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Abstract

We theoretically analyse the effects of sick pay and employees' health on collective bargaining, assuming that individuals determine absence optimally. If sick pay is set by the government and not paid for by firms, it induces the trade union to lower wages. This mitigates the positive impact on absence. Moreover, a union may oppose higher sick pay if it reduces labour supply sufficiently. Better employee health tends to foster wage demands. If the union determines both wages and sick pay, we identify situations in which it will substitute wages for sick pay because adverse absence effects can be mitigated.

JEL-Codes: D620, I130, I180, J220, J510, J520.

Keywords: absence, employment, sick pay, trade union, wage determination.

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1. Introduction

1.1 Motivation

Individuals who are absent from work for illness-related reasons are entitled to continued wage payments or other types of income replacements in many countries. The amount of sick pay and the regulations concerning its receipt are often determined by the government and, hence, widely applicable. Similarly, alterations in the quality of health services and of medical treatments, modifications in the availability of medicines, in imbursement rules for medication costs and also advances in medical technology are likely to concern a substantial fraction of an economy's population. This will particularly be the true if insurance is mandatory or if health expenditure is predominantly publicly funded.[1] Therefore, policy-induced changes in the determinants of absenteeism – such as in sick pay or the health status of employees – often affect large parts of an economy and its labour market. Knowledge of the resulting consequences is particularly important for labour markets which are not fully competitive. This is the case because trade unions and firms or employer associations generally determine wages and working conditions in many countries. In the European Union, for example, collective bargaining coverage averages almost 70% and reaches or exceeds 90% in about a quarter of its member states (European Commission 2015, p. 29).

Consequently, in this paper we analyse the labour market repercussions of changes in the determinants of absence, assuming a unionised workforce. We focus on sick pay and the quality of medical treatments. First, we investigate a setting in which the trade union can directly influence wages, while sick pay is exogenous. We show that wages will fall with sick pay if the direct labour demand effects of an increase in sick pay are small. Higher sick pay will, for example, leave labour demand unaffected if it is not paid by firms but by social insurance funds or publicly funded institutions. In such a case, the union's preferred wage is affected via the impact of sick pay on the utility of employed members. Higher sick pay makes them better off. Therefore, increasing employment becomes more attractive for the trade union. Such a rise in employment necessitates lower wages demands. If wages fall and the direct labour demand consequences of higher sick pay are either absent or relatively moderate, an increase in sick pay may thus raise employment. Alternatively, it can be assumed that sick pay results from continued wage payments in case of absence. Accordingly, firms are likely to bear its entire costs. This implies that employment declines at a given wage with a higher level of sick pay. Hence, the

[1] The first requirement – mandatory insurance – is fulfilled, for example, in most countries belonging to the European Union (MISSOC 2015). The second condition – public funding – is satisfied in many if not most member states of the OECD and the European Union, where the public share of total expenditure on health averages almost 75% (OECD 2012, p. 129, OECD 2013, p. 165).

trade union's incentives to lower wages are enhanced further. However, the wage reduction may not fully balance the increase in labour costs via sick pay. In such an alternative institutional set-up employment may decline with sick pay. In consequence, the labour market effects of sick pay crucially depend on whether the income of employees during illness-related absence periods results from continued wage payments or transfers, for example, by the employee's health insurance. In the former case, labour cost and, hence, direct labour demand effects are more pronounced than if a public institution covers the costs. Moreover, if the trade union lowers wages in response to an increase in sick pay, this reinforces the direct impact of sick pay on absence behaviour. This will be the case because the loss of income becomes smaller when the reward for going to work is reduced.

In addition to the effects of sick pay, we analyse the implications of advances in medical technology. Such improvements can make higher wages more attractive because better treatments lower unavoidable absence periods which, in turn, raises labour demand. In consequence, incentives for the trade union to increase wages are enhanced. While lower absence rates tend to raise employment, higher wages have the opposite impact. Accordingly, the employment consequences of advances in medical technologies are basically indeterminate.

Second, we consider a set-up in which there is a basic level of sick pay. This can be supplemented by additional payments which the trade union negotiates with the firm, in addition to wages. In such a setting, the trade union will not desire a positive supplementary level of sick pay if the firm bears a sufficiently high share of its costs. The reason is the following: The labour demand and income effects of supplementary sick pay and wages are basically the same. An increase in sick pay, though, raises absence while the opposite is true with regard to wages. Higher absence, in turn, reduces labour demand. Consequently, the union benefits from substituting wages for sick pay and the optimal supplementary sick pay is zero. Our next result then relies on the assumption that the firm bears a suitably small share of the costs of sick pay, such that the trade union sets a positive level of supplementary sick pay. Since the two types of sick pay, the basic and the supplementary component, are perfect substitutes, the exogenously given basic amount completely crowds out the supplementary component. Therefore, the wage and also the employment level remain unaffected by a variation in the basic level of sick pay.

The findings summarised above have important implications. First, we can provide an explanation for the co-existence of centrally determined and supplementary sick pay, as it is observed in some labour markets, and the absence of such additional payments in others. Second, we clarify that the consequences of changes in sick pay and the health status of employees extend beyond their direct labour supply effects and also involve further (labour) market repercussions. Third, we derive conditions which ensure that the direct effects, for example, of sick pay, are strengthened or mitigated by indirect labour market consequence. Finally, our investigation suggests that the impact of sick pay and health status on absence behaviour depends on the institutional features of the labour market, such as how wages are determined.

In our analytical framework we model absence as an individual's decision about the optimal duration of work. We take up a distinction between voluntary and true or inevitable absence, which is more prominent in fields such as psychology (see Steers and Rhodes 1978) than in economics. Such a distinction makes it possible to analyse the impact of advances in medical technology which have a direct impact on absence periods due to true illness. In contrast to other contributions on absence, we do not assume the wage to be given but suppose that it is determined by a firm-specific trade union. Further, the trade union takes into account the absence choices of its members when deciding about wages. Such an integration of theoretical approaches has to the best of our knowledge not been undertaken yet.

The assumption of a firm-specific trade union is a useful starting point because it allows isolating the effects of variations in sick pay and the determinants of health status on union wage setting. If more centralised bargaining were assumed – say at the industry level – repercussions via, inter alia, product-market interactions would have to be incorporated. Since such effects are by and large independent of the determinants of absence, they are unlikely to qualitatively affect the findings derived below. However, if the trade union bargained at a central or national level, it becomes less likely that sick pay or insurance coverage of medical expenditure are truly exogenous from the union's point of view. Instead, the trade union may bargain with the government and health insurance funds about their magnitude. In such a setting, the assumption that firms do not have to bear the entire costs of sick pay may be less plausible. This will be the case if an increase in sick pay resulting from negotiations between government and centralised trade union leads to higher insurance contributions or taxes with a greater likelihood than in the case of firm-specific negotiations.

1.2 Literature

There is an extensive empirical literature investigating the relationship between unionism and absence. The evidence points towards a positive correlation between collective bargaining and various absence indicators (cf., f. e., Allen 1981, 1984, Leigh 1981, 1985, Dionne and Dostie 2007, and García-Serrano and Malo 2009). Since the subsequent theoretical analysis is based on the assumption that collective negotiations take place, the above empirical studies do not provide information with regard to the effects of higher sick pay or better employee health. In partial contrast to the fairly unanimous image arising from the studies on absence and collective bargaining, the investigations focussing on the effects of individual union membership, which is not necessarily equivalent to union representation in many countries, yield no consistent picture. While a number of studies find a positive correlation and partially try to establish a causal impact (see, e. g., Leigh 1983, 1984, Vistnes 1997, Mastekaasa 2013, Goerke and Pannenberg 2015), other analyses observe no or even a negative correlation (Leigh 1991, Böckerman and Ilmakunnas 2008, Böckerman et al. 2012). The above investigations have an empirical focus and tend to concentrate on individual absence choices. Therefore, collective bargaining repercussions of absenteeism or its determinants, such as in sick pay or the employees' health status, do not play role.

In some theoretical analyses the labour market imperfection is not due to trade unions but because firms pay efficiency wages. Barmby et al. (1994) set up such a framework in the spirit of Shapiro and Stiglitz (1984), and interpret sickness absence as shirking. Employees differ in the relative evaluation of leisure and income. Individuals exhibiting the highest preference for leisure are truly sick and can be absent without disciplinary consequences. Some employees will shirk in equilibrium because they call in sick without being characterised by a sufficiently high relative preference for leisure. Dale-Olsen (2013) and Shi and Skuterud (2015) extend this approach by including taxation and differential valuations for indoor and outdoor leisure activities. In contrast to the models based on Barmby et al. (1994) who focus on employee heterogeneity, Ose (2005) assumes homogeneous employees. She investigates the impact of working conditions on absence behaviour. In none of the efficiency wage analyses, the wage and broader labour market repercussions of sick pay or the quality of medical services are looked at. In sum, the present contribution with its focus on the wage effect of the determinants of absence in a unionised labour market helps to fill a substantial gap in the literature.

