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The Effect of Statutory Sick-Pay on Workers' Labor Supply and Subsequent Health*

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Abstract

Social insurance programs typically comprise sick-leave insurance. An important policy parameter is how the costs of lost productivity due to sick leave are shared between workers, firms, and the social security system. We show that this sharing rule affects not only absence behavior but also workers' subsequent health. To inform our empirical analysis, we propose a model in which workers' absence decisions are conditional on the sharing rule, health, and a dismissal probability. Our empirical analysis is based on high-quality administrative data sources from Austria. Identification is based on idiosyncratic variation in the sharing rule caused by different policy reforms and sharp discontinuities at certain job tenure levels and firm sizes. An increase in either the workers' or the firms' cost share, both at public expense, decreases the number of sick-leave days. Policy-induced variation in sick leave has a significant effect on subsequent healthcare costs. The average worker in our sample is in the domain of presenteeism, that is, an increase in sick leave due to reductions in workers' or firms' cost share would reduce healthcare costs and the incidence of workplace accidents.

JEL Classification: I18, J22, J38.
Keywords: statutory sick-pay, sick leave, presenteeism, absenteeism, moral hazard, healthcare cost.

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1 Introduction

Governments typically provide public insurance against health-related shocks to individual productivity. In most developed countries, social insurance programs comprise not only disability insurance, but also sick-leave insurance, which covers temporary withdrawals from the labor market. The majority of all OECD-member countries would give a typical worker not only full pay while recovering from a shorter illness, but also mandate substantial sick pack for illness lasting several months (Heymann *et al.*, 2009). In fact, the United States is the only OECD-member country that has currently no federal legal requirements for paid sick leave.[1] An important policy parameter in the context of sick-leave insurance (as in the case of temporary disability) is how to split the costs due to lost productivity between sick workers, firms, and the social security system. Theoretically, policymakers should find a sharing rule that maximizes welfare by trading off the distortionary costs of the public insurance program against the benefits it provides in reducing exposure to risk (Chetty and Finkelstein, 2013).

The key issue is that an individual's health is not perfectly observable to others. Thus, moral hazard problems may arise. If workers bear only a small fraction of the cost (i. e., a low wage loss while on sick leave), they face a high incentive to be absent from work even if they are healthy. This adaptation of work-absence behavior, called *absenteeism*, is not only costly for firms, but also puts an unwarranted burden on the social security system. By contrast, in a setting in which workers bear a substantial share of the burden, they may choose to attend work even if they are sick. This so-called *presenteeism* may have adverse long-run consequences for all parties involved (Chatterji and Tilley, 2002; Johns, 2010). Presenteeism may impair a worker's future health, decrease her lifetime productivity, and increase her demand for different components of social security insurance in the future. Moreover, presenteeism may lead to more workplace accidents, and negative externalities on co-workers may arise.[2]

A rarely discussed aspect is that sick-leave insurance programs may also lead to either firm-driven presenteeism or absenteeism. In a setting in which firms have to bear a large share of the cost burden (i. e., a high sick pay), they may compel sick workers to attend work, for instance, under the threat of a layoff. On the other hand, if firms bear a negligible share of the cost, they face a moral hazard to promote absenteeism. They may ask healthy workers to go on sick leave in order to adjust labor demand in the short term. Both adaptations may have the same negative consequences as in the case of worker-driven

[1] Recently, a number of cities and some states have passed paid sick leave laws (e.g., New York City, San Francisco, Washington D.C., California, Massachusetts, Oregon; for an overview see Pichler and Ziebarth (2016)). Moreover, state law in five states (CA, NY, NJ, RI, HI) and in Puerto Rico mandates temporary disability insurance that regulates the compensation for wage losses due to short-term (non-occupational) sickness and disability (Social Security Administration, 2016, page 70).

[2] Chatterji and Tilley (2002) show that firms may even offer sick pay in order to prevent presenteeism. Pichler and Ziebarth (2016) provide evidence for contagious presenteeism arising from infectious diseases.

absenteeism and presenteeism. Moreover, firms may pass their costs onto the public by exerting too little effort in preventing or monitoring absence.

Two interrelated empirical questions of interest arise from this discussion. First, how does the sharing rule affect workers' absence behavior? Second, how does the sharing rule (via its impact on absence behavior) affect workers' subsequent health? An analysis of the first question is comparably easier, as less data is needed. The general finding of the literature on the first question is that higher workers' costs reduce absence.[3] One shortcoming in the literature is its focus on variation in workers' cost share and disregard of the potential role of firms. Two notable exceptions are Fevang *et al.* (2014) and Böheim and Leoni (2011), who show that firms' costs share have an impact on their workers' absence behavior.

To answer the second question, a link to health data is necessary. Although the impact of the sharing rule on workers' subsequent health (via its impact on absence behavior) is of great interest, and may even help policymakers to reach an optimal sharing rule, the empirical evidence is sparse. We are aware of only two empirical studies (Puhani and Sonderhof, 2010; Ziebarth and Karlsson, 2014), both using the *German Socio-economic Panel*. Neither study finds any significant effects of changes in statutory sick pay on workers' subjective health.[4]

In this paper, we aim to answer both questions. We study the effects of workers' and firms' cost shares on absence behavior *and* the resulting effects on subsequent health. We first outline a simple theoretical framework in which the absence decision is a worker's individual choice taken conditional on health, the cost shares, and a dismissal probability. Our model shows that the workers' absence behavior, triggered by different cost shares, has an effect on subsequent health. It provides a precise definition of absenteeism and presenteeism, and describes under which circumstances either behavior arises. This model helps us to specify the parameters of interest and informs our empirical model.

The (empirical) analysis is based on the Austrian sick-leave insurance system. Under this system the cost of sick leave are shared among workers, firms and the social security system. Our identification strategy exploits exogenous variation in workers' and firms' cost shares — induced by policy reforms, and sharp discontinuities at certain job tenure levels and firm sizes — within a *two-stage least squares* (2SLS) estimation approach. The empirical analysis combines various sources of administrative data. We have access to the

[3]See, e. g., Johansson and Palme (1996); Dale-Olsen (2014); Henrekson and Persson (2004); Johansson and Palme (2005); Puhani and Sonderhof (2010); Ziebarth and Karlsson (2010); Markussen *et al.* (2011); Pettersson-Lidbom and Thoursie (2013); De Paola *et al.* (2014); Ziebarth and Karlsson (2014). One recent exception is Stearns and White (2016). These authors evaluate the introduction of paid sick leave laws in Washington D.C and Connecticut. They find that these introductions (which can be interpreted as a reduction in workers' costs) reduced leave-taking.

[4]Puhani and Sonderhof (2010) find that the reduction of statutory sick pay decreased the average number of hospital days, which they interpret as a decrease in the utilization of the healthcare system and not as a decrease in absenteeism.

database of the *Upper Austrian Health Insurance Fund*, which covers all private sector workers in the province of Upper Austria. These data include detailed information on sick leave and healthcare service utilization. We complement this data with information from the *Austrian Social Security Database*. This is a matched firm–worker dataset that includes individuals' exact employment histories, and workers' and firms' characteristics.

Our main findings are as follows. As predicted by our model, there is strong empirical evidence for an effect of the sharing rule on workers' absence behavior. Increases in either the workers' or the firms' cost share, both at the public expense, significantly decrease the number of sick-leave days. Variations in the workers' cost share turn out to be quantitatively more important by a factor of about two. Our reduced-form estimation shows that the sharing rule also has significant effects on workers' subsequent healthcare costs. The estimated coefficient from our second stage is a local average treatment effect that provides information about the change in healthcare costs caused by a change in sick-leave days, which is triggered by a change in the sharing rule. This parameter is of particular relevance to policymakers. Within our sample, the average worker is within the domain of presenteeism: an increase in annual sick-leave days by 1 day due to reductions in the workers' and/or firms' cost share would reduce total outpatient healthcare costs by about 1 percent and the number of hospital days by about 3 percent. Cost saving would result from improvements in physical and mental health. We also find an impact of the sharing rule on the incidence of workplace accidents.

Our paper adds to the literature in at least four ways. *First*, we extend the existing literature on sick-leave insurance by using variation in both the workers' and the firms' cost share in a single regression framework. By doing so, we can hold either one fixed and analyze variations in each cost share at the public expense as well as compare their quantitative importance. Our results also speak to the literature that discusses workers' responsiveness with respect to the generosity of benefits within disability insurance systems. The distinction between sick-leave and disability insurance is to some degree conceptually arbitrary and simply an institutional one. There is a clear overlap between long sick leave spells and temporary disability. *Second*, our analysis goes further than most of the papers in these two strands of literature by providing evidence that the sharing rule not only affects workers' absence behavior but also their subsequent health. Under certain assumptions, this allows us to infer whether an increase in the public cost share would result in increased absenteeism or decreased presenteeism. *Third*, our results are based on an identification strategy that combines various sources of exogenous variation in one 2SLS estimation approach. We use variation induced by sharp discontinuities at four job tenure levels and at certain firm sizes. Further variation is provided by two types of policy reforms, one of which changed the cost of sick leave for certain types of workers, and the other one changed the cost for firms depending on their size. The major advantage of combining different sources of variation in one estimation approach is that it allows us to identify effects conditional on job tenure, firm size, type of worker, firm and year. This would not be possible in a conventional *regression discontinuity* approach based on either job tenure or firm size. *Fourth*, our empirical analysis is complemented by a theoretical model that precisely defines absenteeism and presenteeism, thereby guiding our interpretation of the estimation results.

The remainder of the paper is structured as follows. In Section 2, we present our theoretical model. In Section 3, we discuss the relevant institutional background and the different sources of exogenous variation in the cost-sharing rule. Then, in Section 4, we describe our data, empirical measurements and estimation sample along with the descriptive statistics. Our estimation strategy and its identifying assumptions are discussed in Section 5. Our estimation results and a sensitivity analysis are presented in Section 6. Section 7 summarizes and concludes the paper.

2 Theoretical model

We formulate a simple two-period model of a worker's absence decision, which allows us to take account of the phenomena of absenteeism and presenteeism. Absenteeism is defined as the sick leave of a healthy worker. Since a healthy worker needs no recuperation, being on sick leave does not alter her future health. Presenteeism is defined as the decision to attend work despite sickness. This, in turn, impedes the worker's full recovery and, thus, has adverse implications for her future health. Since presenteeism and absenteeism are distinct with respect to a worker's health in both the present and future, we consider two periods $s = 1, 2$.[5] We assume that a worker's preferences for consumption C_s, leisure and recuperation time L_s, and health H_s in each period s are represented by

$$U(C_s, L_s, H_s) \tag{1}$$

where the per-period utility function U is strictly increasing in C_s, L_s and H_s, while the marginal utility of each variable is strictly decreasing. Moreover, we assume that the marginal rate of substitution of consumption for leisure $\left|\frac{dC_s}{dL_s}\right| = \frac{\partial U / \partial L_s}{\partial U / \partial C_s}$ is decreasing with increasing health H_s. As the worker experiences a higher level of health, she is willing to forego less consumption for an additional unit of recuperation time, since consumption becomes relatively more important. A sufficient condition for $\left|\frac{dC_s}{dL_s}\right|$ to be decreasing with increasing H_s is $\frac{\partial^2 U}{\partial C_s \partial H_s} > 0$ and $\frac{\partial^2 U}{\partial L_s \partial H_s} \leq 0$.[6]

[5] Former theoretical studies that have analyzed the sick-leave decision also within a dynamic model have been provided by Brown (1994) and Ziebarth (2013), while, e. g., Barmby *et al.* (1994) and Chatterji and Tilley (2002) have chosen a static model.

[6] Note that the assumption that a sicker worker attaches a relatively higher weight on leisure as opposed to consumption has been made quite frequently by former theoretical studies on absence behavior (see, e. g., Chatterji and Tilley, 2002). An overview of this literature is provided by Brown and Sessions (1996). There is some empirical evidence that the marginal utility of consumption indeed is increasing with higher

In each period s, the worker earns labor income $w_s t_s^w$, where w_s denotes the exogenous after-tax wage rate and t_s^w denotes the contracted working time. When the worker calls in sick, she has to forego a fraction η_s^W of her wage rate w_s for any unit of time she is absent from work. Hence, consumption in period s is given by

$$C_s = w_s(t_s^w - \eta_s^W t_s^a), \tag{2}$$

where t_s^a, $0 \leq t_s^a \leq t_s^w$, denotes the time that the worker is on sick leave. Consequently, the worker receives sick pay in the extent of $(1 - \eta_s^W)w_s$ per unit of absence time. According to the institutional setting in Austria, this sick pay is financed by the firm and the social security system, that is $1 - \eta_s^W = \eta_s^F + \eta_s^P$ with η_s^F denoting the share paid by the firm and η_s^P the share paid by the the social security system. The parameter η_s^W can be regarded as the worker's own share of sick-leave costs, as it is that part of the wage rate that the worker has to bear by herself. However, being absent from work increases leisure time. Total time in each period s is normalized to one, thus leisure is given by $L_s = 1 - t_s^w + t_s^a$. The worker will choose a shorter absence time t_s^a, and by this, a larger C_s and smaller L_s, in each period s the higher her current health status H_s is. This is a direct consequence of the characteristic of the worker's preferences that higher health status H_s entails a lower marginal rate of substitution $\left|\frac{dC_s}{dL_s}\right|$ between consumption and leisure.

While the initial health status H_1 is a random draw from some distribution $\mathcal{H}$, and thus, is given exogenously, future health H_2 is influenced by the worker's record, namely, by her former health H_1 and her former sick-leave duration t_1^a. To model these effects, we write $H_2 = H_2(H_1, t_1^a)$ and assume that higher initial health H_1 implies higher health H_2 in the future, that is, $\frac{\partial H_2(H_1,t_1^a)}{\partial H_1} > 0$. For the effect of t_1^a on H_2, it is crucial whether initial health H_1 is below or above a certain threshold H^*, which determines whether a worker is healthy or sick in period 1. If $H_1 < H^*$, the worker is sick in period 1, and sickness absence promotes recovery from illness. Hence, we assume that $\frac{\partial H_2(H_1,t_1^a)}{\partial t_1^a} > 0$ with $\frac{\partial^2 H_2(H_1,t_1^a)}{(\partial t_1^a)^2} < 0$ and $\frac{\partial H_2(H_1,\bar{t}_1^a)}{\partial t_1^a} = 0$ for some $\bar{t}_1^a > 0$. That is, there is some maximal length of sick leave that contributes to the worker's future health: after having spent $\bar{t}_1^a$ units of time absent from work, the worker is healthy again by reaching some maximal health level $H_2^* = H_2(H_1, \bar{t}_1^a)$; taking sick leave for longer than $\bar{t}_1^a$ will not increase her future health above H_2^*. These assumptions allow us to model the phenomenon of presenteeism: if a sick worker chooses some $t_1^a < \bar{t}_1^a$, she will not make a full recovery, and her future health will be affected negatively. For the case in which the worker is healthy in period 1, that is, $H_1 \geq H^*$, we assume that $\frac{\partial H_2(H_1,t_1^a)}{\partial t_1^a} = 0$ for any $t_1^a \geq 0$, and thus, $\bar{t}_1^a = 0$. This assumption describes the phenomenon of absenteeism: calling in sick despite being healthy does not affect the worker's future health.[7]

health levels (Viscusi and Evans, 1990; Finkelstein *et al.*, 2009, 2013).

[7] Moreover, for a sick worker, a sickness absence of length $\bar{t}_1^a$ would be sufficient to be healthy again, and we regard a sick worker who is absent from work for longer than $\bar{t}_1^a$ as being in the domain of

The worker's absence behavior in period 1 is assumed to affect her likelihood of employment in period 2. We follow the proposition by Shapiro and Stiglitz (1984) and, within the context of sick leave, by Barmby *et al.* (1994) that firms use unemployment as a device to discipline workers to reduce absenteeism. Transferring this idea to our framework, one may suppose that the threat of dismissal is larger for a worker who has been on sick leave for a long time, and that firms will be more likely to carry out the threat if they have to bear a large proportion of the sick-leave costs. To take account of this, we write $\rho = \rho(t_1^a, \eta_1^F)$ with ρ denoting the probability of continued employment in period 2, and assume that $\frac{\partial \rho}{\partial t_1^a} < 0$, $\frac{\partial \rho}{\partial \eta_1^F} < 0$, $\frac{\partial^2 \rho}{(\partial t_1^a)^2} < 0$, $\frac{\partial^2 \rho}{(\partial \eta_1^F)^2} < 0$, and $\frac{\partial^2 \rho}{\partial t_1^a \partial \eta_1^F} < 0$. That is, an increase in the duration t_1^a of sick leave as well as in the firm's fraction η_1^F of the sick-leave costs reduces a worker's probability ρ of keeping her job, and either reduction in ρ (due to an increase in t_1^a or η_1^F) is increasing with increasing t_1^a and with increasing η_1^F.

In case the worker keeps her job in period 2, she again chooses her level t_2^a of absence. For the sake of simplicity, we abstract away from periods $t > 2$. This implies that sickness absence in the second period only affects consumption C_2 and leisure L_2 in the second period and has no further effects. If the worker becomes unemployed, she receives an exogenous social security benefit b, which she uses for consumption C_2, and has leisure time $L_2 = 1$.

From these assumptions, it follows that the decision problem of a worker can be decomposed into two parts: she chooses t_1^a (and, by this, determines C_1, L_1, H_2, and ρ) in the first stage, and t_2^a (and, by this, C_2, L_2) in the second stage. Of course, in the first stage, the worker will take into account her optimal second-stage decision $\hat{t}_2^a$, which she will make in period 2 provided that she is still employed. Formally, this two-stage decision problem can be stated as follows. In the second stage, after the resolution of employment uncertainty, the worker solves an optimization problem under certainty for given H_2: she chooses her (C_2, L_2)-bundle by maximizing $U(C_2, L_2, H_2)$ for given H_2 subject to $C_2 = w_2(t_2^w - t_2^a \eta_2^W)$ and $L_2 = 1 - t_2^w + t_2^a$. Substituting both constraints into $U(\cdot)$ and differentiating with respect to t_2^a gives us the first-order condition

$$-w_2 \eta_2^W \frac{\partial U}{\partial C_2} + \frac{\partial U}{\partial L_2} = 0 \tag{3}$$

for an interior optimum $\hat{t}_2^a$, $0 < \hat{t}_2^a < t_2^w$. At $\hat{t}_2^a$, the marginal utility of leisure is equal to the marginal cost of leisure in terms of foregone consumption. Substituting $\hat{t}_2^a$, which depends on w_2, t_2^w, η_2^W, and H_2, into $U(\cdot)$ gives us the indirect utility function to this problem, which we denote by $U_2^e(w_2, t_2^w, \eta_2^W, H_2)$.[8] Moreover, we abbreviate utility in case of non-employment by $U_2^n \equiv U(b, 1, H_2)$, where we assume that the social security benefit

absenteeism.

