relatively cheap (e.g. firms whose production methods display few complementarities).
4. *Compensating differentials*. In this way, a conventional compensating differentials argument yields the conclusion that firms employing more reliable workers should offer them relatively generous remuneration. The market generates a premium for reliability.
5. *Buffering*. In addition, they showed that firms will maintain a buffer stock of workers, that will be larger, the higher the cost of absence to the firm is. This buffer stock need not, of course, be literally in the form of overmanning, but could involve overtime working, flexible manning, or the use of peripheral workers.

The arguments referred to above rely on the idea of variation in firms' cost of absence. Xxx show that this variation arises through the extent of complementarity between inputs in the production function. In particular, if workers contribute jointly to production, then the absence of one of them will involve the loss, not only of that worker's output, but also of productivity of his/her partners. The same is true of complementarity between labour and capital inputs. If stocks of semi-finished goods are not available, then they have to be produced continuously in order to enable downstream workers to continue production. Of course, there are techniques that can be used to buffer the impact of complementaries in the production process. These include the use of some kinds of flexible working, in particular, the ability of workers to take over another worker's role during an absence. They also include the maintenance of stocks of semi-finished goods[4].

The contracts envisaged in the Xxx theory specify, among other things, pay and an acceptable level of absence. Again, among other things, the equilibrium features an efficient acceptable level of absence that the firm attempts to enforce as part of its workers' conditions of work. From both practical and theoretical viewpoints, it is convenient to make the distinction between the actual level of absence and the efficient level. The efficient level can be seen as a target of human resource management policy. The difference between the actual level and the efficient level can be seen as a measure of its success.

What techniques can firms use to manage absence towards the efficient level? They fall into three broad categories: hiring, monitoring and incentive systems. That these are not independent is highlighted by the Xxx argument where firms offer employment packages that compensate more

[4] Although the rigorous derivation provided by Xxx is novel and useful as a basis for empirical work, many of the implications of the theory have been noted before. For instance, a converse version is given in Aoki's (1988) well-known book on lean production methods in Japan:

"*Savings on inventory cost*: If the process used to produce a variety of final outputs using a large number of components is organised in a (quasi-)tree structure, it can respond to continual market fluctuations with reduced in-process inventories through horizontal co-ordination. But it may be vulnerable to drastic shocks because of the reduction in buffer inventory.

The "zero inventory" requirement to dispense with buffer inventory necessitates the effective control of local shocks, such as the malfunctioning of machines, absenteeism of workers, and quality defects, in order to minimize their effect on the smooth operation of horizontal coordination." (p.36)

reliable labour supply with higher wage rates. That is, a pay incentive is offered to attract a particular type of worker. The standard sorting argument (Rosen (1986)) suggests that this will tend to attract reliable workers, but this mechanism is unlikely to be perfect. Workers may not be fully informed about the nature of the job, their circumstances may change, or the firm itself may decide to change its production method. To the extent that sorting through the usual mechanisms of hiring, probation and firing fails to deliver the efficient level, the firm will benefit by devoting resources to enforcement.

Many different kinds of schemes can be used for enforcement. These are the focus of management manuals on absenteeism. The advice given in the management literature usually involves some kind of monitoring scheme: make sure that the workers know that their behaviour is being watched; it also involves a variety of incentive schemes, sometimes financial in nature, sometimes not. Ultimately, most firms will reserve the right to fire an employee whose reliability is unsatisfactory. All of these policies involve the use of resources.

The starting point for this paper is that just as a firm's efficient level of absenteeism is determined in part by its choice of production method, so are its incentives to control deviant behaviour on the part of workers. Firms for which absenteeism is cheap will neither be prepared to pay a wage premium for very reliable workers, nor will they be prepared to devote substantial resources to absence control. On the other hand, firms for which absence is expensive will find it worthwhile to attract reliable workers by paying a wage premium and also to devote resources to enforcing desired standards of attendance.

The claims made in the previous paragraph are direct consequences of the pattern of iso-profit frontiers derived in detail in Xxx (1996). An isoprofit frontier can be drawn for any given level of profit. For each absence rate, the isoprofit frontier shows the wage rate the firm could pay while maintaining profits at the given level. Clearly, the higher the absence rate, the lower the wage rate for a given profit level. But there are other properties of the relationship between the three

quantities (profit, absence rate, and pay) that are just as important. In particular, the slope of the frontier can be shown to be determined by the nature of the firm's choice of production method. We do not repeat the details here, but simply point out that the slope of the isoprofit frontier measures the wage premium that a firm would be prepared to pay to secure a given, small reduction in the absence rate. We describe firms for which this premium is small as using production methods that is *robust to absenteeism* (or just *robust* for short). Firms for which the premium is large have production methods that are not robust.

Now consider firms that are in a competitive labour market. Firms using different production methods can survive, even though they may pay different wages, by offering compensating employment packages. For the purpose of the present paper, we focus on the reliability characteristics of the workforce. Firms that do not have robust production methods will offer a high wage and expect reliable attendance. Firms with robust production methods will offer a low wage and will not expect their workers to be so reliable. The theory therefore predicts that reliable attendance will command a wage premium, and that workers who are able to supply reliable attendance will be employed by firms who adopt non-robust production methods. Since high-wage/low-absence firms are also those with robust production methods, their isoprofit lines are steeply sloped, and the cost of *deviations* from the prescribed reliability will be high too. It is this idea that we pursue empirically here.

What kinds of production methods are robust, and what kind non-robust? This distinction depends crucially on the extent to which productivity of the production process hinges on the attendance of any particular worker. In a craft workshop where workers are assigned individual projects to work on, the cost of an absence is limited to the consequences of the absent worker not working, because his or her absence does not affect the productivity of any other worker. If work is organised in teams, the cost of an absence is higher, since the absence of an individual not only means the loss of that person's product, but that the productivity of others will be affected, too.

Aspects of a worker's relationship with capital equipment are also important. In particular, note that the storage of semi-finished product is important in determining the costs of an absence. A half-finished chair will still be a half-finished chair, even if it is not worked on for six months. A half processed chicken is waste if it is not frozen within a matter of hours.

Finally, instead of trying to manage absence costs, firms can also employ various buffering techniques, in an attempt to mitigate the impact of absence on the rest of its operations. These include the use of overmanning, the use of supply workers, and the use of temporary work agencies. When and where these various techniques are used will depend on a complex of cost considerations. Another buffering technique is the use of flexible working methods, such as ensuring that all members of a team are able to carry out any of the tasks for which the team is responsible. This allows work to be rotated between members of the team, and if a team member is not present, his or her role can be undertaken by other team members, thus reducing the impact of the absence on team productivity.

In the empirical work that follows, our criteria for choice of measures of production method and work organisation are twofold. First, we are constrained by the data that are available in the source that we use[5]. Second, we concentrate on measures that capture aspects of team work and inventory-holding. Our claim is that firms who do not have a robust production method should have an employment structure that is biased towards those demographic groups that display low levels of absence, that they should be more likely to monitor absence and that they should be less generous in sick pay provision. However, the generosity of sick pay will also be influenced by the extent to which firms adopt practices that buffer the impact of absence on production.

[5] For example, we cannot control for cost or quality competition in the product market. It is however true that establishments that compete on costs would care about absenteeism even if they did not implement Just-in-Time methods.

3 The Data Source

The statistical information used in this paper has been constructed by matching two sources. These enable us to draw on a wider range of information about the respondent firms than has previously been used. As far as we know, this is the only data source available anywhere that contains both individual absence records and detailed information about the firms in which the workers are employed[6]

The *Enquête sur le coût de la main d'oeuvre et la structure des salaires* (or ECMOSS) is a large scale survey of French industrial establishments and their workers carried out by INSEE in 1992. It is the French continuation of the European Wage Structure Survey program initiated in 1966 by the European Statistical Office and later abandoned by it after 1978. At establishment level, the survey provides the most extensive set of information about labour costs (including provision of sickness absence) and compensation policies. The 1992 wave also contains questions about work organization and competition in the product market. Furthermore, each establishment included in the survey was instructed to draw a representative sample of employees for which the employer provided detailed information about their individual characteristics and compensation. The *Enquête* therefore consists of two parts: one concerning the productive unit as a whole; the other concerning individual employees. In addition, we use another survey conducted for the first time by the French Ministry of Labour in the same year, known as *Réponse*. It was designed to study industrial relations within workplaces and was inspired by similar official surveys in UK (WIRS), Australia (AWIRS) and Ireland. Crucially for our study, interviewed employers were chosen in a subsample of the universe sampled for ECMOSS. All responses were provided by the establishment without reference to employees and covered complementary information about unions and bargaining activity, industrial relations and changes in technology and work organisation.