In the remainder of the paper, we describe the model in Section 2. Section 3 provides the findings from our comparative statics analysis, while Section 4 concludes. All proofs are relegated to the Appendix.

2. Model

2.1 Set-up

We consider a firm-specific trade union which represents the fixed number of potential employees (cf. Oswald 1985). They receive the union wage when attending work and sick pay when absent. Individuals may not attend work either because of inevitable periods of absence due to, for example, an accident or illness or, alternatively, because they prefer not to work. The latter type of absence is referred to as avoidable or voluntary. The two types of absence cannot be distinguished by the firm or health authorities and, hence, both entitle to sick pay. Moreover, absence periods are deterministic. This simplification allows us to neglect the insurance feature of sick pay. The firm produces a commodity which it sells on a competitive market. Labour is the only factor of production and its quantity is chosen optimally by the profit-maximising firm. For simplicity, we assume that the probability of obtaining a job equals the ratio of employment to the total number of individuals who supply labour to the firm under consideration. Finally, we consider a static setting.

The timing is as follows: First, the trade union determines the wage if sick pay is given exogenously and, for example, fixed by a government agency. Alternatively, it sets the wage and sick pay jointly. Second, the firm decides how many people it employs. Individuals who obtain no job become unemployed. Finally, employed individuals choose the optimal level of voluntary absence.

2.2 Individuals

Preferences and Payoffs

Utility is denoted by u and separable in the (sub-) utility, v(c), from consumption, c, and the (sub-) utility, z(a), from avoidable or voluntary absence, a. Without loss of generality, we assume that inevitable absence, i, is without direct utility effect.[2] Hence, utility, u, can be specified as:

$$u(c, a) = v(c) + z(a) \tag{1}$$

Utility, v(c), is increasing in the consumption level, c, at a weakly decreasing rate, $v' > 0 \geq v''$. If v is strictly concave, the substitution effect of higher wages, is assumed to dominate the income effect. Furthermore, the utility from avoidable absence, z(a), is strictly concave ($z'' < 0$) and reaches a maximum at $\tilde{a}$, $z'(\tilde{a}) = 0$. Additionally, we assume that $z'(a) \to \infty$ for $a \to 0$. This specification ensures an interior choice of avoidable absence. If voluntary absence periods, a, have the same utility impact as non-working time, leisure equals avoidable absence, a, plus the constant difference between time endowment and contractual working time. Therefore, the sub-utility function z(a) indirectly captures the value of leisure.

[2] Utility could also vary with inevitable absence. If such (dis-) utility of inevitable absence is also additively separable, subsequent findings are not altered (a proof is available upon request).

An individual's total time endowment and contractual working time are given exogenously and e normalise contractual working time to unity.[3] Consequently, a and i represent the proportion of total working time an employee is absent from work. For simplicity, we refer to both measures as duration of absence.

Assuming that employees are present at work at least some time, such that $a + i < 1$ holds, and denoting the wage per unit of working time by w, wage income is positive and amounts to $w(1 - a - i)$. Moreover, total payments due to absence equal $s(a + i) \geq 0$, where s, $0 \leq s \leq w$, is referred to as sick pay. Consequently, the income or consumption level of an employee is given by:

$$c = w(1 - a - i) + s(a + i) \quad (2)$$

From the specification of the (sub-) utility function, v, it follows that utility, u, increases with the (hourly) wage, w, and sick pay, s, and that an increase in sick pay mitigates the utility gain from higher wages, u_w, if utility is strictly concave in consumption.[4]

$$u_w = v'(c)(1 - a - i) = u_s \frac{1 - a - i}{a + i} > 0; \quad u_{ws} = v''(c)(1 - a - i)(a + i) \leq 0 \quad (3)$$

An unemployed individual receives an exogenously given income and derives a fixed utility from leisure. We denote the resulting utility level by $\bar{u}$.

Individual Optimisation

An employee maximises utility, u, by determining the optimal level of avoidable absence, a*, taking as given the wage, w, sick pay, s, and the duration of inevitable absence, i.

$$u_a = v'(c)(s - w) + z'(a^*) = 0 \quad (4)$$

$$u_{aa} = v''(c)(s - w)^2 + z''(a^*) < 0 \quad (5)$$

If sick pay equals the wage (s = w), the optimal level of avoidable absence is defined by $a^* = \tilde{a}$. If absence reduces income, $s < w$, a* is lower than $\tilde{a}$ (implying that $z'(a^*) > 0$) and results from the trade-off between a fall in income and the gain in leisure.

For later use, note that the optimal duration of avoidable absence, a*, declines with the wage (cf. equations (5) and (6)).

$$u_{aw} = u_{wi} = -v'(c) + v''(c)(s - w)(1 - a^* - i) < 0 \quad (6)$$

[3] Settings in which a trade union can determine hours of work are analysed by Calmfors (1985), Booth and Schiantarelli (1987), Andrews and Simmons (2001), and Wehke (2009), inter alia.
[4] In equations (3), and also in the remainder of the paper, subscripts denote partial derivatives.

Higher wages raise income and, ceteris paribus, induce individuals to consume more leisure due to the income effect (for v" < 0). However, higher wages also make absence more costly. By assumption, the substitution effect dominates the income effect if the utility function v is strictly concave. In addition, equation (6) shows that a greater duration of inevitable absence, i, reduces the marginal utility from a higher wage. Furthermore, sick pay makes absence more attractive and raises income. Income and substitution effect, hence, both operate in the same direction. Therefore, the combination of equations (5) and (7) shows that a* rises with sick pay.[5]

$$u_{as} = v'(c) + v''(c)(s - w)(a + i) > 0 \tag{7}$$

2.3 Firms

Specification of Profits

The production function, f, is increasing in the number of employees, N, at a decreasing rate, so that f '(N) > 0 > f "(N) holds. Moreover, f '(N) $\rightarrow \infty$ for N $\rightarrow$ 0 guarantees a positive employment level. In order to ensure that absence unambiguously decreases the marginal productivity of labour, total output is given by f(N)(1 – a* – i).

In many OECD-countries, firms have to cover a large part or all of the costs for short-term sick leave, while a remaining share is paid for by health insurance funds or public instititions. Sick pay for employees whose absence periods exceed some minimum duration is also often financed by these institutions (Heymann et al. 2009, MISSOC 2015, OECD 2010, p. 128). In some countries the duration of short-term sick leave is comparatively short (about two weeks in Norway and Sweden), while it is much longer in others (at least six weeks in Austria or Germany). We capture this institutional diversity by introducing a parameter γ, $0 \leq \gamma \leq 1$, which describes the share of total sick pay, sN(a* + i), which the firm has to pay for.[6]

If the direct costs of sick pay are not born entirely by firms, the remaining share has to be covered by other institutions, such as health insurance funds or the public budget. Accordingly, variations in sick pay are likely to modify social security contributions or taxes if $\gamma < 1$ holds. Alternatively, changes in the level of sick pay or advances in medical technologies may affect the extent of other services provided or alter the amount of government debt. In our subsequent analysis we disregard such funding requirements for a number of reasons: First, our restriction makes it feasible to isolate the incentive effects of changes in sick pay. Second, the labour

[5] The positive impact of sick pay on absence has been documented empirically in a variety of settings, employing numerous different approaches (see, for example, Allen 1981, Johansson and Palme 2005, Engström and Holmlund 2007, Lusinyan and Bonato 2007, and Ziebarth and Karlsson 2010).

[6] Halla et al. (2015) use variations in the firms' share of the costs of sick pay across firms, workers and time within Austria to identify the impact on absence and health.

market impact of taxes or social security contributions in unionised settings depends crucially on the tax base, the form of the tax schedule and the treatment of unemployed individuals (cf. the survey in Goerke 2002). Third, we could assume alternatively that the share of the costs not born by firms is financed by lump-sum payments. Because the resulting income effects, in general, do not alter subsequent findings, we refrain from incorporating such a balanced-budget requirement into our analytical setting. This would only add complexity without generating further insights.