[8]Clearly, boundary solutions $\hat{t}_2^a = 0$ and $\hat{t}_2^a = t_2^w$ are possible.

b is sufficiently below labor income such that $U_2^n < U_2^e$.[9] This assumption ensures that the worker has an incentive to stay in employment in period 2 (as the outcome 'employment' is the favorable state of the world); otherwise, she would decide to be unemployed in period 2 anyway.

In the first stage, the worker decides on her absence level t_1^a in period 1 given her optimal absence level $\hat{t}_2^a$ in case of continued employment. We assume that her preferences are described by expected utility. Hence, her first-stage decision problem is to maximize

$$U(C_1, L_1, H_1) + \rho(t_1^a, \eta_1^F)U_2^e + (1 - \rho(t_1^a, \eta_1^F))U_2^n \tag{4}$$

subject to $C_1 = w_1(t_1^w - t_1^a \eta_1^W)$ and $L_1 = 1 - t_1^w + t_1^a$.[10] By substituting both constraints and $H_2 = H_2(H_1, t_1^a)$ into (4) and differentiating with respect to t_1^a, we obtain the first-order condition for an interior solution $\hat{t}_1^a$ as

$$-w_1\eta_1^W \frac{\partial U}{\partial C_1} + \frac{\partial U}{\partial L_1} + \frac{\partial \rho}{\partial t_1^a}(U_2^e - U_2^n) + \left(\rho \frac{\partial U_2^e}{\partial H_2} + (1-\rho)\frac{\partial U_2^n}{\partial H_2}\right)\frac{\partial H_2}{\partial t_1^a} = 0. \tag{5}$$

Remember that for $H_1 \geq H^*$, the last term on the left-hand side (LHS) of (5) is zero, as absenteeism has no effect on future health. Hence, a healthy worker chooses a sickness absence $\hat{t}_1^a$ in which her marginal utility of leisure in period 1 is equal to the marginal cost of leisure in terms of foregone consumption in period 1 and the marginal loss in expected utility that stems from a decrease in employment probability ρ in period 2. For $H_1 < H^*$, the last term on the LHS of (5) is positive. A marginal increase in t_1^a increases health in period 2, and by this, increases second-period utility. Obviously, this additional positive effect is taken into account by a sick worker when choosing $\hat{t}_1^a$.

We are interested in the effects of the worker's and the firm's cost share parameters, η_1^W and η_1^F, respectively, on the worker's absence behavior in period 1. We assume that an increase of either cost share η_1^j, $j = F, W$, is counterbalanced by a decrease in the cost share η_1^P of the social security system. We estimate these effects in the first stage of our regression analysis below.

Proposition 1: An increase in the worker's or firm's share η_1^W, η_1^F of sick-leave costs decreases the duration $\hat{t}_1^a$ of sick leave, regardless of whether the worker is healthy or sick, that is, $\frac{\partial \hat{t}_1^a}{\partial \eta_1^W} < 0$ and $\frac{\partial \hat{t}_1^a}{\partial \eta_1^F} < 0$ for any H_1.

Proof: See Appendix A.

The negative effect of the worker's cost share parameter η_1^W on her absence time $\hat{t}_1^a$ has its equivalent in consumer theory: if the price η_1^W of a good (here, of sickness absence)

[9] A sufficient condition for $U_2^n < U_2^e$ is that $b < w_2 t_2^w(1 - \eta_2^W)$ where $w_2 t_2^w(1 - \eta_2^W)$ is the labor income at $t_2^a = t_2^w$. At $t_2^a = t_2^w$, $L_2 = 1$, hence we have $U_2^n < U(w_2 t_2^w(1 - \eta_2^W), 1, H_2) \leq U_2^e$ for any given H_2.

[10] Note that the specification in (4) means that the worker discounts future utility only due to risk aversion, but not due to time preference. A zero rate of time preference does not affect the qualitative results and is chosen for sake of simplicity.

is increased, it is optimal to reduce demand for that good (here, to reduce the optimal absence level $\hat{t}_1^a$). This negative price effect occurs irrespectively of the initial health status H_1 of a worker. In any case, an increase in η_1^W would entail a decrease in first-period consumption for unchanged absence time, and a worker has an incentive to mitigate this consumption loss by decreasing her absence time, no matter whether she is in good or bad health.[11]

The driving force behind the negative effect of the firm's cost share η_1^F on a worker's absence time $\hat{t}_1^a$ is that a rise in the firm's cost share η_1^F increases the worker's risk of becoming unemployed, which makes the worker worse off. Therefore, it is optimal for the worker to counteract this increase of her unemployment risk, to some extent, by reducing her sickness absence.

Although the theoretical analysis does not provide a definite answer to the question of the quantitative importance of these two effects, it is plausible to presume that an increase in the worker's cost share η_1^W decreases the duration $\hat{t}_1^a$ of sickness absence by a larger extent than an increase of the firm's cost share η_1^F does, that is, $\frac{\partial \hat{t}_1^a}{\partial \eta_1^W} < \frac{\partial \hat{t}_1^a}{\partial \eta_1^F} < 0$. For this, note that an increase of η_1^W decreases first-period consumption C_1 (for given t_1^a) of the worker, while an increase of η_1^F decreases the likelihood ρ of keeping her job in the next period. In either case, the optimal worker's response is to counteract the respective negative effect by reducing her absence time. Given that the worker is more concerned about the first effect (reduction of C_1) than the second effect (reduction of ρ), she would reduce her absence time to a greater extent if her own cost share η_1^W (instead of the firm's cost share η_1^F) increases.

Finally, we are interested in the reduced-form effects of both cost share parameters η_1^W and η_1^F on the worker's future health status H_2. These effects are given by

$$\frac{\partial H_2}{\partial \eta_1^j} = \frac{\partial H_2}{\partial t_1^a} \frac{\partial \hat{t}_1^a}{\partial \eta_1^j} \qquad j = F, W, \tag{6}$$

from which it follows, together with our assumptions and results from above, that the effects of both η_1^W and η_1^W on future health are negative if $H_1 < H^*$ and $\hat{t}_1^a < \bar{t}_1^a$; otherwise the effects are zero.[12]

Proposition 2: If a worker is sick in period 1, her health H_2 in period 2 would be negatively affected by an increase in the worker's or firm's share η_1^W, η_1^F of sick-leave costs, that is, if $H_1 < H^*$, $\frac{\partial H_2}{\partial \eta_1^W} < 0$ and $\frac{\partial H_2}{\partial \eta_1^F} < 0$. However, if a worker is healthy

[11] More formally, for unchanged t_1^a, the LHS of the first-order condition (5) becomes negative if η_1^W is increased. By decreasing t_1^a, the first-order condition is restored, as $\frac{\partial U}{\partial C_1}$ decreases with decreasing t_1^a, and $\frac{\partial U}{\partial L_1}$ as well as the entire marginal effect on expected utility (via the impact on ρ and on H_2) increases with decreasing t_1^a (see also the Proof of Proposition 1 in Appendix A).

[12] Note that it may be the case that for $H_1 < H^*$, the LHS of (5) is positive at $\bar{t}_1^a$ which implies that a sick worker chooses some absence time $\hat{t}_1^a > \bar{t}_1^a$, where a small variation in $\hat{t}_1^a$ does not change her future health H_2. For sake of simplicity, we neglect this special case in the following Proposition 2.

in period 1, a change of either cost share parameter has no effect on her health in the next period, that is, if $H_1 \geq H^*$, $\frac{\partial H_2}{\partial \eta_1^W} = \frac{\partial H_2}{\partial \eta_1^F} = 0$.

The explanation of this finding is straightforward: although all workers, irrespective of their initial health status H_1, reduce their absence time owing to an increase in either cost parameter, it is only the future health of sick workers that is affected negatively via this channel; the absence behavior of healthy workers does not influence their future health. Indeed, when a sick worker reacts more strongly to a variation of her own cost share η_1^W compared to the firm's cost share η_1^F, her future health would also react more strongly to a variation of η_1^W than of η_1^F, that is, if $\frac{\partial \hat{t}_1^a}{\partial \eta_1^W} < \frac{\partial \hat{t}_1^a}{\partial \eta_1^F}$ for $H_1 < H^*$, then $\frac{\partial H_2}{\partial \eta_1^W} < \frac{\partial H_2}{\partial \eta_1^F}$, (which is immediate from 6).

3 Institutional background

3.1 The Austrian health insurance system

Our analysis is based on the Austrian social insurance system, which provides high-quality healthcare to every resident. Statutory health insurance is compulsory and linked to employment. Thus, workers have no choice over the healthcare provider or the insurance package. We focus on private sector workers who are — depending on the location of the employer — assigned to one out of nine so-called *District Health Insurance Funds* (*Gebietskrankenkassen*). These cover approximately 75 percent of the Austrian population. In the case of unemployment or retirement, workers stay with their previous *District Health Insurance Fund*.

Statutory health insurance is financed by health insurance contributions, which increase — up to a ceiling — proportionally with income, but are completely independent of the personal risk of the insured. Insurance covers, among others, all healthcare expenditure in the inpatient and outpatient sectors. Insurants have free choice about providers and unrestricted access to all contracted general practitioners, resident medical specialists, and hospitals in Austria.[13]

Private health insurance can be used to complement statutory health insurance, but plays only a minor role in Austria. Depending on the insurance plan, it may cover deductibles for medical drugs, medical devices and hospital stays, and provides fully covered access to physicians that have no contract with the public health insurer. Further benefits include reduced waiting times for surgeries and access to more comfortable rooms at hospitals. According to *OECD* health statistics (OECD, 2013a), public health expenditure accounted for 77 percent of total health expenditure (THE) in 2011. While 17 percent

[13] Contracts are negotiated at the district level between the *District Health Insurance Fund* and the *Austrian Medical Chamber*.

of THE were private household out-of-pocket expenditure, only 5 percent of THE were covered by private health insurance.

3.2 The Austrian sick-leave insurance system

Austria has a long tradition of sick-leave insurance. Already since 1921, workers receive compensation for lost wages caused by temporary (occupational and non-occupational) sickness or injury. Today, sick workers receive their compensation from two sources: First, for a pre-defined duration, workers continue to receive their salaries from firms. Initially, they receive their full salaries. After a certain period they receive only a share of their salaries, however, these are topped up by public sickness benefits. Under specified circumstances, firms are partly reimbursed for salaries paid to sick workers. Second, after this initial period of firm-financed sick leave has ended, workers receive only public sickness benefits.

This system gives rise to a specific cost-sharing rule, which varies with the worker's occupation, job tenure, and firm size. While the basic system has not changed over time, the specific regulations have been subject to multiple changes caused by several policy reforms.[14] This system and its reforms over time generate substantial variation in both the workers' and firms' cost shares, and allows us to study the effect of each cost share on workers' absence behavior and the effect of the cost-sharing rule on workers' health outcomes via its impact on absence behavior.

In our empirical analysis, we exploit variation in the cost-sharing rule generated by differences across occupation, job tenure and firm size and by three reforms between 1998 and 2012. Table 1 details the variation in the workers' cost share, denoted by $\mathcal{W}$, and the firms' cost share, denoted by $\mathcal{F}$. Both cost shares depend on the total number of sick-leave weeks that the worker already has taken within the current year and <u>not</u> on the duration of the current sick-leave spell.[15] In the following two subsections, we explicate the precise sources of variation in workers' and firms' cost cost shares, which we exploit for empirical identification.

[14] In Appendix B, we provide a brief chronological discussion of these admittedly very intricate reforms, and describe how workers' and firms' cost shares were affected by these reforms. These reforms are the outcome of a political process — often triggered by budgetary considerations — which lacks any solid concept or substantive debate. Unsurprisingly, the relevant stakeholders participating in this debate are groups representing the respective interests of firms, such as the *Austrian Economic Chamber*, and of workers, in particular, the *Austrian Chamber of Labour*. The former lobby for low cost shares of firms, while the latter push for low cost shares of workers. Strikingly, the reforms in the most recent years appear like a 'random walk', in which some reforms are undone shortly after being enacted.

[15] The default rule is that the current year starts at the date of job entry. Alternatively, the contract of employment could determine the calendar year as the relevant period. We control for the calendar month of firm entry to account for potential differences across workers.

3.3 Variation in the workers' cost shares

The variation in the workers' cost share is based on two sources: first, variation across workers with different job tenure, and second, variation between white- and blue-collar workers across time. The first type of variation in the workers' cost share is based on decreases in the cost of being sick with job tenure. The Austrian sick-pay scheme changes discontinuously at a tenure of 5, 15, and 25 full years, which generates sharp discontinuities in the incentive to take sick leave at these thresholds. In other words, a small difference in tenure, such as a couple of months, leads to an immediate and considerable difference in the workers' cost of being sick.[16] For instance, consider a white-collar worker in the 7th week of sick leave: this worker is fully compensated if he has 5 years of tenure, whereas he loses 20 percent of his wage if he has only 4 years of tenure. Figure C.1-(a) in Appendix C shows workers' cost shares across tenure groups for white-collar workers and different weeks of sick leave.

The second type of variation is based on the abolition of long-standing differences in the generosity of the sick-pay scheme between white- and blue-collar workers in 2001. Details on this reform are provided in Appendix B.1. For example, consider a worker with 5 years of tenure in the 7th week of sick leave: Before the reform in 2001, a blue-collar worker lost 40 percent of her gross wage, whereas a white-collar worker was fully compensated. After the reform, both groups of workers received their full wage. Figure C.1-(b) shows cost shares for blue-collar workers with 5–14 years of job tenure for different weeks of sick leave. Before the reform, these workers had higher costs between the 7th and 12th weeks of sick leave. Equivalent graphs can be compiled for the other three tenure groups. In sum, the reform decreased the cost of being sick in any tenure group for blue-collar workers, but had no impact on white-collar workers.[17]

3.4 Variation in the firms' cost shares

The main source of variation in the firms' cost share comes from differences between small and large firms across occupation groups and changes in these differences over time. Details on the reforms and the precise definition of small and large firms is provided in Appendix B.2. Figures C.1-(c) and C.1-(d) show firms' cost shares for blue-collar and white-collar workers with 5–14 years of job tenure for different firm sizes (small vs. large firms) and time periods.[18] In period 1 (i. e., before 2001), small firms were reimbursed their total sick-leave cost for blue-collar workers whereas large firms were reimbursed only

[16] The worker's cost share is a deterministic function of her job tenure. This kind of variation can be employed in a sharp *regression discontinuity design*, in which workers with tenure slightly below a certain threshold provide the counterfactual outcome for workers with tenure slightly above that threshold, since the treatment status is 'as good as randomly assigned' in a small neighborhood around the threshold.

[17] This kind of variation can be used in a *difference-in-differences* estimation strategy in which blue-collar workers serve as a treatment group and white-collar workers serve as a control group.

[18] Equivalent graphs can be compiled for the other three tenure groups.

70 percent. For sick white-collar workers, no such reimbursement existed in that period. For instance, in the 3rd week of sick leave, the firms' cost share for a sick blue-collar worker amounted to 30 percent in large firms and zero in small firms. By contrast, firms had to pay a cost share of 100 percent for a sick white-collar worker. After the abolition of reimbursement, firms had to bear the full cost share independently of firm size or workers' occupation. In the example above, the firms' cost share for a sick blue-collar or white-collar worker in the 3rd week of sick leave amounted to 100 percent in period 2 (i. e., between 2001 and 2004). In 2005, a reform re-introduced reimbursement for small firms. Since then (i. e., in period 3), firms' cost share for a sick blue-collar or white-collar worker in the 3rd week of sick leave amounted to 42 percent in small firms and 100 percent in large firms.[19] Additional variation is generated by differences in firms' cost shares across workers' tenure groups.

In sum, we have considerable variation in the workers' and firm's cost share (see Table 1) according to occupation, job tenure, firm size and time period.

4 Data, measurements and sample

For our empirical analysis, we use two linked administrative data sources from Austria. First, we have access to the database of the *Upper Austrian Health Insurance Fund*. This covers the population of all private-sector workers and their dependents in the province of Upper Austria. Upper Austria is one of nine provinces in Austria and comprises about one sixth of the Austrian population and work force. The more than 1 million members of the *Upper Austrian Health Insurance Fund* represent approximately 75 percent of the Upper Austrian population.

These data include detailed information on sick leave, healthcare service utilization in the outpatient sector (i. e., medical attendance and drug use), and some inpatient sector information, such as the number of days of hospitalization. For instance, we are able to observe each single doctor visit and each drug prescription, together with the exact date of service utilization. However, these data includes only services and expenditures that are covered by statutory health insurance. Information on sick leave is provided for each medically certified sick-leave spell. Medical certification is mandatory for each sick-leave spell that lasts at least 4 days. For a spell up to 3 days, no medical certificate is necessary, unless the firm explicitly requests this. Since we observe the exact begin and end date of each sick-leave spell, we can calculate the duration of each spell that lasts at least 4 days.

Second, we complement these data with information from the *Austrian Social Security Database*. This is an administrative record used to verify pension claims for the universe

[19] This kind of variation can be used in a *difference-in-differences-in-differences* estimation strategy in which blue-collar workers in small firms are compared to blue-collar workers in large firms before and after the 2001 reform, and white-collar workers are used as an additional control group. See Böheim and Leoni (2011).

of Austrian workers (Zweimüller *et al.*, 2009). It is structured as a matched firm–worker dataset and includes detailed information on workers' employment and earnings histories, as well as workers' and firms' characteristics (for instance, sex, age, job tenure, broad occupation, firm size and wage bill). Since we observe the employment status at a daily basis we can calculate the worker's exact job tenure and the firm's exact size at any point in time. Information on earnings is provided per year and firm.