[6] All technical details for the two surveys about the covered population and sampling frames, together with a thorough description of the missing observations are given in the statistical appendix.

The matched sample is a representative cross-section of 1983 establishments belonging to firms with at least 50 employees from the non agricultural private sector with representative data on 19699 workers. The originality of the dataset comes from the fact that it embodies the structure of the workforce, the provision of sick pay benefits, the monitoring of attendance, and the nature of the production methods and work organization. For all these aspects information is solicited directly from the firm.

We will first describe the legal minimum and supplementary sick pay schemes offered by the employer and how we have had to construct our own measure of their respective generosity. Then, we will summarize the explanatory variables used in relationship with our theoretical approach. A summary of all variable definitions is given in Table I. Means and standard deviations of all variables are given in Table II.

Dependent variable : sick pay systems

Sick pay in France is regulated by the Social Security law. This lays down minimum levels of provision, and a division of responsibility between the state and employing firms. The *Régime Général* specifies state payments at a replacement rate of 50% for 60 days, following a three day waiting period (*délai de carence*). Qualifications for the state benefits imply that virtually all workers will be eligible.[7] In addition, employing firms must make complementary payments, of 40% for the first 30 days of a spell of sickness and 16.66% for the next 30 days. These payments are subject to a ten-day *délai de carence* and are payable only to workers with at least 3 years tenure in their job. The system is illustrated in Figure I. For workers with tenure in excess of 8 years, the period over which sick pay is payable is extended according to the schedule shown in the horizontal scale.

The *Régime Général* provides a minimum level of replacement, but employing firms are free to exceed these provisions if they wish. They can make more generous provision in a number

[7] Workers must have had at least 200 hours of work in the 3 months prior to the spell of sickness, or have been paid at least 1.015 times the minimum wage in the previous 6 months.

of ways: by increasing the replacement rates, extending the period covered, reducing the *délai de carence*, or reducing the 3-year tenure qualification. The actual provision for the employees of a particular firm may therefore be quite different from the provision specified by the *Régime Général*.

The element of choice that French firms have in sick pay provision, and the availability of data describing the choices firms have made, provide a unique opportunity to investigate some of the issues surrounding the incidence of absence, the moral hazard involved in sick pay provision, and the costs of absence to the firm.

We investigate these ideas in the present work by modelling two variables: i) an indicator of whether or not firms have a supplementary system; ii) the mean replacement ratio. The dependent variables are constructed from a sequence of questions concerning sick pay provision. Firms are asked whether the majority of their employees are affiliated to the *Régime Général* or not. This is necessary, because a few industries have special arrangements that replace the *Régime Général*. We have had to drop establishments in these industries from our analysis, since the ECMOSS survey does not record details of such schemes, preventing construction of a generosity measure for them. After further deletion of establishments that do not even answer the affiliation question, we were left with a sample of 1690 productive units.

Respondent establishments are next asked if they have a supplementary system of sick pay. The first of the variables modelled is derived from the responses to this question.

Those firms that report the adoption of a supplementary scheme are asked to describe its provisions for up to four groups of workers, distinguished by their tenure in the firm. If the scheme adopted is too complex to be described by four sets of parameters, the four most frequent sets are

supposed to be reported, so that coverage of the workforce is maximised. In the present paper we have used information only from the first scheme reported.[8]

The replacement ratio is a useful measure of the generosity of a benefit system. It measures the proportion of normal income that is paid to a person eligible for sick pay. In the case of the French sick pay regime, this idea is not easy to make operational because of the complexity of the system.

Consider the *Régime Général* illustrated in Figure I. It is clear that because of the *délai de carence*, the replacement ratio changes as a spell of sickness absence proceeds. Thus for the first three days the ratio is zero, for the next seven it is 50%, it then rises to 90% for eligible workers, and falls again after 60 days. Eligibility depends on seniority. There are three degrees of freedom that firms have in providing more generous coverage than the state scheme allows. They can vary the rates, the minimum seniority requirement, or the *délai de carence*. Our aim is to develop as parsimonious a representation of the generosity of a scheme as possible. The measure we use is the mean replacement rate throughout a spell. This measure is not unique, since it varies with spell length.

Begin by defining, for each worker (indexed by i), a sequence of variables:

$$\{t_i(d), d = 1,...,T\}.$$

$t_i(d)$ is the replacement rate for the i'th worker on day d of a spell of absence. Our data includes all the information necessary to compute these for each sampled worker. For each firm (indexed by j), n_j workers are sampled and we calculate the sequence of mean replacement ratios. That is:

[8] There are two reasons for doing this. First, establishments reporting the use of more than one supplementary system were also more likely to fail to fully describe all characteristics of the sick pay schemes, implying a trade-off between sample size and measurement error. Second, most of the establishments offering multiple supplementary schemes provide a high replacement ratio for very long spells of absence: 22% of the establishments declared a second supplementary sick pay scheme covering the first month of absence but only 10% offered an arrangement distinct from the first scheme in terms of generosity over this month; similarly, 14% declared a third supplementary sick pay scheme and 8% distinct from the first over the first month; finally only 8% declared up to four schemes with only 4% distinct from the first over the first month. Furthermore, among the 19699 sampled workers, only 1730 employees were protected by a system different from the first scheme reported (8.7%). Consequently, we do not think it will make a great deal of difference to the outcome.

$$\left\{ \bar{t}_j(d) \,|\, \bar{t}_j(d) = \frac{\sum_{i \in j} t_i(d)}{n_j}, d = 1,...,T \right\}.$$

The $\bar{t}_j(d)$ measure the mean replacement ratio on each day of a spell (that is, the mean marginal replacement ratio), but to measure the generosity of a scheme it seems more natural to think of mean replacement ratios throughout a spell. These can be computed as:

$$\left\{ \overline{\bar{t}_j(d)} \,|\, \overline{\bar{t}_j(d)} = \frac{\sum_{d=1,...,d_j} \bar{t}_j(d)}{d}, d = 1,...,T \right\}$$

We have computed these measures for $T = 29$, which covers absences up to one month in duration. Mean values (across firms) of the measures for $d = 4,11,20$ are tabulated in Table II. These three measures are the focus of the analysis carried out in the next section of the paper.

Production methods and Work organisation variables

For our preliminary investigation of the relationship between sick pay provision, work organisation and absence, we use a variety of right-hand side variables. For work organisation measures we rely mainly on questions asked in both the main questionnaire of the *ECMOSS Survey*, and the *Réponse* questionnaire. Two questions are asked about cooperation between workers. The first (*ECMOSS*: D26) is:

Some establishments practice work rotations.

Type A. Within work groups, workers rotate between tasks during the course of their usual work: Is this the case in your establishment? YES or NO.

Type B. Some multi-skilled workers rotate between certain tasks (independently of team organisation): Is this the case in your establishment? YES or NO

and the second: (*ECMOSS:* D28)

Is direct cooperation between workers in different sections encouraged. (For establishments comprising a single branch, answer ``Not applicable'')

We interpret the existence of flexible working as being a method by which firms can reduce the cost of absenteeism, versatile workers being more able to replace absent colleagues between and within work groups. This should therefore increase the generosity of sick pay.

The second group of work organisation variables concern production methods. We use responses to *Réponse*: C4. Both are on a 4-point scale.

C4. For each method of organisation that I cite, please tell me whether it has already been introduced, whether it is about to be introduced, being considered or not under consideration at all in your establishment:

- *Just-in-time? production on demand?*
- *Multidisciplinary work groups*

.

As argued before, the Just-in-time method is more sensitive to interruptions in the production process such as those created by absenteeism in the workshops. This variable would consequently reduce the generosity of the sick pay arrangement chosen by the establishment. On the contrary, multidisciplinarity of the workers would help them to circumvent the loss incurred from a missing worker.

