Workplace Absence in a Downsizing Firm

Wolter Hassink[a], Pierre Koning[b], and Simen Gaure[c]

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Abstract:

We investigate sickness absenteeism in two plants of a Dutch manufacturer over the period July 2001 – May 2005. Both plants are comparable in terms of the structure of production and their work force. In March 2004, the manufacturer unexpectedly announced that it would relocate the production from the smaller plant to some plants abroad. We investigate empirically the effects of this announcement on workplace absence, using a four dimensional hazard rate model. We find evidence that low-effort workers in the small plant are more likely to report less absent after the announcement.

a) Utrecht University and IZA. Utrecht University School of Economics, Kriekenpitplein 21-22, 3584 EC Utrecht, The Netherlands. Phone: (+31)30-2539800. e-mail: w.h.j.hassink@uu.nl.

b) VU University Amsterdam, Tinbergen Institute, and IZA, Department of Economics, De Boelelaan 1105, 1081 HV, Amsterdam, The Netherlands, (+31)70-3334009, e-mail: p.w.c.koning@vu.nl.

c) Frisch Centre, Gaustadalléen 21, 0349 Oslo, Norway. (+47) 97117583, e-mail: simen.gaure@frisch.uio.no.

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1. Introduction

A firm that reduces substantially its workforce inflicts severe economic costs for society – in terms of lost financial resources – so that it often generates wide attention in the (local) media. Downsizing is painful for the employees involved, both for the leavers and for the workers who stay with the firm after the employment reduction. The aim of this paper is to estimate the causal effect of labor downsizing on work effort, for which we allow for a heterogeneous response across workers inside the firm.

Our motivation for a heterogeneous response is that various partial mechanisms will lead to an effect of labor downsizing on work effort in opposite directions. On the one hand, work effort will increase for those who have a poor outside option or who fear the financial consequences of any job loss and work displacement (Jacobsen, LaLonde and Sullivan, 1993). This effect will persist as long as information on current work effort is used for firing decisions (Lange, 2007).[1] On the other, effort will decrease for workers who have a bad work morale (Bewley, 1999) or for workers with an increased work load or for discouraged workers who are anxious to be part of the group of dismissals and who have a lower job satisfaction (Bryson, Barth and Dale-Olsen, 2013).

In this paper we use workplace absenteeism as a measure of work effort, which is consistent with a broad empirical literature (for example, see Barmby, Orme and Treble, 1991; Treble and Barmby, 2011; Ziebarth and Karlsson, 2014). Although the differences in the regulation of paid sick day and sick leave policies are substantial across countries (Barmby, Ercolani and Treble, 2002; Heymann, Rho, Schmidt and Earle, 2010), it is widely accepted that workers have the possibility to slack off by either extending a spell of absence with a few days or reporting absent more often than what is needed. From an empirical point of view, the advantage of the measure of workplace absence is that it is available for all workers inside the firm. Dutch firms carefully register workplace absence for requirements of social security and because

[1] Models of job search (Mortensen and Pissarides, 1994) and labor downsizing (Pfann, 2006) do not allow for any change of work effort as a result of job destruction. Lazear, Shaw and Stanton (2013) emphasize that work effort increases during an economic recession.

of stipulations of law.[2] All of the aforementioned partial mechanisms on work effort have been reported in the economic literature of workplace absenteeism.[3]

For an inquiry of the causal effect of labor downsizing on workplace absence, we claim there are four strong conditions about the structure of the data of investigation. The first condition is that there must be information of the date at which the announcement by the firm took place, because workers may perform differently before and after the bad news of downsizing. Second, the researcher needs to have information on a counterfactual of a firm that had a similar production structure and that did not reduce its employment. Third, the workers in the downsizing firm must have any prospect of being retained by the firm. Consequently, there may be a heterogeneous response of the employees' work effort during the process of downsizing. Fourth, there must be information of the worker's (potential) costs of layoff.

There are various reasons to suspect why previous studies underestimated the true effect of downsizing on absence. First, ignoring the heterogeneous response leads to an average effect across all workers, which is close to zero. This is particularly the case if a group of workers increase their effort, whereas for another group there is no or a negative change of effort. Second, improper information on the date of announcement leads to measurement error, so that there will be an attenuation bias in the estimated coefficient on the downsizing variable. Previous empirical investigations were inconclusive about the direction and size of the effect of labor downsizing on workplace absence.[4] Some studies obtained a small, negative effect of downsizing on absenteeism (Kauermann and Ortlieb, 2004; Røed and Fevang, 2007; Dionne and Dostie, 2007). Other studies found no effect or a small positive effect

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[2] In the Netherlands, a doctor's certificate is not required for reporting absent. Van den Bemd and Hassink (2012) give an exposition of the Dutch institutions of sickness absence.

[3] See for the outside option Leigh (1985), for work morale Hassink and Fernandez (2015), and for increased work effort Böckerman and Ilmakunnas (2008). In addition, in a medically-oriented literature, it was argued that there may be more absence in a downsizing firm, because job insecurity may lead to stress and bad health of the employee (Østhus and Mastekaasa, 2010).

[4] Most of the empirical studies are based on large administrative data sets of firms, which do not include information of the exact date of announcement of downsizing. Furthermore, no counterfactual observations have been used. Although some studies have been flows into absenteeism and presenteeism, no distinction has been made with respect heterogenous responses of workers of different quality (Røed and Fevang, 2007; Henningsen and Hægeland, 2008).

(Westerlund, Ferrie, Hagberg, Jedig and Theorell, 2004; Vahtera, Kivimäki, Pentti, Linna, Virtanen, Virtanen, and Ferrie, 2004; Østhus and Mastekaasa, 2010).[5]

We scrutinize absenteeism in two plants of a Dutch firm, which were similar in terms of the product market and the structure of the production process.[6] A substantial fraction of the work force consisted of lower-educated workers who operated on production lines. The plants were located in the same (local) labor market, at a distance between both plants of about 15 kilometers. The period of investigation is July 2001 – May 2005. The empirical setup of our case satisfies all of the four data requirements. The sudden decline in employment in the smallest plant that was announced on March 1st 2004 was unexpected to its personnel and it pertained to this plant only. Afterwards, some workers managed to stay with the firm by moving laterally to the largest plant. The equation include controls for (potential) layoff costs.

For the empirical application, we construct three Markovian states of (different degrees of) work effort, to which workers can be assigned. It gives a dynamic system of work effort – described by the Markov transition matrix – in which workers transit across states of effort after (not) reporting absent. The empirical question is whether the announcement resulted in different patterns of Markov transitions for the classes of high-effort and low-effort workers in the smallest plant. For this purpose, we specify a four-dimensional mixed proportional hazard rate model, for which the estimation procedure allows for multiple mass points (for details, see Gaure, Røed, and Zhang, 2007). The transitions are observed at the daily level.[7] Three hazards refer to leaving the states of work effort; the fourth hazard registers the transition of leaving

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[5] For an overview of analyses of the relationship between workplace downsizing and work effort in the field of organizational studies, see Datta, Guthrie, Basuil and Pandey (2010).

[6] Earlier research on both plants is reported in Hassink and Koning (2009), which investigates the effectiveness of a lottery on reducing absenteeism, using information over the period July 2001 – July 2003. One of the findings was that lottery winners had an increase in absence after winning the lottery.