4.1 Sick-leave and health indicators

To evaluate the effect of variation in sick leave on health, we construct the following *annual* variables: (i) number of sick leave days; (ii) total health expenditure in the outpatient sector; (iii) expenditure on outpatient medical attendance at general practitioners and resident medical specialists; (iv) expenditure on medical drugs; and (v) days of hospitalization. Note that (ii) is the sum of (iii) and (iv). In the case of medical attendance, we observe the field of the respective resident medical specialists and some information on the services provided. The prescribed medical drugs can be classified according to the Anatomical Therapeutic Chemical (ATC) Classification System code, and the number of days spent in hospital can be distinguished by the main admission diagnoses following the International Statistical Classification of Diseases and Related Health Problems (ICD-10) classification system advocated by the *World Health Organization*.

Obviously, the degree to which these measures reflect individual health varies among the variables. Whereas the number of days of hospitalization and the consumption of medical drugs can be expected to be highly correlated with a person's health status, expenditure on outpatient medical attendance may also capture aspects of preventative care, such as costs of health screening exams.

4.2 Quantification of the variation in cost shares

In principle, we could assign to each worker the exact worker's and firm's cost share she faces after a certain number of sick-leave weeks. The worker's cost share η^W is a function of the worker's characteristics $\mathcal{I}$, in particular, occupation Occ and job tenure T, the duration of the current sick leave spell $S_{\mathcal{D}}$, and the time period s. In addition, the firm's cost share depends on the firm's characteristics $\mathcal{F}$, in particular, firm size FS. Thus, a worker i employed in firm f faces the following cost shares $\eta^W_{i,s,d}$ and $\eta^F_{i,f,s,d}$ in period s at sick-leave duration d:

$$\eta^W_{i,s,d} = \{\mathcal{I}(Occ_i, T_i), S_{\mathcal{D}}, s\} \tag{7}$$

$$\eta^F_{i,f,s,d} = \{\mathcal{I}(Occ_i, T_i), \mathcal{F}(FS_f), S_{\mathcal{D}}, s\} \tag{8}$$

Based on the information in Table 1, we define different cost schemes, which are unique schedules of cost shares over a sick-leave spell of undefined length. As the lowest panel of Table 1 shows, there are 8 different worker cost schemes ($z_0, z_1, \ldots, z_7$) and 13 different firm cost schemes ($Z_0, Z_1, \ldots, Z_{12}$).

Figure 1 provides further information on these cost schemes. Panels (a) and (c) depict the evolution of the workers' and firms' cost shares over sick-leave spell lengths of up to 16 weeks. There is no variation in cost shares after the 16th week of sick leave.[20] In the case of firms' cost schemes, there is considerable variation already starting from the 1st week of sick leave. Compare, for instance, Z_0 (0 percent) with Z_5 (100 percent). In the case of workers, the schemes start to differ after week 5. Nevertheless, we expect workers with different schemes to adapt their behavior before week 5 if they behave in a forward-looking manner since their future health status is uncertain. For instance, a worker with scheme z_0 should economize her sick leave at an early stage, compared to a worker with z_7, since she faces comparably higher costs after week 5. Panels (b) and (d) of Figure 1 show the distribution of the cost schemes. Some cost schemes are relatively uncommon. However, since we have a large number of observations (almost 5 million), we still have a substantial absolute number of observations for each cost scheme (combination).

To operationalize the variation in cost shares across these different schemes, we assume a certain duration $\bar{d}$. We set $\bar{d}$ equal to 16, and calculate the expected value of cost shares for a yearly sick leave of 16 weeks. The resulting expected cost shares for workers and firms are depicted in Figures 2 and 3, respectively. The specific choice of $\bar{d} = 16$ is arbitrary to some degree. However, this assumption should be innocuous, since there is a substantial correlation in the expected cost shares across different choices of $\bar{d} \leq 16$. We show in Subsection 6.4 that our results are not sensitive to the specific choice of $\bar{d}$.

Finally, it should be noted that there is a correlation between (the expected value of) workers' and firms' cost shares. Put differently, some pairings of workers and firms are more common than others. There are two upshots of this for our empirical analysis. First, the econometric specification of our estimation models always has to comprise both cost shares as explanatory variables. Second, we have to check whether the correlation between the two variables (conditional on other covariates) creates problems of multicollinearity. Fortunately, despite a high raw correlation, it turns out that no problems of multicollinearity arise. In all estimated models, both variables turn out to be significant individually.

4.3 Estimation sample and descriptive statistics

Our estimation sample covers the period 1998 through 2012. It includes all individuals of regular working age who are in period s, when we measure the sharing rule, in permanent

[20]Starting from the 17th week, the workers' and firms' cost shares are, across all cost schemes, 40 and 0 percent, respectively.

employment as either a blue- or white-collar worker.[21] The regular working age is sex-specific. It is 15–60 years for males, and 15–55 years for females. We consider any regular employment with a job tenure of at least 1 year as permanent. Our estimation samples comprise almost 5 million observations. Summary statistics are provided in Table 2. We express all monetary variables in 2008 Euros.

On average, each worker generates about €342 of total outpatient healthcare expenditure per year (median: €197), of which about two-thirds is spent on medical attendance and one-third on medical drugs. As a proxy for health expenditure in the inpatient sector, we use the annual days spent in hospital. About 14 percent of workers have at least 1 hospital day per year; the sample mean is about 1 day. The variation in all these health indicators is substantial. This is true in particular for expenditure on medical drugs and hospitalization, for which the standard deviation is about seven and five times the mean, respectively. Figure C.2 (a)-(d) in Appendix C shows the distribution of each health indicator in our estimation sample (excluding individuals with zero values).

The average worker takes about 10 days of sick leave per year. In each year, about 50 percent of all workers have 0 days of sick leave.[22] Even in the sample with non-zero sick-leave days, there is considerable variation in this variable (see Figure C.3). In the overall sample, the standard deviation is about twice the mean. Official data for 2012 (as reported by Leoni, 2014) show that almost 70 percent of all sick-leave days are caused by diseases from just four ICD-10 chapters: musculoskeletal system and connective tissue (22.3 percent); respiratory system (19.6 percent); injury, poisoning, and other external causes (17.3 percent); and mental and behavioural disorders (8.6 percent). A comparison with previous years shows that this distribution of sick-leave causes is quite stable over time, with the exception of mental and behavioural disorders, which are on the rise.

The worker's expected cost share for sick leave of 16 weeks per year varies between 5 and 31 percent. The sample mean is about 17 percent. The equivalent firm's expected cost share has a larger variation (between 0 and 88 percent) and a mean of about 52 percent.

Table 2 also provides summary statistics for worker's age, sex, job tenure, occupation, and firm size, amongst others. In our sample, 42 percent of workers are female, 56 percent have a white collar job and 31 percent are employed in small firms (as defined in Appendix B.2). The average worker is 39 years old and has a tenure of almost 8 years.

[21] An attractive feature of our dataset is that we observe workers' healthcare costs in period $s+x$, when we measure the outcome variables in the second stage, also in the case of non-employment. Thus, we do not have to worry about selective labor market exits into unemployment, retirement, and so on.

[22] For very short sick-leave spells, we have a measurement error in our data. For a spell up to 3 days, no medical certificate is necessary, unless the firm explicitly requests this. To achieve comparable measurement across firms, we replace sick-leave spells that are 3 days or shorter with 0. Given that only the total annual sick-leave days matter for a given worker's cost (and not the lengths of the individual spells), she has no incentive to consume short versus long spells strategically. Thus, this measurement error should introduce only noise, not bias, to our estimates.

These variables are measured on July 1st of each year.

5 Estimation strategy

To leverage the different sources of exogenous variation we combine them in a 2SLS estimation approach. This allows us to identify effects conditional on tenure, firm size, type of worker, firm and year. We can even control for those discontinuous jumps in tenure and firm size that would be the source of identification in a conventional regression discontinuity approach.

Our first-stage estimation captures the effect of the sharing rule on absence behavior and is given by the following equation:

$$sick\,leave_{i,f,s} = \alpha + \kappa \times \eta^{W}_{i,s,\bar{d}} + \delta \times \eta^{F}_{i,f,s,\bar{d}} + \beta \mathbf{X_{i,f,s}} + F_f + Y_s + \varepsilon_{i,f,s}. \tag{9}$$

The dependent variable $sick\,leave_{i,f,s}$ measures the annual number of sick leave days in calendar year s of worker i employed in firm f. The explanatory variables of primary interest are the worker's and the firm's expected cost share for annual sick leave $\bar{d}$ of 16 weeks, which are denoted by $\eta^{W}_{i,s,\bar{d}}$ and $\eta^{F}_{i,f,s,\bar{d}}$, respectively. Thus, the parameters κ and δ provide estimates of how workers adjust their absence behavior in response to a marginal increase in the cost share of workers and firms, respectively. The set of basic covariates $\mathbf{X_{i,f,s}}$ comprises information on sex, age (binary indicators for each year), occupation (blue-collar versus white-collar worker), tenure (binary indicators for each year), firm size (20 binary indicators based on percentiles), firm's wage bill (20 binary indicators based on percentiles), small firm (a binary indicator defined by the regulation for reimbursement of firms), and calendar month of entry (indicators). Since workers within a firm typically belong to different occupational and tenure groups, we can also control for fixed effects at the firm level F_f.[23] Finally, we control for calendar-year fixed effects denoted by Y_s.

In the second-stage equation, we are interested in a health measure of worker i at point $s + x$ (where $x \in \{1, 2\}$):

$$health_{i,f,s+x} = \gamma + \nu \times sick\,leave_{i,f,s} + \Gamma \mathbf{X_{i,f,s}} + F_f + Y_s + \epsilon_{i,f,t}. \tag{10}$$

The explanatory variable of primary interest $sick\,leave_{i,f,s}$ is most likely endogenous. In a contemporaneous specification ($x = 0$), there is an obvious problem of reverse causality since health should affect absence behavior. While this source of bias should not be present in our lagged specifications ($x \in \{1, 2\}$), there may be some other unobserved factors that are correlated with absence behavior and health. Therefore, we use workers' and firms'

[23]We do not include individual fixed effects since there is too little variation within workers; a typical worker does not change occupational group, and changes across tenure groups happen only at rare intervals.

cost shares for yearly sick leave of 16 weeks, $\eta^{W}_{i,s,\bar{d}}$ and $\eta^{F}_{i,f,s,\bar{d}}$, respectively, as instrumental variables and substitute the endogenous variable with the prediction $\widehat{sick\,leave}_{i,f,s}$ from (9). This 2SLS estimation approach gives us a weighted average of *local average treatment effects* for particular subgroups of the population. In addition, we estimate the reduced-form equation, which relates the health of worker i to her past cost shares.

The identifying assumption of this instrumental-variable strategy is that $\eta^{W}_{i,s,\bar{d}}$ and $\eta^{F}_{i,f,s,\bar{d}}$ are randomly assigned conditional on our covariates, and affect workers' health only through the channel of the cost shares. While these assumption are not testable, we regard them as quite reasonable assumptions. As discussed above, the cost shares are a specific function of occupation, tenure, firm size, and year (see equations 7 and 8). While each of these characteristics may have an independent effect on health, we can condition on all of them in a very flexible way. In other words, our instrumental-variable strategy rests only on variation in these variables, which comes from a very specific functional form, i. e., two-way, three-way and four-way interactions between tenure, occupation, firm size and year. For instance, regarding the part of the identification that comes from tenure, we allow for a direct effect of tenure on health. Given that we include binary indicators capturing the different tenure levels, we even allow health to vary discontinuously with tenure at the thresholds of 5, 15, and 25 years.[24]

We only have to assume that if health varies discontinuously with tenure, these discontinuous jumps are the same for blue- and white collar-workers, for workers in small and large firms, and for all years. An equivalent line of reasoning applies to firm size and occupation, and firm size and year. If health varies discontinuously with firm size, we have to assume that any discontinuous jump is the same for blue- and white-collar workers and for all years. With respect to the part of the variation that comes from occupation and year, we have to assume that changes in the occupational gradient in health did not coincide with the timing of the reforms. We regard these assumptions as quite reasonable. Still, we provide evidence that these assumptions are innocuous. In Subsection 6.4 we present estimation results based on alternative specifications, which partly relax these assumptions.

6 Estimation results

We first summarize our estimation results on the effects of variations in cost shares on absence behavior. These estimates constitute the first stage within our 2SLS estimation approach. Then, we present our reduced-form estimates on the effects of exogenous variations in cost shares on workers' health. Following this, we report on our second-stage

[24]One might worry that a firm may assign the most hazardous tasks to workers, who cause low firm cost in case of their sickness absence (for instance, to workers with the lowest tenure) or even hire these workers for those task. In any case, our exclusion restriction would also <u>not</u> fail since we control for each tenure level in our regression.

results, which provide estimates of the effect of policy-induced sick-leave changes on workers' health. Before we discuss how we can relate our estimation results to the presence of absenteeism versus presenteeism, we report on some robustness checks. In a final step, we examine workplace accidents and explore potential treatment effect heterogeneity.

6.1 The effect of cost shares on absence behavior (first-stage results)

Our first-stage results summarized in Table 3 provide us with estimates on how variations in the sharing rule affect absence behavior. The estimated effects on variation in the worker's and the firm's cost share correspond with the comparative static effects discussed in Proposition 1: $\frac{\partial t_1^a}{\partial \eta^j}$, $j = F, W$.

As predicted by our model, all specifications show that an increase in either cost share decreases the days of sick leave. The estimated effects are highly statistically significant, which allows us to abstract from weak instrumental variable problems in the interpretation of our second-stage results.

To assess the quantitative importance of these effects, we have to keep in mind that both explanatory variables capture the respective expected cost share. Thus, an increase in the worker's expected cost share of 10 percentage points decreases the annual sick days by about 0.8 days. An equivalent increase in the firm's cost share decreases the sick days by only about 0.4 days. Given a sample mean of about 10.4 sick days per year, these are equivalent to decreases of about 8 and 4 percent, respectively (semi-elasticities are provided in brackets). The relatively higher importance of the worker's cost share compared to the firm's cost share corresponds with our expectation (see theoretical discussion).

As a robustness check, we control in specifications (II) through (V), in turn, for different health indicators measured in period $s - 1$. In particular, we include total outpatient expenditure, expenditure on medical attendance, expenditure on medical drugs, or days spent in hospital. The estimated effects vary only marginally owing to the inclusion of lagged health indicators. The results from these robustness checks are very reassuring, since they provide evidence that the cost shares are not correlated with individual health status, and that the variation in the sharing rule is indeed exogenous.

This set of results has important implications. First, the significant effect of workers' and firms' cost shares on absence behavior confirms the findings of the existing literature (see Section 1). Second, for our subsequent analysis, we can observe that the workers' and the firms' cost shares are strong instrumental variables.

6.2 The effect of the cost shares on workers' health (reduced-form results)

Our reduced-form results are summarized in Table 4. The estimated effects on variation in the worker's and the firm's cost shares on health correspond with the comparative static effects discussed in Proposition 2: $\frac{\partial H_2}{\partial \eta_1^j}$, $j = F, W$. We use two different specifications of the lag structure and examine the effect of the sharing rules measured in period $s-1$ (see Panel A) and in $s-2$ (see Panel B) on current health outcomes. As predicted by our model, we find across all specifications and outcomes that an increase in either cost share negatively affects future health. More precisely, we find a rise in healthcare costs and in hospitalization.

Considering Panel A, we observe that an increase in the worker's expected cost share by 10 percentage points is estimated to increase total outpatient expenditure by €23, expenditure on medical attendance in the outpatient sector by €14, expenditure on medical drugs by €9, and days spent in hospital by about 0.1 days. The estimated coefficients on total outpatient expenditure, service expenditure, and hospital days are statistically significant at the 1 percent level, but the effect on medical drug expenditure is not statistically significant. In addition, to facilitate a comparison of the relative importance of these effects across outcomes, Table 4 provides estimated semi-elasticities in brackets below the standard errors. The estimated effects are equivalent to increases by 7, 6, 7, and 11 percent, respectively. An equivalent increase in the firm's expected cost share has quantitatively smaller effects. Depending on the outcome, the estimated effects are one-sixth to one-fourth, or about plus 1 percent of total health expenditure and expenditure on medical attendance, and about plus 2 percent expenditure on medical drugs and days spent in hospital. In Panel B, we examine the effect of cost shares measured in period $s-2$ on current health outcomes and find very similar results compared to those obtained above. This may suggest that cost shares have not only short-term effects on health outcomes but also medium-term effects.

6.3 The effect of policy-induced sick-leave changes on later health (second-stage results)

Our second-stage results are summarized in Table 5. They correspond with $\frac{\partial H_2}{\partial t_1^a}$ from our theoretical model. These estimates give us the effect of policy-induced variations in sick leave on health. In particular, the variation comes from two policy variables: the workers' and firms' cost shares. Again, we impose a lagged structure and estimate the effect of variation in past sick-leave days (in period $s-1$ and $s-2$) on current health indicators. Across all outcomes and specifications, we find that exogenous increases in sick leave — due to a reduction in either workers' or firms' cost shares — improve subsequent health. More precisely, we observe a reduction in healthcare costs and the extent of hospitalization. With the exception of expenditure on medical attendance, all estimated coefficients are highly statistically significant. For each specification, we report the *Kleibergen–Paap Wald rk F statistic*. The values, around 70, indicate that our instruments are sufficiently strong.

Considering Panel A, we see that an increase in annual sick-leave days by 1 day is estimated to decrease total outpatient expenditure, as well as expenditure on medical drugs by €3–4. Thus, the cost-reducing effect of more sick leave in the outpatient sector is driven mostly by expenditure on medical drugs. For the inpatient sector, we find that about 0.04 fewer days are spent in hospital. The semi-elasticities, in brackets below the standard errors, facilitate a comparison of the relative importance of these effects across outcomes and imply that an increase in sick leave by 1 day decreases total health expenditure by 1 percent, expenditure on medical drugs by 3 percent, and days spent in hospital by 3 percent. A comparison across panels shows quantitatively higher effects when a lag of 2 years is considered. Moreover, the statistical significance is higher throughout. For instance, the effect on medical attendance (minus 0.6 percent) is significant at the ten percent level.

Physical or mental impairments. To explore whether the estimated effects are driven by physical or mental impairments, we exploit the information on the type of medical drugs.[25] We distinguish between expenditure on nervous-system drugs (ATC code N, comprising anti-depressants and barbiturates) and other medical drugs. On average, expenditure for nervous-system drugs accounts for 17.5 percent of all drug expenditure. Our estimation results (see Table C.1 in Appendix C) reveal that policy-induced increases in sick leave have a stronger effect on nervous-system drugs (minus 8 percent) compared to other drugs (minus 3 percent). Thus, by increasing sick leave, physical and mental health could be improved.