Thirdly, a detailed set of questions about shift working have been collapsed into a single variable as to whether shift working is part of the contract for 25% or more of the workers.[9] The variable is important because shift work schemes imply a more rigid form of work organization

[9] Our definition of shift work is frequently used in the literature on compensating differentials: anyone who has scheduled working time outside normal working hours during the week is considered as a shift worker. Consequently, shift workers include those working rotating teams, but also night workers and those who work uncommon working hours, and an extended work day or work week.

than non-shift work. As reported by Cette (1995) for France, shift working is primarily introduced to increase the capital operating time in order to maximize the returns of capital asset before it becomes obsolete. Such work organization reflects a higher complementarity between labour and capital and should therefore decrease the generosity of sick pay schemes.

Measures of absence

The next group of variables that we use attempts to capture the importance of absenteeism to the firm. Firms are asked directly if absenteeism was a problem in 1992 for the four main categories of workers: White-collar and blue-collar in manufacturing and services; whether it is one of three criteria used in determining pay increments; whether they keep records of absenteeism and whether they regard absenteeism as an indicator of social relations.

Control variables

First, we use a group of questions about union activity. These are important since supplementary sick pay arrangements are usually the outcome of bargaining between firms and unions, either at branch or at firm level. Respondents are asked if the majority of the firm's workers are covered by a collective agreement. These will normally be agreements at branch level. In addition, we use a question from *Réponse* about whether there exists union representation at establishment level. We take this as a (rather weak) indicator of the probability of an establishment agreement.

In addition, we use the size and industry of the establishment. The first has been shown by many investigators[10] to be associated with absence. Dummy variables are included measuring the manufacturing or service industries in the private sector the establishment is operating in.[11]

[10] See, for example, Barmby and Stephan(1996). Theoretical arguments about this phenomenon are not easy to construct. Xxx argue that it can be understood in the context of their theory, since larger firms have greater flexibility in rescheduling production than small ones.

[11] Only manufacturing and services industries in the private sector are included. There are twelve classes of industry within the classification: 2. Foodstuffs and other agriculture-based products; 3. Production and distribution of energy; 4. Intermediate goods industries; 5. Equipment; 6. Current consumption goods; 7. Construction; 8.Retailing; 9.

Data management and restriction of the original sample are described in detail in the statistical appendix. Because of missing observations, especially in the detailed description of the supplementary sick pay scheme, we finally use a sample of 854 establishments that have fully completed the set of questions used in the two surveys.

4 Analysis and Results

The paper is concerned with the relationship between sickpay provision and the production method adopted by the firm. We turn directly to our results, before considering other issues.

In the French system, the provision of sick pay within an establishment is agreed at three levels, which are best understood with reference to the *Régime Général*. This determines both a minimum level of provision and a particular structure that sick pay should take. At the first level it is possible for establishments to opt out of the *Régime Général*. As long as the minimum provision is adhered to, they can deviate from the structure.

Firms who adopt the *Régime Général* accept the structure of sick pay laid down by it, but can increase the generosity of provision in several ways. Figure I details the parameters of the scheme, and also indicates what deviations from the basic regime may be made. Thus, marginal replacement rates may be enhanced, or given to workers with lesser seniority than specified. The *jours de carence* may be shortened or eliminated altogether. These variations are made at two levels: the level of the industry, or locally at each establishment.

Industry level negotiations take place for each of about 350 *branches*[12], and typically final agreements (*"conventions collectives de branches")* determine whether or not the establishments within each *branche* will adopt a supplementary scheme or not. A level of supplementation of the

Transport and Telecommunications; 10. Commercial services; 11. Housing rental; 12. Insurance; 13. Other financial services. Category 3 is heavily nationalised and is excluded from our analysis because it contributes only 2 establishments to our sample. The omitted category is Category 2.

[12] The classification of establishments into *branches* is different from the industry classification used in France for statistical purposes.

provisions laid down in the *Régime Général* is also agreed, so that all establishments in a *branche* that adopts a supplementary scheme will be subject to higher minimum provision than those in *branches* that do not adopt a supplementary scheme.

Local negotiations may also enhance the rates of sick pay provided, but where the *Régime Général* is adopted the structure is constrained by its provisions.

The tables present two sets of results: one including logit regressions explaining the structure of the adoption of a supplementary scheme; the other including tobit regressions explaining the structure of our measure of the generosity of sick pay. Roughly speaking, the message of the tables is that the relationship between the generosity of sick pay and JIT suggested by the theory appears in the analysis of generosity, but not in the analysis of adoption. This is not very surprising, given the nature of the negotiating institutions outlined above. It is unlikely that a relationship that is posited on the form of a production function would readily appear at the level of aggregation of the *branche*.

The use of JIT as our main characterisation of 'production method' raises issues that we address in the Tables. These issues have to do with the fact, documented by Wood(1999) and MacDuffie(1995), that production and work organization methods are often introduced in tandem with number of other measures. For example, McDuffie highlights that diminished buffers of semi-finished goods and inventory stocks together with an increased percentage of workers involved in multi-tasking and job rotation has a positive effect on performance in the automobile industry. The bundles of measures are referred to by a variety of names in the literature[13]. From the large number of possibilities, we choose to call them 'high performance work organisation measures'. The fact of this bundling creates both conceptual and econometric issues for our analysis.

If, as our theory suggests, the introduction of JIT (by itself) increases the potential costs to firms of absenteeism, this is probably not unnoticed by firms. The main rationale for JIT is that it

[13] Kalleberg(2001) lists 8 different collective names for these practices.

reduces inventory holding costs, and enables production to be more responsive to changes in demand. A firm may therefore find it worthwhile to introduce JIT, but nonetheless anticipate that some of the gains made are dissipated in additional costs of absenteeism. The ways in which these extra costs can be diminished fall into two groups: techniques for reducing absenteeism itself, and techniques for reducing the impact of absenteeism on costs. Viewed in this way, increased control of workers' behaviour by monitoring absence and providing incentives to attend, either through less generous sick pay provision or, for instance, tying promotion prospects to an absence record are likely to be complementary practices to JIT.

Similarly, methods of reducing the impact of absence on costs are also likely to be complementary. These include the use of buffer stocks of workers, either as part of a core labour force (overmanning), or as part of a peripheral work force (supply arrangements, and agency work); increasing the ability (and willingness) of workers to fill in for absent workers, by various measures of workforce flexibility.

For these reasons, we adopt an empirical specification that includes as many variables of this sort as we have access to. In addition, since there is evidence from the work of Wood(1999) and MacDuffie(1995) that these practices are complementary, we include pairwise interactions of each of them.

Since JIT is often introduced into firms as part of a package of measures, collectively known as high performance work organisation, the use of JIT as a means of discriminating between high absence cost firms and low absence cost firms raises the issue of the extent to which we are justified in singling it out for special treatment. For this reason, we go to some lengths to control for the presence of other characteristics of such organisations. This effort yields an additional payoff to the study, since as well as being able to document some aspects of absence control, we are also able to point to a sense in which the introduction of new organisational structures could be seen as changing the working environment of workers in a negative way. Specifically, the introduction of

JIT is seen as imposing on the firm either the acceptance of higher costs, or the necessity to reduce the implied cost increases by the introduction of other measures.

The Tables contain two statistical analyses:

1. An analysis of the probability of adoption of a sick pay agreement supplementary to the *Régime Général*. Since the dependent variable here is a dummy taking the value one if an agreement is adopted or zero if it is not, we use a logit specification for this.
2. An analysis of the generosity of sick pay. Here we use the three dependent variables described in the last section. Since the dependent variable is continuous but includes many observations that are zeroes, we use a tobit specification for these estimates.

The first column of Table III shows the result of running a basic logistic regression. On the left hand side is the variable indicating whether or not a supplementary sick pay scheme is adopted. On the right hand side are the main variable of interest: a dummy indicating whether or not a JIT system is operated, together with a set of dummy variables indicating which industry the firm operates in, plus eight other variables: i) whether or not the establishment is covered by an agreement at *branche* level; ii) the logarithm of the size of the establishment, measured as the number of employees; iii) whether or not the establishment appoints a union delegate; iv) whether or not the firm practices rotation within work groups; v) whether or not the firm practices rotation between work groups; vi) whether or not the firm encourages co-operation between work groups; vii) whether the firm uses multidisciplinary work groups; viii) whether a shift work system is operated.