[7] A review of the empirical studies that applied techniques of discrete time duration models of sickness absenteeism learns us the following about the unit of time. Most of the studies applied daily information: for a UK manufacturing firm (e.g. Barmby, 2002), Dutch primary-school teachers (Kerkhoffs and Lindeboom, 2000), Swedish social security (e.g. Broström, Johanssen, and Palme, 2004), an Italian bank (Ichino and Moretti, 2009), Dutch self-employed (e.g. Spierdijk, Van Lomwel, and Peppelman, 2009). Monthly data are applied by many studies that used Norwegian records of social security (e.g. Røed and Fevang, 2007).

the firm. By adding the latter equation to the three transitions of work effort, we correct for the composition of workers leaving the firm, so that the effect of downsizing identifies the true incentive effect on work effort.[8] Our estimates indicate that the announcement induced a higher effort for the low-effort workers in the plant that had the labor reduction.

The setup of this paper is as follows. Section 2 outlays the economic states and the transitions across these states. Section 3 gives further background information about the firm and the development of labor. The statistical identification is described in Section 4. In Section 5 the baseline estimates are discussed. In Section 6, makes use of placebo estimates to check the robustness of the baseline estimates. Section 7 provides the conclusions.

2. A classification of work effort

We develop a Markov model of work effort that allows for heterogeneous responses by workers of different classes of effort. High-effort and low-effort workers may respond - in terms of their workplace absenteeism - differently to the bad news of downsizing. Our classification of work effort is based on the employer’s assessment of individual work effort in the years prior to the downsizing (see Hassink and Koning, 2009). In particular, we exploit the structure of a monthly lottery incentive system that the firm introduced to reduce the workplace absence of its employees. The lottery that was organized by the firm was based on a simple criterion of eligibility: eligible workers are those who had not reported absent in the last three calendar months in the period before the lottery draw.[9] We reformulate this decision rule to a measure with which we can distinguish between high-effort and low-effort workers.

It renders three states of work effort (Z1-Z3) at the daily level. Workers in state Z1 have the highest effort. More specifically, the worker has not been absent neither during the working days in the present month so far (*m*) nor in the two

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[8] The effect of downsizing on absence may be the result of an incentive effect as well as a composition effect. A substantial literature has scrutinized both effects to explain the procyclical pattern of absenteeism across the business cycle (Leigh, 1985; Kaivanto, 1997; Arai and Thoursie, 2005; Røed and Fevang, 2007; Heijnen, Hassink and Plantenga, 2015).

[9] Another requirement of eligibility was that participating workers had not won any of the previous lotteries. The lotteries were held in both plants in the period June 2002 – December 2004.We will pay further attention to the setup of the lottery in Section 3.

previous calendar months (m-1 and m-2). In the second state ($Z2$), the worker has not been absent neither in the current month so far nor in the past calendar month (m-1). However, the worker was absent in month m-2. In the third state ($Z3$), the worker was on sick leave either during the present month or in the past calendar month (m-1). Finally, we add an absorbing fourth state, $Z4$, in which the worker is not employed anymore with the firm.

We formulate a four-dimensional state (row) vector $\mathbf{z}$, which registers presence of the worker in either of four mutually exclusive states at the daily level. The state indicators Z1-Z4 are 0-1 indicator variables. At working day k of month m, the state vector is[10]

(2a) $\mathbf{z}_{k,m} = (Z1_{k,m}, Z2_{k,m}, Z3_{k,m}, Z4_{k,m}) =$

$$= \left((1-Q_{k,m})\vec{P}_{k,m}(1-S_{m-1})(1-S_{m-2}), (1-Q_{k,m})\vec{P}_{k,m}(1-S_{m-1})S_{m-2}, (1-Q_{k,m})\vec{P}_{k,m}S_{m-2}, Q_{k,m}\right)$$

where

(2b) $Z1_{k,m} + Z2_{k,m} + Z3_{k,m} + Z4_{k,m} = 1$

and we used the 0-1 indicator variable $S_{t,m}$ as one if the worker is absent on working day t in month m (and zero otherwise). For completed months, the 0-1 indicator S_m is one if the worker is absent at any of the K work days during the m-th month:

$$S_m = \prod_{t=1}^{K} S_{t,m}$$

whereas for ongoing months, the 0-1 indicator $\vec{P}_{k,m}$ is one if the worker has been not been on sick leave on all of the first k-th working days of the m-th month.

(2c) $\vec{P}_{k,m} = \prod_{t=1}^{k}(1-S_{t,m})$

Q is an indicator variable that is one after the worker left the firm.

The day-to-day transitions across the four states can be described by the Markov transition matrix:

$$(3) \qquad (t-1) \quad M = \overset{(t)}{\begin{bmatrix} P_{11} & 0 & P_{13} & P_{14} \\ P_{21} & P_{22} & P_{23} & P_{24} \\ 0 & P_{32} & P_{33} & P_{34} \\ 0 & 0 & 0 & P_{44} \end{bmatrix}}$$

[10] New hires start in state Z3 during their first month of tenure.

where P_{ij} (i,j = 1,…,4) registers the conditional probability of moving from origin state i to destination state j from day t to day t+1.

The dynamic system describes the transitions of workers across the three states as a result of a change of effort as well as leaving the firm. After reporting absent, workers who are in Z1 or Z2 will move immediately to the state of lowest effort Z3; by not reporting absent during the calendar month, they can either move from Z3 and Z2 to a state of higher effort or they will remain in the state of highest effort Z1. It leads to a dynamic system of work effort, described by the Markov transition matrix, in which workers transit across states of effort. After leaving the firm, the worker will be in Z4. The empirical aim is to measure whether downsizing induces a change of effort as measured by any change of the transition probabilities P_{ij} .

/ Figure 1 about here */*

3. Descriptive evidence

Development and structure of employment

The process of downsizing started on 1 March 2004, when there was an unexpected announcement to the personnel of the smaller plant that the manufacturer intended to relocate its production from this Dutch plant to production plants in Italy and Switzerland. Furthermore, the manufacturer considered either to close or to sell the plant. Subsequently, about 30 workers were encouraged to leave the plant, for which they were assisted in finding another job elsewhere. In October 2004, the manufacturer announced that it intended to sell two of the four production lines from this plant to local firms. A third production line would be removed to the larger plant nearby, and the fourth production line would be closed. It implied that part of the work force continued to be employed in the plant (although it would be owned by another manufacturer). Another part of the work force switched from job to the other plant. Finally, about 20 workers had to leave the firm.[11]

Figure 1 displays the development of the number of workers in both plants over the period of investigation. The plants were acquired by a large Dutch

[11] Although there were no formal layoffs (leading to costs of severance payment or a period of notification of dismissal) the applied procedures of labor reduction were costly to the firm. These costs are based on salary, age, and tenure.

manufacturer in July 2001. There were 435 workers (163 and 272 workers in both plants, respectively) on 1 July 2001, 371 workers (156 and 215 workers) on 1 March 2004, and it decreased to 268 workers (68 and 200 workers) on 27 May 2005. Over the entire period of investigation, 226 workers had left both plants and 59 were hired. Furthermore, 19 workers moved from the small plant to the large plant, and 4 workers vice versa. In total, we have information of 492 workers. The entire period of observation comprises 1003 work days.