Normalising the output price to unity, profits are given by

$$\pi = f(N)(1 - a^* - i) - wN(1 - a^* - i) - \gamma sN(a^* + i), \tag{8}$$

and assumed to be positive. Consequently, they decline with higher absence, such that $\pi_a = \pi_i = -(f(N) - wN + \gamma sN) < 0$ holds. The negative direct profit effect arises because absence reduces (the value of) output and wages proportionally, while wages must be less than output if the firm is profitable. Moreover, if the firm bears some of the costs of sick pay ($\gamma > 0$), these costs will also increase with absence, further diminishing profits.

Profit Maximisation

The first- and second-order conditions for a profit maximum are:

$$\pi_N = f'(N^*)(1 - a^* - i) - w(1 - a^* - i) - \gamma s(a^* + i) = 0 \tag{9}$$

$$\pi_{NN} = f''(N^*)(1 - a^* - i) < 0 \tag{10}$$

Since $a^* + i < 1$, equation (9) clarifies that $f' - w > -\gamma s$ $(= 0)$ holds for $\gamma > (=)\ 0$ at the firm's optimal choice of employment N^*. Using the cross-derivatives of the first-order condition, we can calculate the changes in labour demand, $N^* = N(w, s, a, i)$, owing to variations in the wage, sick pay and absence.

$$N_w = \frac{1}{f''(N)} < 0; \qquad N_s = \frac{\gamma(a^* + i)}{1 - a^* - i} N_w \leq 0; \qquad N_a = N_i = \frac{f' - w + \gamma s}{1 - a^* - i} N_w \leq 0 \tag{11}$$

2.4 Trade Union

Preferences

The exogenously given number of union members, M, weakly exceeds employment, N, $M \geq N$. The trade union is utilitarian and its objective is:

$$U = Nu(c, a) + (M - N)\bar{u} \tag{12}$$

To simplify the analysis, we focus on a trade union which can unilaterally determine wages or wages and sick pay, i.e. a monopoly union. We also consider a bargaining version of the right-to-manage approach and demonstrate that the findings derived in Section 3 below are basically unaffected (see Appendix B).

Wage Determination

The trade union determines the wage, taking into account that consumption, c, and employment, N, are functions of the wage, w, according to (2) and (11). Moreover, avoidable absence, a*(w), declines with the wage, as clarified by equations (5) and (6). In consequence, the first-order condition for a maximum, taking into account $u_a = 0$ and using $a_w^* = \partial a^*/\partial w < 0$ for notational convenience, is:

$$U_w = N_w(u(c(w), a^*(w)) - \bar{u}) + Nu_w + N_a(u(c(w), a^*(w)) - \bar{u})a_w^* = 0 \qquad (13)$$

The second-order condition $U_{ww} < 0$ is assumed to be fulfilled. In a standard monopoly union model, the optimal wage balances the utility gain from a higher wage, u_w, for N employed union members with the reduction in utility, $(u(c, a) - \bar{u})$, for those N_w members who lose their job on account of a higher wage. In a setting in which individuals decrease avoidable absence, a*, once the wage rises, the costs of a wage increase will be mitigated if higher absence reduces labour demand. Ceteris paribus, the wage will be higher if absence can be adjusted than if this is not feasible because a wage increase is less costly for the trade union (for $N_a < 0$).

3. Comparative Statics

In this section we, first, analyse how an increase in sick pay affects union wage setting, absence behaviour and payoffs. Second, we consider a general improvement in employees' health, which results in a lower level of inevitable absence. Third, we assume that there is a basic level of sick pay and enquire under which conditions it will be complemented by a collectively bargained amount and how the later will be determined. Proofs of all propositions and corollaries are found in Appendix A.

3.1 Exogenous Change in Sick Pay

The wage effect of sick pay is determined by the derivative of the trade union's first-order condition with respect to s. Taking into account $u_a = 0$ and omitting arguments for notational simplicity, we obtain:

$$U_{ws} = \frac{\partial U_w}{\partial s} + \frac{\partial U_w}{\partial a^*}\underbrace{\frac{\partial a^*}{\partial s}}_{=a_s^*}$$

$$= N_{ws}(u-\bar{u}) + N_s u_w + N u_{ws} + N_{as}(u-\bar{u})a_w^* + N_a(u-\bar{u})\left(\frac{\partial a_w^*}{\partial s}\right) + (N_a a_w^* + N_w)u_s$$

$$+a_s^*\left\{N_{wa}(u-\bar{u}) + N_a u_w + N u_{wa} + N_{aa}(u-\bar{u})a_w^* + N_a(u-\bar{u})\left(\frac{\partial a_w^*}{\partial a}\right)\right\}$$

$$= u_w(N_s + N_a a_s^*) + N(u_{ws} + u_{wa}a_s^*) + \frac{d[(N_w + N_a a_w^*)(u-\bar{u})]}{ds} \qquad (14)$$

The wage change results from a direct impact – described in the second line of (14) – and an indirect one via an adjustment in the optimal duration of avoidable absence, a*, as captured by the third line. Both effects can be decomposed further. First, sick pay can affect the slope of the labour demand curve, N_W, directly and indirectly via a*, and thus alter the costs of a wage increase because of the resulting employment loss. Second, sick pay tends to alter labour demand directly and via avoidable absence. This, in turn changes the gain from a higher wage. Third, the marginal utility from a higher wage, u_W, is affected. Fourth, the absence consequences of a higher wage, $N_a(u - \bar{u})a_w^*$, can vary with sick pay and avoidable absence. This effect results if absence lowers labour demand and will then occur because the wage reduces avoidable absence. In addition to these adjustments, sick pay affects the utility of an employed individual directly. This, in turn, alters the costs of an employment change due to a higher wage, that is $N_a a_w^* + N_W$. The sum of all these direct and indirect effects is ambiguous.

A complementary interpretation of the wage impact of sick pay is presented in the fourth line of equation (14), in which the various consequences via the slope of the labour demand curve are summarised in the last term. We refer to them as the impact of sick pay on the labour demand effects of higher wages, namely on the term $(N_W + N_a a_w^*)(u - \bar{u})$.

The two preceding interpretations of the derivative of the union's first-order condition provide for a prediction of the wage effect of higher sick pay, as summarised in

Proposition 1: Wage Effects of Sick Pay
Assume that the trade union sets wages. Sufficient conditions for the union to lower the wage in response to a rise in sick pay, s, are that

a) firms do not bear the costs of sick pay ($\gamma = 0$), or

b) the labour demand effects of higher wages, $(N_W + N_a a_w^*)(u - \bar{u})$ are accentuated.

Proof: See Appendix A

If $\gamma = 0$ holds, absence does not affect labour demand directly because it alters the marginal costs and gains of employment proportionally. Therefore, the wage effect of sick pay is solely determined by the impact on an employee's utility. Sick pay reduces the gain from a higher wage because the marginal utility of income declines with sick pay (for $v'' < 0$) and the absence level. Thus, raising wages become less attractive for the trade union. Additionally, the utility of an employed individual increases with sick pay, such that employment losses become more costly. This effect also contributes to wage moderation. If the wage falls, while there is no direct labour demand impact of sick pay, employment will increase ($dN/ds = N_s + N_a a_s^* + N_w(dw/ds) = N_w(dw/ds)$).