In this specification, the main variables driving the adoption of a supplementary scheme are those concerned with union activity, and the presence of shift working. In addition, larger firms are more likely to adopt a supplementary scheme. None of the remaining variables have coefficients that are significantly different from zero, including the industrial dummies. The apparent weakness of those results can be explained by the fact that adoption of a supplementary scheme is a crude

indicator of the policy towards absenteeism of the establishment. Influence of collective bargaining is not surprising because: i) a large number of the "*conventions collectives de branche*" include a definition of the minimum levels of sick pay on the one hand; and ii) since 1982 all establishments with at least one union delegate are required to conduct annual compensation negotiations.

The positive effect of shift working appears in contradiction with our predictions. However, shift working is usually seen as a disamenity by workers that should be compensated for. Sick pay could then be given as a part of the compensation package that would induce workers to accept those working time schedules.

In the second column, we have added a number of variables to the specification which refer specifically to firms' absenteeism policies and attitudes. There are two policy variables and three attitudinal variables. The policy variables are an indicator of whether absence records are kept by the firm and an indicator of whether those records are used by the firm in making decisions about pay. The attitudinal variables are: i) whether the firm considers that absenteeism affects its social climate; ii) and iii) whether the firm regards absence among, respectively, blue-collar or white-collar workers, as a problem. It is not surprising that the keeping of absence records is positively associated with the adoption of a supplementary scheme. However, the use of absence as a determinant of pay suggests that the firm uses pay as part of its incentive scheme to control absence, as such it may be either a substitute for or a complement to other kinds of incentive mechanism. The results in the second column of the Table suggest that sick pay and the use of absence as a determinant of pay are substitutes. Firms that use absence to determine pay are less likely to adopt a supplementary scheme than those that do not[14].

[14] In an earlier version of this paper, as well as JIT and shift variables in the analysis, we used three variables recording whether firms had shorter production runs, reduction in production delays and reduction of inventories as goals of their policy. A referee has criticised the inclusion of such aspirational variables on the grounds that actual practices (JIT, shift working) are likely to be better predictors than goals. When we include the variables representing goals, we find that only one of them, shortening production runs, yields a significant coefficient. Furthermore, inclusion of these variables does not change the qualitative nature of our results. In the rest of the paper, we report only results obtained with these variables excluded.

Turning now to the tobit analysis of the generosity of sick pay. In this analysis, we have run each specification three times, once for each of the three generosity measures relating to absences of duration 4, 11 and 20 days described in the previous section. Table IV presents the basic analyses of this type, which follow the same pattern as the logit analysis.

These results indicate a robust effect of the adoption of JIT on the generosity of sick pay. In particular, the adoption of JIT production appears to reduce the generosity of sick pay by about 2.5 percentage points for all three durations. The estimates for the three durations tell similar stories. The use of shift working has no significant impact on generosity. The presence of a union delegate in the firm increases it. Of the four work organisation variables (rotation within teams, rotation between teams, co-operation between teams and the use of multidisciplinary work groups), the first and the last have significant positive effects on generosity. It is only for the 4 day durations that the use of pay incentives appears to be a substitute for incentives based on sick pay generosity. For the longer durations, recording of absence is positively associated with generosity[15,16].

In contrast to the results of the analysis of the adoption of a supplementary sick pay scheme, the analysis of its generosity reveals the importance of the productive and organizational choices of the employer while the influence of the *branche* agreement disappears. From our point of view, those results highlight the difficulty faced by central bargainers in taking into account the diversity of productive and organizational practices. At the local level, however, negotiations can be conducted in the light of human resources policies that may be specific to a particular firm or establishment.[17]

In a final set of results, we take account of an issue raised by the literature on lean production systems, that could well cause biases in the results shown here (even if it does not introduce a bias, ignoring it is likely to lead to difficulties of interpretation). There is substantial evidence that high performance work organisation measures not only tend to be introduced as

[15] It would have to be a generous sick pay scheme indeed that paid without recording the absence!
[16] These patterns are unchanged when the variables representing firms' goals are included in the regressions.
[17] A similar argument is used by Lindbeck and Snower(2001) to explain the decline of centralized negotiation.

packages, but that they are complementary in the sense that the marginal product generated by one of them is likely to be enhanced by its introduction accompanied by others. If this is the case, then the measured impact of one such measure introduced into a regression without the others will pick up the impact not only of the measure of interest, but also of the impact of its complementary measures. One is likely therefore to overestimate such an impact if other measures are not introduced.

Furthermore, if indicators of all members of a set of complementary measures are introduced into a regression, a problem of collinearity is likely to arise, implying that the estimates obtained for the impact of any single measure is likely to be unreliable and an upward bias in the estimated standard errors.[18]

In the final set of results, we address these problems by including a comprehensive set of two-way interactions[19]. The results are reported in Tables V.1-V.4. As an example of how the estimations work, consider the first column of the Table V.1. This regression includes the variable of interest, JIT, plus four supposedly complementary measures: rotation within and between workgroups, co-operation between workgroups, and the use of multidisciplinary workgroups. There are then binomial(5,2)=10 possible two-way interactions. When interactions are included in this way, the impact of any single measure can be assessed (at the mean) by computing the weighted sum of the coefficients in which it is included, where the weights are the means of the variables with which it is interacted. Thus if variable X, is interacted with variables Y and Z, and the estimated coefficients of X, XY and XZ respectively are b_X, b_{XY} and b_{XZ}, the gross impact of X on the dependent variable is $b_X + b_{XY}\overline{Y} + b_{XZ}\overline{Z}$. In contrast, b_X only measure the impact of X in isolation, that is when Y and Z take the value zero. Tests of linear hypotheses can be carried out in the usual way, using a c^2-test for the logit regressions and an F-test in the tobits.

[18] A correlation matrix of production methods and organizational variables is given in Table VII.
[19] Higher-order interactions are not necessary. Topkis(1978).

The results recorded in Tables V.1-V.4 using this method confirm the results obtained previously in broad outline. The adoption of a supplementary scheme is affected by the two union variables and firm size. None of the work organisation variables have a significant gross effect. However, the use of rotation within workgroups in isolation raises the likelihood of a supplementary sick pay scheme.

The tobit analysis of generosity does little to change the impression given in the previous Table IV. It is worthwhile dwelling a little on the interpretation of the results here. Looking at the first set of tobit results, they reveal impacts of JIT, rotation within teams, and the use of multidisciplinary workgroups that are significant at 5 %, 0.6% and 0.2% respectively. The estimates indicate that the use JIT lowers the generosity of sickpay by almost 3 percentage points, that use of rotation within teams tends to raise it by about than 6 percentage point, and the use of multidisciplinary workgroups tends also to raise it by a bit more than 4 percentage points. Thus while firms using this package of measures may pay more generous sick pay, that generosity is less than it would have been have JIT not been adopted as part of the package. We interpret this to be an illustration of the buffering effect described above. Multidisciplinarity and rotation tend to make absence cheaper, JIT tends to make it more expensive.

Another way to assess this complementarity effect is the comparison with the effect of those variables when they are used in isolation. As expected, when an establishment is implementing JIT in isolation, its generosity is lowered by more than 5 percentage points. On the contrary, adoption of rotation within groups and multidisciplinary work groups in isolation raises the generosity of sick pay scheme by respectively by 8.8 and 6.6%.

The magnitude of these effects varies a little across the different durations of spells that we consider here, while the qualitative pattern remains stable.[20]

[20] As before, the estimates are not substantially affected by the inclusion of the managerial goals.

Finally, we have concentrated on the policies of firms adopted in connection with their existing workforces, but firms can also control the characteristics of their workforces through selection of workers. In the formal model, this comes about through a matching process, and implies that we should find that the characteristics of the workforces of firms with JIT differ from those without. Table VI examines the relationship between the adoption of Just-in-Time methods, the structure of the workforce, and absence monitoring. The relationship is very clear with adopting firms employing a smaller proportion of women than non-adopting firms, and also having workforces that are younger than average. Since there is considerable evidence pointing to higher rates of absenteeism among women and older people,[21] this finding supports the presence of the selection effects suggested by the theory. It is also true that firms that monitor absence carefully are more likely to be JIT adopters. However, we do not overestimate this last evidence considering that it could also be possible that new production method also allows for easier monitoring.

5 Conclusion

This paper presents what we believe to be the first evidence for relationships between the nature of a firm's production methods and its personnel policies, particularly as they are directed towards absence control. Such evidence is hard to assemble because data sources containing information about both technology and monitoring and incentive schemes are rare. Indeed, as far as we know the French data we use here are unique in this respect. Certainly, no similar data exist for Britain.