/ Table 1 about here */*

The larger plant will be used as a counterfactual for the process of downsizing in the smaller plant, as both plants are similar with respect to the type of production process, the product market, and their local proximity. We compare the composition of the workforce between both plants in the period before the announcement -- see Table 1. On 1 July 2001, there was a higher fraction of workers with non-native parents in the smaller plant (0.362 versus 0.250), whereas in the larger plant there was a higher fraction of workers in the highest categories of age (0.099 versus 0.055), tenure (0.503 versus 0.563), and job level (for level 5 and higher). In the period until 1 March 2004, the distributions of age and tenure shifted to the higher categories in the smaller plant. In the larger plant there was there was an increase of the fraction of women (from 0.217 to 0.144) and of the fraction of non-native parents (from 0.250 to 0.316). In both plants there was no change of the distribution of the job level.

/ Figures 2, 3 about here */*

States of effort

Figure 2 portrays the average monthly rate of absence for both plants separately. It suggests that the developments of absence were similar until 2004, but that they diverged in the months shortly after the announcement, with the average sick leave strongly decreasing in the smaller plant.

Using the information on absence (equation (2)), we classify work effort with respect to the three states Z1 (highest effort) - Z3 (lowest effort) at the daily level. Figure 3 displays the development over time of averages of Z1-Z3. After excluding

July and August 2001,[12] states Z1 and Z3 exhibit a seasonal pattern, whereas Z2 turns out to be relatively stable until March 2004. There seems to be a shift to the states of higher effort afterwards.

/ Table 2 about here */*

Table 2 summarizes the composition of the workforce for each of the three states.[13] The averages hardly differ between Z2 and Z3, so that we compare the averages of states Z1 and Z3. In Z1, there is a higher fraction of workers of the smaller plant, a smaller fraction of workers with non-native parents (0.302 versus 0.381), the workers are relatively of older age (for the oldest category 0.125 versus 0.086), the workers in Z1 are of longer tenure (for the highest tenure 0.583 versus 0.496). Finally, the workers in Z1 are at a relatively higher job level (0.116 versus 0.046). The fourth column of Table 2 gives the composition of the 214 workers on the work day before they left the firm. It contains a higher fraction of females, older workers, and short-tenured workers among the leavers.[14]

/ Tables 3A, 3B about here */*

Markov transition matrix

In Table 3A we report the average conditional transition probabilities of the Markov transition matrix (equation (3)). The averages at the main diagonal are close to one, because they reflect day-to-day changes. Next, we consider the conditional probabilities for four subgroups: in both plants separately and before and after the

[12] The prevalence in state Z1 is relatively large in both months, but exclusion of the information of both months does not alter our conclusions.

[13] The information starts on 1 September 2001, the information of July and August 2001 is needed to determine whether the workers are in state Z1- Z3 in the work days of September 2001. As a result, the set of information on which the table is based is reduced to 958 work days and 481 workers. 11 workers left the firm in July and August 2001. The estimates of the empirical analysis in Sections 6 and 7 are based on the same period.

[14] The lower part of Table 2 gives essential information about the structure of the spells for the states Z1-Z3. Almost all workers (476 out of 481 workers) had reached state Z1 on any of the work days over the period of investigation. In addition, the number of repeated spells is relatively large for most of the states, which is helpful to correct for duration dependency in the statistical duration analysis.

announcement of downsizing. Table 3B gives the averages of the conditional probabilities for each of the four groups. The fifth row of each cell gives the dif-in-dif probabilities. It suggests there is an increase in the transition from Z2 to Z3 in the small plant after the announcement of downsizing. For all of the other possible transitions, there seem to be no differences.

/ Figure 4 about here */*

The lottery

We give a detailed discussion of the lottery for two reasons. First, our classification of the three states of work effort in Section 2 is based on the design of the lottery. Second, in our empirical analysis, we must control for the lottery, because it may have a confounding effect on the estimates. The lottery incentive may be positively correlated to the workers' response to the announcement of downsizing.

The monthly lottery was organized by the firm over the period June 2002 – December 2004. Eligible workers had not been absent during the past three calendar months. Neither had they won any of the previous monthly lotteries.[15] The random selection of seven lottery winners – four winners in the largest plant and three in the other plant – was done by the firm at the first work day of each month. Each winner received a gift coupon of 75 Euros, and after each draw the names of the seven winners were announced to the co-workers.

In total there were 30 lottery draws (and 209 winners) over the period June 2002 – December 2004.[16] Figure 4 displays the development of workers who are eligible, in state Z1 or who have been a lottery winner. The number of workers who are eligible for the lottery is smaller than the number of workers in state Z1, because of the rule that lottery winners (even if they were in Z1) were not eligible for any of the remaining lotteries. From June 2002 onwards, the number of the workers who had won one of the previous lotteries increased gradually; 7 winners were added to the number of lottery winners each month. There was a decrease from January 2005 onwards, because some of the lottery winners left the firm. Finally, the decline of the

[15] Because of the specific design of this incentive system, in informal talks prof. Tim Barmby referred to the structure of the lottery as the "Utrecht problem".

[16] There was no draw in July 2004. In September 2002, one anonymous lottery winner of the largest plant declined the lottery prize.

number of eligible workers for the monthly lottery (non-winner and not having been absent in the past three calendar months) reflects the increase of the number of lottery winners.[17]

4. Statistical specification

We group the transitions associated with the ten non-zero conditional probabilities of the Markov transition matrix *M* (equation (3)) into four transitions. Grouping is required because of the implication of Table 3A that some of the probabilities are too small to obtain a proper identification of the effects of the explanatory variables on each of the ten hazard rates. We introduce the transition variable *s*, for which *s* =1,2,3 correspond to the origin states of effort Z1-Z3, respectively. *s* = 4 refers to the transition of leaving the firm. To be more specific,

$s=1$: Its hazard is based on the transition from state Z1 to destination state Z3 (corresponding to the conditional probability P_{13} in equation (3)). It means that the highest-effort worker (state Z1) reported absent during the month, so that he returned to the state of the lowest effort.

$s=2$: Its hazard is related to the transition from state Z2 to either state Z1 or state Z3 (P_{21} and P_{23} in equation (3)). A transition to state Z1 means that the worker did not report absent during the month, whereas the transition to Z3 is the result of an absence.

$s=3$: It refers to the hazard associated with the transition from state Z3 to destination state Z2 (P_{32}). A transition to Z2 means that the low-effort worker in state Z3 did not report absent during the month;

$s=4$: transition from states Z1, Z2 or Z3 to destination state Z4 (thus the associated conditional probabilities are P_{14}, P_{24}, and P_{34}). It means that the worker is not working in the firm after the transition.

[17] For a selection of 209 winners, an OLS estimate of a regression of the lottery draw on the workers' background characteristics does not indicate any significant joint effect (F-statistic: 0.91). In addition, we considered the workers on 1 March 2004 for both plants separately, and we investigated whether they were still employed with the firm on the final day of observation 27 May 2005. A simple descriptive OLS regression suggests there is a positive association between winning the lottery and staying with the firm for the winners in the smaller plant whereas this effect is absent for the winning workers of the other plant.