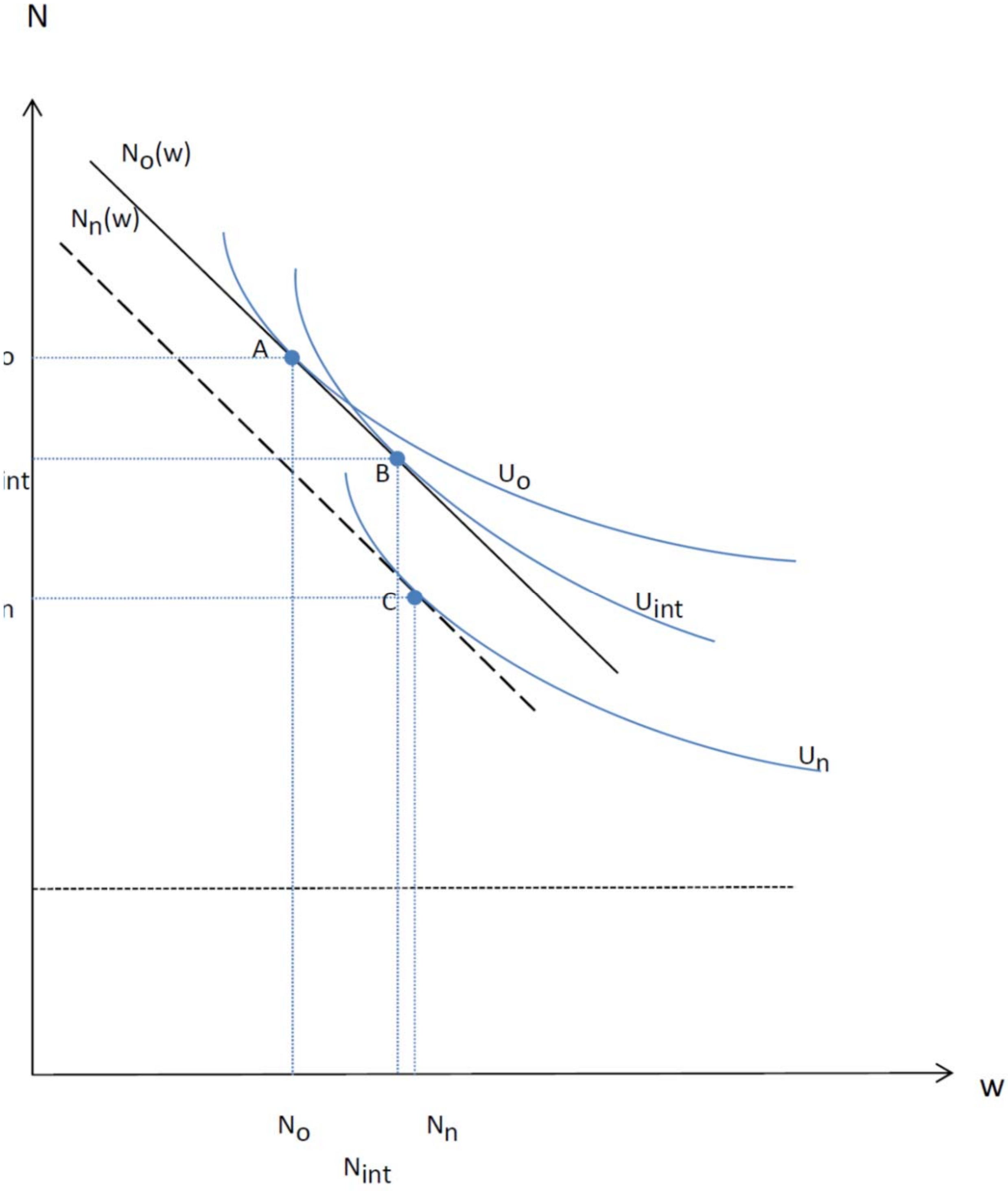
If the firm has to bear part of its costs ($\gamma > 0$), sick pay reduces labour demand, ceteris paribus, and, hence, contributes to a further dampening of wage demands. Additionally, the slope of the labour demand curve and the associated utility loss can vary. If this labour demand effect of wages is accentuated by sick pay, the employment loss due to a wage increase becomes larger. Consequently, this effect also works in the direction of lower wages. Such accentuation will occur if the labour demand curve becomes flatter in the wage-employment space, given $u_s > 0$ from (3), because a given wage increase has more detrimental employment consequences.

Assuming wages to fall, the employment consequences of higher sick pay will be uncertain if the costs of sick pay are partially born by firms ($\gamma > 0$). This is the case because the magnitude of the employment-enhancing wage effect cannot be compared to the size of the direct negative impact of sick pay. Therefore, the employment consequences can only be determined if sick pay raises wages. In this case, employment declines (given $\gamma > 0$).

In a substantial number of OECD countries, sick pay in the case of long-term absenteeism is paid for by social insurance or public funds, but not by the employer (cf. Heymann et al. 2009, MISSOC 2015). Our findings suggest that higher levels of such long-term benefits may actually have beneficial labour market consequences because they raise the consumption level, without imposing costs on firms, such that the trade union will moderate its wage demands.

The various effects of higher sick pay on the union's optimal wage, as described by equation (14) can also be illustrated graphically. In Figure 1, the monopoly union outcome is characterised by the tangency of the (original) labour demand curve $N_o(w)$ with the union's (initial) indifference curve U_o, that is, point A, where $\overline{w}$ is the wage associated with the utility level $\bar{u}$ of unemployed individuals.

Figure 1: Monopoly Union Outcome and Increase in Sick Pay



The reduction in labour demand due to the cost effect of higher sick pay (for $\gamma > 0$) is tantamount to a shift of the labour demand curve to the south-east in the wage-employment space (from $N_o(w)$ to $N_n(w)$). For simplicity, these curves have been depicted as linear in Figure 1. Ceteris paribus, this labour demand impact results in a lower wage since the tangency with an indifference curve will be below point A (not depicted).

Furthermore, higher sick pay increases the slope of the union's indifference curve because the utility level u(c), c = w(1 – a* – i) + s(a* + i), rises ($u_s > 0$) and the marginal utility from a higher wage (weakly) declines ($u_{ws} \leq 0$, see equations (3)). The (intermediate) indifference curve U_{int} in Figure 1 captures this clockwise rotation. A steeper indifference curve in the wage-employment space implies that the trade union is willing to accept a larger wage reduction in exchange for a given expansion of employment, relative to the situation before the rise in sick pay. This greater willingness to substitute wages for employment induces the union to lower the wage. The effect via the union's indifference curve, ceteris paribus, results in a move from point A to point B in Figure 1. The new wage, w_{int}, would be lower than the original wage, w_o, while employment would rise to N_{int}.

Combining the effect on the slope of the indifference curve with the impact on the position of the labour demand schedule, as captured by point C in Figure 1, clearly demonstrates that the wage declines from w_o to w_n on account of these two responses to higher sick. The graphical illustration also indicates the possibility that employment rises (from N_o to N_n).

The final channel by which sick pay may alter the union's optimal wage is via a change in the slope of the labour demand curve. If it becomes flatter in the wage-employment space, a given wage change will have larger labour demand effects. This would make wage reductions more attractive. Consequently, wages would unambiguously decline. If, however, the labour demand curve becomes steeper, the relative magnitude of the resulting positive wage effect cannot be ascertained, that is, relative to the wage-reducing consequences via the slope of the indifference curve and the position of the labour demand schedule.

In order to relate the graphical analysis of Figure 1 to Proposition 1, note that $\gamma = 0$ (cf. part a) of the Proposition) implies that the labour demand curve changes neither its position nor its slope. Therefore, only the movement from point A to point B is relevant. The wage declines and employment rises. If $\gamma > 0$ applies (part b) of Proposition 1) and the labour demand effects of higher wages are accentuated, a change in the slope of the labour demand curve will not counteract the unambiguously negative wage impact via the change in the position of the labour demand curve and the indifference curve's slope.

Proposition 1 summarises the wage impact of a rise in sick pay. As a consequence of the wage adjustments, the increase will have broader labour market consequences. Three corollaries summarise our findings.

> Corollary 1: Overall Absence Effects of Sick Pay
> If the wage set by the union declines or rises by less than sick pay, higher sick pay will increase the optimal level of voluntary absence, a*, taking into account labour market repercussions.
>
> Proof: See Appendix A

Corollary 1 has a number of implications. From a policy perspective, it is noteworthy that the overall absence effects of sick pay depend on the characteristics of the labour market and, in particular, on the direction and strength of the wage adjustment. The direct positive impact on voluntary absence will surely be mitigated if the wage rises by less than sick pay. Moreover, the entire consequences for absence behaviour may only be revealed with substantial delay if the wage impact of a change in sick pay needs time to materialise. Additionally, variations in sick pay for shorter and longer absence periods are likely to have different overall incentives effects. This will be the case if their wage consequences are not the same because firms have to bear the respective costs to a different degree.[7] Finally, from a research perspective, Corollary 1 suggests that the complete absence effects of variations in sick pay will only be measured adequately if resulting wage consequences are taken into account.

The next corollary concerns the change in the employees' payoff.

> Corollary 2: Union Utility and Sick Pay
> Suppose that sick pay raises the optimal level of voluntary absence, a*, taking into account wage repercussions. Union utility will rise if sick pay has no direct labour demand effect and it will decline if the firm bears the entire costs of sick pay.
>
> Proof: See Appendix A

Sick pay has detrimental labour demand effects if the firm has to bear some of the costs of sick pay. The negative employment consequences make union members worse off. Corollary 2

[7] An interesting piece of evidence consistent with this argument is provided in two papers on a cut in sick pay in Germany. Whereas a reduction in the replacement rate for those who were absent less than six weeks annually reduced absence (as documented, inter alia, by Ziebarth and Karlsson 2010), a cut for long-term absence periods (of more than six weeks) had basically no impact (cf. Ziebarth 2013).

establishes two polar cases. The first describes a setting in which the detrimental labour demand effects are absent, such that union utility goes up. The second case delineates a framework in which the beneficial effects for union utility are sufficiently small, such that the adverse labour demand consequences dominate. A further implication of Corollary 2 is also noteworthy: The trade union may oppose an increase in sick pay because overall union utility declines, despite a higher consumption level for its members.