Even given the limitations of the data, the results suggest strongly that firms' choices of personnel policy are driven in a significant way by reliability considerations. Firms who might be

[21] See, for example, Barmby et al.(2002), this finding is consistent with the idea that firms adopting JIT have lower exposure to absenteeism induced by the structure of their workforces.

expected to value reliability particularly highly (those adopting JIT production) are seen to have workforces with a demographic profile different from other firms. They are also more likely to monitor absence and tend to be more concerned to provide appropriate incentives, in the form of additional and/or more generous sick pay.

We believe that the importance of this work is rather wider than simple illumination of what determines firms' policies. Absence research has been dominated by the idea that absenteeism is a supply-side phenomenon: workers decide when and how often they are going to be absent, and thus determine the observed absence rate. The present research suggests that this view is excessively restrictive. Although workers themselves make the decision to be absent, the decision is moderated by the policies of the firm. In seeking explanations of the observed absence rate, we must look beyond models of worker behaviour, to consider the interests and actions of the firms in which they are employed.

The work also has relevance for two related debates in the industrial relations literature. There is a considerable body of work discussing the impact on productivity and worker well-being of high performance work organisation measures[22]. These were originally portrayed as performance enhancing, in the sense not only of increased productivity, but also in the sense that they improved worker welfare through increased involvement in production decisions, and empowerment in the workplace. A more recent strand of literature[23] has criticised the claim that such measures are uniformly beneficial to workers. Our work can be interpreted as shedding some light on the way in which one vector of work intensification may operate, through increased absence costs to firms.

[22] See for example Ichniowski et al.(1997). Kalleberg(2001) provides a useful survey of this literature.
[23] See for example Green and McIntosh(2001), and Brenner et al.(2004)

Statistical Appendix

This statistical appendix describes our two data sources, how the matching was done, and gives details of the implications of the matching for the final sample size.

Our first source, The 1992 *Enquête sur le coût de la main d'oeuvre et la structure des salaries* (ECMOSS), collects establishment compensation information as well as individual wages for a sample of employees in a sample of establishments with more than ten employees in manufacturing, construction and service industries. The sampling rate has been stratified according to the sector, the region and the size of the productive unit, and varies from 1 for the establishments of more than 500 employees to 1/48 for establishments between 10 and 20 employees. The sampling rate for the employees is based on their month and year of birth. The average number of sampled workers per establishment is around 10, but varies between establishments, partly because the sampling rate falls as establishment size decreases.

ECMOSS is then a nationally representative cross-section of establishments with representative data on workers. It contains information on 15,858 establishments as well as an employer-reported description of individual characteristics of 148,976 of their employees.

Our second data set is the *Enquête sur les Relations Professionnelles et les Négociations d'Entreprise* (REPONSE) and collected by the French Ministry of Labour for the same year, 1992. The REPONSE sample was drawn from a subset of the ECMOSS population consisting of 12,293 establishments from firms with at least 50 employees. Among these, 3,091 managers and union representatives of production units were interviewed resulting in 2,998 usable questionnaires. The sampling rate is stratified according to 6 classes of size, 5 large industries and 9 regions.

Only two thirds of the REPONSE respondents also responded to ECMOSS, resulting in an original merged sample of 1,983 establishments. Accordingly, our final matched file can be seen as a representative sample of the French establishments belonging to firms with at least 50 employees from the non agricultural private sector.

The information about sick pay comes from the establishment questionnaire in ECMOSS. Establishments are asked firstly if they follow the *Régime Général* of the French Social Security System or not. They are then asked if they have a complementary system of sick pay. This is an ambiguous question. It is intended to find out if firms have any provision over and above the *Régime Général*, but respondents who are conversant with the Social Security law will know that the firm's contribution to sick pay within the *Régime Général* is referred to as the *système complémentaire*. Such responses are easily corrected.

Among the 1,983 establishments, 60 did not answer those questions while 233 reported that they did not follow the *Régime Général* because they have special regulations. Amongst these are firms that are at least partly state-owned. Since we do not have any information on those special rules, we restricted the sample to the remaining 1690 productive units. This sample remains representative of the establishments where the majority of the workforce is regulated by the *Régime Général*.

Respondents who report they operate a complementary system are finally asked to specify its provisions. Up to four systems can be described by each firm. Respondents who have more than four are asked to report details of those that cover the four largest groups of workers. The systems are described by the minimum tenure qualifying a worker for sick pay, the number of *days of carence,* and the replacement rates month by month for up to six months of absence.

Before the data could be used, some cleaning was necessary to correct some obvious mistakes in the figures reported by the establishments for the characteristics of their complementary system. Some of these problems were easily tackled:

i) some respondents did not enter their responses in the correct lines of the form. Such responses are easily identified by the pattern of missing values, and also easily corrected.

ii) some respondents entered replacement rates as proportions rather than as percentages. Again, these are easily identified and corrected by multiplying by 100.

iii) those respondents who reported the firm's contribution to the *Régime Général* as a *système complémentaire* are also easily identified, since their reported replacement ratios are recorded as 4000 for the first month and 1600 (or 1666) for the second month. Once again these cases are easily recognised and amended. If such a response appeared as a single *système complémentaire* we also altered the response to the question asking if such a system was in use.

iv) a number of other changes (and a few deletions) were made in cases where the coded responses were either obvious nonsense or inconsistent with the law.[24]

Among the 1690 sampled establishments, 205 offer the minimum replacement rates specified in the *Régime Général*. Of the remaining 1485 productive units 631 provide insufficient information to enable calculation of the generosity measure. Of these, 36 establishments fail to report fully the tenure of the sampled workforce, 631 omit the number of *days of carence* and 255 omit the minimum tenure qualifying workers for sick pay. On the other hand, it is worth noting that all respondents reported the replacement ratio during the first month of absence spell. Consequently, no establishment failed to describe its complementary sick pay scheme completely.

Missing values for these determinants cannot be imputed since they are already the main components of one of our dependent variables, the generosity of the complementary sick pay scheme. Instead, we have restrict our main analysis of the generosity of the establishments to those who had reported all the characteristics of their complementary sick pay scheme, that is, 854 establishments. In the table AI below, we present the average values for the explanatory variables in respectively the initial sample of 1690 establishments and the final sample used in the main body of the paper. Including a higher percentage of establishments not offering any complementary sick pay, the group of 854 establishments contains productive units on average smaller, less unionized, using multidisciplinary workgroups and encouraging cooperation between workers less frequently. However, this sample contains the same proportion of establishments that have implemented Just-

[24] The STATA program used to clean the data is available from the authors on request.

in-Time and rotation between and within workgroups. The average values of the variables attempting to capture the importance of absenteeism to the firm are also not significantly different between the two samples.

Despite choosing this route for our preferred dataset, we also assessed the robustness of our result by replicating the estimations presented in the fourth section of the paper in two different samples. In the first one (sample 2), we imputed the value in the *Régime Général* when the information was missing, that is 3 days of *délai de carence* and 36 months of minimum seniority requirement. In the second one (sample 3), we have chosen to replace the missing value by the mode of the variable in the largest available sample, that is 3 days of *délai de carence* and 12 months of minimum seniority requirement. The qualitative nature of the results discussed in the text remains unchanged in Tables AII and AIII . In particular, note that the negative effect of the use of Just-in-Time method of production on sickpay generosity is not qualitatively changed.[25]

[25] All results replicating the tables commented in the main body of the paper are available from the authors on request.

References

M.Aoki (1988): *Information, incentives and bargaining in the Japanese economy,* CUP, Cambridge.

Arai, M., Lanfranchi, J., Meurs, D. & A. Skalli (1997) : " Nouveaux modes de l'organisation du travail et pratiques salariales: une comparaison France-Suède " Rapport pour le Commissariat Général Du Plan.

Audas, R, T.A.Barmby and J.G. Treble(2004): "Luck, Effort and Reward in an Organisational Hierarchy", *Journal of Labor Economics* (forthcoming, April)

Barmby, T.A., M.G. Ercolani and J.G.Treble (2002): 'Sickness Absence: An International Comparison' *Economic Journal* v112(480) ppF315-331.

Barmy, T.A. and G. Stephan (2000): 'Worker Absenteeism: Why Firm Size May Matter' *The Manchester School* v68(5) pp568-77.