We formulate the grouped transitions as a four-dimensional mixed proportional hazard model, for which we assume that the hazard rates are proportional in the effects.. The four hazard rates are specified as

$$(4) \qquad \varphi_s(t,d,\mathbf{x}_i,\mathbf{w}_{it},\mathbf{v}_{si}) = \exp(\boldsymbol{\beta}_\mathbf{s}'\mathbf{x}_i + \boldsymbol{\gamma}_\mathbf{s}'\mathbf{w}_{it} + \boldsymbol{\sigma}_{st} + \boldsymbol{\lambda}_{sd} + \mathbf{v}_{si}) \qquad s=1,\ldots,4$$

for which d is the spell duration, t is calendar time, $\mathbf{x}_i$ is a vector of individual-specific covariates (0-1 indicators for female, non-native parents, and job level (6 indicators)), and $\mathbf{w}_{it}$ is a vector of calendar time-varying covariates (0-1 indicators for plant, classes of age (4 indicators), and tenure (3 indicators)).[18] $\mathbf{v}_{si}$ is vector of unobserved covariates (mass points). $\boldsymbol{\sigma}$ is a vector of calendar-time effects (day of the week (3 indicators), quarter of the year (3 indicators), and year (3 indicators)). $\boldsymbol{\lambda}$ is a vector of baseline effects associated with the spell duration (depending on the state, 4 indicators at maximum).

The vector $\mathbf{w}$ includes two important additional time-varying explanatory variables. First, $\mathbf{w}$ contains the interaction term *DShock* ($DShock_{it}$ =1 if person *i* is employed with the smaller plant at calendar day *t*, for which the day *t* is from 1 March 2004 onwards).[19] Our purpose is to compare any differences of the effect of *DShock* on the hazard rate across the transitions *s*=1, 2, 3. A positive (negative) parameter estimate on *DShock* implies that the workers in the small plant are providing more (less) effort by being less (more) absent after the announcement of downsizing.

Second, the vector $\mathbf{w}$ includes the time-varying indicator *DWinner* ($DWinner_{it}$ =1 on the calendar day *t* after the *i*-th worker has won the lottery). A negative parameter on *DWinner* indicates that lottery winners are providing lower effort after having won the lottery (s=1,2,3) or whether they will have a prolonged stay with the firm (*s*=4).[20] *DWinner* has an important and interesting statistical

[18] It is crucial to control for job level, age and tenure, since these pieces of information shape the potential cost of layoffs to firms in the Netherlands.

[19] Note that for persons who moved from the smaller plant to the larger plant after 1 March 2004, the value of the interaction term changes.

[20] We can even expand the framework by including a interaction term between *DShock* and *Dwinner*.

feature, because it is based on the randomness of the lottery draw by the firm, conditional on the fact that the worker is eligible for the lottery.

We can disentangle the effect of duration dependence from that of individual heterogeneity, by relying on repeated spells for individuals. Most of the employees have been multiple times in one of the three states of effort (see lower part of Table 2). Furthermore, the specification includes time-varying explanatory variables.

The parameter values of equation (4) are estimated by means of a non-parametric maximum likelihood estimator. For a detailed description and assessment of the estimation procedure, see Gaure, Røed and Zhang (2007) and for an application we refer to, for instance, Nordberg and Røed (2009) and Markussen et al. (2011).[21] The procedure consists of various rounds of estimation. It increases the number of mass points each round, starting with a heterogeneity distribution of one mass point. The estimation procedure first derives the likelihood function conditional on the unobserved individual effects. Next, the unobserved heterogeneity is integrated out of the likelihood function for a discrete joint distribution of mass points. The likelihood function is maximized with respect to the parameters of interest, together with the parameters that characterize the heterogeneity distribution. It is repeated by adding another mass point to the heterogeneity distribution of mass points, and the model is "saturated" for the number of mass points for which the addition of another mass point would not lead to an increase of the likelihood function. We select the preferred model by the lowest Akaike Information Criterion (AIC).

/ Tables 4, 5 about here */*

5. Estimates

Table 4 gives the parameter estimates for the system of four hazard rates, for which there were 6 mass points required to attain the lowest AIC. The number of baseline indicators differs across the hazards. First, we consider the effect of the announcement of downsizing on the hazards. It turns out that there is no influence on the hazard of

[21] Compared to previous applications of the estimation procedure, our estimates are based on a different format of the data, because the time dimension (cross-sectional dimension) is much larger (smaller) than usual. As a result of using daily data, in our application the maximum duration consists of 958 discrete time units, whereas the number of the individuals (481) is rather limited.

leaving the highest states of effort Z1 and Z2. Both parameter estimates are statistically insignificant. There is however a positive effect of leaving the lowest state of effort Z3 (parameter estimate: 0.260). It indicates that downsizing leads to an increase in effort for the lower part of the effort distribution, suggesting that this group experienced the threat of firing the most.

Next, we consider the effect of having won the lottery. Winning the lottery has no influence on the hazard of leaving Z1 and Z2, whereas there is an increase in the stay in Z3 (estimate: -0.244). Furthermore, the parameter estimate of this variable on leaving the firm is statistically insignificant (estimate: -0.351 (0.261)).[22]

To improve the efficiency of the estimates, we group the transitions from Z2 and Z1 into one single transition. The reason is that Kendal's tau between the random coefficients of Z1 and Z2 is positive (value: 0.599), whereas it is negative for all of the other combinations of the four hazards (a transition from Z2 can be to either Z1 (no absence during the month) or Z3 (the worker reports absent). In Table 5 we report the parameter estimates for the three-hazards system, in which the transitions from Z1 and Z2 are grouped. The estimates confirm the finding the previous result that the announcement results in a higher effort for the low-effort workers (Z3) in the smaller plant (estimate: 0.240 (0.119)). After winning the lottery, the hazard rate of leaving Z3 becomes smaller (-0.306 (0.106)).[23]

/ Table 6 about here */*

6. Placebo estimates

The estimates of equation (4) suggest an effect on the hazards for lottery winners after they have won the lottery, so that it is important to control for *Dwinner*. However one may wonder why the lottery would have an effect on the absence decisions of these workers anyway. This section examines the validity of the explanatory variable

[22] The interaction term between *Dshock* and *Dwinner* becomes strongly insignificant, so that this term is not included in the specification. Thus, there is no indication of any differences in effort and sorting of lottery winners after the announcement of downsizing.

[23] Furthermore, we are extremely cautious there is some very weak indication that for lottery winners there is a decrease in the hazard of leaving the firm, because the parameter estimate of -0.369 (0.237). The placebo estimates of Section 6 do not seem to contradict this outcome.

Dwinner. There may be two reasons for *Dwinner* switching from a zero to a one at a particular day. First, there is a composition effect, because the better workers are more likely to become eligible for one of the monthly lotteries. Consequently, *Dwinner* measures the between-worker effect of ability on the hazards. Second, the specific date of winning the lottery can be considered a within-worker effect, because it contains specific information to both the worker and the firm. Hence, what matters is not only whether someone has won one of the lotteries, but also at which specific date the prize was won. Thus, exogeneity of the lottery draw implies a causal effect of *Dwinner* on the hazards of effort and sorting.

We can test for both explanations by using a series of placebo estimates. For each of the estimates we constructed a pseudo dataset, which is identical to the one that was for our baseline estimates except for the variable *Dwinner*. We constructed the pseudo explanatory variable *Dwinner*, by taking random draws of "pseudo" lottery winners ourselves, under the restriction of the design of the lottery.