A rise in sick pay not only affects union utility but also alters profits, as Corollary 3 indicates.

> Corollary 3: Profits and Sick Pay
> Sick pay will reduce profits if it raises the optimal level of voluntary absence, a^*, and does not induce the trade union to lower wages too much.
>
> Proof: See Appendix A

Corollaries 2 and 3 imply that there may be settings in which both the trade union and firms oppose an increase in sick pay or, alternatively, both support it. The former situation could, for example, arise if the firm bears the entire costs of sick pay ($\gamma = 1$) and the optimal level of voluntary absence rises. If, furthermore, the initial level of overall absence, $a^* + i$, is not too high, union utility will decline and non-decreasing wages in addition ensure that profits shrink. If, on the contrary, sick pay is not financed by firms ($\gamma = 0$), wages are more likely to decline with sick pay. If the optimal level of avoidable absence rises, union utility will go up and this will also be true with regard to profits if the direct absence effect of sick pay is not too pronounced.

Although the above line of argument ignores insurance effects, it suggests that the level of sick pay as set by a benevolent government may be higher in countries in which sick pay is financed by taxes or social security contributions than in countries in which sick pay results from continued wage payments or is paid for by firms. Our analysis identifies a reason for this tentative prediction, in addition to the externality argument which applies if firms do not bear the entire costs. In particular, the wage and employment consequences are more favourable both from the trade union's and firm's point of view. This, in turn, would also be advantageous from a social planner's perspective.

Thus far, the analysis has been restricted to a monopoly union setting. In Appendix B we show that under mild additional requirements the condition which ensures that the wage declines with sick pay also holds in a bargaining framework. Furthermore, the Corollaries are independent of the union's bargaining power. Therefore, the simplification of a wage-setting trade union does not have a qualitative impact on results.

Finally, wage dependent sick pay can be considered. In such a setting, the marginal utility from a higher wage, u_W, may also rise with sick pay. This can be the case because variations in sick pay would also have a substitution, and not only an income effect. Signing the wage impact of higher sick pay then requires additional restrictions, inter alia, with regard to the Arrow-Pratt measure of relative risk aversion.

3.2 Inevitable Absence

It is often argued that certain illnesses become more widespread. For a subsample of European Union membership states, for example, the occurrence of musculoskeletal and psychological health problems (stress, anxiety etc.) has increased by about 60% from 1999 to 2007 (Eurostat 2010, p. 65). In terms of the model, the rise in the prevalence of such diseases can be interpreted as an increase in the duration of inevitable illness, i. However, we have also observed a decline in workplace accidents in recent decades (see Eurostat 2010, p. 35 ff, OECD 2007, 108 f, Nishikitani and Yano 2008). Moreover, advances in medical technology have made diagnoses more precise and widened the applicability of relevant treatments. The number of computed tomography and magnetic resonance imagining exams per capita, for example, has increased by 33% and 20%, respectively, from 2007 to 2011 in the OECD.[8] Finally, we have seen a decline in the average length of a hospital stay for acute care in the OECD by almost 25% to around 6.5 days from 1995 to 2007 and by more than 15% to 6.9 days from 2000 to 2010 in the European Union (OECD 2009, p. 98 f, 2012, p. 80 f).[9] All these changes can be viewed as resulting from advances in medical technologies which lead to a reduction in inevitable absence, i.

While the absence effects of variations in sick pay are likely to arise with little delay, changes in medical technologies will probably take more time to alter behaviour. Moreover, changes in sick pay may be reversed by policy makers, whereas this is not feasible with regard to medical innovations. These features suggest that alterations in sick pay and in inevitable absence periods due to new medical technologies are qualitatively different. This will all the more so be true if the duration of absence i can be influenced by investments in health capital. However, improvements in medical technology will only result in better health and lower inevitable

[8] See OECD (2009, p. 93, 2013, p. 87). Note that the comparability is somewhat limited because the data for 2007 refers to 22 member states and that for the later period to a sample of countries of about twice this size.

[9] Including the new OECD member states Chile, Estonia, Israel and Slovenia into the sample and not restricting it to acute care cases, the average length of a hospital stay has decreased from 9.2 days in 2000 to around 8 days eleven years later (cf. OECD 2013, p. 93).

absence if according treatments become affordable to consumers or if health insurance funds cover the costs of such therapies. This raises the possibility that the decline in inevitable absence may take long to materialise, but then occur for a large part of the population, as it is the case for changes in sick pay. Moreover, medical treatments may become ineffective or health insurance funds may decide not to bear the costs of such medication any longer. Hence, it is also conceivable that a fall in inevitable absence is reversed. Therefore, from a modelling perspective the qualitative differences between changes in sick pay and inevitable absence may be less pronounced than they appear to be at first sight.

A change in inevitable absence implies that both the costs and gains of higher wages are altered. From equation (11) we may remember that $N_a = N_i \leq 0$. Furthermore, we have established $N_{wa} = N_{wi}$ and $N_{aa} = N_{ai}$ (cf. equations (A.1) and (A.2) in Appendix A). Finally, the change in the utility from a higher wage is affected identically by a rise in inevitable and voluntary absence (cf. equation (6)), such that $u_{wa} = u_{wi} < 0$ holds. Using these equalities and noting that $u_i = v'(c)(s - w) \leq 0$, we can express the derivative of the trade union's first-order condition (13) with respect to inevitable absence, i, as:

$$U_{wi} = \frac{\partial U_w}{\partial i} + \frac{\partial U_w}{\partial a^*}\underbrace{\frac{\partial a^*}{\partial i}}_{=a_i^*} = (1 + a_i^*)(N_i u_w + N u_{wi}) + \frac{d[(N_w + N_a a_w^*)(u - \bar{u})]}{di} \tag{15}$$

A variation in inevitable absence, i, alters the various gains and costs of a higher wage in a similar manner as a change in sick pay, s (cf. Section 3.1). Moreover, it is possible to show that the direct impact dominates its indirect effect via the change in voluntary absence, a*, such that $\partial(a^* + i)/\partial i = 1 + a_i^* > 0$ results (see Appendix A). Using this information, we obtain

Proposition 2: Wage Effects of Inevitable Absence Periods

A sufficient condition for a wage-setting union to raise the wage in response to a decline in the duration of inevitable absence, i, is that the labour demand effects of higher wages, $(N_w + N_a a_w^*)(u - \bar{u})$, are accentuated.

Proof: See Appendix A

The union's optimal wage results from the trade-off between the increase in utility for those individuals who remain employed, and the decrease for those who lose their job owing to higher wages. If inevitable absence periods decline, for example, due to better medical technologies, the gain resulting from a wage increase rises for two reasons: First, wage income will be obtained for a longer period of time. Second, if the firm covers at least part of the costs of sick pay, employment will grow. Therefore, more individuals obtain the union wage. In consequence, the gain from raising the wage becomes larger. Moreover, the costs of higher wages, i.e. the labour demand effects of wages, change. This variation is ambiguous, as demonstrated in Section 3.1. If higher inevitable absence accentuates these costs, the union will have greater incentives to raise wages in case of lower inevitable absence.

In terms of Figure 1, higher inevitable absence induces a counter-clockwise rotation of the union's indifference curve and a shift of the labour demand curve to the north-east. Both effects contribute to a wage increase. If the impact via the rotation of the labour demand curve does not dominate the effects described above, the wage will surely rise. This outcome will occur if the labour demand effects of higher wages, $(N_w + N_a a_w^*)(u - \bar{u})$, are accentuated by the increase in inevitable evidence, i.

As it is true with regard to a variation in sick pay, we can determine how a change in inevitable absence affects the overall level of absence, union utility and profits, taking into account labour market repercussions.

Corollary 4: Overall Duration of Absence, Payoff Levels and Inevitable Absence

Assume that the duration of inevitable absence, i, declines. This will lower overall absence, a* + i, if there is no wage reduction. Union utility will go up either if total absence declines and the firm bears part of the costs of sick pay or, alternatively, firms do not cover the costs of sick pay which, in turn, is less than the wage. Finally, profits will increase if wages do not rise too much.