Brenner, M.D., Fairris, D. and Ruser, J. (2004): '"Flexible" work practices and occupational safety and health: Exploring the relationship between cumulative trauma disorders and workplace transformation', *Industrial Relations*, v43(1), pp242-266.

Cappelli, P. and Neumark, D. (2001): 'Do 'high performance' work practices improve establishment-level outcomes?' *Industrial and Labor Relations Review* v54(4), pp737-775.

Cette, G. (1995): 'Capital Operating Time and Shiftworking in France.', in D.Anxo, G.Bosch, D.Bosworth, G.Cette, T.Sterner and D.Taddei, ed., *Work Patterns and Capital Utilization : An International Comparative Study*, pp149-175, Kluwer Academic Publishers, Dordrecht

Chatterji, M. and C. Tilley (2002): 'Sickness, Absenteeism, "Presenteeism" and Sick Pay' *Oxford Economic Papers*, v54, pp669-687.

Xxx (1993)

Xxx (1996)

Flabbi, Luca and Ichino, Andrea. "Productivity, Seniority and Wages: New Evidence from Personnel Data" *Labour Economics*, Vol 8, (2001): pp359-387.

Green, F. and McIntosh, S.(2001): 'The intensification of work in Europe', *Labour Economics*, vol.8, pp.291-308.

Ichnowski, C., Shaw, K. and Prennushi, G. (1997): 'The effects of human resource management practices on productivity: A study of steel finishing lines', *American Economic Review,* vol.87(3), pp.291-313.

Kalleberg, A.L. (2001): 'Organizing Flexibility: The Flexible Firm in a New Century', *British Journal of Industrial Relations*, v39:4, pp. 479-504.

Lindbeck, A. and Snower, D. (2001): 'Centralized bargaining and reorganized work: are thay compatible?', *European Economic Review*, v45, n°10, pp. 1851-1876.

McDuffie, J.P. (1995): 'Human Resource Bundles and manufacturing Performance: Organizational Logic and Flexible Production Systems in the World Auto Industry' *Industrial and Labor Relations Review*, v48, no.2, pp. 197-221.

Rosen, S. (1986): 'The Theory of Equalizing Differences' in O.C. Ashenfelter and R. Layard (eds) *The Handbook of Labor Economics, Volume 1*, North-Holland, pp. 641-692.

Topkis, D.M.(1978): 'Minimizing a submodular function on a Lattice', *Operations Research*, v26, pp305-321.

Weiss, A. (1985): 'Absenteeism and Wages' *Economics Letters*, 19, 277-279.

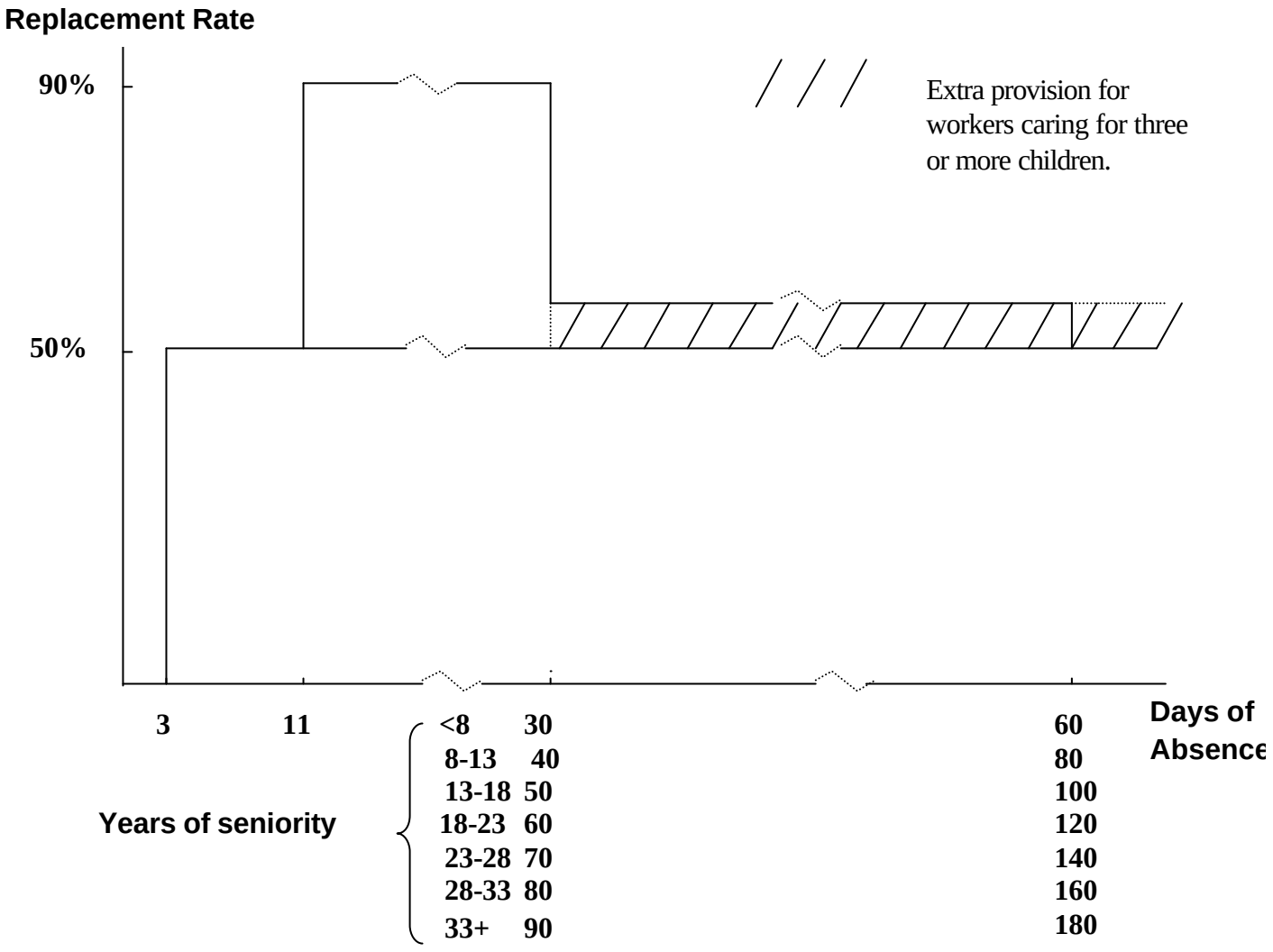
Womack, J., Jones, D., and Roos, D. (1990): *The machine that changed the world*. New-York: Rawson Associates.

Wood, S. (1999): 'Getting the measure of the Transformed High-Performance Organisation', *British Journal of Industrial Relations*, v37:3, pp. 391-417.

Figure I

Marginal replacement rates in the Régime Général

In the *Régime Général* the replacement rate of sick pay depends on the length of the spell of absence. Up to 3 days, no sick pay is payable. From 3-11 days, the replacement rate is 50%. For longer spells, the replacement rate rises to 90%, and entitlement depends on tenure in the job as indicated in the Figure.



Variable	*Type*	*Definition*
Supplementary sick pay system	Dummy	if supplementary system exists
Collective Agreement	Dummy	if collective agreement at branch level exists
Just-in-Time	Dummy	if just-in-time methods used
Multidisciplinary Workgroups	Dummy	if multidisciplinary work groups are used
Rotation within workgroups	Dummy	if rotation of tasks within workgroups is practised
Rotation between workgroups	Dummy	if rotation of tasks between workgroups is practised
Interdepartmental Co-operation	Dummy	if interdepartmental cooperation is encouraged
Shift Work	Dummy	if shift working used
Absence of production workers a problem	Dummy	if absenteeism of blue-collar production workers was a problem in 1992
Absence of service workers a problem	Dummy	if absenteeism of blue-collar service workers was a problem in 1992
Absence used in setting pay rises	Dummy	if absenteeism was a criterion in setting individual pay rises
Union representation	Dummy	if union representation in establishment
Indicator of social climate	Dummy	if absenteeism regarded as indicator of social climate
Absenteeism regularly monitored	Dummy	if absenteeism regularly monitored
Establishment Size	Count	size of establishment
$\overline{t_j(4)}$	Continuous	Mean replacement ratio for a spell of 4 days
$\overline{t_j(11)}$	Continuous	Mean replacement ratio for a spell of 11 days
$\overline{t_j(20)}$	Continuous	Mean replacement ratio for a spell of 20 days