More precisely, we took at random 7 pseudo winners for the first lottery of June 2002, for which we applied the formal rule that 4 of them were drawn from the eligible workers employed in the large plant and 3 of the pseudo winners were employed in the small plant. The 7 pseudo winners are not necessarily the workers who actually won the lottery in June 2002. In total there were 30 lottery draws. For the subsequent 29 pseudo draws of the lottery after June 2002, we sequentially replicated the draws. For each draw, we randomly selected 7 eligible workers, under the restriction that the previous pseudo lottery winners (selected in our pseudo lottery of previous rounds) had no access to the lotteries afterwards. In total we ended up with 209 pseudo lottery winners. Some "true" lottery winners may be also part of the group of pseudo lottery winners, albeit that the pseudo winners may have won one of the other monthly lotteries.[24] The procedure that we apply is comparable to a block bootstrapping procedure, because with the exception of the variable 'winner of the lottery in month *t*', no changes in the explanatory variables were made.

For each pseudo dataset we determined the maximum-likelihood estimates of the three hazard rate model, for which the number of mass points of the preferred

[24] Thus for a true lottery winner who also happens to be also a pseudo lottery winner, the month of winning the true (or actual) lottery does not necessarily correspond to the month of winning the pseudo lottery that we have drawn.

model may differ across the estimates. We replicated the maximum-likelihood estimates for 100 pseudo datasets. For most of the explanatory variables and hazard rates, the averages of the 100 pseudo estimates are similar to the estimates based on the “real data” that are reported in Table 5.

Table 6 contains the average parameter estimates of the pseudo estimates for the variables of interest. The estimates of the effect of the announcement effect on the hazards in the small plant are hardly different. The major difference is the effect of *Dwinner* on the hazards of Z1 and Z2, Z3, and Z4. All of the averages of the parameter estimates move to zero, so that the average parameter estimate is small relative to the average standard error. The estimates with the placebo data imply that the lottery leads to a decrease in effort of lottery winners in state Z3, because they have won the lottery. In addition, lottery winners seem to be more likely to stay with the firm.

7. Conclusions

The empirical design that has been used in this study implies that the specific parameter on the downsizing variable of the multivariate hazard rate model can be interpreted as a causal effect. Moreover, the parameter estimates suggest that during a process of downsizing there are heterogeneous effects on work effort across the workforce within the firm of investigation. To be more specific, the estimates imply that downsizing does not induce any change of effort for the high-effort workers, whereas it leads to a higher effort for the low-effort workers.

Our conclusions are fourfold. First, the estimation results may be due to a difference in the effect of downsizing on effort between high-effort and low-effort workers, because the latter group has a lower value of the outside option. Consequently low-effort workers may have felt the need to report less absent, thus influencing the decision of the firm to fire workers.

Second, the increase in effort during the process of downsizing indicates that in times of an economic downturn there will be a higher work effort due to sorting. It may provide an additional explanation for the pro-cyclical pattern of workplace absence across the business cycle, because there will be more downsizing during an economic downturn (see e.g. Leigh, 1985; Røed and Fevang, 2007).

Third, this estimation result has implications for the design of other empirical studies on downsizing that goes beyond the literature of workplace absenteeism. In general, any empirical setup of a study that measures the development of work effort (or productivity) in times of a recession should allow for differences in effort (or productivity) across workers within the firm. The heterogeneity that was used in this study was based on a simple decision rule of the firm – absenteeism in past calendar months –, but it can be easily generalized to other measures of work effort or productivity (Lazear et al., 2013)

Fourth, we applied specific placebo estimates of pseudo lotteries to check for the exogeneity of the lottery variable on absenteeism. The counterfactual that we used was based on the design of a lottery. The estimates indicate a slowdown in effort after winning the lottery, whereas the placebo estimates indicate no change at all. In this way, placebo estimates can be used to disentangle any between-worker effect from within-worker effects. This is a new application of the use of placebo estimates to make claims about causality to the existing methods applied in regression discontinuity and dif-in-dif designs.

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Table 1: Composition of workforce in both plants

	1 July 2001		1 March 2004		27 May 2005	
	Small plant	**Large Plant**	**Small plant**	**Large Plant**	**Small plant**	**Large Plant**
Female	0.245	0.217	0.231	0.144	0.162	0.150
Non-native parents	0.362	0.250	0.359	0.316	0.382	0.315
Age:						
< 25 years	0.037	0.040	0.006	0.019	0.000	0.000
25 – 35 years	0.252	0.261	0.231	0.214	0.162	0.200
35 – 45 years	0.399	0.346	0.397	0.400	0.353	0.420
45 – 55 years	0.258	0.254	0.269	0.260	0.279	0.270
> 55 years	0.055	0.099	0.096	0.107	0.206	0.110
Tenure:						
< 2 years	0.135	0.162	0.109	0.093	0.029	0.005
2 – 5 years	0.209	0.140	0.103	0.195	0.074	0.165
5 – 10 years	0.153	0.136	0.244	0.172	0.265	0.240
> 10 years	0.503	0.563	0.545	0.540	0.632	0.590
Job level:						
Level 1,2	0.135	0.067	0.115	0.070	0.132	0.065
Level 3	0.245	0.159	0.250	0.182	0.265	0.166
Level 4	0.190	0.159	0.192	0.210	0.191	0.191
Level 5	0.110	0.133	0.109	0.150	0.029	0.176
Level 6	0.110	0.181	0.122	0.168	0.118	0.166
Level 7 – 10	0.129	0.185	0.128	0.136	0.147	0.146
Level > 10	0.080	0.111	0.083	0.084	0.118	0.090
Number of workers	163	272	156	215	68	200

Table 2: Composition of workforce by state [a)]

	Z1	Z2	Z3	Leaving the firm [b)]
Small plant	0.416	0.342	0.336	0.493
Female	0.189	0.182	0.203	0.299
Non-native parents	0.302	0.371	0.381	0.280
Age:				
< 25 years	0.012	0.013	0.019	0.023
25 – 35 years	0.210	0.250	0.244	0.206
35 – 45 years	0.378	0.414	0.410	0.388
45 – 55 years	0.274	0.235	0.241	0.182
> 55 years	0.125	0.088	0.086	0.201
Tenure:				
< 2 years	0.096	0.133	0.130	0.192
2 – 5 years	0.176	0.188	0.186	0.164
5 – 10 years	0.145	0.190	0.190	0.168
> 10 years	0.583	0.490	0.495	0.477
Job level:				
Level 1,2	0.082	0.098	0.106	0.103
Level 3	0.175	0.247	0.258	0.229
Level 4	0.176	0.207	0.220	0.164
Level 5	0.118	0.155	0.151	0.107
Level 6	0.159	0.140	0.125	0.145
Level 7-10	0.174	0.099	0.093	0.154
Level > 10	0.116	0.054	0.046	0.098
Day of the week:				
Monday	0.199	0.197	0.198	0.234
Tuesday	0.201	0.200	0.200	0.126
Wednesday	0.199	0.201	0.199	0.126
Thursday	0.199	0.200	0.201	0.154
Friday	0.202	0.203	0.203	0.360
# observations	231296	31634	94381	214
# employees who have been in this state	476	394	410	
# employees > 1 spell in this state	405	394	405	
# employees > 4 spells in this state	217	208	228	
Number of spells	1660	1667	1805	
Number of spells not ending in an exit of the worker from the firm	1525	1654	1739	
Average length of spell	139.3	19.0	52.3	
Median length of spell	67	21	39	
Minimum length of spell	1	1	2	
Maximum length of spell	958	23	489	

a) Z1 (Z3): state with the highest (lowest) work effort (for the definition, see equation (2)); 481 workers; 357311 work days, which equals the sum of lengths of all spells.

b) Characteristics of the worker on the work day before they left the firm.