Proof: See Appendix A

If inevitable absence, i, declines, income will go up as long as sick pay is less than the wage. Higher income will reduce the marginal utility from consumption if the utility function is strictly concave and will, hence, induce an individual to choose a higher level of voluntary absence, a*. This increase in voluntary absence will never fully compensate the decline in inevitable absence, i, because the marginal utility from voluntary absence falls with its level. If the wage rises, there are further incentives for voluntary absence to decline. Therefore, a non-decreasing wage is a sufficient condition for advances in medical technology to lower total absence, taking into account repercussions in a unionised labour market.

If total absence declines and labour demand rises, union utility will increase, ceteris paribus. Furthermore, a lower absence level increases income if sick pay is less than the wage, but will not have direct detrimental utility consequences. Both components contribute to a higher level of union utility, given a lower duration of inevitable absence. All further repercussions via changes in the wage and avoidable absence have no direct impact on union utility because these variables are chosen optimally. Consequently, Corollary 4 enumerates two cases in which either both or at least one of the components of union utility – labour demand and/ or the utility of an employed member – rise with advances in medical technology. Finally, lower inevitable absence will reduce overall absence, a* + i, and, hence, increase profits for a given wage. If wages do not rise (too much) the positive profit effect will persist.

3.3 Supplementary Sick Pay

Suppose now that sick pay, s, consists of a basic, non-negative component, S, which is set by, for example, the government, and a supplementary element, $\sigma \geq 0$, which is chosen by the trade union, such that $s = \sigma + S$ holds. Such additional payments, σ, are agreed upon in collective bargaining contracts in a number of but by no means all OECD countries (cf. OECD 2010, p. 128 f). Moreover, the union sets the wage. A fraction γ, $0 < \gamma \leq 1$, of the entire costs of sick pay is born by the firm.

The first-order conditions for a maximum of the trade union's objective are $U_W = 0$ (cf. equation (13)) and $U_\sigma = 0$, where U_σ equals:

$$U_\sigma = N_\sigma(u(c,a^*) - \bar{u}) + Nu_\sigma + N_a(u(c,a^*) - \bar{u})a^*_\sigma = 0 \qquad (16)$$

The second-order conditions are given by U_{WW}, $U_{\sigma\sigma} < 0$ and $U_{WW}U_{\sigma\sigma} - (U_{W\sigma})^2 > 0$. For such a setting we can show:

> Proposition 3: Zero Supplementary Sick Pay
> Suppose there is an exogenously given basic level of sick pay, while the trade union determines wages and supplementary sick pay. If the firm has to bear a sufficiently high share of the costs of sick pay, the trade union will choose a zero supplementary level.
>
> Proof: See Appendix A

If the firm bears the entire costs of sick pay (i.e. if $\gamma = 1$), the labour demand effects of higher sick pay and wages are qualitatively the same. Similarly, the utility gain resulting from higher wages or sick pay is comparable. For a given level of voluntary absence, therefore, the trade union is indifferent between raising supplementary sick pay or the wage. Sick pay and wages differ, though, with respect to their impact on absence behaviour. Wages have a negative impact on absence, while the opposite is true with respect to sick pay. Furthermore, labour demand declines with absence if it is costly for the firm. Therefore, the union's costs of an increase in sick pay are higher than the costs of a wage increase. This implies that raising supplementary sick pay above a minimum level of zero will reduce union utility at the optimal wage if the entire costs of sick pay are born by the firm. Whether the optimal level of supplementary sick pay will be positive if the firm does not bear all of its costs, depends on whether the differential cost effects outweigh the conflicting consequences for absence behaviour.[10]

Proposition 3 implies that if sick pay results from a continuation of wage payments or has to be paid for by firms directly, the trade union will set the supplementary level of sick pay equal to zero. This, in turn, means that the trade union is willing to substitute wages for sick pay, possibly up to a situation in which sick pay becomes zero. Moreover, the analysis clarifies that the setting looked at in Section 3.1 is suitable to analyse the labour market repercussions of sick pay and inevitable absence periods. If, conversely, sick pay is paid for by health insurance funds, such as it is the case for payments to long-term ill relatively often, we are more likely to observe collectively negotiated supplementary payments. Additionally, our analysis suggests that collectively bargained supplementary sick pay regulations are more prevalent in countries such as Sweden and Norway, where firms cover the costs of sick pay for only relatively short absence periods, in comparison to e.g. Austria and Germany, where public insurance funds take over after a much longer duration of absence.

We next assume that the optimal level of supplementary sick pay is positive because the costs of sick pay for the firm are sufficiently low, $0 < \gamma < 1$. In such a setting we can establish

> Proposition 4: Composition of Sick Pay
>
> Suppose that, first, the trade union determines wages and supplementary sick pay and, second, there is an exogenously given level of sick pay which is less than the total amount desired by the union, such that supplementary sick pay is positive.
>
> An increase in the exogenous level will leave unaffected the overall amount of sick pay, wages, and employment.

The intuition for this neutrality result is straightforward: From an individual's perspective only the level but not the composition of sick pay is relevant. Therefore, a change in its composition

[10] A comparable reasoning is applicable in the case of (Nash-) bargaining. Therefore, there is an incentive for the firm and the trade union to reduce supplementary sick pay to the lowest feasible level of zero for any level of the bargained wage if the firm bears the costs of sick pay.

will not alter absence behaviour. From the firm's perspective, the composition of sick pay is also without impact, as the cost effect of the two elements S and σ are the same. Consequently, the trade-off faced by the trade union between the costs and gains of higher wages is independent of the composition of sick pay. Note finally that if neither the payoff nor the marginal incentives to alter wages or sick pay change in a monopoly union model, the same neutrality finding will obtain in a bargaining framework.

So far, we have assumed that the firm bears the same share of the costs of both components of sick pay, i.e. that $\gamma = \gamma(S) = \gamma(\sigma)$. If, however, firms have to pay for a greater fraction of the costs of supplementary sick pay than of the part set, for example, by the government, such that $\gamma(S) < \gamma(\sigma)$ holds, a rise in the exogenous component, S, is likely to result in a higher wage. The reasoning is as follows: Assume that the rise in the exogenously determined amount of sick pay, S, is fully compensated by a decline in the supplementary component, σ. Such change in the composition leaves individual incentives to be absent and utility levels unchanged. Moreover, labour costs will decline because firms have to bear a lower fraction of the total costs of sick pay, given $\gamma(S) < \gamma(\sigma)$. Lower labour costs imply that labour demand rises. The increase in demand will induce the trade union to increase the wage (cf. equation (13)). If this expansion in labour demand dominates a potentially adverse effect via the slope of the labour demand curve, $N_w + N_a a_w^*$, the gain from raising wages will become larger and the trade union will respond to the substitution by increasing the wage.

4. Conclusions

Changes in sick pay and improvements in medical technologies usually affect a large part of the labour force. Nonetheless, the labour market repercussions of such determinants of absence have generally been neglected. Moreover, the interaction of different types of absence, namely episodes which can be influenced by employees and incidents of absence that are unavoidable, for example, due to accidents, has also largely been ignored. In this paper, we explicitly model the labour market and focus on a setting which characterises many countries, namely one in which wages result from collective negotiations.

We show, first, that an increase in the exogenously determined level of sick pay may result in lower wages and higher employment. This outcome can arise if the costs of sick pay are predominantly born by public institutions but not by firms. If wages fall, this will strengthen the direct absence effects of higher sick pay. While a rise in sick pay may well increase union utility, we can also identify a situation in which both employees and firms suffer and will, thus, oppose a rise in sick pay. If the trade union can set wages and sick pay we, furthermore, demonstrate that the union will avoid supplementing a basic level of sick pay, given that the firm has to bear a sufficiently high share of its costs. The reason is that the trade union prefers higher wages which have no detrimental impact on absence behaviour. If, however, the supplementary level of sick pay set by the trade union is positive, a rise in the basic, exogenously given level will be compensated by a decline of the supplementary component by the same amount. These findings clarify that the overall incentive effects of sick pay strongly depend on the resulting labour market repercussions. These, in turn, are influenced by an institutional feature, i.e. whether sick pay is financed by firms or not. Therefore, our analysis can help to explain why we observe different absence effects of variations in sick pay in different countries that are characterised by diverging modes of financing sick pay. We also analyse the consequences of a healthier workforce which we model as shorter periods of inevitable absence. Less such unavoidable absence makes higher wages more attractive to the trade union. This is the case, inter alia, because wage payments are received for a longer duration and because labour demand increases if employees are absent less.