Table I: Variable Definitions

Note: variables taken from Réponse in italic

Variable	*Observations*	*Mean*	*Std. Deviation*
$\overline{t_j(4)}$	854	17.146	7.956
$\overline{t_j(11)}$	854	50.764	14.854
$\overline{t_j(20)}$	854	65.351	13.539
supplementary sick pay system	854	0.774	0.418
Collective Agreement	852	0.917	0.277
Establishment Size	854	176.2	431.05
Just-in-Time	854	0.280	0.449
Multidisciplinary Workgroups	854	0.348	0.477
Rotation within workgroups	854	0.219	0.414
Rotation between Workgroups	854	0.383	0.486
Interdepartmental Co-operation	854	0.629	0.483
Shift Work	854	0.392	0.489
Absence of production workers a problem	848	0.265	0.442
Absence of service workers a problem	851	0.221	0.414
Absence used in setting pay rises	854	0.267	0.443
Union Representation	854	0.365	0.482
Indicator of social climate	850	0.698	0.460
Absenteeism regularly monitored	851	0.767	0.443

Table II: Summary Statistics of Variables

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Exogenous Variables	*IIIa*	*IIIb*
Collective Agreement	0.75	0.82
	(0.008)	(0.005)
Log of Establishment Size /1000	0.15	0.15
	(0.085)	(0.099)
Union representation	0.36	0.40
	(0.084)	(0.056)
Just-in-Time	-0.23	-0.23
	(0.261)	(0.269)
Rotation within workgroups	0.30	0.28
	(0.220)	(0.268)
Rotation between Workgroups	-0.02	-0.08
	(0.914)	(0.705)
Interdepartmental Co-operation	0.27	0.23
	(0.137)	(0.202)
Multidisciplinary Workgroups	0.03	0.02
	(0.858)	(0.919)
Shift Working Used	0.37	0.33
	(0.060)	(0.098)
Absence used in setting pay rises		-0.49
		(0.015)
Indicator of social climate		0.47
		(0.027)
Absenteeism regularly monitored		0.47
		(0.033)
Absence of production workers a problem		0.04
		(0.860)
Absence of service workers a problem		0.29
		(0.214)
Intermediate goods	-0.10 (0.876)	-0.04 (0.953)
Equipment	-0.26 (0.691)	-0.26 (0.688)
Current consumption goods	0.30 (0.610)	0.41 (0.491)
Construction	-0.11 (0.872)	0.06 (0.929)
Retailing	-0.31 (0.579)	-0.41 (0.466)
Transports and Telecommunication	-0.09 (0.879)	-0.16 (0.791)
Commercial services	-0.11 (0.838)	-0.11 (0.833)
Housing rental	-2.11 (0.101)	-1.87 (0.149)
Insurance	-0.39 (0.628)	-0.62 (0.449)
Other Financial Services	-0.13 (0.847)	-0.22 (0.749)
Log Likelihood	-430.2	-414.6
Observations	850	840

Note: significance level for the z statistic in parentheses.

Table III: Logit estimation of the probability of adopting a supplementary sick pay scheme

Exogenous Variables	*4 days*	*11 days*	*20 days*
Collective Agreement	1.75 (0.480)	1.70 (0.339)	1.97 (0.218)
Log of Establishment Size/1000	-0.091 (0.877)	0.222 (0.630)	0.043 (0.918)
Union representation	4.05 (0.004)	4.01 (0.000)	4.22 (0.000)
Just-in-Time	-2.67 (0.070)	-2.39 (0.036)	-2.66 (0.009)
Rotation within workgroups	4.04 (0.009)	3.68 (0.003)	2.47 (0.027)
Rotation between Workgroups	-0.70 (0.611)	-0.61 (0.572)	-0.30 (0.753)
Interdepartmental Co-operation	-0.44 (0.738)	-0.43 (0.672)	0.18 (0.842)
Multidisciplinary Workgroups	3.85 (0.004)	2.63 (0.012)	2.26 (0.016)
Shift Working Used	2.04 (0.128)	0.58 (0.578)	-0.25 (0.786)
Absence used in setting pay rises	-3.00 (0.037)	-1.41 (0.195)	-0.57 (0.560)
Indicator of social climate	1.47 (0.334)	0.44 (0.710)	-0.45 (0.672)
Absenteeism regularly monitored	2.09 (0.206)	2.25 (0.076)	2.03 (0.076)
Absence of production workers a problem	-1.75 (0.231)	-0.42 (0.711)	-0.61 (0.552)
Absence of service workers a problem	0.61 (0.697)	0.67 (0.574)	0.41 (0.701)
Intermediate goods	30.5 (0.000)	19.0 (0.000)	16.1 (0.000)
Equipment	19.3 (0.000)	10.2 (0.002)	8.7 (0.004)
Current consumption goods	24.1 (0.000)	15.1 (0.000)	13.1 (0.000)
Construction	27.9 (0.000)	20.1 (0.000)	17.8 (0.000)
Retailing	14.8 (0.002)	6.3 (0.031)	5.5 (0.035)
Transports and Telecommunication	13.8 (0.006)	5.0 (0.099)	4.8 (0.080)
Commercial services	9.1 (0.057)	0.24 (0.931)	-0.9 (713)
Housing rental	-66.4 (0.000)	-3.0 (0.683)	-1.14 (0.861)
Insurance	7.4 (0.293)	0.57 (0.900)	0.9 (0.829)
Other Financial Services	20.3 (0.000)	13.3 (0.000)	12.2 (0.000)
Log Likelihood	-1583.1	-3281.2	-3213.1
Left-Censored Observations	517	31	29
(censored at)	12.5	36.36	42.5
Total Observations	842	842	842

Note: : significance level for the Student t statistic in parentheses.

Table IV: Tobit estimation of the mean replacement ratio throughout a x days spell of absence

Exogenous Variables	***V1a***	***V1b***
Collective Agreement	0.73 (0.011)	0.80 (0.007)
Log of Establishment Size /1000	0.16 (0.069)	0.16 (0.076)
Union representation	0.36 (0.082)	0.41 (0.056)
Just-in-Time	-0.21 (0.539)	-0.23 (0.269)
Rotation within workgroups	1.19 (0.048)	1.20 (0.053)
Rotation between Workgroups	-0.24 (0.497)	-0.27 (0.442)
Interdepartmental Co-operation	0.40 (0.130)	0.45 (0.097)
Multidisciplinary Workgroups	0.47 (0.186)	0.49 (0.183)
Shift Working Used	0.39 (0.045)	0.36 (0.075)
Absence used in setting pay rises		-0.52 (0.010)
Indicator of social climate		0.50 (0.019)
Absenteeism regularly monitored		0.46 (0.038)
Absence of production workers a problem		0.04 (0.867)
Absence of service workers a problem		0.28 (0.232)
Just-in-Time* Rotation within workgroups	-0.82 (0.105)	-0.92 (0.079)
Just-in-Time* Rotation between workgroups	0.19 (0.658)	0.23 (0.607)
Just-in-Time* Interdepartmental Co-operation	0.13 (0.754)	-0.08 (0.856)
Just-in-Time* Multidisciplinary Workgroups	-0.03 (0.945)	0.195 (0.650)
Rotation within workgroups* Rotation between workgroups	0.01 (0.995)	-0.01 (0.994)
Rotation within workgroups* Interdepartmental Co-operation	-0.65 (0.256)	-0.54 (0.368)
Rotation within workgroups* Multidisciplinary Workgroups	-0.27 (0.608)	-0.40 (0.452)
Rotation between workgroups* Interdepartmental Co-operation	0.24 (0.557)	0.20 (0.624)
Rotation between workgroups* Multidisciplinary Workgroups	0.01 (0.975)	0.03 (0.944)
Interdepartmental Co-operation* Multidisciplinary Workgroups	-0.60 (0.142)	-0.73 (0.080)
Log Likelihood	-426.5	-410.0
Observations	850	840

Note: significance level for the z statistic in parentheses. Dummies for eleven sectors are included in this regression but are not reported for space reasons.