Table 3A – Estimated probabilities, transition matrix (all workers)

	day				
		Z1	Z2	Z3	Z4
day - 1	Z1	0.9935	0	0.0059	0.0006
	Z2	0.0405	0.9483	0.0108	0.0004
	Z3	0	0.0177	0.9816	0.0007
	Z4	0	0	0	1

a) Z1 (Z3): state with the highest (lowest) work effort (for the definition, see equation (2)); Z4: state of having left the firm.

Table 3B – Estimated probabilities, transition matrix (Large plant and small plant; before 1 March 2004 and from 1 March 2004 onwards)[a), b)]

	day				
		Z1	Z2	Z3	Z4
day - 1	Z1	0.9931 0.9930 *0.9947* *0.9927* -0.0019	0	0.0063 0.0068 *0.0050* *0.0056* 0.0001	0.0006 0.0003 *0.0003* *0.0017* 0.0017
	Z2	0.0408 0.0363 *0.0444* *0.0388* -0.0011	0.9453 0.9516 *0.9496* *0.9511* -0.0048	0.0138 0.0117 *0.0056* *0.0083* 0.0048	0.0001 0.0004 *0.0004* *0.0017* 0.0010
	Z3	0	0.0185 0.0164 *0.0178* *0.0163* 0.0006	0.9810 0.9828 *0.9819* *0.9811* -0.0026	0.0005 0.0007 *0.0003* *0.0026* 0.0021
	Z4	0	0	0	1

a) Z1 (Z3): state with the highest (lowest) work effort (for the definition, see equation (2)); Z4: state of having left the firm.
b) 1st row: large plant (before 1 March 2004); 2nd row: large plant (1 March 2004 onwards); 3rd row (italics): small plant (before 1 March 2004); 4th row (italics): small plant (1 March 2004 onwards). 5th row: dif-in-dif conditional probability.

Table 4: Estimates – 4 states (equation (4)) a), b)

	Z1		Z2		Z3		Z4	
	Est. Coeff	**Std Err.**	**Est. Coeff**	**Std Err.**	**Est. Coeff**	**Std Err.**	**Est. Coeff**	**Std Err.**
Small plant	0.088	0.405	0.099	0.108	-0.482	0.129	-0.548	0.275
Female	0.006	0.356	-0.236	0.112	0.044	0.151	0.973	0.241
Non-native parents	0.033	0.327	-0.024	0.106	-0.072	0.136	-0.332	0.278
Age:								
25 – 35 years	0.138	1.556	0.232	0.311	-0.064	0.331	-0.257	0.777
35 – 45 years	0.144	1.541	0.229	0.319	-0.117	0.351	0.141	0.773
45 – 55 years	0.164	1.555	0.192	0.337	-0.236	0.364	-0.360	0.798
> 55 years	0.153	1.576	0.154	0.359	-0.433	0.368	1.131	0.803
Tenure:								
2 – 5 years	0.036	0.569	-0.279	0.136	-0.260	0.145	-0.778	0.309
5 – 10 years	-0.034	0.480	-0.285	0.158	-0.209	0.168	-0.865	0.330
> 10 years	0.028	0.493	-0.283	0.156	-0.403	0.169	-1.405	0.312
Job level:								
Level 3	-0.010	0.454	0.180	0.160	0.285	0.200	-0.237	0.394
Level 4	0.033	0.514	0.271	0.158	-0.133	0.204	-0.463	0.415
Level 5	0.030	0.523	0.235	0.183	0.139	0.228	-0.344	0.454
Level 6	0.114	0.544	0.371	0.167	-0.322	0.215	-0.335	0.457
Level 7 – 10	0.109	0.638	0.510	0.218	-0.788	0.222	-0.253	0.432
Level > 10	0.105	0.904	0.396	0.217	-0.962	0.262	-0.549	0.447
Incentives:								
after winning lottery	0.029	0.367	0.181	0.134	-0.244	0.111	-0.351	0.261
from 1st March 2004, small plant	-0.043	0.543	-0.078	0.183	0.260	0.132	2.257	0.415
Time:								
June 2002 – Dec 2003	0.031	0.467	0.234	0.128	0.070	0.106	-0.036	0.273
2004	-0.017	0.552	0.039	0.152	0.214	0.130	-0.169	0.354
Jan – May 2005	-0.335	0.602	-0.204	0.222	0.290	0.167	0.911	0.492
Day of the week:								
Tuesday	-0.655	0.162	-0.480	0.129	-0.170	0.100	-0.606	0.353
Wednesday	-0.525	0.171	-0.828	0.164	-0.280	0.109	-0.602	0.330
Thursday	-0.137	0.173	-0.493	0.146	-1.124	0.153	-0.407	0.326
Friday	0.832	0.134	0.745	0.110	0.709	0.083	0.439	0.275
Quarter:								
Q2	-0.073	0.332	-0.049	0.133	-0.380	0.104	-0.631	0.310
Q3	-0.098	0.423	0.004	0.149	-0.518	0.113	0.360	0.284
Q4	-0.087	0.395	-0.083	0.134	-0.080	0.096	0.011	0.304
Baseline:								
2 days	-		-		-0.832	0.248	-1.967	1.379
3 – 4 days	-		-5.231	1.485	-0.141	0.150	-1.757	0.846
5 – 9 days	-		-4.277	0.740	-0.112	0.126	-1.788	0.718
10 – 19 days	-0.738	0.112	-3.348	0.305	-0.177	0.113	-0.736	0.330

a) Z1 (Z3): state with the highest (lowest) work effort (for the definition, see equation (2)); Z4: state of having left the firm. All explanatory variables are 0-1 dummy variables (1 refers to variable name). Reference categories: Age (<25 year), Tenure (< 2 year), job level (< 3), Time (July 2001 - May 2002); Quarter of the year (Q1). Baseline: (20 days and above).

b) 6 support points; 153 parameters; log-likelihood: -23720.2537; 357311 dates; 481 workers.

Table 5: Estimates; 3 states (states Z1 and Z2 combined); (equation (4)) [a), b)]