In the course of the analysis we have considered policy consequences at various instances. A comprehensive discussion of such consequences requires an explicit specification of a society's objective and is clearly beyond the scope of the present paper. We can, however, tentatively indicate possible implications when concentrating on the labour market effects of sick pay. Sick pay raises absence. Such a rise is least likely to occur if payments for long-term sick are concerned. This is the case because moral hazard problems are probably most pronounced in the case of short absence periods which are more responsive to economic incentives (cf. Ose 2005). Moreover, sick pay for longer absence periods is financed by public institutions in many more countries than for instances of short-term absence. Since we have shown that wage reductions and, hence, positive employment effects, can arise if sick pay is not paid for by firms, the labour market effects of sick pay for long-term absence periods are likely to be less detrimental than for shorter absence durations. As an additional argument, which we did not incorporate into our above investigation, the insurance feature of sick pay can be taken into account. Insurance against income variations is undoubtedly needed most if sickness-related absence lasts for a longer period and less so in case of shorter absence durations. Hence, there are a number of arguments to advocate substituting higher sick pay for long-term absence periods for lower levels of sick pay for shorter absence durations.

The theoretical analysis in this paper is based on a number of simplifying assumptions which may deserve closer scrutiny in subsequent work. First, we consider firm-specific trade unions. If, however, collective bargaining takes place at a more centralised level, the costs of sick pay born by firms is likely to vary with its level, as argued above. Second, firms are assumed to be relatively passive in that they only choose employment. If absence affects profits, firms may try to reduce absence by altering incentives. Obviously, the gains and costs of such alterations could have further repercussions on wage setting. Third, we have assumed that wages and sick pay are perfect substitutes in terms of consumption. This may not be an adequate approach in case of long-term illness. Accordingly, sick pay can have additional wage repercussions in a dynamic perspective. Fourth, the model does not incorporate the direct health effects associated with absence as, f. e., Halla et al. (2015) do. This may be particularly relevant with respect to inevitable absence. Alternatively, one could, for example, assume that employees do not only decide on voluntary absence but also make investments in health capital which, in turn, negatively affects the duration of inevitable absence. Finally, we have ignored peer effects relating to absence, for which there is considerable evidence (cf., for example, Ichino and Maggi 2000, Hesselius et al. 2013, and Lindbeck et al. 2016). They are likely to be particularly relevant in a unionised world because the union may be able to partially internalise the absence externality (Hansen et al. 2012).

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Appendix A: Proofs

Proof of Proposition 1

The derivatives of N_w and N_a are:

$$N_{wa} = N_{wi} = -\frac{f'''(N)}{(f''(N))^2}N_a; \qquad N_{ws} = -\frac{f'''(N)}{(f''(N))^2}N_s \tag{A.1}$$

$$N_{aa} = N_{ai} = \frac{(f'')^2(1-a^*-i)N_a - (f'-w+\gamma s)[f'''(1-a^*-i)N_a - f'']}{(f''(1-a^*-i))^2} \tag{A.2}$$

$$N_{as} = \gamma\frac{f'' - (a^*+i)f'''N_a}{(f'')^2(1-a^*-i)} \tag{A.3}$$

Suppose $\gamma = 0$. This implies that $N_a = N_s = 0$ from (11), $f' - w = 0$ from (9) and $N_{ws} = N_{wa} = N_{as} = N_{aa} = 0$ from (A.1) to (A.3). Using (5) and (7) we obtain $a_s^* > 0$. Given our assumption that the substitution effect dominates an income impact, we have u_{ws}, $u_{wa} < 0$ (cf. (3) and (6)). Since $u_s > 0$ according to (3) and $N_w < 0$, the derivative in (14) is negative:

$$U_{ws|\gamma=0} = N[u_{ws} + u_{wa}a_s^*] + N_w u_s < 0 \tag{A.4}$$

Because, furthermore, $dw/ds = -U_{ws}/U_{ww}$ and $U_{ww} < 0$ by the second-order condition of the union's maximisation problem, we have established part a).

To prove part b), note that N_s, $N_a < 0$ will hold if $\gamma > 0$. Given $u_w > 0$ from (3), the first term in the last line of (14) is negative. As shown above, the second term in (14) is also negative. The labour demand effects of higher wages are defined by $(N_w + N_a a_w^*)(u - \bar{u})$. If these labour demand consequences are accentuated by sick pay, i.e., the term $(N_w + N_a a_w^*)(u - \bar{u})$ becomes greater in absolute terms, the last term in (14) will also negative. Hence, we have proven part b).

Proof of Corollary 1

The change in a* is given by $da^*/ds = a_s^* + a_w^*(dw/ds)$. Since $a_s^* > a_s^* + a_w^* \geq 0 > a_w^*$ from (5) to (7), the direct, positive absence effect will be reinforced if wages decline and will continue to be positive for $0 < dw/ds < ds/ds = 1$.

Proof of Corollary 2

The change in union utility, U, owing to higher sick pay is given by:

$$\frac{dU}{ds} = \underbrace{U_w}_{=0}\frac{dw}{ds} + U_a\frac{da^*}{ds} + U_s = N_a(u-\bar{u})\frac{da^*}{ds} + N\underbrace{u_a}_{=0}\frac{da^*}{ds} + N_s(u-\bar{u}) + Nu_s \tag{A.5}$$

From (3) we know that $u_s > 0$. Furthermore, $N_a = N_s = 0$ will hold for $\gamma = 0$ and, accordingly, $dU/ds = Nu_s > 0$. For $\gamma > 0$, the first term in (A.6) will be negative if $da^*/ds > 0$ because $N_a < 0$ according to (11). Furthermore, we can substitute N_s and u_s in (A.5) by terms involving N_w and u_w, using (3) and (11). This yields:

$$\frac{dU}{ds} = N_a(u - \bar{u})\frac{da^*}{ds} + \frac{a^* + i}{1 - a^* - i}[N_w\gamma(u - \bar{u}) + Nu_w] \qquad (A.6)$$

Comparing the term in square brackets in (A.6) with the trade union's first-order condition, (13), clarifies that this term will be negative if $\gamma = 1$, because (13) implies that $N_w(u - \bar{u}) + Nu_w < 0$. Hence, we have proven Corollary 2.

Proof of Corollary 3

The change in profits owing to a rise in sick pay, taking into account wage repercussions, is:

$$\frac{d\pi(w(s))}{ds} = \pi_s + \underbrace{\pi_N}_{=0} N_s + \pi_a\frac{da^*}{ds} + \pi_w\frac{dw}{ds}$$

$$= -\gamma N(a^* + i) - (f(N) - wN - \gamma sN)\frac{da^*}{ds} - N(1 - a^* - i)\frac{dw}{ds} \qquad (A.7)$$

If sick pay raises voluntary absence, a*, taking into account wage repercussions, the first two terms in the last line of (A.7) will be negative. Consequently, as long as wages do not fall too much, profits decline, as Corollary 3 claims.

Proof of Proposition 2

The impact of an increase in i on the individual's first-order condition (4) is:

$$u_{ai} = v''(c)(s - w)^2 \leq 0 \qquad (A.8)$$

Using equations (5) and (A.8) and holding constant the wage, the change in the optimal level of avoidable absence, a*, in response to a decline in inevitable absence, i, is found to be:

$$0 \geq a_i^* = \frac{\partial a^*}{\partial i} = -\frac{u_{ai}}{u_{aa}} = -\frac{v''(c)(s - w)^2}{v''(c)(s - w)^2 + z''(a)} > -1 \qquad (A.9)$$

Hence, $\partial(a^* + i)/\partial i = 1 + a_i^* > 0$ holds. The labour demand effects of higher wages are accentuated by an increase in inevitable absence, i, if the term $(N_w + N_a a_w^*)(u - \bar{u})$ becomes more negative with i. Therefore, given $1 + a_i^* > 0$, $N_i \leq 0$ and $u_{wi} < 0$, we have $U_{wi} < 0$. Hence, wages rise with lower inevitable absence, i, proving Proposition 2.

Proof of Corollary 4

The change in the overall absence level, a* + i, incorporating wage-induced effects, is given by:

$$\frac{d(a^* + i)}{di} = 1 + a_i^* + a_w^* \frac{dw}{di} \qquad (A.10)$$

Since $1 + a_i^* > 0$ and $a_w^* < 0$, $dw/di \leq 0$ is a sufficient condition for $d(a^* + i)/di > 0$. As we consider a decline in i, wages must not be reduced for overall absence to shrink.