6.4 Sensitivity analysis

Controlling for the wage rate. In principle, it is possible that the firm's cost share has an effect on wages. Firms could aim for constant labor cost across workers, and pay lower wages to workers for whom they bear higher sick-leave costs. Theoretically, even the worker's cost share could have an effect on wages. For instance, workers with high sick-leave costs could try to bargain for higher wages. In practice, especially in the Austrian context, we assess these effects to be of minor importance. First, a large share of workers is covered by collective-bargaining agreements. Second, wages are typically downward rigid. In our baseline specification, we exclude the wage rate as a covariate, since it is a potential

[25] Our two other healthcare cost variables are less suited for this analysis. The field of the resident medical specialists is not fully informative, since many patients with mental problems consult general practitioners and not psychologists. We infer this from the information on who is prescribing anti-depressants. Hospitalization due to mental problems is rare and represents severe cases.

bad control (i. e., it could itself be an outcome). Nevertheless, as a robustness check, we re-run our second-stage estimations with the daily wage rate (defined as the annual wage in 2008 Euros divided by employment days) as an additional covariate. The results based on this alternative specification, which allows for a correlation between wages and cost shares, are summarized (along with other specifications discussed below) in Figure 4. The first bar of each graph plots our estimation results from the baseline specification. The second bar shows results when the daily wage rate is added as a covariate. The inclusion of the wage rate does not change our results.

Controlling for interaction effects between tenure, occupation, firm size and year. In our baseline specification, we allow for direct effects of occupation, tenure, firm size and year on health outcomes, and use only within-variation in cost shares to identify our parameters. We present now four alternative specifications that relax our identifying assumptions by adding specific two-way and three-way interactions between occupation, tenure, firm size and year. This comes at the cost of restricting our variation in cost shares.

In our baseline specification, we had to assume that if health varies discontinuously with tenure, that these discontinuous jumps are the same for blue- and white collar-workers and for workers in small and large firms. We relax this assumption by adding two-way interactions of tenure levels (binary indicators) with occupation and firm size, respectively. This implies that we only use the variation in the workers' cost share that is due to the reform. The third bar of Figure 4 shows the respective second-stage estimates along with 95% confidence intervals. A comparison with the respective first bar, summarizing the baseline estimates, shows that the estimates are very comparable (slightly lower) and have somewhat higher standard errors. In a next step we additionally include an interaction between firm size and occupation, and a three-way interaction between tenure, firm size and occupation. In this model, we only use the variation in workers' and firms' cost shares that is due to the reforms. The estimated effect from this model (fourth bar) fully confirms our baseline results.

The third specification (fifth bar) augments the baseline specification with two-way interactions between year and occupation, and year and firm size. This implies that we do not use the variation in the workers' cost share that is due to the reform. The fourth specification (sixth bar) additionally controls for a two-way interaction between firm size and occupation, and a three-way interaction between year, firm size and occupation. In this specification, we use for both cost shares only the variation that is due to differences across tenure levels within year, occupation and firm size. The estimated effects from these two specifications provide the same qualitative result, but are quantitatively higher as compared to our baseline estimates. These differences should be no cause for concern, since these specifications use different parts of the total variation and therefore estimate different local average treatment effects. In sum, this sensitivity analysis provides evidence that our main results hold even when we relax our identifying assumptions.

Definition of the instrumental variables. To implement our 2SLS approach, we define our instrumental variables as the expected value of workers' and firms' cost shares for an annual sick leave duration of 16 weeks (i. e., we set d to $\bar{d} = 16$). As argued above, while the choice of $\bar{d} = 16$ is arbitrary to some degree, we expect it to be an innocuous assumption given forward-looking individuals and the high correlation in the cost shares across different choices of $\bar{d} \leq 16$. To check our supposition, we repeat our analysis for different choices of $\bar{d} = \{7, 8, \ldots, 15\}$.[26] As expected, we see little variation in the estimated coefficients across different choices of $\bar{d}$. See Figures C.4 and C.5 in Appendix C, which summarize the first- and second-stage results, respectively.

6.5 Absenteeism or presenteeism

How can we relate our estimation results to the presence of absenteeism versus presenteeism? This can be achieved by mapping these two phenomena into the space of policy-induced sick leave and subsequent healthcare costs. See stylized Figure 5. Here, we define the domain of presenteeism as the segment of the healthcare cost function that decreases in sick leave. This captures the idea that a sick worker who rests instead of attending work would recover faster and generate lower healthcare costs. This is in line with our theoretical model, in which presenteeism is defined as a situation in which a worker with a current level of health below H^* attends work. Absenteeism is present when a worker with a current level of health greater than or equal to H^* does not attend work. In the domain of absenteeism, the shape of the healthcare cost function is less clear. One may assume, as we do in our theoretical model, that staying home despite not being sick is equally healthy or unhealthy as being at work. This is captured by the sold line, which is horizontal in the domain of absenteeism (i. e., absenteeism has no effect on subsequent healthcare costs).

Alternatively, one may consider that absenteeism (or more precisely, specific activities) are less healthy compared to being healthy at work. This would be the case if absent workers were to engage, for instance, in risky activities. This case is captured by the scattered line, which is upward slopping in the domain of absenteeism (i. e., absenteeism increases subsequent healthcare costs).[27] As argued above, a negative effect on healthcare costs is ruled out by definition. This is equivalent to assuming that there are no unhealthy jobs (i. e. workers with unhealthy jobs would be permanently on presenteeism). Thus, a negative effect of sick leave on healthcare costs can be found only in the domain of presenteeism. We conclude that in our sample, the average worker is in the domain of

[26] For lower values of $\bar{d}$, there is not enough variation across workers' schemes. See Panel (a) of Figure 1.

[27] Note, our theoretical model rules out a positive effect of absenteeism on healthcare costs. A rational worker would never go on sick leave in the domain of absenteeism if she knew that this would cause her future health to deteriorate. To allow for this behavior, one could incorporate a taste for risky activities or include myopia.

presenteeism and reductions in the workers' or firms' cost shares would reduce healthcare costs by increasing sick-leave days.

6.6 Sick leave and workplace accidents

To substantiate our claim that the average worker is in the domain of presenteeism, we examine work place accidents. Sick workers who attend work, may not only be less productive, put also at a higher risk to experience a workplace accident. In line with our estimation strategy above, we test the hypothesis that workers with comparable higher cost shares (and accordingly low levels of sick leave) are more likely to have workplace accidents.

For this analysis, we use data from the *Austrian Workers' Compensation Board* (AWCB). This is the major social accident insurance institution in Austria, which covers all private sector employees. Thus, it covers all individuals in our estimation sample used above. Occupational accidents are defined as unexpected external events causing injury, in locational, temporal and causal relationship to the insurant's occupation.[28] Employers are bound by law to report every occupational accident to the AWCB. The database of the AWCB provides us with information on all incidents in the period from 2000 to 2006 with information on date, time, and type of accident, as well as the resulting days of sick leave and any hospitalization. About 3.5 percent of all workers have an workplace accident each year. These workplace accidents include workplace accidents in the narrow sense (91 percent), commuting accidents (9 percent) and a small number of occupational diseases (<0.1 percent). The sick leave duration caused by the average accident is about 15 days, and 7 percent of injured workers need inpatient care.

For our estimation analysis, we define a binary indicator equal to one if a worker had a workplace accident in a given year. Table 6 summarizes our estimation results. As before, we present a model with a one-period lag (Panel A) and a two-period lag (Panel B) specification. The first column shows the first-stage estimation. The power of this first stage is not as high as compared to our previous analysis. This results from the reduced number of years, which do not cover the full range of policy reforms. The second column lists the reduced form estimates, i. e., the estimated effects of variation in the worker's and the firm's cost shares on the likelihood of a workplace accident. We find that an increase in either cost share increases the propensity of a workplace accident. In line with the findings of our previous analysis, we see that the worker's expected cost is quantitatively more important as compared to the firm's expected cost share. An increase in the respective one-period lagged cost share by 1 percentage point is estimated to increase the likelihood of a workplace accident by 2 percent and 0.3 percent, respectively. The estimates based on

[28] The AWCB also covers occupational diseases. These are defined as health impairments caused by the insurant's occupation and are explicitly listed in the annex to the *General Social Insurance Act*. These are comparably rare events.

the two-period lagged cost shares gives somewhat larger estimates. These findings confirm our hypothesis and supports the interpretation that the average worker is in the domain of presenteeism. More precisely, this suggests that reductions in the workers' or firms' cost shares would reduce the incidence of workplace accidents. The second-stage estimate is only statistically significant in Panel B. This estimate suggests that an exogenous increase in sick leave days two periods ago by one — caused by a reduction in either workers' or firms' cost shares — decreases the likelihood of a workplace accident in the current period by 0.6 percentage points.

6.7 Treatment effect heterogeneity

In a final step, we explore whether the effects of cost shares on absence behavior and subsequent health differs across workers, and whether they vary with macroeconomic conditions. Regarding workers' characteristics, we consider the degree of labor market attachment and health as important dimensions. To approximate these variables, we suggest the use of sex and age. While Austria has reasonably high female labor-force participation of about 0.7, men are on average more strongly attached to the labor market. After becoming mothers, many women work only part time or leave the labor market completely. Younger workers, defined as those below 50 years of age, can be expected to be healthier than older workers. To capture macroeconomic conditions, we use local unemployment rates measured at district level and assign each worker the annual local unemployment rate at her place of residence. We distinguish between observations with a local unemployment rate below and above the median of the total sample of district years, which should mimic the situation of a recession versus a boom.

Which predictions can be derived from the theoretical model? While we obtain the definite result that a worker in good health chooses to be less absent compared to a worker in bad health, it is ambiguous whether the former or the latter would react more strongly to cost-share variations.[29] Analogously, we find that a worker with a higher degree of labor-market attachment is less absent.[30] Yet, the theoretical analysis cannot provide a definite answer on how variations in the attachment affect the response to cost-share variations. Finally, by assuming that a recession increases the likelihood of being dismissed[31], we can show that workers reduce their sickness absence during recessions. Again, we have no definite result on the relative response to cost-share changes.

Empirical results. Table 7 summarizes the first-stage estimation results for these six subsamples. In each case, we observe the same qualitative result. The first two columns show that the point estimates are somewhat larger in absolute terms for female workers

[29] It depends on the shapes of all functions, in particular, on the second and third partial derivatives, and their relations to each other.

[30] We simply introduce a weighting parameter in the worker's expected utility of period 2, which captures how important or necessary it is to keep her job.

[31] That is, we assume that the employment probability ρ also depends on a business-cycle parameter.

compared to male workers. However, it should not be concluded that women (the group with lower labor-market attachment) react more strongly to increases in cost shares, since the difference in the estimated coefficients is not statistically significant. The next two columns show that old workers react significantly more strongly to cost shares compared to young workers. The effect of the worker's cost shares is statistically significant only for older workers. The firm's cost share is significant for both groups, however, it is quantitatively more important for older workers. This suggests that workers with lower health status respond more to cost shares. The remaining two columns provide evidence for heterogeneous effects along the business cycle. While the reaction to the firm's cost share seems to be uniform, we observe that changes in the worker's cost share are about two times more effective during recessions.[32]

Table 8 summarizes selected second-stage estimation results, which inform us whether *one* additional policy-induced sick-leave day has different effects on health for different subsamples, and abstracts as such from any heterogeneity in the first stage. Panel A relates to the outpatient sector (annual total expenditure, the sum of medical attendance, and medical drugs), while Panel B relates to the inpatient sector (annual days in hospital). In both panels, we provide the results of sick-leave days in periods $s-1$ and $s-2$. In each subsample, we find evidence for a negative effect of past sick-leave days on healthcare costs, and thus, there is evidence that the average worker is in the domain of presenteeism. A comparison of the elasticities, provided in brackets, shows that the relative effects are by and large comparable across the respective subsamples. The only notable difference is between young and old workers. Among older workers, we observe no evidence for cost savings in the inpatient sector, but there are significant reductions in the outpatient sector. A possible explanation is that presenteeism causes different medical conditions among young and old workers, which lead to different medical treatments.

7 Conclusions

We show that different absence behavior and varying healthcare costs are observed, depending on how the cost of temporary withdrawals from the labor market due to sickness are shared among firms, workers, and the social security system. Our empirical analysis based on Austrian data suggests that the average worker is in the domain of presenteeism. In a simple static back-of-the-envelope calculation we consider a redistribution of the sick leave cost from either workers or firms to the social security system. In the case of a reduction in the workers' cost, the savings in health care cost (about minus 160 percent) would outweigh the additional wage compensation born by the social security system. If the firms' sick leave cost would be redistributed, the savings in the health care sector

[32]Since the composition of the workforce may change over the business cycle, we cannot disentangle whether the estimated behavioral change is within or across individuals.

would cover about 75 percent of the additional public expenses.

Our findings are in line with the persistent problem of early retirement, especially due to disability, in Austria compared to other *OECD* member countries (OECD, 2013b). Thus, a redistribution in the cost of sick leave to the public would increase the inefficiently low level of sick leave, and may also help to increase the actual retirement age. An alternative public policy option is to reduce the risk and cost of unemployment.

Clearly, we cannot contribute to the difficult issue of what an optimal sick-pay scheme and sharing rule should feature. To clarify this problem, a welfare analysis is required. This would be an important direction for further research, but is beyond the scope of this paper.

References

Barmby, T., Sessions, J. and Treble, J. (1994). Absenteeism, Efficiency Wages and Shirking. *Scandinavian Journal of Economics*, **96** (4), 561–566.

Böheim, R. and Leoni, T. (2011). *Firms' Moral Hazard in Sickness Absences*. Discussion Paper 6005, Institute for the Study of Labor (IZA), Bonn, Germany.

Brown, S. (1994). Dynamic Implications of Absence Behaviour. *Applied Economics*, **26** (12), 1163–1175.

— and Sessions, J. G. (1996). The Economics of Absence: Theory and Evidence. *Journal of Economic Surveys*, **10** (1), 23–53.

Chatterji, M. and Tilley, C. J. (2002). Sickness, Absenteeism, Presenteeism, and Sick Pay. *Oxford Economic Papers*, **54** (4), 669–687.

Chetty, R. and Finkelstein, A. (2013). Social Insurance: Connecting Theory to Data. In A. J. Auerbach, R. Chetty, M. Feldstein and E. Saez (eds.), *Handbook of Public Economics*, vol. 5, *3*, Elsevier, pp. 111–193.

Dale-Olsen, H. (2014). Sickness Absence, Sick Leave Pay, and Pay Schemes. *LABOUR*, **28** (1), 40–63.

De Paola, M., Scoppa, V. and Pupo, V. (2014). Absenteeism in the Italian Public Sector: The Effects of Changes in Sick Leave Policy. *Journal of Labor Economics*, **32** (2), 337–360.

Fevang, E., Markussen, S. and Røed, K. (2014). The Sick Pay Trap. *Journal of Labor Economics*, **32** (2), 305–336.

Finkelstein, A., Luttmer, E. F. and Notowidigdo, M. J. (2009). Approaches to Estimating the Health State Dependence of the Utility Function. *American Economic Review: Papers & Proceedings*, **99** (2), 116–121.

—, — and — (2013). That Good is Wealth without Health? The Effect of Health on the Marginal Utility of Consumption, . *Journal of the European Economic Association*, **11** (S1), 221–258.

Henrekson, M. and Persson, M. (2004). The Effects on Sick Leave of Changes in the Sickness Insurance System. *Journal of Labor Economics*, **22** (1), 87–113.

Heymann, J., Rho, H. J., Schmitt, J. and Earle, A. (2009). *Contagion Nation: A Comparison of Paid Sick Day Policies in 22 Countries*. Tech. rep., Center for Economic and Policy Research, Washington, D.C.

Johansson, P. and Palme, M. (1996). Do Economic Incentives Affect Work Absence? Empirical Evidence Using Swedish Micro Data. *Journal of Public Economics*, **59** (2), 195–218.

— and — (2005). Moral Hazard and Sickness Insurance. *Journal of Public Economics*, **89** (9–10), 1879–1890.

Johns, G. (2010). Presenteeism in the Workplace: A Review and Research Agenda. *Journal of Organizational Behavior*, **31** (4), 519–542.

Leoni, T. (2014). *Fehlzeitenreport 2013 Krankheits- und unfallbedingte Fehlzeiten in Österreich*. Tech. rep., WIFO (Austrian Institute of Economic Research), Vienna.

Markussen, S., Røed, K., Røgeberg, O. J. and Gaure, S. (2011). The Anatomy of Absenteeism. *Journal of Health Economics*, **30** (2), 277–292.

OECD (2013a). *Health at a Glance 2013*. Paris: OECD Publishing.

OECD (2013b). *Pensions at a Glance 2013: OECD and G20 Indicators*. Paris: OECD Publishing.

Pettersson-Lidbom, P. and Thoursie, P. S. (2013). Temporary Disability Insurance and Labor Supply: Evidence from a Natural Experiment. *Scandinavian Journal of Economics*, **115** (2), 485–507.

Pichler, S. and Ziebarth, N. R. (2016). *The Pros and Cons of Sick Pay Schemes: Testing for Contagious Presenteeism and Noncontagious Absenteeism Behavior*. Working Paper 22530, NBER.

Puhani, P. A. and Sonderhof, K. (2010). The Effects of a Sick Pay Reform on Absence and on Health-Related Outcomes. *Journal of Health Economics*, **29** (2), 285–302.

Shapiro, C. and Stiglitz, J. E. (1984). Equilibrium Unemployment as a Worker Discipline Device. *American Economic Review*, **74** (3), 433–444.

Social Security Administration (2016). *Annual Statistical Supplement to the Social Security Bulletin*. SSA Publication 13-11700.

Stearns, J. and White, C. (2016). *Can Paid Sick Leave Mandates Reduce Leave-Taking?* Unpublished manuscript, University of California, Santa Barbara.

Viscusi, K. W. and Evans, W. N. (1990). Utility Functions That Depend on Health Status: Estimates and Economic Implications. *American Economic Review*, **80** (3), 353–374.

ZIEBARTH, N. R. (2013). Long-term Absenteeism and Moral Hazard—Evidence from a Natural Experiment. *Labour Economics*, **24**, 277–292.