	Z1 and Z2		Z3		Z4	
	Est. Coeff	Std Err.	Est. Coeff	Std Err.	Est. Coeff	Std Err.
Small plant	0.021	0.104	-0.552	0.119	-0.524	0.273
Female	-0.154	0.118	0.018	0.136	0.733	0.213
Non-native parents	-0.054	0.108	0.110	0.132	-0.372	0.229
Age:						
25 – 35 years	0.279	0.261	-0.166	0.287	-0.221	0.900
35 – 45 years	0.248	0.265	-0.148	0.302	0.129	0.898
45 – 55 years	0.209	0.285	-0.280	0.310	-0.243	0.910
> 55 years	0.240	0.310	-0.492	0.330	0.693	0.923
Tenure:						
2 – 5 years	-0.172	0.151	-0.158	0.129	-0.821	0.304
5 – 10 years	-0.154	0.169	0.023	0.157	-0.988	0.305
> 10 years	-0.201	0.159	-0.106	0.161	-1.379	0.312
Job level:						
Level 3	0.024	0.166	0.270	0.213	0.239	0.328
Level 4	0.138	0.171	-0.085	0.217	-0.016	0.354
Level 5	0.110	0.177	-0.055	0.245	0.065	0.377
Level 6	0.239	0.172	-0.431	0.234	0.047	0.356
Level 7 – 10	0.314	0.206	-0.818	0.238	0.153	0.361
Level > 10	0.252	0.236	-1.039	0.281	-0.213	0.374
Incentives:						
after winning lottery	0.151	0.138	-0.306	0.106	-0.369	0.237
from 1st March 2004, small plant	-0.095	0.191	0.240	0.119	2.202	0.386
Time:						
June 2002 – Dec 2003	0.226	0.129	0.035	0.099	0.060	0.360
2004	0.070	0.152	0.176	0.112	-0.065	0.438
Jan – May 2005	-0.165	0.223	0.245	0.142	0.859	0.573
Day of the week:						
Tuesday	-0.460	0.111	-0.168	0.091	-0.608	0.346
Wednesday	-0.850	0.132	-0.260	0.099	-0.605	0.320
Thursday	-0.520	0.120	-1.102	0.147	-0.410	0.318
Friday	0.703	0.081	0.729	0.078	0.438	0.267
Quarter:						
Q2	-0.003	0.127	-0.362	0.089	-0.660	0.313
Q3	-0.014	0.151	-0.498	0.098	0.341	0.277
Q4	-0.101	0.126	-0.060	0.079	-0.026	0.304
Baseline:						
2 days	-		-		-1.984	1.131
3 – 4 days	-		-0.072	0.138	-1.771	0.838
5 – 9 days	-		-0.043	0.113	-1.804	0.698
10 – 19 days	-3.049	0.292	-0.113	0.087	-0.754	0.321

a) Z1 (Z3): state with the highest (lowest) work effort (for the definition, see equation (2)); Z4: state of having left the firm. All explanatory variables are 0-1 dummy variables (1 refers to variable name). Reference categories: Age (<25 year), Tenure (< 2 year), job level (< 3), Time (July 2001 - May 2002); Quarter of the year (Q1). Baseline: (20 days and above).
b) 8 support points: 8; 123 parameters; log-likelihood: -19029.5556; 357311 days; 481 workers.

Table 6 - Placebo estimates 100 replications (average of replications in bold)[a)]

	Z1 and Z2		Z3		Z4	
	Est. Coeff	**Std Err.**	**Est. Coeff**	**Std Err.**	**Est. Coeff**	**Std Err.**
Incentives:						
After winning lottery	0.151	0.138	-0.306	0.106	-0.369	0.237
	0.0571	**0.125**	**-0.056** [b)]	**0.093**	**-0.075**	**0.226**
From 1st March 2004, small plant	-0.095	0.191	0.240	0.119	2.202	0.386
	-0.083	**0.190**	**0.236**	**0.121**	**2.220**	**0.286**
Time:						
June 2002 – Dec 2003	0.226	0.129	0.035	0.099	0.060	0.360
	0.248	**0.127**	**0.030**	**0.095**	**-0.064**	**0.281**
2004	0.070	0.152	0.176	0.112	-0.065	0.438
	0.109	**0.146**	**0.132**	**0.111**	**-0.251**	**0.349**
Jan – May 2005	-0.165	0.223	0.245	0.142	0.859	0.573
	-0.109	**0.214**	**0.199**	**0.136**	**0.751**	**0.464**

a) Z1 (Z3): state with the highest (lowest) work effort (for the definition, see equation (2)); Z4: state of having left the firm. In each row, the upper line gives the estimates of Table 5, whereas the row below (in bold) gives the estimates of the 100 pseudo estimates.
b) For 9 out of 100 samples is the estimated parameter below -0.369.

Figure 1 – Employment in both plants (period: July 2001 – June 2005)

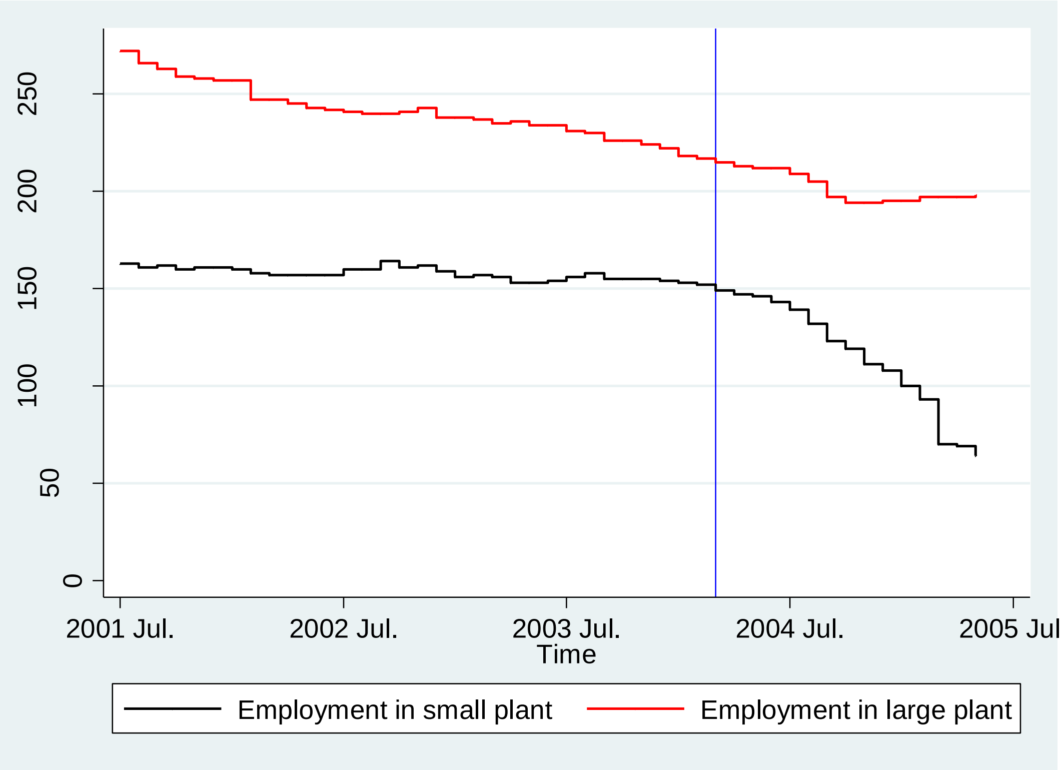


Figure 2 – Rate of sick leave in both plants (period: July 2001 – June 2005)