Table V.1: Effects of dependent variables in interaction on adopting a supplementary sick pay scheme

Exogenous Variables	***V2a***	***V2b***
Just-in-Time	-0.25 (0.230)	-0.28 (0.20)
Rotation within workgroups	0.46 (0.110)	0.47 (0.118)
Rotation between Workgroups	-0.03 (0.889)	-0.07 (0.726)
Interdepartmental Co-operation	0.18 (0.361)	0.13 (0.509)
Multidisciplinary Workgroups	0.03 (0.863)	0.01 (0.989)

Note: significance level for the chi-square statistic in parentheses. Once again, dummies for eleven sectors are included in this regression but are not reported for space reasons.

Table V.2: Effects of dependent variables in interaction on adopting a supplementary sick pay scheme

Exogenous Variables	*4 days*	*11 days*	*20 days*
Collective Agreement	1.90 (0.443)	1.66 (0.352)	2.02 (0.205)
Establishment Size/1000	0.02 (0.971)	0.27 (0.566)	0.07 (0.870)
Union representation	4.09 (0.003)	3.99 (0.000)	4.21 (0.000)
Just-in-Time	-5.07 (0.067)	-3.28 (0.112)	-3.38 (0.068)
Rotation within workgroups	8.85 (0.014)	5.93 (0.040)	4.53 (0.081)
Rotation between Workgroups	-0.61 (0.820)	0.82 (0.685)	-0.24 (0.854)
Interdepartmental Co-operation	-1.24 (0.407)	-0.44 (0.768)	1.00 (0.)
Multidisciplinary Workgroups	6.58 (0.009)	5.31 (0.006)	4.79 (0.006)
Shift Working Used	2.13 (0.112)	0.58 (0.573)	-0.21 (0.820)
Absence used in setting pay rises	-2.85 (0.048)	-1.35 (0.218)	-0.48 (0.627)
Indicator of social climate	1.76 (0.249)	0.60 (0.612)	-0.36 (0.737)
Absenteeism regularly monitored	2.23 (0.177)	2.30 (0.070)	2.12 (0.063)
Absence of production workers a problem	-2.00 (0.169)	-0.50 (0.662)	-0.69 (0.500)
Absence of service workers a problem	0.40 (0.795)	0.62 (0.605)	0.31 (0.769)
Just-in-Time* Rotation within workgroups	-3.29 (0.291)	-0.39 (0.876)	-0.37 (0.870)
Just-in-Time* Rotation between workgroups	2.21 (0.446)	1.31 (0.567)	1.36 (0.510)
Just-in-Time* Interdepartmental Co-operation	1.70 (0.571)	0.22 (0.922)	0.74 (0.722)
Just-in-Time* Multidisciplinary Workgroups	2.65 (0.339)	0.68 (0.758)	-0.65 (0.744)
Rotation within workgroups* Rotation between workgroups	-6.84 (0.028)	-6.17 (0.016)	-7.12 (0.002)
Rotation within workgroups* Interdepartmental Co-operation	4.12 (0.238)	4.49 (0.105)	5.19 (0.038)
Rotation within workgroups* Multidisciplinary Workgroups	-5.67 (0.067)	-3.26 (0.200)	-2.64 (0.249)
Rotation between workgroups* Interdepartmental Co-operation	1.74 (0.545)	-0.18 (0.935)	0.01 (0.997)
Rotation between workgroups* Multidisciplinary Workgroups	-1.26 (0.660)	-1.07 (0.642)	-0.57 (0.785)
Interdepartmental Co-operation* Multidisciplinary Workgroups	-2.31 (0.408)	-2.54 (0.244)	-2.20 (0.262)
Log Likelihood	-1575.8	-3281.2	-3205.1
Left-Censored Observations	517	31	29
(censored at)	12.5	36.36	42.5
Total Observations	842	842	842

Note: significance level for the Student t statistic in parentheses. Once again, dummies for eleven sectors are included in this regression but not reported for space reasons.

Table V.3: Tobit estimation of the mean replacement ratio throughout a x days spell of absence

Exogenous Variables	*4 days*	*11 days*	*20 days*
Just-in-Time	-2.96 (0.050)	-2.48 (0.031)	-2.71 (0.009)
Rotation within workgroups	5.93 (0.006)	5.14 (0.001)	4.04 (0.001)
Rotation between Workgroups	-0.83 (0.551)	-0.65 (0.551)	-0.37 (0.702)
Interdepartmental Co-operation	-0.40 (0.764)	-0.35 (0.735)	0.33 (0.716)
Multidisciplinary Workgroups	4.15 (0.002)	2.77 (0.008)	2.43 (0.010)

Note: significance level for the F statistic in parentheses.

Table V.4: Effects of dependent variables in interaction on the mean replacement ratio

Variable	*Coefficient*	*Significance level of the Z statistic*
Constant	-1.857	0.230
Proportion Female	-0.371	0.090
Proportion Married	- 0.039	0.904
Mean Number of Children	-0.034	0.785
Mean Age	-0.038	0.004
Absence Regularly monitored	0.259	0.054
Log of establishment size	0.106	0.039
Number of Observations	1619	
Pseudo-R^2	0.1447	
Log-likelihood	-822.4544	

Note: 12 industry dummies were included in the logit estimation.

Table VI: Logit Regression of Adoption of Just-in-Time Methods on Employment

	Just-in-Time	*Rotation within workgroups*	*Rotation between Workgroups*	*Interdepartmental Cooperation*	*Multidisciplinary Workgroups*	*Shift Wor*
Just-in-Time	1					
Rotation within workgroups	0.1303	1				
Rotation between Workgroups	0.1099	0.3518	1			
Interdepartmental Cooperation	-0.007	0.1196	0.1814	1		
Multidisciplinary Workgroups	0.1417	0.1068	-0.0138	0.1132	1	
Shift Work	0.0868	0.1661	0.1664	0.0812	0.0126	1

Table VII: Correlation Matrix between production methods and organizational variables

Variable	*Mean in the used sample (N=854)*	*Mean in the original sample (N=1690)*
Supplementary Sick Pay System	0.774	**0.879**
Collective Agreement	0.917	0.923
Establishment Size	176.2	**229.7**
Just-in-Time	0.280	0.282
Multidisciplinary Workgroups	0.348	**0.419**
Rotation within workgroups	0.219	0.229
Rotation between Workgroups	0.383	0.363
Interdepartmental Co-operation	0.629	**0.662**
Shift Work	0.392	**0.334**
Absence of production workers a problem	0.265	0.256
Absence of service workers a problem	0.221	0.213
Absence used in setting pay rises	0.267	0.263
Union Representation	0.365	**0.438**
Indicator of social climate	0.698	0.692
Absenteeism regularly monitored	0.767	0.777

Note: Bold figures reflect a 5% threshold significant difference in the average value between the two samples.

Table AI: Means of variables in original and main samples

Exogenous Variables	*4 days*	*11 days*	*20 days*
Just-in-Time	-1.18 (0.072)	-1.56 (0.075)	-1.60 (0.041)
Rotation within workgroups	1.24 (0.107)	1.88 (0.071)	1.35 (0.148)
Rotation between Workgroups	-0.63 (0.309)	-0.97 (0.238)	-0.69 (0.353)
Interdepartmental Co-operation	1.19 (0.045)	1.58 (0.046)	1.49 (0.035)
Multidisciplinary Workgroups	1.00 (0.077)	1.18 (0.124)	1.07 (0.119)
Log Likelihood	-4090.9	-6435.4	-6276.6
Left-Censored Observations	645	44	42
(censored at)	12.5	36.36	42.5
Total Observations	1617	1617	1617

Note: significance level for the F statistic in parentheses.

Table AII: Effects of dependant variables in interaction on the mean replacement ratio in sample 2

Exogenous Variables	*4 days*	*11 days*	*20 days*
Just-in-Time	-1.24 (0.053)	-1.72 (0.050)	-1.75 (0.024)
Rotation within workgroups	1.19 (0.112)	1.86 (0.075)	1.32 (0.154)
Rotation between Workgroups	-0.52 (0.388)	-0.87 (0.294)	-0.68 (0.352)
Interdepartmental Co-operation	0.88 (0.126)	1.21 (0.126)	1.22 (0.083)
Multidisciplinary Workgroups	1.12 (0.043)	1.40 (0.067)	1.30 (0.056)
Log Likelihood	-4166.4	-6450.4	-6280.8
Left-Censored Observations	618	39	37
(censored at)	12.5	36.36	42.5
Total Observations	1617	1617	1617

Note: significance level for the F statistic in parentheses.

Table AIII: Effects of dependent variables in interaction on the mean replacement ratio in sample 3