— and KARLSSON, M. (2010). A Natural Experiment on Sick Pay Cuts, Sickness Absence, and Labor Costs. *Journal of Public Economics*, **94** (11-12), 1108–1122.

— and — (2014). The Effects of Expanding the Generosity of the Statutory Sickness Insurance System. *Journal of Applied Econometrics*, **29** (2), 208–230.

ZWEIMÜLLER, J., WINTER-EBMER, R., LALIVE, R., KUHN, A., WUELLRICH, J., RUF, O. and BÜCHI, S. (2009). *The Austrian Social Security Database (ASSD)*. Working Paper 0901, The Austrian Center for Labor Economics and the Analysis of the Welfare State, University of Linz.

8 Tables and Figures

Table 1: Sick leave cost shares for workers ($\mathcal{W}$) and firms ($\mathcal{F}$) by period, occupation, tenure and firm size groups (. . . continued on the next page).

Weeks of sick leave	Period 1: 1998 – 2000												Period 2: 2001[†] – 2004			
	Blue-collar workers								White-collar workers				All workers			
Tenure groups[§]	0 – 4		5 – 14		15 – 24		≥ 25		0 – 4	5 – 14	15 – 24	≥ 25	0 – 4	5 – 14	15 – 24	≥ 25
Firm size[¶]	Small	Large	Small	Large	Small	Large	Small	Large								
	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$
1	0/0	0/30	0/0	0/30	0/0	0/30	0/0	0/30	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
2	0/0	0/30	0/0	0/30	0/0	0/30	0/0	0/30	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
3	0/0	0/30	0/0	0/30	0/0	0/30	0/0	0/30	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
4	0/0	0/30	0/0	0/30	0/0	0/30	0/0	0/30	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
5	50/0	50/0	0/0	0/30	0/0	0/30	0/0	0/30	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
6	50/0	50/0	0/0	0/30	0/0	0/30	0/0	0/30	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
7	40/0	40/0	40/0	40/0	0/0	0/30	0/0	0/30	20/50	0/100	0/100	0/100	20/50	0/100	0/100	0/100
8	40/0	40/0	40/0	40/0	0/0	0/30	0/0	0/30	20/50	0/100	0/100	0/100	20/50	0/100	0/100	0/100
9	40/0	40/0	40/0	40/0	40/0	40/0	0/0	0/30	20/50	20/50	0/100	0/100	20/50	20/50	0/100	0/100
10	40/0	40/0	40/0	40/0	40/0	40/0	0/0	0/30	20/50	20/50	0/100	0/100	20/50	20/50	0/100	0/100
11	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	20/50	20/50	0/100	40/0	20/50	20/50	0/100
12	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	20/50	20/50	0/100	40/0	20/50	20/50	0/100
13	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	20/50	20/50	40/0	40/0	20/50	20/50
14	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	20/50	20/50	40/0	40/0	20/50	20/50
15	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	20/50	40/0	40/0	40/0	20/50
16	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	20/50	40/0	40/0	40/0	20/50
≥ 17	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0
Cost scheme[‡]																
$\mathcal{W}$	z_0	z_0	z_1	z_1	z_2	z_2	z_3	z_3	z_4	z_5	z_6	z_7	z_4	z_5	z_6	z_7
$\mathcal{F}$	Z_0	Z_1	Z_0	Z_2	Z_0	Z_3	Z_0	Z_4	Z_5	Z_6	Z_7	Z_8	Z_5	Z_6	Z_7	Z_8

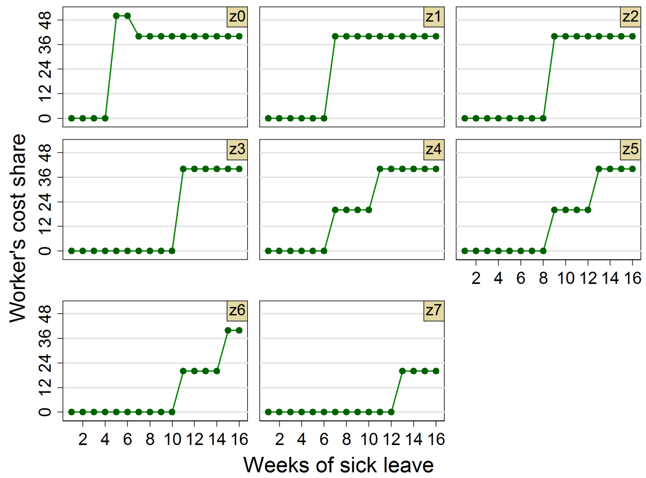
[†] In September 2000, the firm cost scheme was changed; however, the old worker scheme remained in place until December 2000. [§] Full years of tenure. [¶] The definition of small firms has changed in our sample period. Until September 2002, a small (large) firm was defined by a total payroll below (above) 180 times the maximal daily social security contribution basis. Since October 2002, a small (large) firm has been defined as 51 workers or less (more than 51 workers).[‡] A cost scheme is defined as a unique schedule of cost shares over a sick-leave spell of undefined length.

Table 1 (...continued)

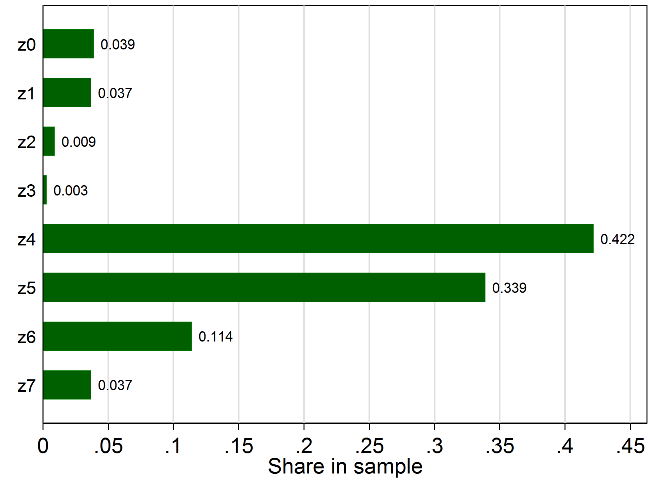
Weeks of sick leave	Period 3: 2005 – 2012							
	All workers							
Tenure groups[§]	0 – 4		5 – 14		15 – 24		≥ 25	
Firm size[¶]	Small	Large	Small	Large	Small	Large	Small	Large
	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$	$\mathcal{W}/\mathcal{F}$
1	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
2	0/100	0/100	0/100	0/100	0/100	0/100	0/100	0/100
3	0/42	0/100	0/42	0/100	0/42	0/100	0/42	0/100
4	0/42	0/100	0/42	0/100	0/42	0/100	0/42	0/100
5	0/42	0/100	0/42	0/100	0/42	0/100	0/42	0/100
6	0/42	0/100	0/42	0/100	0/42	0/100	0/42	0/100
7	20/50	20/50	0/100	0/100	0/100	0/100	0/100	0/100
8	20/50	20/50	0/100	0/100	0/100	0/100	0/100	0/100
9	20/50	20/50	20/50	20/50	0/100	0/100	0/100	0/100
10	20/50	20/50	20/50	20/50	0/100	0/100	0/100	0/100
11	40/0	40/0	20/50	20/50	20/50	20/50	0/100	0/100
12	40/0	40/0	20/50	20/50	20/50	20/50	0/100	0/100
13	40/0	40/0	40/0	40/0	20/50	20/50	20/50	20/50
14	40/0	40/0	40/0	40/0	20/50	20/50	20/50	20/50
15	40/0	40/0	40/0	40/0	40/0	40/0	20/50	20/50
16	40/0	40/0	40/0	40/0	40/0	40/0	20/50	20/50
≥ 17	40/0	40/0	40/0	40/0	40/0	40/0	40/0	40/0
Cost scheme[‡]								
$\mathcal{W}$	z_4	z_4	z_5	z_5	z_6	z_6	z_7	z_7
$\mathcal{F}$	Z_9	Z_5	Z_{10}	Z_6	Z_{11}	Z_7	Z_{12}	Z_8

[§] Full years of tenure. [¶] Since October 2002, a small (large) firm has been defined as 51 workers or less (more than 51 workers). [‡] A cost scheme is defined as a unique schedule of cost shares over a sick-leave spell of undefined length.

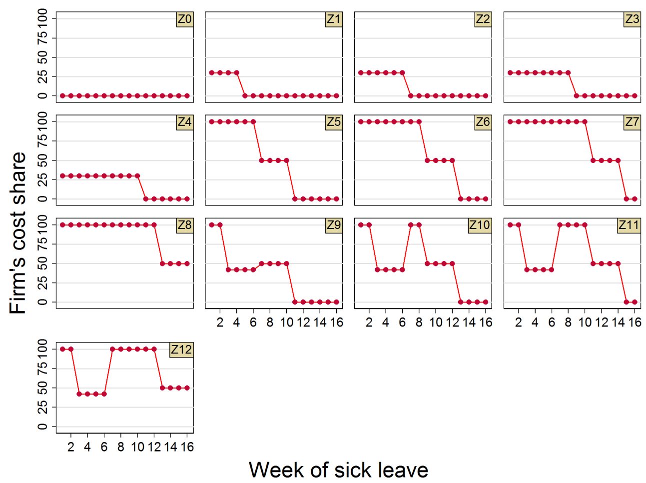
Figure 1: Workers' and firms' cost shares over sick-leave length by cost schemes



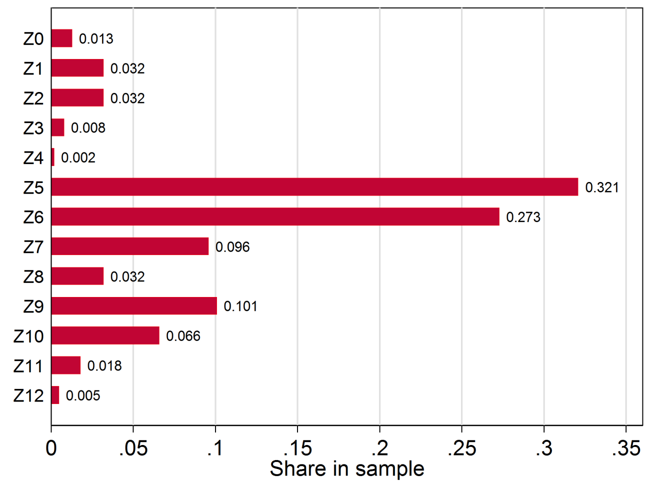
(a) Workers' cost shares over sick-leave length



(b) Distribution of workers' cost schemes



(c) Firms' cost shares over sick-leave length



(d) Distribution of firms' cost schemes

Notes: A cost scheme is defined as a unique schedule of cost shares over a sick-leave spell of undefined length (see Table 1).

Figure 2: Workers' cost share for annual sick leave of 16 weeks by cost scheme

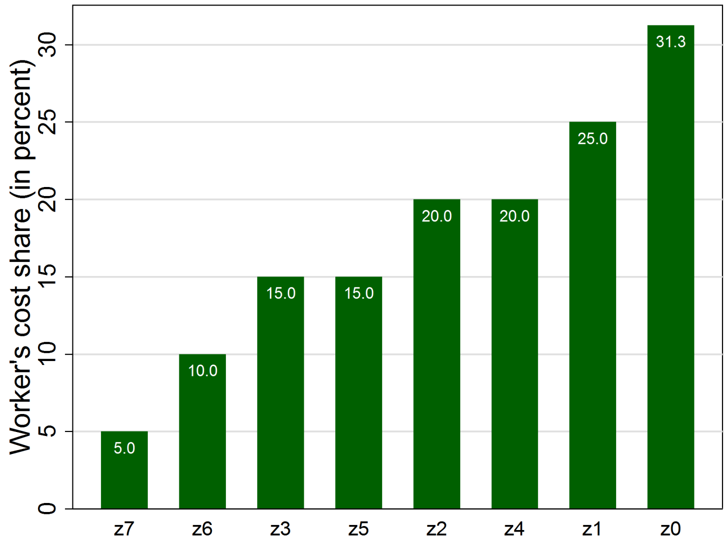


Figure 3: Firms' cost share for annual sick leave of 16 weeks by cost scheme

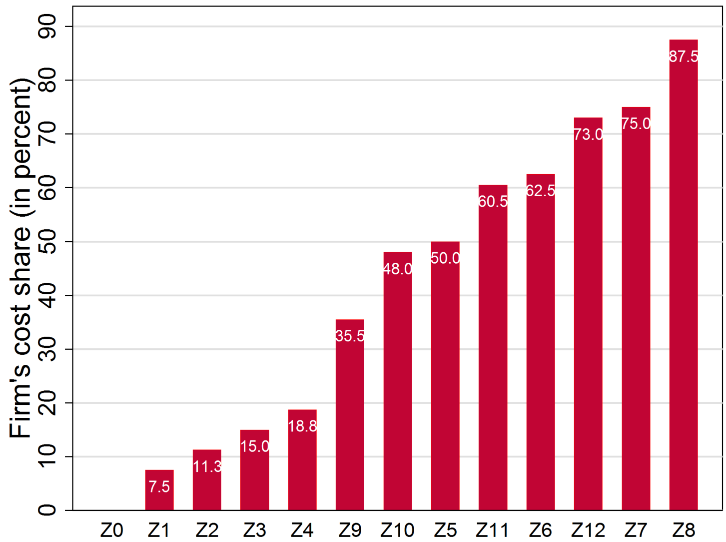


Table 2: Summary statistics of key variables

Variable	Mean	Std.Dev.	Min	Max
Endogenous and instrumental variables:				
Sick-leave days	10.42	19.646	0	366
Worker's expected cost share	17.22	5.18	5	31
Firm's expected cost share	52.28	18.33	0	88
Outcome variables (measured in year s+1):				
Total outpatient health expenditure	342.20	897.17	0	419,788
Expenditure on:				
Medical attendance	226.81	269.35	0	23,320
Medical drugs	115.39	828.45	0	419,104
Nervous-system drugs	13.59	113.72	0	9,672
Other drugs	101.80	817.13	0	419,088
Hospital days	1.24	5.71	0	366
Workplace accidents§	0.03		0	1
Control variables:				
Age	38.86	10.00	16	60
Female	0.42		0	1
Blue-collar	0.45		0	1
White-collar	0.56		0	1
Tenure (years)	7.72	7.15	1	39
Tenure group:				
1–4 years	0.46		0	1
5–14 years	0.38		0	1
15–24 years	0.13		0	1
25 years or more	0.04		0	1
Firm size:				
Number of workers	1,045	2,687	1	43,667
Firm's wage bill (Euro)	2,042,333	4,948,437	0	48,500,000
Small firm	0.31		0	1
Real daily wage†	85.00	35.07	0	777.29
Period:‡				
1: 1998–2000	0.20		0	1
2: 2001–2004	0.28		0	1
3: 2005–2011	0.52		0	1
N=4,819,556				

Notes: We express all monetary variables in 2008 Euros. §Workplace accidents are only observed between 2000 and 2006 (N=1,706,917). †The daily wage is defined as the annual wage divided by the number of employment days. ‡For simplicity, we show the distribution across the relevant periods and not across years.

Table 3: The effect of cost shares on absence behavior (first stage)

	(I)	(II)	(III)	(IV)	(V)
Worker's cost share in s	-0.084***	-0.076***	-0.083***	-0.071***	-0.084***
	(0.019)	(0.019)	(0.019)	(0.019)	(0.018)
	[-0.81%]	[-0.73%]	[-0.80%]	[-0.68%]	[-0.81%]
Firm's cost share in s	-0.041***	-0.039***	-0.040***	-0.038***	-0.041***
	(0.005)	(0.004)	(0.004)	(0.004)	(0.004)
	[-0.39%]	[-0.37%]	[-0.38%]	[-0.37%]	[-0.39%]
Controlling for basic covariates:[a]					
Sex	yes	yes	yes	yes	yes
Age	yes	yes	yes	yes	yes
Occupation	yes	yes	yes	yes	yes
Firm size	yes	yes	yes	yes	yes
Firm's wage bill	yes	yes	yes	yes	yes
Small firm	yes	yes	yes	yes	yes
Tenure	yes	yes	yes	yes	yes
Month of entry	yes	yes	yes	yes	yes
Firm fixed effects	yes	yes	yes	yes	yes
Year fixed effects	yes	yes	yes	yes	yes
Controlling for health indicators $(s-1)$*:*[b]					
Total outpatient	no	yes	no	no	no
Medical attendance	no	no	yes	no	no
Medical drugs	no	no	no	yes	no
Hospital days	no	no	no	no	yes
Number of observations	4,819,556	4,485,535	4,485,535	4,485,535	4,485,535
Mean of dep. var.	10.42	10.40	10.40	10.40	10.40

Notes: This table summarizes the estimation results of the effect of workers' and firms' cost shares on absence behavior. Each column represents a separate ordinary least squares estimation, in which the dependent variable is equal to the annual sick-leave days in period s. The explanatory variables of primary interest are the expected values of workers' and firms' cost shares based on annual sick leave of 16 weeks in period s. Robust standard errors, allowing for clustering at firm level and heteroskedasticity of unknown form, are in parentheses below. *, **, and *** indicate statistical significance at the 10-percent, 5-percent, and 1-percent levels, respectively. [a] The set of basic covariates includes information on sex, age (binary indicators for each year), occupation (blue-collar versus white-collar worker), tenure (binary indicators), firm size (20 groups based on percentiles), firm's wage bill (20 groups based on percentiles), small firm (a binary indicator, as defined by the regulation for reimbursement of firms), month of entry (binary indicators for calendar month), fixed effects at the firm level, and each calendar year (binary indicators). [b] Specifications II through V control in addition for health indicators measured in period $s-1$: total outpatient expenditure in II, expenditure on medical attendance in III, expenditure on medical drugs in IV, days spent in hospital in V.