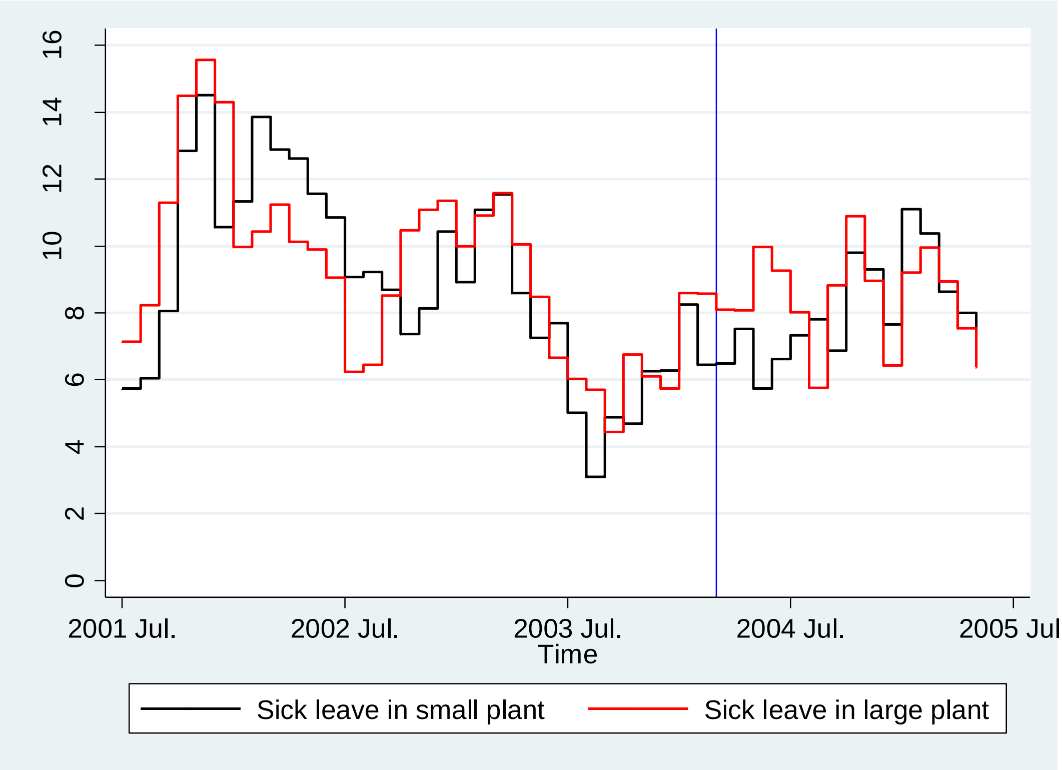
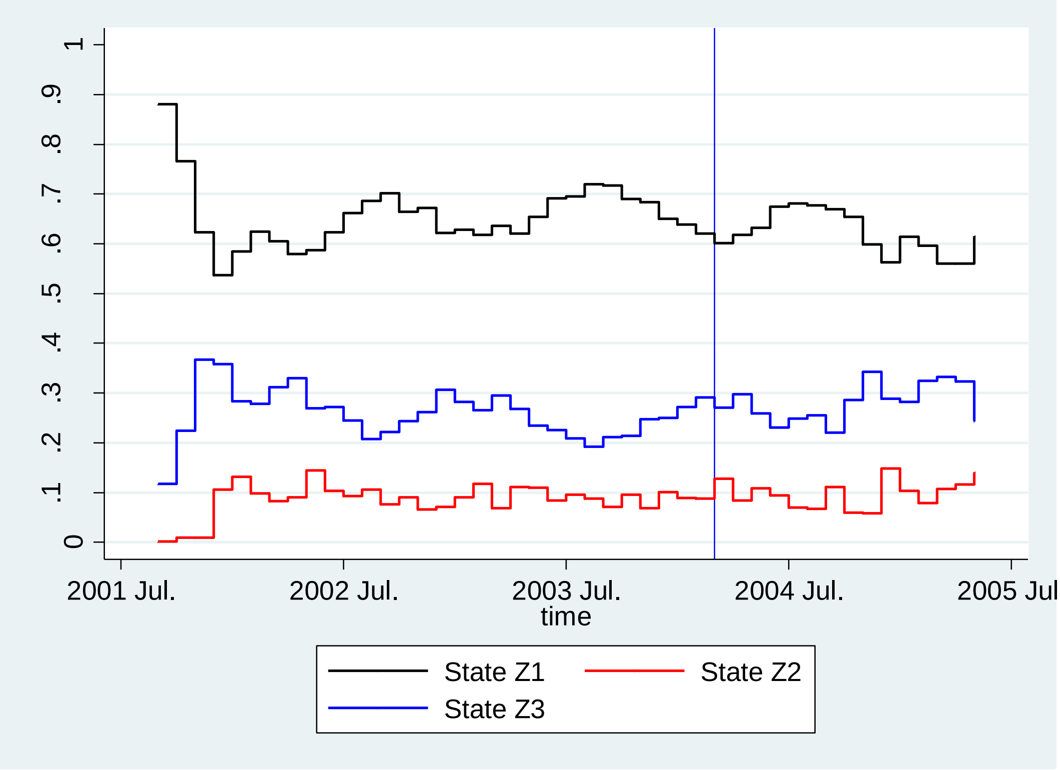
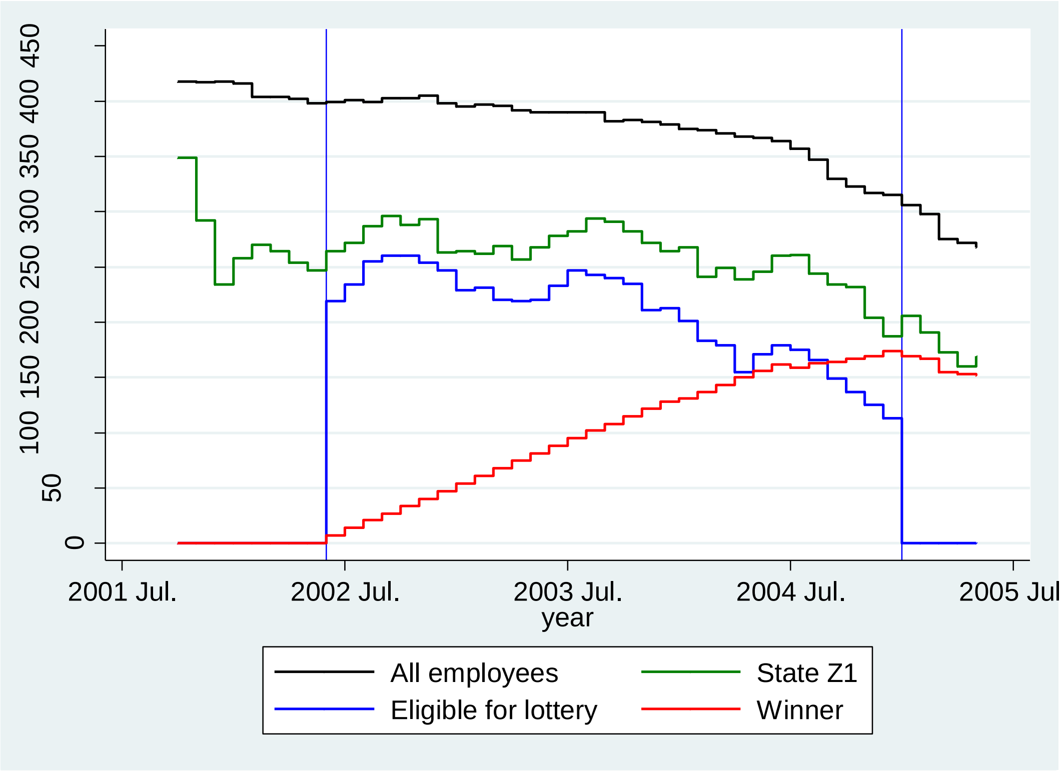


Figure 3 – 3 States (Z1 – Z3) (period: September 2001 – June 2005) [a)]



a) Z1 (Z3): state with the highest (lowest) work effort (for the definition, see equation (2)).

Figure 4 – Development of lottery and eligibility (period: September 2001 – June 2005) a)



a) Z1: state with the highest (lowest) work effort.