The variation in union utility, U, owing to an increase in i, is defined by:

$$\frac{dU}{di} = \underbrace{U_w}_{=0} \frac{dw}{di} + U_a \frac{da^*}{di} + U_i = N_a(u - \bar{u}) \frac{da^*}{di} + N \underbrace{u_a}_{=0} \frac{da^*}{di} + N_i(u - \bar{u}) + Nu_i$$

$$= N_i(u - \bar{u}) \left[1 + a_i^* + a_w^* \frac{dw}{di}\right] + Nu_i \qquad (A.11)$$

If the wage does not rise with i, the term in square brackets (A.11) will be positive. Given $N_i \leq 0$, the first summand in the last line is negative or zero. Therefore, a fall in i will weakly increase this component of union utility for $N_i < 0$. The second summand will be negative if sick pay is less than the wage and, hence, also contribute to greater union utility if i shrinks. Since $s \leq w$, $N_i < 0$ and $dw/di \leq 0$ are sufficient conditions for $dU/di < 0$ to hold.

The change in profits due to a rise in i is, using $\pi_a = \pi_i$, given by:

$$\frac{d\pi(w(i))}{di} = \pi_i + \underbrace{\pi_N}_{=0} N_i + \pi_a \frac{da^*}{di} + \pi_w \frac{dw}{di} = \pi_i(1 + a_i^*) - \frac{dw}{di}(1 - a^* - i) \qquad (A.12)$$

Since $\pi_i < 0$, the direct profit effect of less inevitable absence is positive. If, in addition, the wage does not rise too much, the overall impact will be positive. This establishes Corollary 4.

Proof of Proposition 3

Changes in the exogenously given level of sick pay, S, and the supplementary component, σ, alter labour demand, N, utility, u, and absence, a*, in the same way; $N_\sigma = N_S$, $u_\sigma = u_S$, and $a_\sigma^* = a_S^*$. Using (3), (6) and (11), we can express the changes in labour demand, utility, and absence due to a higher supplementary benefit level in terms of wage alterations. This yields $N_\sigma = \gamma(a^* + i)N_W/(1 - a^* - i)$, $u_\sigma = u_W(a^* + i)/(1 - a^* - i)$, and $a_\sigma^* = -a_w^* - v''(c)(s - w)/u_{aa}$. Substituting these terms in the derivative of U with respect to supplementary sick pay (cf. equation (16)) yields:

$$U_\sigma = \frac{a^* + i}{1 - a^* - i}\{\gamma N_w(u(c, a^*) - \bar{u}) + Nu_w\} - N_a(u(c, a^*) - \bar{u})a_w^*$$

$$- \underbrace{N_a(u(c,a^*) - \bar{u}) \frac{v''(c)(s-w)}{u_{aa}}}_{(\geq 0)} \qquad (A.13)$$

From the first-order condition with respect to the wage (13) we know that $N_a(u(c, a) - \bar{u})\, a^*_w$ is positive at the optimal wage, given $\gamma > 0$. The term in curly brackets in the first line of (A.13) will be negative if γ is sufficiently high, since (13) requires $N_w(u(c, a) - \bar{u}) + Nu_w < 0$. Accordingly, the term U_σ will be negative if evaluated at the union's optimal wage, given a value of γ which is sufficiently close to unity. This proves Proposition 3.

Proof of Proposition 4

Since variations in the exogenous component of sick pay, S, or the endogenously set supplementary amount, σ, alter labour demand N and the changes in labour demand due to higher wages, N_w, sick pay, N_s, and absence, N_a, in the same way, given $\gamma(S) = \gamma(\sigma)$, we have $N_\sigma = N_S$, $N_{wS} = N_{w\sigma}$, $N_{ss} = N_{sS} = N_{s\sigma}$, and $N_{aS} = N_{a\sigma}$. Furthermore, both components of sick pay affect utility or utility variations equally. Hence, $u_s = u_\sigma = u_S$, $u_{ws} = u_{w\sigma} = u_{wS}$, and $u_{ss} = u_{sS} = u_{s\sigma}$. In consequence, the derivatives of the trade union's first-order conditions with respect to the endogenously determined level of sick pay, σ, and the exogenously predetermined amount, S, are the same; $U_{w\sigma} = U_{wS}$ and $U_{\sigma\sigma} = U_{\sigma S}$. Therefore, we have $d\sigma/dS = -1$ and $dw/dS = 0$. Since the rise in S is fully compensated by a fall in σ, employment is constant ($dN = N_S + N_\sigma(d\sigma/dS) = N_S - N_\sigma = 0$). This establishes Proposition 4.

Appendix B: Right-to-manage model

Assume that the trade union and the firm bargain over the wage. With the exception of this modification, the assumptions outlined in Section 2 and employed in Section 3.1 apply. In particular, sick pay is given exogenously. We first derive the condition which characterises the bargained wage and subsequently show that under mild additional constraints the requirement which ensures that the wage declines with sick pay in the monopoly union model (cf. Proposition 1) is also applicable in a bargaining framework.

The union's gain from bargaining is given by:

$$V = U(w) - M\bar{u} = N(w)[u(c(w), a^*(w)) - \bar{u}] \qquad (B.1)$$

Let α $(1 - \alpha)$, $0 \leq \alpha \leq 1$, be an indicator of the trade union's (firm's) bargaining power. Assuming that the firm earns zero profit in the case of no agreement, the Nash-product is:

$$NP = V^{\alpha}\pi^{1-\alpha} \qquad (B.2)$$

The first-order condition for a maximum of NP, taking into account dV/dw = U_w from (13), can be simplified to yield an expression which we denote by Z:

$$Z = \alpha\pi U_w + (1-\alpha)V\frac{d\pi}{dw} = 0 \qquad (B.3)$$

The second-order condition $Z_w < 0$ is assumed to be fulfilled. The profit effect of higher wages, is given by $d\pi/dw = \pi_N N_w + \pi_w + \pi_a a_w^* = -(1 - a - i) + \pi_a a_w^*$, where $\pi_a a_w^* > 0$ and because $\pi_N = 0$ according to (9). If we assume that the wage resulting from a Nash-bargain is lower than if the trade union determines it unilaterally, $U_w > 0 > d\pi/dw$ must hold.

The wage effect of a rise in sick pay, s, is given by $dw/ds = -Z_s/Z_w$, Z_s is:

$$Z_s = \alpha\left(\frac{d\pi}{ds}U_w + \pi U_{ws}\right) + (1-\alpha)\left(\frac{dU}{ds}\frac{d\pi}{dw} + V\frac{d^2\pi}{dwds}\right) \qquad (B.4)$$

The direct effect of sick pay on profits, π, is negative for a given wage, as long as the firm has to pay at least part of the costs of sick pay ($\gamma > 0$). Moreover, absence rises with sick pay ($a_s^* > 0$, see equations (5) and (7)). Since profits decline with absence, also the overall profit effect of higher sick pay is negative, as (B.5) demonstrates.

$$\frac{d\pi}{ds} = \pi_s + \underbrace{\pi_N}_{=0} N_s + \pi_a a_s^* = -\gamma N(a^* + i) - (f(N) - wN - \gamma sN)a_s^* \qquad (B.5)$$

Moreover, the change in union utility, U, resulting from higher sick pay, for a given wage, consists of a direct effect and an indirect one via adjustments in avoidable absence, a*.

$$\frac{dU}{ds} = U_s + U_a a_s^* = (N_s + N_a a_s^*)(u(c, a^*) - \bar{u}) + Nu_s \qquad (B.6)$$

We know that sick pay raises utility of employees directly (cf. (3)). However, sick pay reduces labour demand if there is a direct cost effect ($\gamma > 0$). If the labour demand effect is not too strong, union utility will increase with sick pay. This is consistent with Proposition 3.

The change in the profit effect of higher wages, due to a rise in sick pay, is given by:

$$\frac{d^2\pi}{dwds} = \pi_{as}a_w^* + \pi_a a_{ws}^* = \{-(f'(N) - w - \gamma s)(N_s + N_a a_s^*) + \gamma N\}a_w^* + \pi_a a_{ws}^* \qquad (B.7)$$

The term in curly brackets in (B.7) is positive, as N_s, $N_a \leq 0$ and $f' - w - \gamma s > 0$ from the first-order condition (9). Since π_a, $a_w^* < 0$, a sufficient condition for $d^2\pi/(dwds) < 0$ is that a_{ws}^* is non-negative. This will, for example, be the case if utility from consumption is linear, because a^*_w = $1/z''(a^*)$ is independent of s.

Given $d\pi/ds$, $d^2\pi/(dwds) < 0$ and $dU/ds > 0$, a sufficient condition for $Z_s < 0$ is that $U_{ws} < 0$. This is exactly the condition which has to be warranted in the monopoly union model to ensure that the union lowers the wage in response to a higher level of sick pay.