Table 4: The effect of cost shares on health (reduced form)

	Total outpatient expenditure	Medical attendance	Medical drugs	Hospital days
PANEL A:				
Worker's cost share in $s-1$	2.262***	1.417***	0.845	0.013***
	(0.585)	(0.246)	(0.530)	(0.004)
	[0.66%]	[0.62%]	[0.73%]	[1.05%]
Firm's cost share in $s-1$	0.470***	0.239***	0.231**	0.003***
	(0.114)	(0.052)	(0.105)	(0.001)
	[0.14%]	[0.11%]	[0.20%]	[0.24%]
Number of observations	4,819,556	4,819,556	4,819,556	4,819,556
Mean of dep. var.	342.20	226.81	115.39	1.24
PANEL B:				
Worker's cost share in $s-2$	1.841***	1.249***	0.592	0.013***
	(0.656)	(0.284)	(0.574)	(0.004)
	[0.51%]	[0.52%]	[0.47%]	[0.99%]
Firm's cost share in $s-2$	0.440***	0.232***	0.208*	0.003***
	(0.127)	(0.054)	(0.114)	(0.001)
	[0.12%]	[0.10%]	[0.17%]	[0.23%]
Number of observations	4,369,416	4,369,416	4,369,416	4,369,416
Mean of dep. var.	363.36	238.53	124.83	1.31

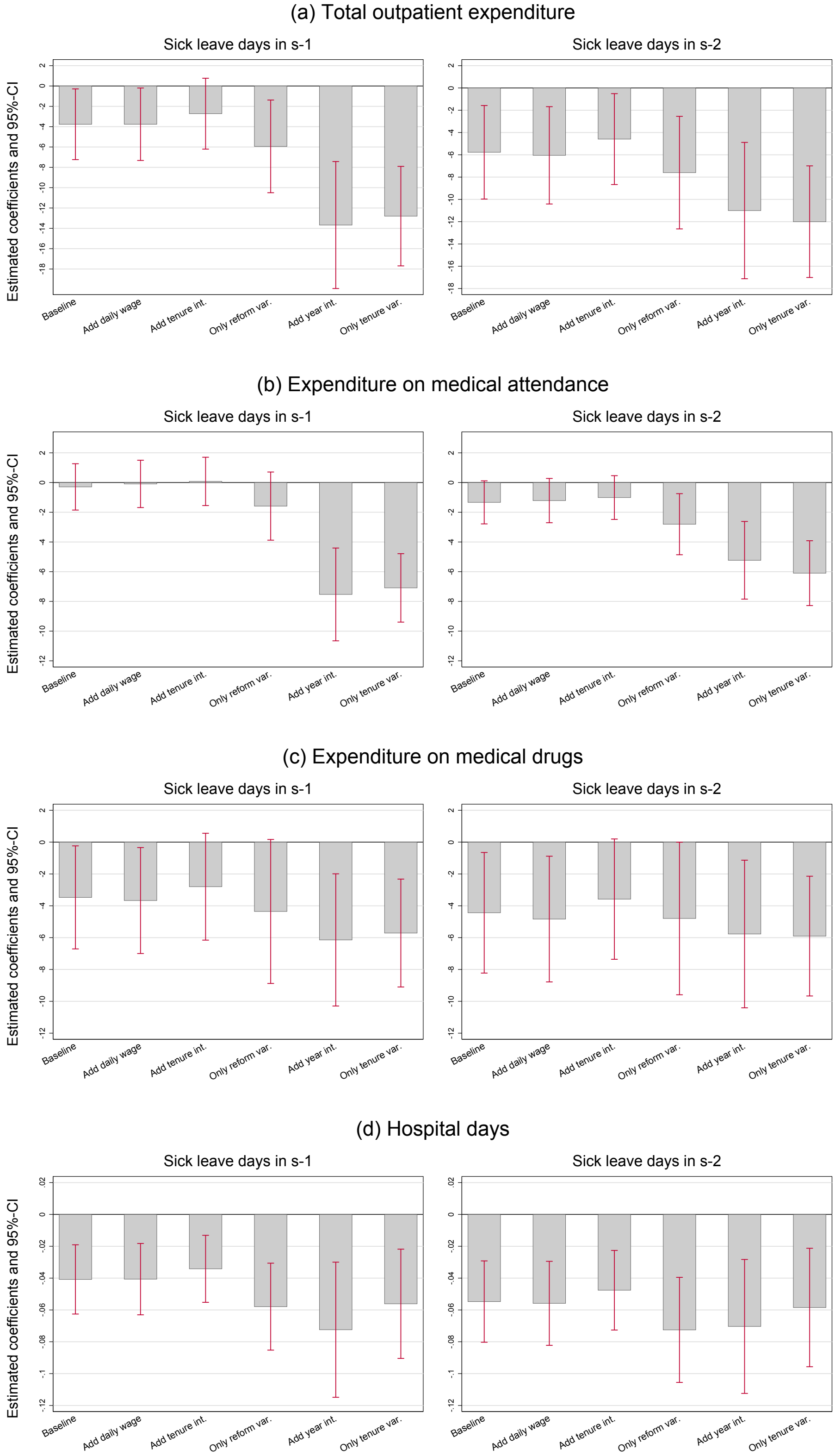
Notes: This table summarizes the estimation results of the effect of lagged cost shares on different health indicators. Each column represents a separate ordinary least squares estimation, in which the dependent variable is equal to a health measure as indicated in the header. The explanatory variables of primary interest are the expected values of workers' and firms' cost shares based on yearly sick leave of 16 weeks in period $s-1$ ($s-2$). The set of basic covariates measured in periods $s-1$ and $s-2$, respectively, are listed in the notes to Table 3. Robust standard errors, allowing for clustering at firm level and heteroskedasticity of unknown form, are in parentheses below. *, **, and *** indicate statistical significance at the 10-percent, 5-percent, and 1-percent levels, respectively.

Table 5: The effect of policy-induced changes in sick leave on health (second stage)

	Total outpatient expenditure	Medical attendance	Medical drugs	Hospital days
PANEL A:				
Sick-leave days in $s-1$	-3.765**	-0.292	-3.473**	-0.041***
	(1.774)	(0.796)	(1.651)	(0.011)
	[-1.10%]	[-0.13%]	[-3.01%]	[-3.30%]
Number of observations	4,807,649	4,807,649	4,807,649	4,807649
Mean of dep. var.	342.20	226.81	115.39	1.24
Kleibergen–Paap Wald rk F	72.62	72.62	72.62	72.62
PANEL B:				
Sick-leave days in $s-2$	-5.772***	-1.334*	-4.438**	-0.055***
	(2.141)	(0.739)	(1.932)	(0.013)
	[-1.59%]	[-0.56%]	[-3.56%]	[-4.19%]
Number of observations	4,357,998	4,357,998	4,357,998	4,357,998
Mean of dep. var.	363.36	238.53	124.83	1.31
Kleibergen–Paap Wald rk F	66.50	66.50	66.50	66.50

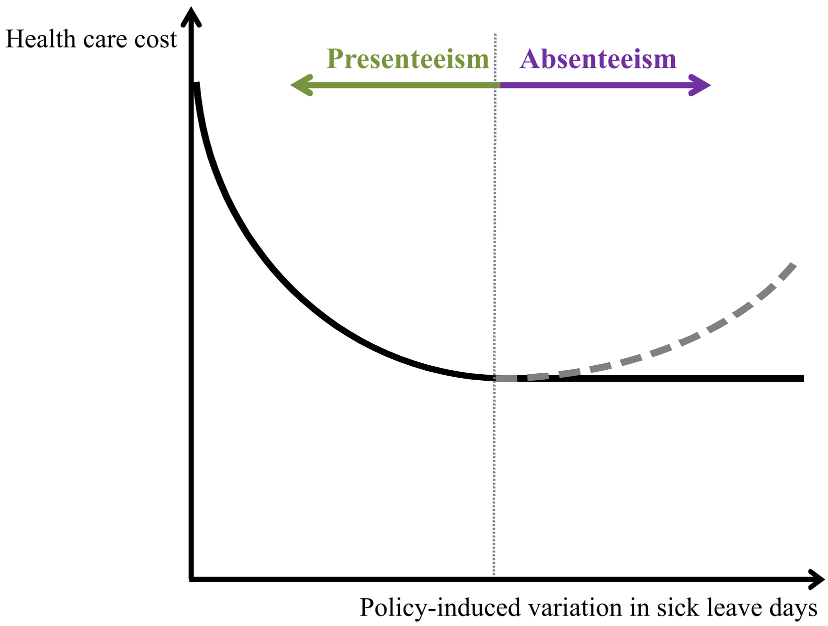
Notes: This table summarizes the estimation results of the effect of policy-induced sick leave changes on health outcomes. Each column represents the second-stage results from a separate 2SLS estimation, in which the dependent variable is equal to a health measure as indicated in the header. The endogenous variable 'annual sick leave days in period $s-1$ ($s-2$)' is instrumented with two variables: expected values of workers' and firms' cost shares based on annual sick leave of 16 weeks in period $s-1$ ($s-2$). These expected cost shares are specific to period, occupation, firm size and tenure. The set of basic covariates measured in periods $s-1$ and $s-2$, respectively, are listed in the notes to Table 3. Robust standard errors, allowing for clustering at firm level and heteroskedasticity of unknown form, are in parentheses below. *, **, and *** indicate statistical significance at the 10-percent, 5-percent, and 1-percent levels, respectively.

Figure 4: Sensitivity analysis for second-stage results



Notes: These figures summarizes a sensitivity analysis of the estimation results presented in Table 5. The grey bars represent the effect of policy-induced sick leave changes on various health outcomes as indicated in the header. The first estimate replicates our baseline estimates (using the same set of basic covariates as in Table 5). In the second estimation, we control in addition for the daily wage rate. In the third estimation, we augment our baseline estimation with two-way interactions of tenure levels (binary indicators) with occupation and firm size. In the fourth estimation, we additionally include an interaction between firm size and occupation, and a three-way interaction between tenure, firm size and occupation. In the fifth estimation, we augment the baseline specification with two-way interactions between year and occupation, and year and firm size. In the sixth estimation, we additionally control for a two-way interaction between firm size and occupation, and a three-way interaction between year, firm size and occupation.

Figure 5: A stylized functional relationship between sick leave and healthcare cost



Notes: If absenteeism has no effect on subsequent healthcare cost, then the relation between healthcare cost and policy-induced variation in sick leave days is described by the solid line. If absenteeism has a positive effect on subsequent healthcare cost, then this relationship is described by the scattered line.

Table 6: Further evidence from workplace accidents

Dependent variable	*Annual sick leave days*	*Binary indicator: workplace accident*	
	First stage	Reduced form	Second stage
PANEL A:			
Worker's cost share in $s-1$	-0.054**	0.0007***	
	(0.023)	(0.0002)	
	[-0.54%]	[2.00%]	
Firm's cost share in $s-1$	-0.020***	0.0001**	
	(0.005)	(0.0000)	
	[-0.20%]	[0.29%]	
Sick leave days in $s-1$			0.002
			(0.002)
			[-]
Number of observations	1,706,917	1,706,917	1,701,511
Mean of dep. var.	10.00	0.035	0.035
Kleibergen–Paap Wald rk F			20.96
PANEL B:			
Worker's cost share in $s-2$	-0.096***	0.0010**	
	(0.033)	(0.0004)	
	[-0.97%]	[2.94%]	
Firm's cost share in $s-2$	-0.025***	0.0002***	
	(0.007)	(0.0001)	
	[-0.25%]	[0.59%]	
Sick leave days in $s-2$			-0.006**
			(0.002)
			[-17.6%]
Number of observations	1,314,519	1,314,519	1,308,232
Mean of dep. var.	9.87	0.034	0.034
Kleibergen–Paap Wald rk F			11.17

Notes: This table summarizes the estimation results of the effect of lagged cost shares on annual sick leave days (first column), the effect of lagged cost shares on the likelihood of a workplace accident (second column), and the estimation results of the effect of policy-induced sick leave on the likelihood of a workplace accident (third column). In the first and second columns, the explanatory variables of primary interest are the expected values of workers' and firms' cost shares based on yearly sick leave of 16 weeks in period $s-1$ ($s-2$). In the third column, the endogenous variable 'annual sick leave days in period $s-1$ ($s-2$)' is instrumented with two variables: expected values of workers' and firms' cost shares based on annual sick leave of 16 weeks in period $s-1$ ($s-2$). These expected cost shares are specific to period, occupation, and tenure. The set of basic covariates measured in periods $s-1$ and $s-2$, respectively, are listed in the notes to Table 3. Robust standard errors, allowing for clustering at firm level and heteroskedasticity of unknown form, are in parentheses below. *, **, and *** indicate statistical significance at the 10-percent, 5-percent, and 1-percent levels, respectively.

Table 7: The effect of cost shares on absence behavior among different groups[a]

	Sex		Age		Business Cycle	
	Male	Female	Young	Old	Boom	Recession
Worker's cost share in s	-0.078***	-0.106***	0.017	-0.314***	-0.072***	-0.169***
	(0.025)	(0.019)	(0.019)	(0.090)	(0.027)	(0.029)
	[-0.71%]	[-1.09%]	[0.18%]	[-1.96%]	[-0.67%]	[-1.63%]
Firm's cost share in s	-0.038***	-0.045***	-0.019***	-0.094***	-0.043***	-0.047***
	(0.006)	(0.007)	(0.004)	(0.017)	(0.007)	(0.006)
	[-0.35%]	[-0.46%]	[-0.20%]	[-0.59%]	[-0.40%]	[-0.45%]
Number of observations	2,785,935	2,033,621	4,133,314	686,242	3,267,303	1,332,357
Mean of dep. var.	10.96	9.69	9.49	16.04	10.79	10.37

Notes: This table summarizes the estimation results of cost shares on absence behavior for different subsamples. Each column represents a separate ordinary least squares estimation for a specific subsample, in which the dependent variable is equal to the annual sick-leave period s. For further information, see the notes to Table 3. Robust standard errors, allowing for clustering at firm level and heteroskedasticity of unknown form, are in parentheses below. *, **, and *** indicate statistical significance at the 10-percent, 5-percent, and 1-percent levels, respectively.

Table 8: The effect of policy-induced changes in sick leave on health among different groups

	Sex		Age		Business Cycle	
	Male	Female	Young	Old	Boom	Recession
Panel A (Effect on total outpatient expenditure):						
Sick-leave days in $s-1$	-3.922	-6.919*	1.035	-10.134***	-3.435*	-7.065**
	(2.406)	(3.690)	(1.950)	(3.639)	(2.073)	(2.841)
	[-1.34%]	[-1.69%]	[0.33%]	[-1.93%]	[-0.95%]	[2.21%]
Number of observations	2,778,095	2,024,234	4,121,435	681,349	3,260,863	1,328,571
Mean of dep. var.	293.39	409.06	311.95	524.38	361.15	319.28
Kleibergen–Paap Wald rk F	56.54	24.14	79.58	29.25	46.11	34.58
Sick-leave days in $s-2$	-6.038**	-6.098	0.083	-14.858***	-5.918**	-6.779**
	(2.793)	(4.397)	(2.416)	(4.549)	(2.780)	(2.679)
	[-1.92%]	[-1.42%]	[0.03%]	[-2.64%]	[-1.55%]	[-1.99%]
Number of observations	2,514,983	1,838,026	3,746,891	606,625	2,881,192	1,288,986
Mean of dep. var.	314.49	430.08	330.95	562.62	382.41	340.93
Kleibergen–Paap Wald rk F	47.89	25.61	72.66	25.31	39.154	34.81
Panel B (Effect on hospital days):						
Sick-leave days in $s-1$	-0.017	-0.036**	-0.023*	-0.028	-0.044***	-0.040*
	(0.014)	(0.018)	(0.014)	(0.020)	(0.012)	(0.022)
	[-1.46%]	[-2.67%]	[-2.09%]	[-1.35%]	[-3.41%]	[-3.29%]
Number of observations	2,778,095	2,024,234	4,121,435	681.349	3,260,863	1,328,571
Mean of dep. var.	1.16	1.35	1.10	2.07	1.29	1.21
Kleibergen–Paap Wald rk F	56.54	24.14	79.58	29.25	46.11	34.58
Sick-leave days in $s-2$	-0.034*	-0.033	-0.044***	-0.023	-0.061***	-0.054**
	(0.017)	(0.020)	(0.015)	(0.024)	(0.015)	(0.025)
	[-2.73%]	[-2.35%]	[-3.77%]	[-1.04%]	[-4.48%]	[-4.21%]
Number of observations	2,514,983	1,838,026	3,746,891	606,625	2,881,192	1,288,986
Mean of dep. var.	1.25	1.40	1.17	2.21	1.36	1.28
Kleibergen–Paap Wald rk F	47.89	25.61	72.66	25.31	39.15	34.81

Notes: This table summarizes the estimation results of the effect of policy-induced sick leave changes on health outcomes. Each column represents the second-stage results from a separate 2SLS estimation for a specific subsample, in which the dependent variable is equal to total outpatient expenditure in Panel A and days spent in hospital in Panel B. For further information, see the notes to Table 5. Robust standard errors, allowing for clustering at firm level and heteroskedasticity of unknown form, are in parentheses below. *, **, and *** indicate statistical significance at the 10-percent, 5-percent, and 1-percent levels, respectively.

Supplementary Appendix

A Proof of Proposition 1

We denote the LHS of (5) by V_1 and the LHS of (3) by V_2. Implicit differentiation of (5) and (3) gives

$$\begin{pmatrix} \frac{\partial \hat{t}_1^a}{\partial \eta_1^F} & \frac{\partial \hat{t}_1^a}{\partial \eta_1^W} \\ \frac{\partial \hat{t}_2^a}{\partial \eta_1^F} & \frac{\partial \hat{t}_2^a}{\partial \eta_1^W} \end{pmatrix} = -\begin{pmatrix} \frac{\partial V_1}{\partial t_1^a} & \frac{\partial V_1}{\partial t_2^a} \\ \frac{\partial V_2}{\partial t_1^a} & \frac{\partial V_2}{\partial t_2^a} \end{pmatrix}^{-1} \begin{pmatrix} \frac{\partial V_1}{\partial \eta_1^F} & \frac{\partial V_1}{\partial \eta_1^W} \\ \frac{\partial V_2}{\partial \eta_1^F} & \frac{\partial V_2}{\partial \eta_1^W} \end{pmatrix}. \tag{11}$$

By inverting the first matrix on the right-hand side (RHS) of (11) and multiplying, we obtain

$$\frac{\partial \hat{t}_1^a}{\partial \eta_1^j} = -\frac{\frac{\partial V_2}{\partial t_2^a}\frac{\partial V_1}{\partial \eta_1^j} - \frac{\partial V_1}{\partial t_2^a}\frac{\partial V_2}{\partial \eta_1^j}}{\frac{\partial V_1}{\partial t_1^a}\frac{\partial V_2}{\partial t_2^a} - \frac{\partial V_1}{\partial t_2^a}\frac{\partial V_2}{\partial t_1^a}}, \quad j = F, W, \tag{12}$$

Note that $\frac{\partial V_1}{\partial t_2^a} = 0$, and hence, (12) reduces to

$$\frac{\partial \hat{t}_1^a}{\partial \eta_1^j} = -\frac{\frac{\partial V_1}{\partial \eta_1^j}}{\frac{\partial V_1}{\partial t_1^a}}, \quad j = F, W. \tag{13}$$

We find that

$$\begin{aligned} \frac{\partial V_1}{\partial t_1^a} = {} & (w_1\eta_1^W)^2 \frac{\partial^2 U}{\partial C_1^2} + \frac{\partial^2 U}{\partial L_1^2} + \frac{\partial^2 \rho}{(\partial t_1^a)^2}(U_2^e - U_2^n) + 2\frac{\partial \rho}{\partial t_1^a}\left(\frac{\partial U_2^e}{\partial H_2} - \frac{\partial U_2^n}{\partial H_2}\right)\frac{\partial H_2}{\partial t_1^a} \\ & + \left(\rho\frac{\partial^2 U_2^e}{\partial H_2^2} + (1-\rho)\frac{\partial^2 U_2^n}{\partial H_2^2}\right)\left(\frac{\partial H_2}{\partial t_1^a}\right)^2 + \left(\rho\frac{\partial U_2^e}{\partial H_2} + (1-\rho)\frac{\partial U_2^n}{\partial H_2}\right)\frac{\partial^2 H_2}{(\partial t_1^a)^2} \\ & + \rho\frac{\partial^2 U_2^e}{\partial H_2 \partial t_1^a}\frac{\partial H_2}{\partial t_1^a}. \end{aligned} \tag{14}$$

By application of the envelope theorem,

$$\frac{\partial U_2^e}{\partial H_2} = \frac{\partial U(C_2, L_2, H_2)}{\partial H_2}, \tag{15}$$

and hence, $\frac{\partial^2 U_2^e}{\partial H_2 \partial t_1^a}$ in the last line of (14) is given by

$$\frac{\partial^2 U_2^e}{\partial H_2 \partial t_1^a} = \left(-w_2\eta_2^W \frac{\partial^2 U(C_2, L_2, H_2)}{\partial H_2 \partial C_2} + \frac{\partial^2 U(C_2, L_2, H_2)}{\partial H_2 \partial L_2}\right)\frac{\partial \hat{t}_2^a(w_2, t_2^w, \eta_2^W, H_2)}{\partial H_2}\frac{\partial H_2}{\partial t_1^a} \tag{16}$$

with $\hat{t}_2^a(w_2, t_2^w, \eta_2^W, H_2)$ being the optimal absence time in period 2 for given H_2. Hence, for an interior solution $0 < \hat{t}_2^a < t_2^w$, $\frac{\partial \hat{t}_2^a(w_2, t_2^w, \eta_2^W, H_2)}{\partial H_2}$ is derived by implicit differentiation of

(3) as

$$\frac{\partial \hat{t}_2^a}{\partial H_2} = -\frac{\frac{\partial V_2}{\partial H_2}}{\frac{\partial V_2}{\partial t_2^a}} = -\frac{-w_2\eta_2^W \frac{\partial^2 U}{\partial C_2 \partial H_2} + \frac{\partial^2 U}{\partial L_2 \partial H_2}}{(w_2\eta_2^W)^2 \frac{\partial^2 U}{\partial C_2^2} + \frac{\partial^2 U}{\partial L_2^2}}, \tag{17}$$

which is negative due to assumptions on the signs of the second derivatives of (1). In case of a boundary solution $\hat{t}_2^a = 0$ or $\hat{t}_2^a = t_2^w$, we have $\frac{\partial \hat{t}_2^a}{\partial H_2} = 0$.

Due to the assumptions on per-period utility (1), $H_2(H_1, t_1^a)$ and $\rho(t_1^a, \eta_1^F)$, together with $U_2^e > U_2^n$ (see Section 2), we find as follows. If $H_1 \geq H^*$ or if $H_1 < H^*$ and $\hat{t}_1^a \geq \bar{t}_1^a$, the sign of (14) is negative (the first three terms are negative; all other terms are zero). If $H_1 < H^*$ and $\hat{t}_1^a < \bar{t}_1^a$, all terms on the RHS of (14) have negative signs, except the last term, which is non-negative (use (16), together with $\frac{\partial \hat{t}_2^a}{\partial H_2} \leq 0$, see above). Observe that the fourth term on the RHS of (14) is negative because $\frac{\partial U_2^e}{\partial H_2} > \frac{\partial U_2^n}{\partial H_2}$, which can be shown as follows. Due to the properties $\frac{\partial^2 U}{\partial C_s \partial H_s} > 0$ and $\frac{\partial^2 U}{\partial L_s \partial H_s} \leq 0$ of (1), the marginal utility of health H_2 at any bundle (C_2, L_2, H_2) increases if C_2 is increased by a small amount and L_2 is non-increased by a small amount, that is, $d\frac{\partial U}{\partial H_2} = \frac{\partial^2 U}{\partial H_2 \partial C_2} dC_2 + \frac{\partial^2 U}{\partial H_2 \partial L_2} dL_2 > 0$, if $dC_2 > 0$ and $dL_2 \leq 0$. From this consideration and by use of the mean-value theorem, it follows that $\frac{\partial U(C_2^g, L_2^g, H_2)}{\partial H_2} > \frac{\partial U(C_2^h, L_2^h, H_2)}{\partial H_2}$ for any given H_2, if $C_2^g > C_2^h$ and $L_2^g \leq L_2^h$. Finally, remember that $U_2^n = U(b, 1, H_2)$ and $U_2^e = U(\widehat{C}_2, \widehat{L}_2, H_2)$ with $\widehat{C}_2$, $\widehat{L}_2$ being the optimal consumption–leisure decision for any given H_2, where $\widehat{C}_2 > b$ and $\widehat{L} \leq 1$; consequently $\frac{\partial U_2^e}{\partial H_2} > \frac{\partial U_2^n}{\partial H_2}$. Altogether, by excluding some peculiar exceptions in which the last term, when being positive, could dominate all other negative terms in (14), we obtain $\frac{\partial V_1}{\partial t_1^a} < 0$.

Moreover, we obtain

$$\frac{\partial V_1}{\partial \eta_1^W} = -w_1 \frac{\partial U}{\partial C_1} + w_1^2 t_1^a \eta_1^W \frac{\partial^2 U}{\partial C_1^2} < 0 \tag{18}$$

$$\frac{\partial V_1}{\partial \eta_1^F} = \frac{\partial^2 \rho}{\partial t_1^a \partial \eta_1^F}(U_2^e - U_2^n) + \frac{\partial \rho}{\partial \eta_1^F}\left(\frac{\partial U_2^e}{\partial H_2} - \frac{\partial U_2^n}{\partial H_2}\right)\frac{\partial H_2}{\partial t_1^a} < 0. \tag{19}$$

By use of (18) and (19) together with $\frac{\partial V_1}{\partial t_1^a} < 0$ in (13), we find that $\frac{\partial \hat{t}_1^a}{\partial \eta_1^j} < 0$, $j = F, W$. Q.E.D.

B Sick-leave reforms

Table B.1 provides a complete overview of all reforms since 1974.

B.1 Reforms affecting workers' cost share

Since 1921, a tenure-based sick-pay scheme has been in place for white-collar workers. The generosity of this scheme increases with worker's tenure with firms and provides at least 6 weeks of fully compensated, and fully firm-financed sick leave.[a] White-collar workers with a tenure of at least 5 years are paid their regular gross wages for the first 8 weeks. After 15 years of tenure, eligibility increases to 10 weeks, and after 25 years of tenure, eligibility increases to 12 weeks. When eligibility for full compensation has expired, white-collar workers are entitled to another 4 weeks of partly compensated, and partly firm-financed sick leave. Workers' total compensation amounts to 80 percent of gross wages during this period.[b] After this period, workers receive only public sickness benefits, which amount to 60 percent of their gross wages.[c] The maximum duration of entitlement is 1 year.

In contrast, blue-collar workers traditionally have had to bear on their own almost all the cost of being sick. They were eligible for only 1 week of fully compensated sick leave until a reform in 1974 partly removed the difference in the cost-sharing rule for blue-collar and white-collar workers. This reform introduced a tenure-based sick-pay scheme for blue-collar workers that was comparable, but not equal, to the white-collar workers' scheme. Depending on their tenure, blue-collar workers received a firm-financed compensation payment amounting to 100 percent of their gross wages for the first 4, 6, 8, or 10 weeks of sickness. After this period, the sick-leave insurance system kicked in, and blue-collar workers received sickness benefits accounting for 60 percent of their gross wages. Compared to white-collar workers, blue-collar workers remained disadvantaged because they were eligible for fully compensated sick leave for a shorter period (2 weeks less) in each tenure group and they were not eligible for any firm-financed sick leave thereafter.[d] In 2001, a reform almost entirely aligned blue-collar workers' sick-pay scheme with that of white-collar workers. This reform clearly shifted the cost of being sick from blue-collar workers to firms.

[a] In case of an occupational accident, workers are eligible for at least 8 weeks of fully compensated sick leave.

[b] Firms have to pay 50 percent of gross wages to white-collar workers, and workers additionally receive sickness benefits from the public social insurance, which amount to 30 percent of their gross wages.

[c] The specific regulations for public sickness benefits are as follows: As long as workers are compensated fully by firms, public sickness benefits are suspended. As soon as workers are compensated only half of their gross wages by firms, they receive an additional half of the public sickness benefits. Public sickness benefits amount to 50 percent of the gross wage for days 4–42 of sick leave and 60 percent after day 42.

[d] There is another difference between white-collar and blue-collar workers, that is, white-collar workers' eligibility is renewed every half-year, whereas blue-collar workers' eligibility is renewed each year. This difference has remained until today.

B.2 Reforms affecting firms' cost share

Firms are obliged to pay workers on sick leave part of their salary for a pre-defined period. The length of this period varies across workers, depending on their occupation and tenure, and over time. Under specified circumstances, firms are partly reimbursed for their expenses by a public fund.[e] Figure B.1 shows that this reimbursement varies across firms, across workers, and over time. Between 1974 and 1978, firms received a 100 percent reimbursement of salaries paid to sick blue-collar workers. There was no reimbursement in the case of white-collar workers. In 1979, this reimbursement was restricted to smaller firms, who were defined as firms with a total wage bill below a certain threshold. In 1982, the reimbursement was extended again to larger firms (i. e., firms above the wage-bill threshold) but these firms received only 80 percent of the salaries paid to sick blue-collar workers. In September 2000, a major reform took place, which abolished reimbursement for sick blue-collar workers completely. This shifted the sickness cost from the social security system to blue-collar workers' firms. However, part of the reform was undone in 2005. The new regulation, which is currently in place, applies to both blue- and white-collar workers. Small firms with less than a yearly average of 51 workers receive a partial reimbursement.[f] Larger firms are not eligible for any reimbursement.

[e] This fund is financed predominantly by the *Austrian Workers' Compensation Board* and by compulsory payments of firms.

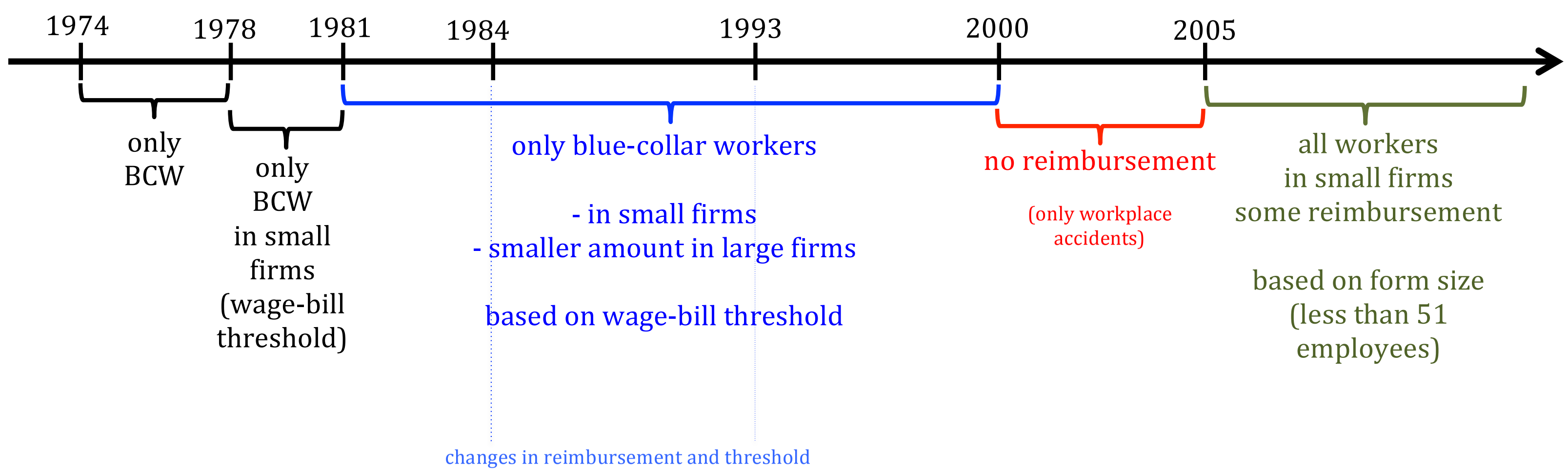
[f] Eligible firms receive 58.34 percent of their expenses for a maximum of 42 sick-leave days per worker per year. However, the reimbursement is paid only for sick-leave spells that last at least 11 days. For workplace accidents, somewhat different rules apply. Moreover, sick-leave compensation due to workplace accidents has been reimbursed to small firms since October 2002. See Table B.1 for details.

Table B.1: Important changes in sick pay for workers and firms since 1974

Date	Federal law	Type	Description
September 1974	BGBl. 399/1974 EFZG	Worker	Introduction of a tenure-based sick-pay scheme for blue-collar workers.†
		Firm	Introduction of an insurance fund that reimburses firms for sick blue-collar workers. 100% of the sick leave compensation is reimbursed.
January 1979	BGBl. 664/1978 EFZG	Firm	Reimbursement of sick-leave compensation paid to blue-collar workers is restricted to firms with a total wage bill below a certain threshold (ATS 108,000).
January 1982	BGBl. 596/1981 EFZG	Firm	Reimbursement of sick-leave compensation paid to blue-collar workers is extended to firms with a total wage bill above a certain threshold (ATS 129,600). However, these firms are reimbursed only 80% of the sick-leave compensation paid to blue-collar workers.
January 1984	BGBl. 590/1983 ASVG	Firm	The wage bill threshold is changed to 180 times the maximal daily social security contribution basis. (In this year, the maximal social security contribution basis amounted to 180× €58.14 = €10,464.9)
January 1993	BGBl. 833/1992 ASVG	Firm	Firms with a total wage bill above the threshold are reimbursed only 70% (instead of 80%) of the sick-leave compensation paid to blue-collar workers.
September 2000	BGBl. I 44/2000 EFGZ	Firm	Abolition and liquidation of the insurance fund. Firms are no longer reimbursed for sick blue-collar workers.
January 2001	BGBl. I 44/2000 EFGZ	Worker	Blue-collar workers are subject to the same (more generous) tenured-based insurance scheme as white-collar workers. Differences in the renewal of claims remain.
October 2002	BGBl. II 443/2002 (VO)	Firm	Reintroduction of a 50% reimbursement for firms with less than 51 workers (yearly average). The reimbursement is paid for sick blue- and white-collar workers but only in the case of sick leave due to workplace accidents.
January 2005	BGBl. II 64/2005 (VO)	Firm	Reimbursement for firms is increased to 58.34% and extended to all kinds of sick leave. The maximal duration of reimbursement is 42 days per worker per year. The reimbursement is paid only for sick-leave spells that last at least 11 days. In the case of workplace accidents, reimbursement starts at day 1 but only for sick-leave spells that last at least 3 days.

Notes: †Austria has a long tradition of sick-leave insurance. As far back as 1917, 1 week of paid sick leave was introduced in the General Civil Code (RGBl. 69/1916). For white-collar workers, a more generous tenure-based sick-pay scheme started in 1921 (BGBl. 292/1921 AngG). Until 1974, blue-collar workers were eligible for only 1 week of paid sick leave.

Figure B.1: Policy-induced variation in firms' cost shares



Notes: In 1993, the reimbursement for firms above the wage-bill threshold was reduced from 80 to 70 percent.

C Additional Tables and Figures

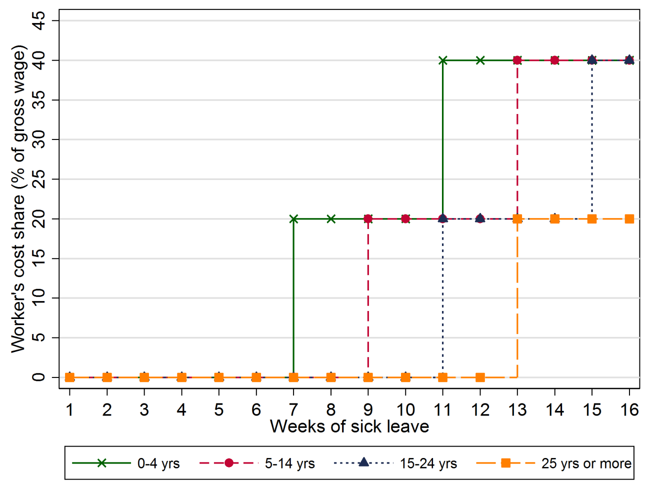
Table C.1: Second-stage results for nervous-system drugs and other drugs[a]

	Nervous-system drugs	Other drugs
PANEL A:		
Sick leave days in $s-1$	-0.889***	-2.583
	(0.248)	(1.583)
	[-6.54%]	[-]
Number of observations	4,807,649	4,807,649
Mean of dep. var.	13.59	101.80
Kleibergen–Paap Wald rk F	72.62	72.62
PANEL B:		
Sick leave days in $s-2$	-1.239***	-3.199*
	(0.296)	(1.858)
	[-8.12%]	[-2.92%]
Number of observations	4,357,998	4,357,998
Mean of dep. var.	15.28	109.56
Kleibergen–Paap Wald rk F	66.50	66.50

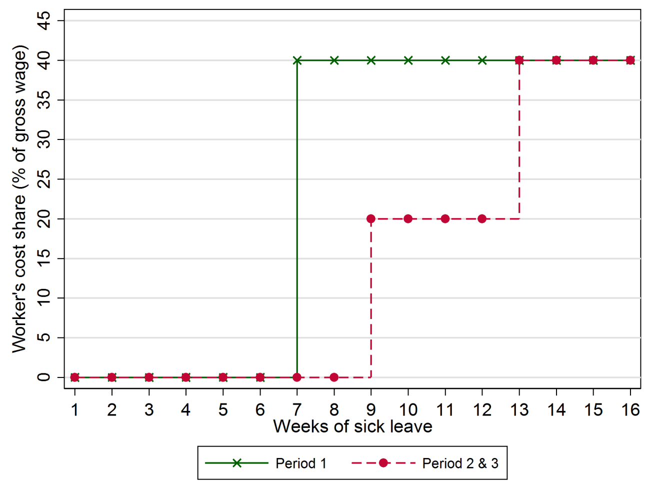
Notes: This table summarizes the estimation results of the effect of policy-induced sick leave on expenditure on nervous-system drugs (ATC code N) and expenditure on other drugs (all other ATC codes). The endogenous variable 'annual sick leave days in period $s-1$ ($s-2$)' is instrumented with two variables: expected values of workers' and firms' cost shares based on annual sick leave of 16 weeks in period $s-1$ ($s-2$). These expected cost shares are specific to period, occupation, firm size and tenure. The set of basic covariates measured in periods $s-1$ and $s-2$, respectively, include information on sex, age (binary indicators for each year), occupation (blue-collar versus white-collar worker), tenure (binary indicators), firm size (20 groups based on percentiles), firm's wage bill (20 groups based on percentiles), small firm (a binary indicator, as defined by the regulation for reimbursement of firms), month of entry (binary indicators for each calendar month), fixed effects at the firm level, and each calendar year (binary indicators). Robust standard errors, allowing for clustering at firm level and heteroskedasticity of unknown form, are in parentheses below. *, **, and *** indicate statistical significance at the 10-percent, 5-percent, and 1-percent levels, respectively.

Figure C.1: Selected workers' and firms' cost shares over sick-leave length to highlight changes due to reforms

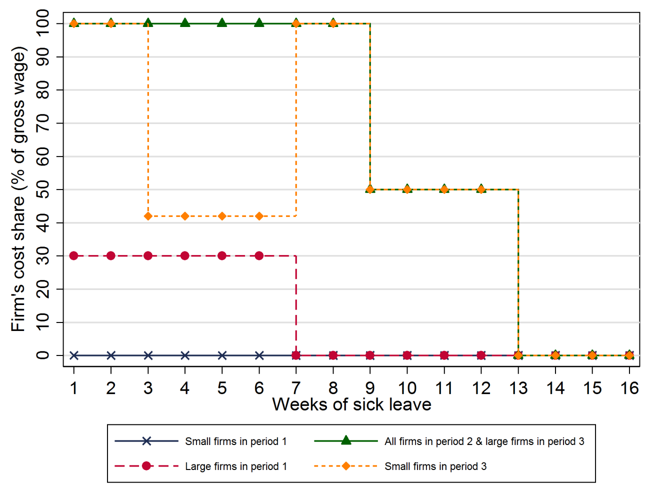
(a) Workers' cost shares for white-collar workers across tenure groups



(b) Workers' cost shares for blue-collar workers with tenure of 5–14 years before and after the reform in 2001



(c) Firms' cost shares for blue-collar workers with tenure of 5–14 years in small and large firms



(d) Firms' cost shares for white-collar workers with tenure of 5–14 years in small and large firms

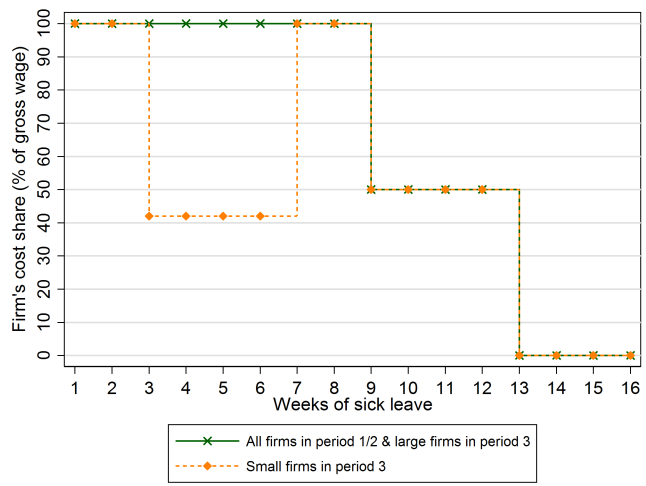
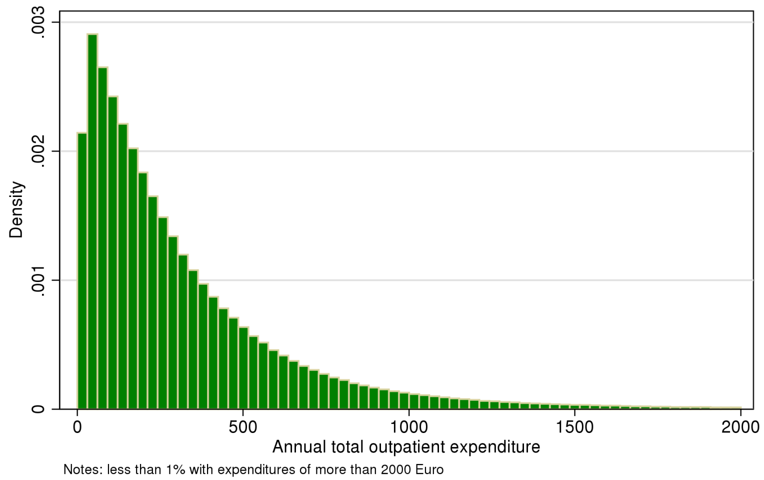
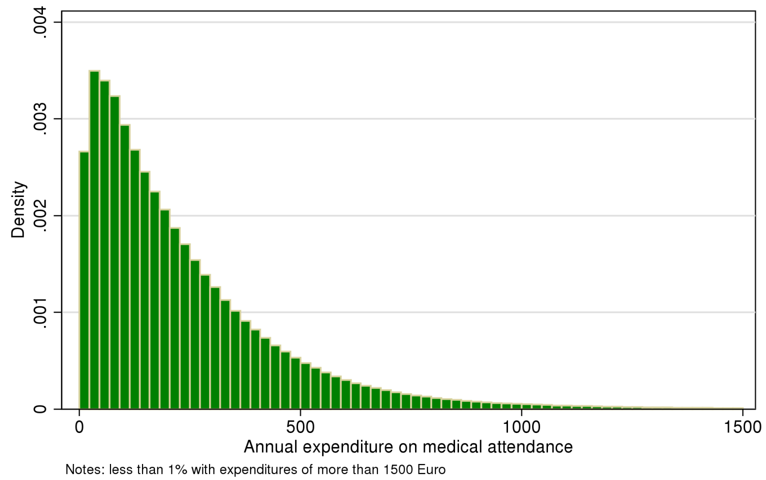


Figure C.2: Distribution of health indicators

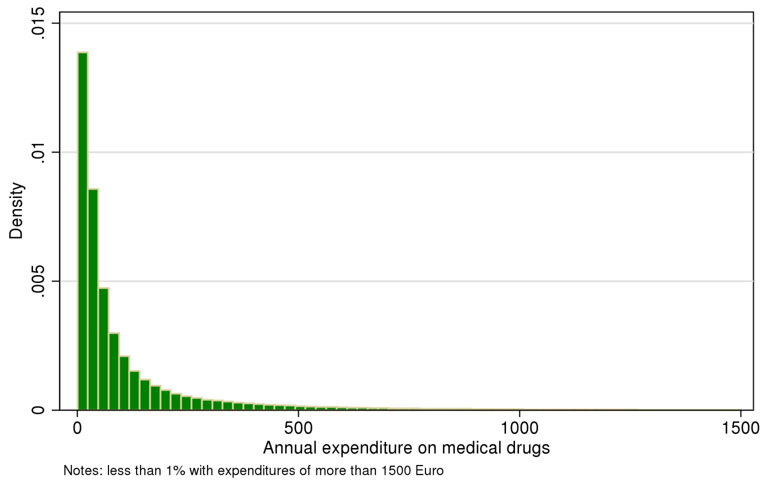
(a) Annual total outpatient expenditure



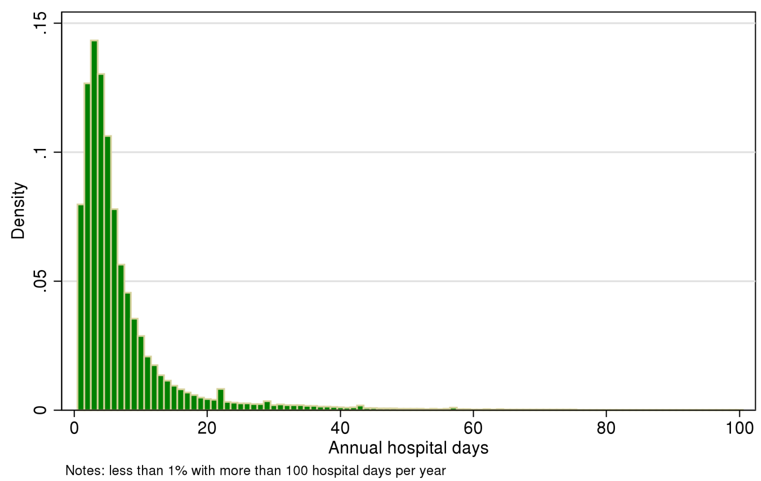
(b) Annual expenditure on medical attendance



(c) Annual expenditure on medical drugs

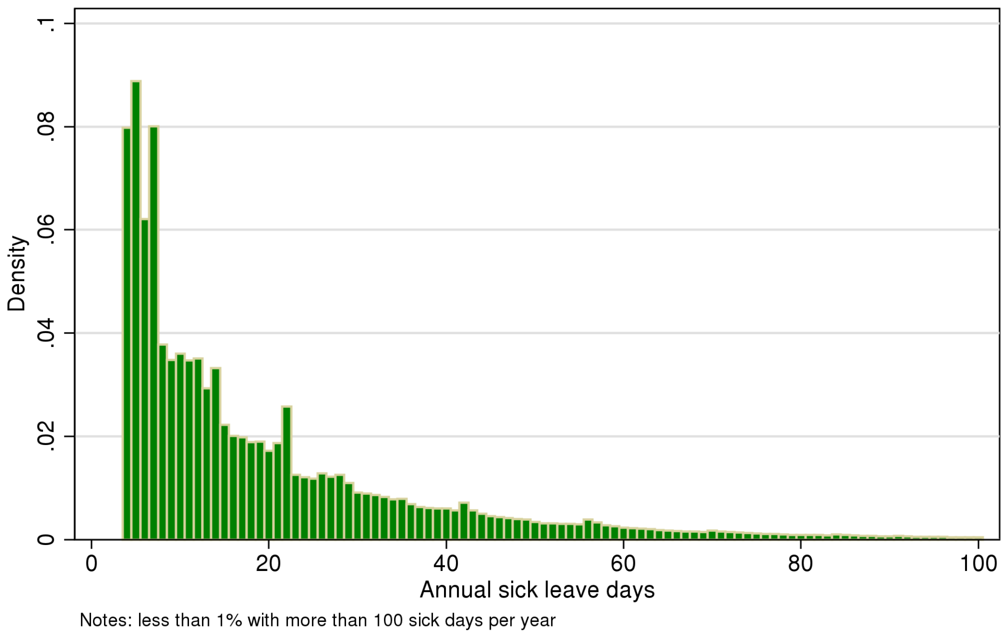


(d) Annual hospital days



Notes: Each graph excludes observations with zero expenditure (days). These amount to 11.5% in the case of total outpatient expenditure, 12.1% in the case of expenditure on medical attendance, 33.5% in the case of expenditure on medical drugs, and 85.8% in the case of hospital days.

Figure C.3: Distribution of annual sick-leave days



Notes: This graph excludes observations with zero sick-leave days (51%). Observations with sick-leave spells of 3 days or less are set to zero (see footnote 22).

Figure C.4: Sensitivity analysis for first-stage results: Alternative definition of the instrumental variables

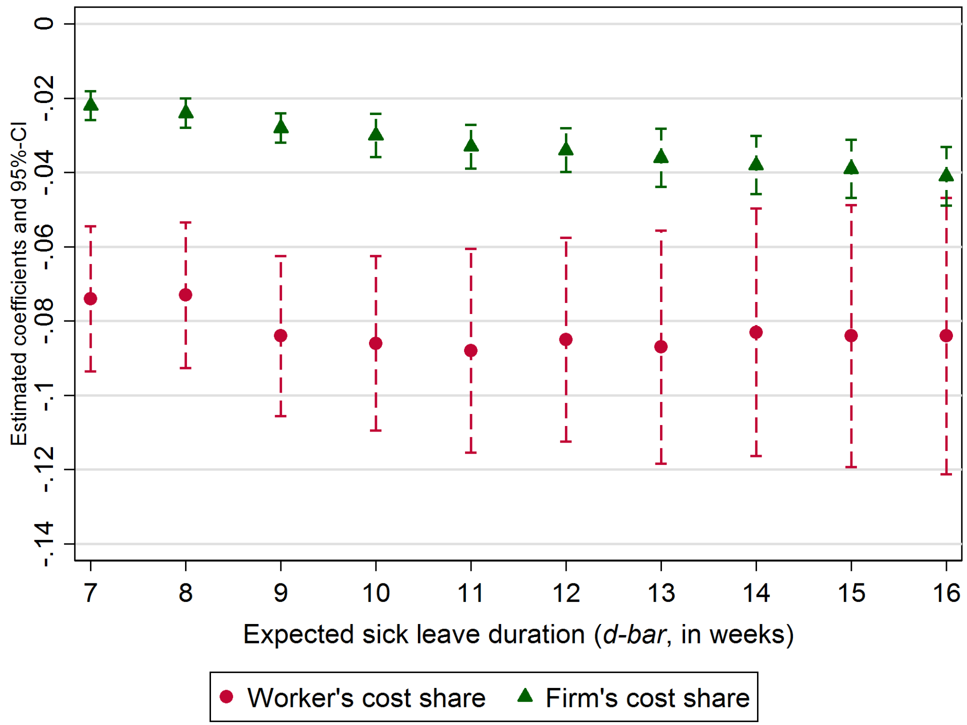
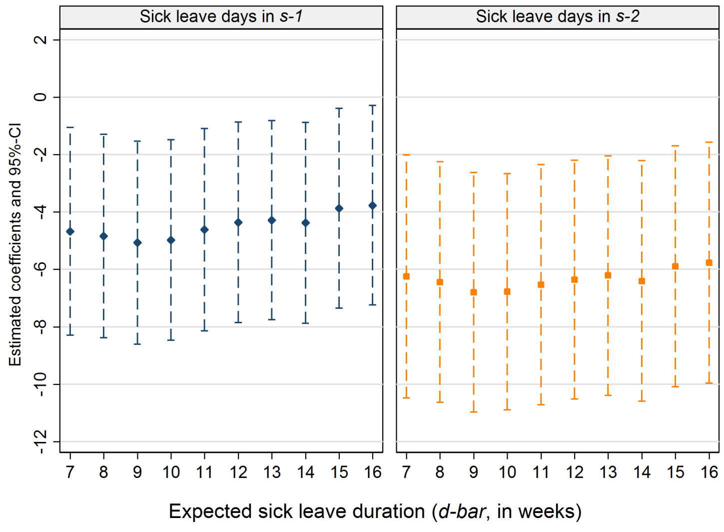
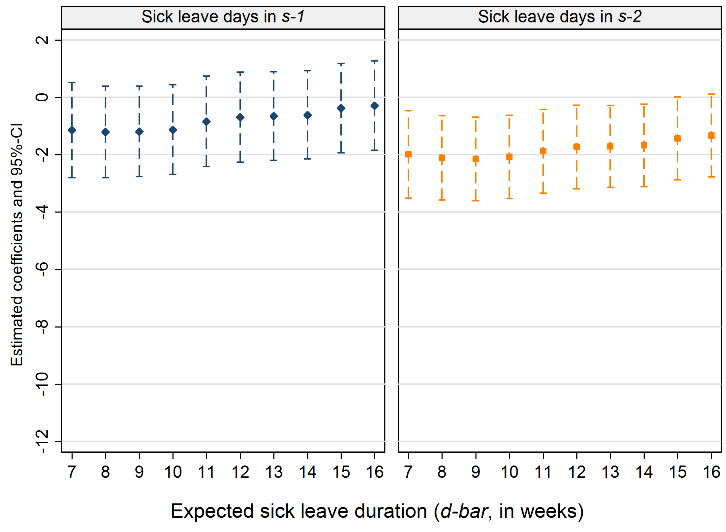


Figure C.5: Sensitivity analysis for second-stage results: Alternative definition of the instrumental variables

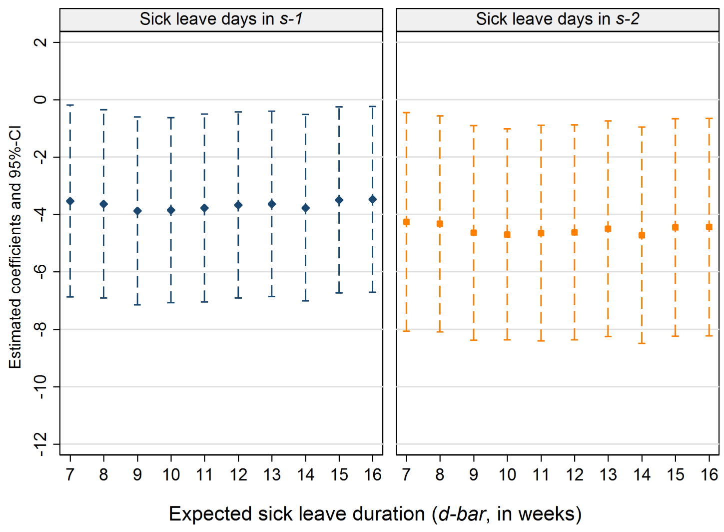
(a) Annual total outpatient expenditure



(b) Annual expenditure on medical attendance



(c) Annual expenditure on medical drugs



(d) Annual hospital days